

January, they had a bill ready to go. Lapidès' sickle cell bill was repeated.

In comparison to other states' genetic disease laws, which tend to say that screening for PKU or whatever shall be done and leave it at that, the Maryland statute establishing the commission is a lengthy and philosophical document. While granting the commission unusual authority to actually write regulations on the one hand, it carefully lays out the principles that must govern its actions on the other. Thus, no programs can be adopted unless the public—particularly those groups that will be most directly affected—has been consulted. The principles also provide for the confidentiality of medical information, counseling services for persons screened, and the right of any person to refuse screening for any reason. Furthermore, the principles preclude any restrictions on childbearing.

Says Lapidès, "We realized that research and various programs on hereditary disorders raise extremely important questions about how medical science will become involved in couples' decisions to conceive and bear children. In the short run, we are confident that a well-run program on certain hereditary diseases, conducted by ethical and competent professionals, should alleviate a great deal of human suffering. But we just don't know where this will lead in the future. One thing was clear in writing this bill. These decisions must not be made in medical laboratories. They have to be made in public. That's why we made the commission an open, public forum."

Experience with the commission so far indicates that it is working. At present, for example, it is preparing regulations for a sickle cell program, and at a recent meeting it devoted time to discussing in detail the various tests that are available to detect hemoglobin abnormalities. This is precisely what scientists throughout the coun-

try would like to see happen. The legislature cannot weigh the accuracy of method A versus method B, nor can it know which method is suitable for mass screening and which needs more research. The commission can do this, and it can easily change its rules as medical advances occur.

The commission is also busy with a new PKU program. Maryland and the District of Columbia are the only two governments that have repealed mandatory PKU screening laws, albeit for different reasons. In Maryland, the mandatory law was repealed because the commissioners fervently believe that all screening should be strictly voluntary. The District dropped mandatory screening for cost-benefit reasons. PKU is extremely rare among blacks, who constitute a large majority of the District's population. According to Holtzman, in 3 years the District screened 77,000 babies at a cost of \$135,000 and did not pick up a single case of PKU.

Although many persons experienced with genetic screening think the voluntary nature of Maryland's new PKU program is laudable, they also fear that the new program may cause problems because of a provision requiring informed consent that goes into effect 1 July 1976. When you start talking about truly informed consent, you are talking about educating people to an extent that can hardly be called a usual feature of present medical practice. Brochures explaining PKU and consent forms are being prepared and physicians are being asked to start informing their patients, but no one is sure how it will work or whether the provision will discourage parents from participating. Holtzman tried to get a \$10,000 grant so that informed consent procedures could be tried in a few hospitals before they go into effect statewide in July, but he had no luck.

However, the commission is getting a bit of anecdotal information on informed con-

sent as a by-product of another aspect of its PKU program. Although testing newborns for blood phenylalanine concentrations is prudent, it is not sufficient to catch all PKU babies. Often, concentrations that appear normal within days of birth may rise after 8 days or more of life, well after the baby has been discharged from the hospital. Therefore, the commission has asked pediatricians to test for PKU when babies come in for their 1-month checkup. And, it is asking doctors at that stage to obtain only oral, not written, consent. Some are discovering, when they explain they want to take a second PKU test, that mothers do not remember being told that there had ever been a first.

At the present time, most of the social and ethical issues relating to genetic screening have to do with childbearing in one way or another. If a mother has one affected child, should she be allowed to conceive again and risk having another? If a mother knows, through in utero diagnosis, that she is carrying a defective baby, should she be forced to have an abortion? These questions are on the horizon. But there is another question, too, that will have to be faced soon because of advances in understanding the relationship of genetics to other sorts of diseases. Heart disease is a good example. Researchers today have preliminary evidence linking certain genetic constitutions with heart disease in adulthood. If, or more probably when, those links are more clearly known, society will have to confront the possibility that it will want to regulate the lives of potential heart victims; a kind of enforced preventive medicine, if you will. Maryland's broadly constituted, wholly open commission approach may prove to be an invaluable precedent in the handling of sensitive social issues that should not be left to scientists or lawmakers alone.

—BARBARA J. CULLITON

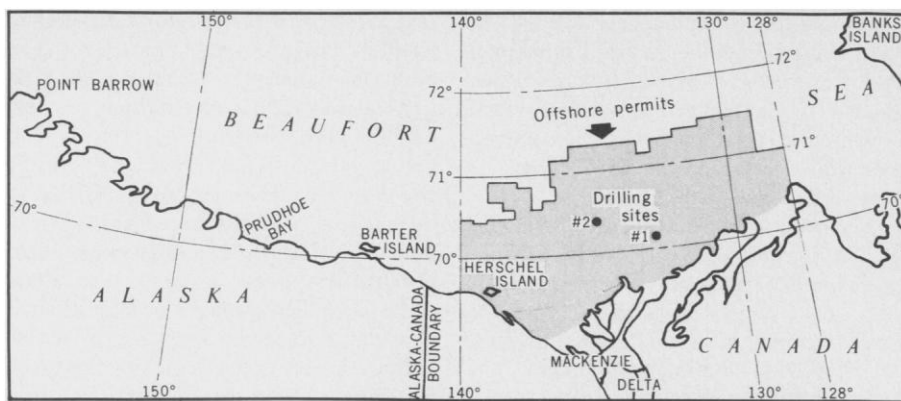
Oil Drilling in the Beaufort Sea: Leaving It to Luck and Technology

Plans to sell leases for potential oil- and gas-bearing tracts on the U.S. outercontinental shelf (OCS) continue to generate outcries from state and local officials and environmental leaders worried about possible adverse impacts. But even as this public furor has been going on in California,

Alaska, and elsewhere, the Canadian government has been moving quietly toward a final decision to allow exploratory oil drilling to begin in that part of the Arctic Ocean known as the Beaufort Sea, an OCS province so fraught with environmental problems and hazards that the technology

necessary for recovery of the oil and gas that might be found is still far from being available. A blowout of an exploratory well could lead to massive losses of fish, ocean mammals, and birds—including tens of thousands of migratory waterfowl—along some 400 miles of the Alaskan coast as well as along the Canadian coast.

In 1973 the Canadian government granted Dome Petroleum Ltd., a Canadian company based in Calgary, "approval in principle" to conduct exploratory drilling at two sites in the southeast Beaufort Sea. One of these sites is some 46 kilometers from land, at a water depth of 26 meters; the other is 83 kilometers offshore, at a



depth of 58 meters. The sites are within a large Canadian OCS area (see map), which may all eventually be subject to oil exploration and development under permits already issued. According to current industry estimates, recoverable reserves within this area run to 3 billion barrels of oil and 20 trillion cubic feet of natural gas.

In granting the permits to Dome Petroleum, the government stipulated that the drilling could not begin before 1976 and that it would be subject to appropriate conditions that would be based on a major environmental study to be conducted by Canada's Department of the Environment. This \$12-million, 18-month study (to which 18 oil companies have contributed about \$4 million) is nearing completion, and a preliminary environmental assessment was made public a few weeks ago.

Judd Buchanan, the Canadian Minister of Indian Affairs and Northern Development, had been expected to announce by mid-February the conditions under which the drilling could be carried out. But, on 12 February, Buchanan indicated that the announcement would be delayed for a time while he conferred further with the Minister of Environment, Jean Marchand. Although the environmental assessment prepared by Marchand's department is frank in acknowledging the problems and damages that a blowout could cause, it appears to reflect a basic assumption that the drilling will in fact be allowed. Indeed, offshore drilling in the Beaufort Sea actually began several years ago on artificial islands built in shallow water close to the Mackenzie Delta, under conditions relatively amenable to corrective measures if something goes wrong.

Whatever the attitude of Marchand and his Department of the Environment, there may be American opposition to any early approval of the exploratory drilling project. On 13 February, the U.S. Department of State, after having called in several U.S. environmental and energy agencies for a quick review of the Canadian environmental assessment, asked Ottawa to delay final action on the project

pending a more detailed examination of that assessment by the U.S. government and pending consultation between U.S. and Canadian officials.

The Beaufort Sea is clearly one of the world's most hostile environments for oil exploration and development. Ice conditions can make drilling a nightmare. The polar ice pack crowds in upon the waters of the continental shelf, and the heavy, mobile ice which forms each winter over all but the shallower waters of the shelf itself often resembles the polar pack. Affected by powerful winds, tides, and currents, this ice is subject to active shearing and the formation of formidable pressure ridges so thick and massive as to scour the sea bottom in waters up to 45 meters deep. Along the coast, "landfast ice," which is ice held fast to the shore, extends out to water depths of about 25 meters and is about 2 meters thick.

In spring, the landfast ice and the ice farther out begin to break up and move far offshore with the polar pack, with much of the Beaufort Sea thus becoming open water by midsummer. It is under these favorable open-water conditions, which can last from the end of July until the freeze-up in October, that the Dome Petroleum drill ships are expected to operate. But, if westerly winds prevail throughout most of the summer, as they not infrequently do, ice conditions will be heavy and drilling operations will be impossible.

The severity and unpredictability of the ice conditions bear upon prospects for oil exploration and development in several ways. In an interview with *Science*, Price McDonald, a staff petroleum engineer with the U.S. Geological Survey's conservation division (the unit responsible for regulating drilling operations in the American OCS), spoke of the immense and unresolved difficulties posed for the actual recovery and production of oil and gas, once they are found. Any conventional offshore production platform placed well offshore in the open waters of the sea would eventually be crushed and swept away by the ice.

Also, the cost of building an artificial is-

land strong and massive enough to withstand the ice would appear to be prohibitive, even if such a project were possible. This would seem to leave only one alternative—putting the wellhead equipment on the ocean floor and connecting it to a pipeline buried deeply enough in the bottom to escape the scouring effects of the pressure ridges, whose keels may gouge out trenches up to 6 meters deep.

Around the world, some 60 or 70 oil wells can be found which have their wellhead equipment at the sea bottom, and 20 or 30 of these are in the Gulf of Mexico. But in every case these wells are readily accessible to emergency vessels and divers which are brought in from time to time to keep them properly maintained, as when sand or paraffin builds up in a well and blocks or impedes the flow of oil.

Even from the standpoint of oil exploration, the Beaufort Sea ice conditions pose major difficulties, although these are not so great as those that would beset oil production. A particularly serious problem, and the one to which the Canadian environmental assessment is largely addressed, turns on the fact that, if a blowout occurs in an exploratory well, the well may run wild for a year or more before anything can be done to bring it under control. Furthermore, the escaped oil would eventually pollute the "leads," or strips of open water that form within the offshore ice at the spring breakup; these leads would thus become traps for thousands of mammals—whales, seals, polar bears, and arctic fox—and countless waterfowl (in the spring of 1974, some 175,000 eider and old-squaw ducks were observed within a week's time in an open water area northeast of the Mackenzie delta).

Relying on industry calculations that are based on admittedly limited experience and information, the Canadian Department of Environment estimates the probability of a blowout this summer at either of the two proposed exploratory drilling sites as between 1 chance in 1,000 and 1 chance in 10,000. In its assessment, the department hypothesizes a "worst case" blowout scenario which, under Beaufort Sea ice conditions, seems not at all farfetched.

With the drilling of the exploratory wells getting under way in early August, an oil strike would not be likely to occur until shortly before the fall freeze-up. With such a strike, the well could simply be capped if there were no mishap. But, if a blowout were to happen, there would be an urgent need to drill a "relief well" through which heavy drilling mud could be pumped into the oil-bearing zone to overcome the reservoir pressure. Yet no time would remain to drill such a well before the freeze-up, and, if the next summer turned out to be bad

from the standpoint of ice conditions, there would be no chance to drill a relief well even then. Within a year's time, a blowout could result in the escape of some 87,000 cubic meters of oil unless the well is sealed spontaneously by debris.

Biodegradation of the oil would be slow under the arctic conditions, and in many places the oil would be too weathered to permit burning it off the surface. And, to make the situation still worse, storm surges could carry some of the oil inshore to pollute embayments, lagoons, beaches, and even some lakes. Such inshore pollution would occur principally in Canada, but pollution offshore could reach as far to the west as Point Barrow, Alaska.

The Canadian Arctic Resources Committee (CARC), a group made up of 28 Canadians prominent in business, law, science, and other fields, is criticizing the exploratory drilling project as outrageously precipitous and premature. Kit Vincent, executive secretary of this Ottawa-based group, says that CARC's objections to the way Prime Minister Pierre Trudeau's Liberal government has been handling this matter have to do with both substance and procedure.

Substantively, CARC is convinced that the 18-month study has not been adequate for the gathering of either the necessary ecological baseline data or the necessary information pertaining to such vital questions as weather patterns and ice movements. In the absence of such information, any regulatory program or blowout contingency plans that might be adopted will be poorly founded, CARC believes.

The group feels that, procedurally, the government has behaved very badly indeed. According to Vincent, "the whole offshore play [in the Beaufort Sea] was set in motion without public hearings and with extreme secrecy." The government gave its conditional approval of the Dome Petroleum permits 3 years ago without even informing or consulting its own party caucus in Parliament, Vincent says. In CARC's view, no final action should be taken with respect to the exploratory drilling without public hearings and parliamentary debate. CARC has just made its own contribution to serious public consideration of this issue by publishing a book, *Oil Under the Ice*, written by Douglas Pimlott of the University of Toronto.

How the question of oil exploration and

development in the Beaufort Sea is handled by the Canadians is important not only in itself but also in terms of setting precedents that could influence U.S. decisions about oil drilling in this OCS province. The U.S. Department of the Interior has tentatively scheduled a Beaufort Sea lease sale for October 1977. At the moment, this proposed sale may look like just so much pie in the sky, but it does signify an intent ultimately to develop these oil and gas resources.

One big question that seems to underlie the whole matter of oil exploration and development in the Beaufort Sea has not yet been squarely addressed. It is simply whether either Canada or the United States should run the risks inherent in exploratory drilling in this OCS region of extreme hazards without first deciding whether the still greater risks that will have to be faced in recovering the oil are acceptable.

If the past is any guide, this question will go begging and the decision-makers in Ottawa and Washington will leave it to good luck and technology to get the oil out without polluting the Beaufort Sea.

—LUTHER J. CARTER

Basic Research Funding: ERDA De-energizes Nuclear Science

One of the questions that has worried many scientists about the creation of the Energy Research and Development Administration (ERDA) was what effect the urgency of its energy mission would have on basic research. Last year's budget was completed before the agency came into existence, so that the new staff made only mid-year course corrections to the funding patterns that had been established by their predecessors in the Atomic Energy Commission.

Now ERDA has submitted its own budget for fiscal 1977, and many scientists—particularly those doing nuclear research—are unhappy with the result. The message in the figures is that some fields of nuclear physics, particularly those centered in the universities, face a declining future with the agency. In 1977, the energy agency has eliminated funding for the Maryland cyclotron laboratory, canceled the contract for the Iowa State reactor program, and reduced support for virtually

all of its low energy nuclear physics laboratories. In the previous 2 years, similar programs had been closed out at Rice, Texas, Michigan, and Kansas State, so there is evidence of a growing trend. All the surviving programs are being given a very careful review. Many scientists fear that these actions mean that sometime in the future all remaining nuclear science facilities at the universities, now numbering about a dozen, will be phased out. ERDA officials do not rule out the possibility.

"Nuclear science has been singled out for budget cuts," says Gerhart Friedlander, a nuclear chemist at the Brookhaven National Laboratory, "whereas the other physical sciences are doing rather well." At ERDA, most basic research categories were increased at least enough to compensate for inflation, but the nuclear science budget was reduced. The situation appears bleak enough that the somewhat somnolent community of nuclear scientists

is beginning to mobilize its members, and knock on important doors in Washington. A National Academy of Sciences committee on the future of nuclear sciences, chaired by Friedlander, is turning its attention immediately to the effects of the 1977 budget, to recommend new government guidelines. Some nuclear scientists favor the formation of another broadly based committee, including a number of eminent physicists, to call attention to their plight.

Ironically, the area of research that the energy administration has chosen to cut back is the one upon which the Atomic Energy Commission was built. The facilities that are now being closed, small reactors and low energy accelerators, provided the data that led to atomic weapons and nuclear power. Many scientists argue that they are still important for the same purposes.

ERDA inherited a number of programs that had been competently managed for three decades by the Atomic Energy Commission, but bore little, if any, relation to the development of new energy resources. Foremost among these was the bulk of the country's high energy physics research, a \$165 million program which appeared out of place in an energy agency, especially to some members of Congress. The legislative mandate for the Atomic Energy Commission included the study of the atom, but ERDA's mandate is to develop new and