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The Arctic Oil Rush  
and  
Attendant Conservation Problems

by

A. H. Macpherson

and

H. Boyd

CANADIAN WILDLIFE SERVICE - EASTERN REGION

## Introduction

Oil, as the cheapest, most easily obtained and transported, and most convenient of energy sources, is a major economic fact of life throughout the world. Oil as much as any single factor has enabled humanity to perform the technological wonders of today. As the basis of the modern agricultural revolution, the fuel for tractors and the source of agricultural chemicals, oil has enabled human populations to soar far beyond the limits of sustained resource yield. Some people believe that the using up of world oil reserves will presage the fall of man from his pre-eminence in nature, by forcing him to return to a less dominant position in the biological community. Others have warned that the rapid burning up of these huge fixed carbon reserves may have catastrophic effects on our environment: sulphur dioxide from the chimneys of Western Europe is already believed responsible for acidity in rainfall and decreasing growth rates in Swedish forests.

The oil consumption of the world is rapidly rising. Coal mines close, finding it impossible to compete with oil wells, even thousands of miles away. A part of the increased consumption is due to human population increase:

more people mean more cars to run and more houses to heat. But per capita energy use is also rapidly increasing. In developing countries, oil needs increase as agriculture is modernized and industrialization proceeds: in developed countries oil consumption increases as standards of living rise. In 1967, it was estimated that world consumption of oil was about 12 billion barrels, up 2 billion barrels from the 1964 estimate of 10 billion. The free world consumption was 22 million barrels a day, and is expected to reach 50 million barrels a day in 1980. In the U.S. alone, daily consumption in 1968 was estimated to be 13 million barrels, and in 1980 predictions are that it will reach 18 million. We are now using every year the equivalent of about 1/12th of the entire world consumption of oil in the last 100 years.

How long can world reserves last? In the United States, the level of reserves has been steadily falling, and the deficit of consumption over production growing steadily from its present level of some 4 million barrels per day. However, the world's total proven recoverable reserves

amount to 420 billion barrels, enough for thirty years or so at the present rate of increase, and oil exploration activity is increasing them at the rate of some 30 billion barrels a year, or by over twice as much as consumption.

There are doubtless very large volumes still to be found, and others that will be recoverable as market demands influence the economics of recovery. The Athabasca tar sands, for example, are believed to hold some 600 billion barrels of recoverable oil, and the Canadian Petroleum Association recently estimated a total Canadian recoverable reserve of 120 billion additional barrels. Exploration activity is not merely a response to falling reserves: its intensity and location respond also to geopolitics, and doubtless the present interest in oil from the Arctic stems in part from fears for the continued accessibility of oil from the Middle East, Africa and South America for the huge market of the developed world. Military power and political independence depend on secure oil supplies as never before, and arctic oil exploration owes much of its impetus to this fact. The Middle East, with its 300 billion barrel reserve and cheap production, still dominates a large proportion of the world's petroleum market.

## Arctic Oil Production and Exploration

Huge reserves of oil are suspected to be present in all the large sedimentary basins of the Arctic. The ~~size~~ <sup>quantity</sup> ~~figures~~ can be roughly estimated from the volumes of sediments. For the Canadian arctic islands estimates range from 50 to 150 billion barrels. The arctic extension of the sedimentary basin of Western Canada may contain some 35 billion barrels: adjacent areas of Alaska are believed to hold about the same amount again. The Hudson Bay sedimentary basin may hold another billion barrels or so. Altogether it has been suggested that 100 to 300 billion barrels of oil will be found in the Canadian Arctic and Alaska.

Exploration for oil has been held up in Greenland until recently by <sup>the</sup> law which made it impossible for a company to obtain extraction rights until deposits had been located. The oil companies are now showing interest in the continental shelf off ~~the~~ Western Greenland, and it is expected that leases will soon be negotiated. There is an active exploration program on Svalbard. In the U.S.S.R., the great oil-fields of the Pechora, <sup>and</sup> of the Ob and Taz river basins are being developed. Gas has already been found

near the mouth of the Ob near the Arctic Ocean, but the oil-fields south to the Kuznetsk Basin east of Nov<sup>c</sup>sibirsk appear to be satisfying current Siberian demand and placing central U.S.S.R. in an oil export position.

The arctic environment presents enormous problems for oil exploration and drilling, and costs are necessarily very great. Oilmen say that it has cost them \$1.5 million a well, or five times the industry average, to drill in Alaska. The three wildcat wells drilled in the Canadian Arctic islands have cost considerably more - \$1.5 to nearly \$2.2 million. Remoteness is very costly; labour costs are high (productivity in extreme weather may be only 30% of normal), transport is expensive, and the lack of services means that the companies must make provision for all eventualities on site. The lack of the services that are taken for granted farther south is illustrated by transport to the Alaskan North Slope. Cargo planes are so scarce in the region that the companies are said to have had to use land transport even at considerably greater costs per ton delivered. Transport by sea is possible to the Mackenzie River and the eastern half of the Canadian arctic islands, but insurance costs are high and the season is very limited.

Another major problem, and one that greatly concerns the public and the scientific community, is the fragility of the arctic landscapes. The Minister responsible for northern development in Canada, the Hon. Jean Chrétien, has pointed out how easily the landscape is marred by vehicles and how long it takes to recover. Part of the problem lies in the slow growth and regeneration of the vegetation. Another is in the slow rate of decomposition of junk and organic refuse. A third part is due to the small annual precipitation and run-off.

This problem of landscape damage is universal in the arctic lands. Where it is most evident and serious, however, is in the areas of deep, unconsolidated sediments, and here it reaches dramatic proportions. Unfortunately, in the region of the Mackenzie River delta and on the Alaskan Arctic Slope, where oil companies are most active, the landscape is least able to endure heavy use. Imperial Oil Limited has quickly brought the problem to public attention. Officials of this company have reported on their experience in detail at the Third Canadian Conference on Permafrost in Calgary (January, 1969) and at the Canadian Transportation Research Forum in Toronto (May, 1969).

Briefly, the problem is that the material near the surface of such unconsolidated sediments is composed to a great extent of ice. In summer, the ice in the upper layers turns to water, until the wet blanket of vegetation and soil attains a depth great enough to insulate the remaining ice. When some of this material is bladed off with a bulldozer to obtain a firm surface, melting will continue into the permafrost, water will run into the hole, the sides begin to slip, and a large gully begins to develop. Any damage to the terrain will begin the process: *damage by* construction, tracked vehicles, fires and seismic lines included.

Drilling also presents particular problems. If the drill pipe is withdrawn, unconsolidated material from the sides tends to fall into the drill-hole. British Petroleum Company Ltd., and other companies also, are experimenting with new drilling <sup>methods</sup> ~~needs~~ and new drilling techniques.

Because of the lack of solid rock, the well must literally hang on the layer of permafrost, 800 to 1200 feet thick, near the surface. The operators are forced



to protect this vital junction, using insulation and even refrigerating plants. When large volumes of oil begin to flow, the difficulty will be enormous. Oil leaves the ground at a high temperature, perhaps 150° or 200° F, and some very efficient methods of carrying off the heat and of insulating the pipe, will be required.

The Arctic presents also great difficulties and hazards in transporting oil to market. The preferred bulk carriers are ships and pipelines. Shipping at present is confined to a very brief season. Very large ships may offer efficiencies of scale in the ease of ice navigation as they do in the costs of bulk transported, and the S.S. Manhattan, a specially strengthened tanker of 115,000 tons deadweight, is being tested on the Northwest Passage route this summer by a consortium of oil companies. If she is successful, it is planned to build a fleet of six 250,000 ton tankers for year-round service to arctic loading facilities. Ships of whatever size and power will, however, always be vulnerable to collision with ice, ice pressure and damage by collision or shipwreck in the narrow channels of the Arctic. Pipelines also

present enormous problems. If the permafrost is not protected from the heat which they give off, experiments indicate that the ground upon which they rest, or in which they are buried, will rapidly subside, leaving sections of pipe suspended and liable to breakage. Hanging the pipelines, the only obvious solution, will require the building of immense numbers of pilings. As is well known, an 800 mile, 48 inch, \$900 million pipeline is planned to carry Alaskan North Slope oil to Valdez on the Gulf of Alaska. A break in such a pipe would release oil at the rate of nearly half a million gallons per mile drained.

These are a few of the problems faced by the oil industry <sup>and public interests,</sup> in arctic lands. There are others for which solutions will be required, for example before off-shore drilling can be considered possible in the zone of arctic pack-ice, which is prevalent in all the waters of the Canadian Arctic and off the Alaskan north coast. Studies have been made of submarine tanker feasibility, but the capital costs would probably be two to three times those of surface vessels of similar speed and capacity. So far this problem appears to have daunted the industry.

The problems of oil pollution are obviously worse in <sup>northern part of the</sup> the U.S.S.R. than they are in Northern North America.

Priroda last year carried an article by a fisheries official, B.G. Burdiyan, who attributes a drastic decline in the huge fisheries resources of the Ob-Irtysh river basin to pollution, largely from the oil and gas industries, which in 1964 dumped some 5 million  $m^3$  of effluent per day into the Ob basin. <sup>Burdiyan</sup> He believes that the damage done has been very considerable, one effect being a decrease of about 8 million kg of fish per year, or 16 per cent, of an average annual catch of some 50 million kg. ~~He~~. Burdiyan seems to have spoken to some effect: a year later, according to a news report of February 17, 1969 a western Siberian court sentenced two oil-well operators to prison for polluting a river and killing its fish. The engineer was sentenced to three years and the foreman to two years for criminal negligence.

Waste oil from drilling sites flowing into the Volga River is so abundant that ten giant purification plants have been constructed to remove it.

The problems of landscape degradation in the U.S.S.R. are probably very similar to those faced in Alaska and

Canada, except that in addition to permafrost, the drillers in the Ob basin have to contend with extensive seasonal floods.

Oil is at present being extracted from a second arctic area in the Soviet Union, the Pechora River basin west of the Urals.

#### Conservation Problems in the Arctic

The Arctic is a region of low biological productivity. Each growing season is short: the snow cover, which persists well into June in most areas, hides the vegetation from the sun for eight months or more each year, and reflects back much of the insolation which reaches the arctic lands in spring. The winds, which carry with them an abrasive hail of drifting snow, desiccate and abrade the vegetation of exposed areas. Hence vegetation is scanty and meagre, and annual production is very low. The arctic fauna is of course correspondingly scant.

Chemical processes also are slowed by the low heat regime. Junk degrades imperceptibly; recent explorers report that cans of food left in the Arctic in the last century are palatable, or at least as much so as they

were originally. The living decomposers are equally slow to degrade materials such as wood and paper, and organic wastes such as garbage and sewage. Last year a party dug up the body of Charles Francis Hall, left buried in a shallow grave at Polaris Harbour in 18~~70~~<sup>71</sup>: his body had undergone surprisingly little decomposition.

What would happen if a major oil spill were to occur in the Arctic? It seems probable that much greater harm would result than from a similar occurrence in a warmer climatic zone. Much less of the spill would presumably be absorbed in the shallow, sodden arctic soils than would be in more temperate areas. Run-off is comparatively weak because the annual precipitation is under 10 inches in parts of the Canadian Arctic where exploration is active. Ice cover <sup>would</sup> presumably tends to slow the dispersion of oil floating in the sea by preventing it <sup>from</sup> being washed onto beaches or emulsified in rough waters. Worse, the degradation of spilled oil will be much slower. The evaporation of the more volatile components, the oxidation of heavier residues, and the biological decomposition of crude oil, all proceed at temperature-dependent rates.

Microbial oxidation seems to be far more important in the destruction of oil at sea than spontaneous oxidation. This is a complex process: many of the responsible organisms attack only particular constituents of the crude oil. An article by D.N. Pilpel in Endeavour (January, 1968) includes the remark, "Below about 5° C it (microbial oxidation) is rather slow and thus hardly proceeds at all in latitudes beyond 75° N or S." The latitude passes to the south of the area of interest in the Canadian arctic islands. More significantly, surface temperatures remain below 5° C the year round in arctic waters, except where large volumes of floating river water raise them locally, as in southern Hudson Bay. For most of the year, they remain at or below 0° C. This problem is clearly an important subject of concern.

The likelihood of pollution is compounded by a number of factors. One may be the public interest in encouraging industry into remote and economically distressed parts of the arctic countries. Another is possibly the indifference that exploiters<sup>ive industry</sup> typically have<sup>s</sup> to wilderness<sup>values, when undependded</sup>, particularly ~~wilderness~~ <sup>by strong public pressures.</sup> ~~wilderness that has few defenders.~~ Again, there are not

many areas in which people are more nomadic: in the Arctic there are few of us who have to live with our mistakes. In addition to the hazards posed by environmental conditions and human attitudes, the arctic fish, birds and mammal populations share an Achilles heel: a vulnerability to calamity that seems rare among the animal populations of more equable zones.

Evidence accumulating from several sources, including studies of the Fisheries Research Board of Canada and the Canadian Wildlife Service, suggests that several fish, bird and mammal populations of the Canadian Arctic, and perhaps many of them, experience comparatively frequent reproductive failure. That is, whole cohorts or year-classes fail to survive to breeding age. Consequently several of the best studied vertebrate populations appear to depend inordinately on a very few year-classes. Obviously the recognition of this weakness is basic to management practices, and in particular to the avoidance of catastrophic mortality such as might be caused by a large oil spill.

The Biological Values at Hazard

Direct mortality of wildlife from a large oil gush or a tanker accident could be enormous. Arctic wildlife has a dangerous tendency to concentrate: King Eider drakes, after the hens begin to lay, concentrate in enormous rafts in Baffin Bay: scoters and <sup>Oldsquaws</sup> ~~Old Squaws~~ do so as well. Old Squaws are known, from reports of the Baltic population, to be very vulnerable to oil *at sea*.

We must remember too that many birds are restricted at migration times to narrow flyways. The great autumn outrush of waterfowl and seabirds along the Barrow coastline has been described by such observers as Bailey.

In spring heavy oil pollution in open water off the floe-edge in the Beaufort Sea or Hudson Bay would unquestionably trap very large proportions of swan, duck, goose, gull, guillemot, murre, fulmar, jaeger and phalarope populations.

The storm-wreck, thrown onto exposed beaches in fall, often covering a thick accumulation of wave-piled brash ice, is among the first sources of food for returning birds. On Coats Island, I have seen mixed flocks of Purple Sandpipers, Sanderlings, Semi-palmated-Sandpipers,



Turnstones and Knots feeding in proximity to Pintails, jaegers, terns<sup>n</sup>, gulls, longspurs, pipits and Whistling Swans on piles of storm-wreck in early June. An oil spill could coat this food source and make it a lethal trap.

Crude oil is toxic to many birds, and would presumably be also to mammals attempting to remove it from their pelts with their tongues. Polar bears and arctic foxes might suffer on the sea-coasts: muskrats, beavers, mink, otter and lesser species would doubtless be affected by a major oil spill in the delta of the Mackenzie River. I am unaware of how the Pinnipeds would fare.

The most permanent <sup>potential</sup> casualty, and what appears the major value at immediate hazard, is the arctic landscape. A traveller returning from a recent tour of the Canadian Arctic, when asked for his impressions, said "The face of the moon". My first reaction, visualizing the many beautiful arctic environments in which I have travelled, was incredulity; until I realized that he had probably never been off the disturbed ground around airstrips and settlements. If people are to live in and enjoy our

Arctic, as surely they will increasingly find cause to as resources come into production and as the recreation boom expands, we must find ways to preserve its landscapes. And it is not only a question of amenity. Wildlife and fish resources are still worth some \$10 million a year in the Northwest Territories, and immeasurably more culturally and socially. These resources depend on productive landscapes.

#### Present Regulation and Present Needs

Legislation for the protection and conservation of environment and biological values during oil exploration, drilling, production and transport comprises a large, multijurisdictional, complex field in which I have no specialized knowledge. In Canada there are regulations, both federal and provincial (the Minister of Indian Affairs and Northern Development acts in the place of the territorial authority in the Northwest Territories) governing the drilling and production of wells - off-shore and land-based. Guidelines are issued to exploration lease-holders <sup>in the Territories,</sup> urging them to respect the environment, but so far there appear to no mandatory provisions in force to govern the operation of tracked vehicles or the

running of seismic lines and other potentially destructive machines and techniques. A new bill, "An act respecting the production and conservation of oil and gas in the Yukon Territory and the Northwest Territories" contains provisions authorizing the Governor-in-Council to prescribe the measures necessary to prevent pollution of air, land and water as the result of handling or producing oil or gas, but no mention is made therein of landscape damage. It is understood that the Northwest Territorial Lands Act, now in process of revision, will include such provisions, and it is to be hoped that these will be proclaimed in time to prevent more damage. This revised act will fill a very urgent need.

In Alaska, both state and federal authorities are making careful studies. The pace of development has been tremendous and much damage has already been done. The Wildlife Management Institute reported in May that the U.S. Secretary of the Interior had recently appointed a special task-force under the Chairmanship of Russell E. Train, Under Secretary, to prepare guidelines for development on federal lands on the Arctic Slope. A staff team of

Bureau of Land Management specialists is also at work developing safeguards to be written into any permit issued to the oil industry for the construction of the planned 800-mile pipeline from the Arctic Slope to Valdez on the Gulf of Alaska. It is expected that the permit will be applied for in mid-summer.

At present, four agencies govern land-use in various parts of the Alaskan tundra: the U.S. Navy on Petroleum Reserve No. 4, the Bureau of Land Management on public federal lands, the Alaska Department of Natural Resources on lands selected by the state, and the Bureau of Sport Fisheries and Wildlife in the Arctic Wildlife Range.

Petroleum Reserve No. 4<sup>†</sup> is <sup>at present</sup> ~~so far~~ closed to exploration, but may not <sup>remain so</sup> ~~be~~ for long. The Bureau of Sport Fisheries and Wildlife has shown its effectiveness in protecting surface values on the Kenai National Moose Range: so far the Arctic Wildlife Range still remains closed.

The Bureau of Land Management has established guidelines for companies operating on public lands, which include the provision that a B.L.M. District Manager can specify detailed protective stipulations which are mandatory, but surveillance may not in all cases be possible.

Finally activities on state selected lands are governed by restrictions which are based on the authority of the States' Anadromous Fish Act, which is perhaps stretched somewhat in the process. In January of this year additions to the State Laws of Alaska were proposed to minimize surface damage, and there is some expectation that these will pass in their original or perhaps amended form.

Thus in both Alaska and the Northwest Territories, the environmental problems are recognized and appropriate legislation is being framed. The Canadian Committee for the International Biological Program, the Canadian Wildlife Federation, and other groups with interests in environment and wildlife, are doing much to ascertain the exact nature of the problems we face and to bring them to the attention of the responsible Minister and officials. The oil industry itself is being frank and co-operative. Alaska is ahead of us in one respect - in a much more highly developed land classification system, which assigns "highest use" values, doing much to ensure the preservation of uniquely valuable habitats. Canada still seems hesitant to assign priorities and values in her sparsely-settled Arctic, yet every year the public at large makes greater

investments in social capital, railways, etc., to foster extractive industry in the North. The same public is becoming very sensitive to pollution and other forms of environmental degradation. It seems ~~obvious to us~~ <sup>unlikely</sup> that it ~~won't~~ <sup>will</sup> be long before development becomes subject to planning based on exact knowledge not only of mineral and fuel resources but also of surface resources, whose very considerable and rising values we now dismiss lightly as intangible. We must work for a whole scale of natural reserves, for the satisfaction of all comers: parks, wilderness areas, scientific reserves and sanctuaries; we must encourage action on legislation for the prevention and the mitigation of surface and pollution damage; and we must encourage and sustain the environmental scientists who will be needed in the future to recognize and preserve what we have left, and restore to us what we need.

*Author copy*

Title Oil and the Arctic

Author Macpherson & Boyd

Issue *Vol 665*

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World oil consumption is rapidly rising. Part of the increased consumption results from human population increase: more people mean more cars to run and more houses to heat. But per capita energy use is also rapidly increasing. In developing countries, oil needs increase as agriculture is modernized and industrialization proceeds; in developed countries oil consumption increases as standards of living rise. In 1967, world consumption of oil was estimated at 12 billion barrels (1 barrel  $\frac{=}{\approx}$  42 gallons), up 2 billion barrels from the 1966 estimate of 10 billion. ~~The~~ free world consumption was 22 million barrels a day, and is expected to reach 50 million barrels a day in 1980. In the U.S. ~~alone~~, <sup>in 1968</sup> daily consumption was estimated to be 13 million barrels, and predictions are that in 1980 it will reach 18 million. We are now using every year the equivalent of about 1/12th of the entire world consumption of oil in the last 100 years.

How long can world reserves last? In the United States, the level of

*AQ: Are the 1968 estimates out yet?*

Title

Oil

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5 10 15 20 25 30 35 40 45 50 55 57

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 27 reflects not only falling reserves  
 28 but also geopolitics, and doubtless  
 29 the present interest in oil from  
 30 the Arctic stems in part from fears  
 31 for the continued accessibility of  
 32

A.Q. ~~Has the 1968 estimate  
 come out since you  
 wrote this?~~

A.Q. Do you know of any  
 theoretical estimates  
 of the total world oil  
 supply?

A.Q. Could you locate the  
 Athabasca sands and  
 summarize the difficul-  
 ties (& costs) of  
 extracting the oil?

*spread over an area of some  
 30,000 sq miles near Fort McMurray in northern Alberta,*

*and exploitation of part of the deposit has been underway for the past two years.  
 The extraction process involves heating  
 with steam, centrifuging and coking,  
 and is probably marginally competitive  
 with existing liquid oil production in Alberta.*



Title Oil

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Issue

5 10 15 20 25 30 35 40 45 50 55 57 X 12 1/2 X 19

1 oil from the Middle East, Africa  
 2 and South America. Military power  
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Arctic Oil Production and Exploration

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 28 found in the Canadian Arctic and  
 29 Alaska.

30 Exploration for oil has been  
 31 held up in Greenland until recently  
 32 by a law which made it

*geological*  
 Oil and natural gas are found in permeable strata ~~underground~~. They ~~probably~~ are probably derived from the remains of living things, as they are usually closely associated with fossiliferous formations of marine origin.

A.Q. Could you add a sentence or two explaining what the presence of oil implies about the geologic past?

A.Q. Is this part of Alaska the North Slope? *Yes*

Title Oil

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5 10 15 20 25 30 35 40 45 50 55 57

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 2 for a company to obtain extraction  
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 32

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X 19

Title 011

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 30 which often carry with them an  
 31 abrasive hail of drifting snow,  
 32 desiccate the vegetation of exposed

4 The potential benefits of arctic oil production are indisputable. They range from increased economic opportunity in remote areas of our continent to more objectivity in attempts to settle international disputes. However, there are also dangers inherent in arctic oil exploration and production, in particular the danger to ~~the~~ the landscape and wildlife amenities of ~~the~~ the fragile ~~tundra~~ tundra biome.

A.Q. Seems to need more transition to this section.

Title 011

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5 10 15 20 25 30 35 40 45 50 55 57

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 2 Annual production is very low and  
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*the American explorer  
 by his shipmates*

21 What would happen if a major oil  
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A.Q. Where was Hall from,  
 and who left him there?

Title OIL

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 2 dian Arctic where oil exploration  
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 10 oil will be much slower. Evaporation  
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 12 oxidation of heavier residues, and  
 13 biological decomposition of crude  
 14 oil all proceed at rates dependent  
 15 upon temperature. Microbial oxida-  
 16 tion seems to be far more important  
 17 in the destruction of oil at sea  
 18 than spontaneous oxidation. This  
 19 is a complex process: many of the  
 20 responsible organisms attack only  
 21 particular constituents of the

22 crude oil. D.N. Pilpel *of the University of London* has noted  
 23 that microbial oxidation is rather  
 24 slow below about 40 degrees, and  
 25 thus hardly proceeds at all in lati-  
 26 tudes higher than 75° N or S.

27 The area of interest in the Canad-  
 28 ian arctic islands *is* north of 75°  
 29 N *and the Alaskan North Slope?* More  
 30 significantly, surface temperatures  
 31 remain below 40 degrees the year  
 32 round in arctic waters, except

A.Q. Can you place Pilpel for the reader?

Title Oil

Author

Issue

5 10 15 20 25 30 35 40 45 50 55 57

1 where large volumes of floating  
 2 river water raise them locally, as  
 3 in southern Hudson Bay. For most  
 4 of the year, they remain at or  
 5 below 32 degrees.

6 The likelihood of pollution is  
 7 compounded by a number of factors.  
 8 One is the public interest in en-  
 9 couraging industry into remote and  
 10 economically distressed parts of  
 11 the arctic countries. Another is  
 12 the indifference that exploitative  
 13 industry typically has to wilderness  
 14 values, when they are undefended  
 15 by strong public pressures. Again,  
 16 there are not many areas in which  
 17 people are more nomadic: in the  
 18 Arctic there are few of us who  
 19 have to live with our <sup>i</sup>mistakes. In  
 20 confronting the hazards posed by  
 21 environmental conditions and human  
 22 attitudes, the arctic fish, bird  
 23 and mammal population share an a  
 24 Achilles heel: a liability to cala-  
 25 mity that seems rare among the  
 26 animal populations of more equable  
 27 zones.

28 Fish, bird and mammal populations  
 29 of the Canadian Arctic, and perhaps  
 30 many of them, experienced <sup>re</sup> comparatively  
 31 frequent reproductive failure. That  
 32

X 12 1/2 X 19

Title Oil

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5 10 15 20 25 30 35 40 45 50 55 57

1 is, whole year-classes fail to  
 2 survive to breeding age. Consequent-  
 3 ly several of the best studied  
 4 vertebrate populations appear to  
 5 depend inordinately on a very few  
 6 year-classes. Obviously the recogni-  
 7 tion of this weakness is basic<sup>c</sup> to  
 8 wildlife management practices. In  
 9 particular it emphasizes the im-  
 10 portance of avoiding catastrophic  
 11 mortality such as might be caused  
 12 by a large oil spill.

13 Direct mortality of wildlife  
 14 from a large oil gush or a tanker  
 15 accident could be enormous. Arctic  
 16 wildlife has a dangerous tendency  
 17 to concentrate: King Eider drakes,  
 18 after the hens begin to lay, concen-  
 19 trate in enormous rafts in Baffin  
 20 Bay: scoters and oldsquaws do so  
 21 as well. Oldsquaws are known, from  
 22 reports of the Baltic population,  
 23 to be very vulnerable to oil at  
 24 sea.

25 We must remember, too, that dur-  
 26 ing migration many birds are restric-  
 27 ted to very limited stopping places.  
 28 The great autumn outrush of water-  
 29 fowl and seabirds along the Barrow  
 30 coastline has been described by  
 31 such observers as A.M. Bailey. In  
 32

X 12 1/2 X 19

Title 011

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Issue

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1 spring heavy oil pollution in open  
 2 water off the floe edge in the  
 3 Beaufort Sea or Hudson Bay would  
 4 unquestionably trap very large  
 5 proportions of the arctic popula-  
 6 tion of swans, ducks, geese, gulls,  
 7 gullenots, murre, fulmars, jaegers,  
 8 and phalaropes.

9       The storm-wr<sup>c</sup>ack which is thrown  
 10 onto exposed beaches in fall, often  
 11 covering a thick accumulation of  
 12 wave-piled brash ice, is among the  
 13 first sources of food for returning  
 14 birds. On Coats Island, <sup>(Macpherson)</sup>  
 15 has been seen mixed flocks of purple  
 16 sandpipers, sanderlings, semi-pal-  
 17 mated sandpipers, turnstones, and  
 18 knots feeding in proximity to  
 19 pintails, jaegers, terns, gulls,  
 20 longspurs, pipits, and whistling  
 21 swans on piles of storm-wrack in  
 22 early June. An oil spill coating  
 23 this food source would make it a  
 24 lethal trap.

*I have*

25       Crude oil is toxic to many birds,  
 26 and would presumably also be toxic  
 27 to mammals attempting to remove it  
 28 from their pelts with their tongues.  
 29 Polar bears and arctic foxes might  
 30 suffer on the sea-coasts; muskrats,  
 31 beavers, mink otter, and lesser  
 32



Title 011

Author

Issue

5 10 15 20 25 30 35 40 45 50 55 57

1 species would doubtless be affected  
 2 by a major oil spill in the delta  
 3 of the Mackenzie River. We are un-  
 4 aware of how seals, walruses and  
 5 other marine mammals would fare.

Danger to the Arctic Landscape

7 Another major problem is the  
 8 fragility of the arctic landscape.  
 9 The minister responsible for north-  
 10 ern development in Canada, Jean  
 11 Chretien, has pointed out how easily  
 12 the landscape is marred by vehicles  
 13 and how long it takes to recover.

14 This problem of landscape damage  
 15 is universal in arctic lands. Where  
 16 it is most evident and serious,  
 17 however, is in the areas of deep,  
 18 unconsolidated sediments, and here  
 19 it reaches dramatic proportions.

20 Unfortunately, in the region of the  
 21 Mackenzie River delta and on the  
 22 Alaskan Arctic Slope, where oil  
 23 companies are most active, the land-  
 24 scape is least able to endure heavy  
 25 use. Imperial Oil Limited, a sub-  
 26 sidiary of Standard Oil of New Jersey,  
 27 has quickly brought the problem to  
 28 public attention. Company officials  
 29 have reported their experiences in  
 30 detail at the Third Canadian Confer-  
 31 ence on Permafrost in Calgary (last  
 32 January) and at the

*through crude oil is known to be  
 destructive to a multitude of marine  
 organisms, including algae, plankton,  
 fishes and molluscs, important  
 components of the food chains upon  
 which higher animals  
 depend.*

A.Q. What about fish, plank-  
 ton, etc. You have men-  
 tioned fish populations  
 above.

Title 011

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Issue

5 10 15 20 25 30 35 40 45 50 55 57

1 ~~January~~) and at the Canadian Trans-  
 2 portation Research Forum in Toronto.  
 3 Briefly, material near the sur-  
 4 face of unconsolidated sediments  
 5 is largely composed of ice. In summer,  
 6 the ice in the upper layers turns  
 7 to water, producing the wet blanket  
 8 of vegetation and soil. When some  
 9 of this material is bladed off with  
 10 a bulldozer to obtain a firm surface,  
 11 melting into the permafrost begins  
 12 again, water runs into the hole,  
 13 the sides begin to slip, and a  
 14 gully develops. Any damage to the  
 15 terrain will begin the process,  
 16 whether caused by construction,  
 17 tracked vehicles, fires or seismic  
 18 lines.  
 19 Drilling also presents special  
 20 problems. If the drill pipe is with-  
 21 drawn, unconsolidated material from  
 22 the sides tends to fall into the  
 23 drill-hole. British Petroleum Com-  
 24 pany Ltd., and other companies, are  
 25 experimenting with new drilling muds  
 26 and new drilling techniques.  
 27 Because of the lack of solid  
 28 rock, the well must literally hang  
 29 on the layer of permafrost, 800 to  
 30 1200 feet thick, near the surface.  
 31 The operators are forced to protect  
 32

*Geol. map of arctic basin showing sedimentary rocks*

*AQ: A simple cross section might help the reader here.*

Title Oil

Author

Issue

5 10 15 20 25 30 35 40 45 50 55 57

1 this vital junction, using insula-  
 2 tion and even refrigerating plants.  
 3 When large volumes of oil begin to  
 4 flow, the difficulty will be enor-  
 5 mous. Oil leaves the ground at a  
 6 high temperature, perhaps 150 or  
 7 200 degrees, <sup>Fahrenheit</sup> and some very effi-  
 8 cient methods of carrying off the  
 9 heat and of insulating the pipe  
 10 will be required.

11 The Arctic also presents great  
 12 difficulties and hazards in trans-  
 13 porting oil to market. The preferred  
 14 bulk carriers are ships and pipe-  
 15 lines. Shipping at present is con-  
 16 fined to a very brief season. Very  
 17 large ships may offer efficiencies  
 18 of scale in the case of ice naviga-  
 19 tion as they do in the costs of  
 20 bulk transportation, and the S.S.  
 21 Manhattan, a specially strengthened  
 22 tanker of 115,000 tons deadweight,  
 23 navigated the Northwest Passage  
 24 route this summer. If she is success-  
 25 ful, it is planned to build a fleet  
 26 of six 250,000-ton tankers for year-  
 27 round service to arctic loading  
 28 facilities. Ships of whatever size  
 29 and power will, however, always be  
 30 vulnerable to collision with ice,  
 31 to ice pressure, and to damage by  
 32

*the trip is judged a  
 success,*

Title Oil

Author

Issue

5 10 15 20 25 30 35 40 45 50 55 57

1 collision or shipwreck in the  
 2 narrow channels of the Arctic.  
 3 Pipelines also present enormous  
 4 problems. If the permafrost is not  
 5 protected from the heat which they  
 6 give off, experiments indicate that  
 7 the ground upon which they rest,  
 8 or in which they are buried, will  
 9 rapidly subside, leaving sections  
 10 of pipe suspended and liable to  
 11 breakage. Hanging the pipelines,  
 12 the only obvious solution, will  
 13 require the building of immense  
 14 numbers of pilings. As is well known,  
 15 an 800-mile, 48-inch, \$900-million  
 16 pipeline is planned to carry Alas-  
 17 kan North Slope oil to Valdez on  
 18 the Gulf of Alaska. A break in such  
 19 a pipe would release oil at the  
 20 rate of nearly half a million gallons  
 21 per mile drained.

22 These are a few of the problems  
 23 faced by the oil industry, and  
 24 public interests, in arctic lands.  
 25 There are others for which solutions  
 26 will be required; for example, off-  
 27 shore drilling is not now possible  
 28 in arctic pack-ice. Studies have  
 29 been made of submarine tanker feas-  
 30 ibility, but the capital costs  
 31 would probably be two to three times  
 32

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Issue

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1 those of surface vessels of simi-  
2 lar speed and capacity.

3 The present extent of oil pollu-  
4 tion <sup>may well be</sup> is obviously worse in the  
5 northern parts of the U.S.S.R. than  
6 they are in northern North America.

7 Priroda last year carried an article  
8 by a fisheries official, B.G.

9 Burdiyan, who attributes a drastic  
10 decline in the huge fisheries re-  
11 sources of the Ob-Irtysh river  
12 basin to pollution, largely from  
13 the oil and gas industries, which  
14 in 1964 dumped some 6.5 million  
15 cubic yards of effluent per day  
16 into the Ob basin. Burdiyan bel-  
17 ieves that the damage done has  
18 been very considerable, one effect  
19 being a decrease of about 17.6  
20 million pounds of fish per year,  
21 or 16 per cent, of an average  
22 annual catch of some 110 million  
23 pounds. Burdiyan seems to have  
24 spoken to some effect: a year  
25 later, according to a news report  
26 of February 17, 1969, a western  
27 Siberian court sentenced two oil-  
28 well operators to prison for pollut-  
29 ing a river and killing its fish.  
30 The engineer was sentenced to  
31 three years and the foreman to two  
32

*The problem of future oil pollution  
is everywhere under study. The  
responsible Minister in Canada has  
already outlined publicly an Act  
that will soon be debated in  
Parliament. He has stated that the  
bill will lay the responsibility for  
water quality on the user, though  
the standards to be maintained have  
not yet been revealed.*

A.Q. Can you list major species affected??

Title Oil

Author

Issue

5 10 15 20 25 30 35 40 45 50 55 57

1 years for criminal negligence.

2 Waste oil from drilling sites  
3 flowing into the Volga River is <sup>reported to be</sup> so  
4 abundant that ten giant purifica-  
5 tion plants have been constructed  
6 to remove it.

7 The problems of landscape degra-  
8 dation in the U.S.S.R. are probably  
9 very similar to those faced in  
10 Alaska and Canada, except that in  
11 addition to permafrost, the drillers  
12 in the Ob basin have to contend  
13 with extensive seasonal floods.

14 Oil is at present being extracted  
15 from a second arctic area in the  
16 Soviet Union, the Pechora River  
17 basin west of the Urals, but we  
18 have not seen any accounts of the  
19 <sup>problems</sup> pollution there.

20 The most permanent potential  
21 casualty, and what appears the  
22 major value at immediate hazard,  
23 is the arctic landscape. A traveller  
24 returning from a recent tour of  
25 the Canadian Arctic, when asked for  
26 his impressions, said "The face of  
27 the Moon". My first reaction,  
28 visualizing the many beautiful arctic  
29 environments in which <sup>I</sup> had travell-  
30 ed, was incredulity, until I real-  
31 ized that the visitor had probably  
32

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1 never been off the disturbed ground  
 2 around airstrips and settlements.  
 3 If people are to live in and enjoy  
 4 our Arctic, as surely they will  
 5 increasingly find cause to, we  
 6 must find ways to preserve its  
 7 landscapes. And it is not only a  
 8 question of amenity. Wildlife and  
 9 fish resources are still worth  
 10 some \$10 million a year in the  
 11 Northwest Territories, and immeasurably  
 12 more culturally and socially.  
 13 These resources depend on productive  
 14 landscapes.

15 Present Regulation and Present Needs

16       Legislation for the protection  
 17 of environment and biological values  
 18 during oil exploration, drilling,  
 19 production and transport comprises  
 20 a multi-jurisdictional and complex  
 21 field. In Canada there are regula-  
 22 tions, both federal and provincial  
 23 (the Minister of Indian Affairs  
 24 and Northern Development acts in  
 25 the place of the territorial auth-  
 26 ority in the Northwest Territories)  
 27 governing the drilling and produc-  
 28 tion of wells - off-shore and land-  
 29 based. Guidelines are issued to  
 30 exploration lease-holders in the  
 31 Territories, urging them to respect  
 32

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1 the environment, but so far there  
 2 appear to be no mandatory provisions  
 3 to govern the operation of tracked  
 4 vehicles or the running of seismic  
 5 lines and other potentially destruc-  
 6 tive machines and techniques. A  
 7 new bill, "An act respecting the  
 8 protection and conservation of oil  
 9 and gas in the Yukon Territory and  
 10 the Northwest Territories" contains  
 11 provisions authorizing the Govern-  
 12 in-Council to prescribe the measures  
 13 necessary to prevent pollution of  
 14 air, land and water as the result  
 15 of handling or producing oil or  
 16 gas, but no mention is made therein  
 17 of landscape damage. It is under-  
 18 stood that the Northwest Territorial  
 19 Lands Act, now in process of revision,  
 20 *the legislative means to control* ~~will include such provisions,~~ and  
 21 it is the hope that these will be  
 22 proclaimed in time to prevent more  
 23 damage. This revised act will fill  
 24 a very urgent need.

25 In Alaska, both state and federal  
 26 authorities are making careful stud-  
 27 ies. The pace of development has  
 28 been tremendous and much damage has  
 29 already been done.

30 At present, four agencies govern  
 31 land-use in various parts of the  
 32

*land resource use, including activities affecting landscapes*

A.Q. Is this bill now law?

A.Q. When will the revision take effect?



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1 of the Alaskan tundra: the U.S.  
 2 Navy on Petroleum Reserve No. 4,  
 3 the Bureau of Land Management on  
 4 public federal lands, the Alaska  
 5 Department of Natural Resources on  
 6 lands selected by the state, and  
 7 the Bureau of Sport Fisheries and  
 8 Wildlife in the Arctic Wildlife  
 9 Range,

10 Petroleum Reserve No. 4 is at  
 11 present closed to exploration, but  
 12 may not remain so for long. The  
 13 Bureau of Sport Fisheries and Wild-  
 14 life has shown its effectiveness  
 15 in protecting surface values on the  
 16 Kenai National Moose Range; so far  
 17 the Arctic Wildlife Range still  
 18 remains closed.

19 The Bureau of Land Management  
 20 has established guidelines for  
 21 companies operating on public lands,  
 22 which include the provision that  
 23 a bureau district manager can specify  
 24 detailed protective stipulations  
 25 which are mandatory, but surveill-  
 26 ance may not in all cases be possible.

27 The Wildlife Management Institute  
 28 reported in May that the U.S. Sec-  
 29 retary of the Interior had recently  
 30 appointed a special task-force under  
 31 Russell E. Train, under secretary,  
 32

Title

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Author

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to prepare guidelines for develop-  
ment on federal lands on the Arctic  
Slope. A staff team of Bureau of  
Land Management specialists is  
also at work developing safeguards  
to be written into any permit issued  
to the oil industry for the construc-  
tion of the planned 800-mile pipe-  
line from the Arctic Slope to Valdez.

Finally activities on state-selected  
lands are governed by restrictions  
which are based on the authority  
of the States' Anadromous Fish Act.  
In January 1969 additions to the  
State Laws of Alaska were proposed  
to minimize surface damage, and  
there is some expectation that these  
will pass in their original form.

Thus in both Alaska and the North-  
west Territories, the environmental  
problems are recognized and appro-  
priate legislation is being framed.  
The Canadian Committee for the  
International Biological Program,  
the Canadian Wildlife Federation,  
and other groups with interests in  
environment and wildlife, are doing  
much to ascertain the exact nature  
of the problems we face and to bring  
them to the attention of the respon-  
sible officials. The oil industry

X 12 1/2

X 19

*Presented the case for conservation  
at public hearings. In my country,*

Title

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X 12 1/2

X 18

1 itself is being frank and coopera-

2 tive. Alaska is ahead of Canada in

3 one respect - it has a much more

4 highly developed land classifica-

5 tion system, which assigns "highest

6 use" values, doing much to ensure

7 the preservation of uniquely valuable

8 habitats. Canada still seems hesi-

9 tant to assign priorities and values

10 in her sparsely-settled Arctic, yet

11 every year the public at large makes

12 greater investments in social capi-

13 tal; railways, and so on, to fos-

14 ter extractive industry in the North.

15 The same public is becoming very

16 sensitive to pollution and other

17 forms of environmental degradation.

18 It seems unlikely that it will be

19 long before development becomes

20 subject to planning based on exact

21 knowledge not only of mineral and

22 fuel resources but also of surface

23 resources, whose very considerable

24 and rising values we now dismiss

25 lightly as intangibles. We must

26 work for a whole scale of natural

27 reserves, for the satisfaction of

28 all comers: for parks, wilderness

29 areas, scientific reserves and sanc-

30 tuaries; we must press for action

31 on legislation for the prevention

32

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1991 - 3 300

LIBRARY ENVIRONMENTAL & PROTECTION CONSERVATION & PROTECTION WESTERN & NORTHERN REGION

5 10 15 20 25 30 35 40 45 50 55 57

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and the mitigation of surface and  
pollution damage; and we must en-  
courage and sustain the environ-  
mental scientists who will/needed  
in the future to recognize and pre-  
serve what we have left, and re-  
store to us what we need.