by U.S. consumers being used either in part or in whole for the delivery of Mackenzie gas would be eliminated.*

In any case, once the Canadians have made their decision, President Carter will know whether the Arctic, Alcan, and El Paso options all remain alive, or whether only one or two of them do. Whatever choices left open, and whatever the President and Congress may decide, the U.S. government will not be behaving in the arbitrary way it did in approving the TAPS project. In that case, the decision was made without fully exploring the possibility of delivering the oil to the Midwest (where a hungry market was assured) by way of an overland corridor across Canada that could eventually accommodate both an oil and a natural gas pipeline.

A huge and costly environmental study was prepared by the Department of the Interior for TAPS, but the analysis made of the trans-Canada alternative was a pro forma effort which everyone knew would not upset the commitment of the North Slope oil companies and the Nixon Administration to an all-Alaskan pipeline and tanker system. In fact, much worse things have been said about it. Charles J. Cicchetti, now an economist and energy official for the state of Wisconsin who several years ago authored the book *Alaskan Oil: Alternative Routes and Markets*, recently told a Senate committee that the Interior study's conclusions that the trans-Canada alternative did not offer a clear advantage over TAPS on either economic or environmental grounds were "totally fabricated deceptions."

The federal courts, which environmental groups used to delay the TAPS project for a few years, might have demanded a more rigorous analytical effort except for the fact that, with the energy crisis coming on in 1973, Congress simply declared that all NEPA requirements had been met and gave TAPS the go-ahead. As a concession to the critics who were saying that the North Slope oil would wind up being sold to Japan, Congress did provide that no domestic oil could be sold abroad without a special presidential finding that the sales are in the national interest and will not reduce U.S. oil supplies. In the absence of such a finding, the North Slope producers may be reduced to an awkward, makeshift scheme for domestic deliveries, such as one that would involve the transfer of Alaskan pipeline oil from larger to smaller tankers at the Panama Canal.

In contrast to what has happened with respect to TAPS, the decision-making scenario that has thus far unfolded with respect to the gas delivery system seems to offer a hopeful lesson. It is that, if the government shows that its examination of alternatives is in earnest, industry will take the exercise seriously. In announcing the Alcan project in May 1976, John G. McMillian, board chairman of the Northwest Pipeline Corporation, specifically acknowledged that this project had its "genesis" in the draft environmental impact statement prepared by the FPC staff.

As it turned out, the Alcan proposal suffered from being hurriedly put together. This past February an FPC administrative law judge held, in recommending in favor of the Arctic Gas proposal, that the information offered in support of Alcan was so skimpy that that project could not possibly be approved on the basis of it. That Alcan is now back in the ball game, and with a vengeance, is probably due to the fact that the proposal was drastically amended just before the FPC commissioners had to pass on it—for instance, as now designed, Alcan would be a 48-inch express line instead of the more modest 42-inch system first proposed.

Yet, no matter how the final decision on the North Slope gas delivery system turns out, there is reason to think that it will have been arrived at rationally, and in a way vastly superior to the big put-on that seems to have characterized the decision-making in the case of TAPS. The Council on Environmental Quality is currently holding public hearings on the adequacy of the impact statements and will make its own recommendations to the White House by 1 July, as will other agencies such as the Department of the Interior. Once President Carter has heard from the Canadians and made his own decision as to which project to approve, Congress will have 60 days in which to confirm his choice or toss it back to him for another go-round. The final outcome should be known before the year is out.—LUTHER J. CARTER

*Also pending before the NEB is an application by Foodhills Pipe Line Ltd., a partner in the Alcan project, to build a "Mapleleaf pipeline" from the Mackenzie delta down into Alberta. Foothills has acknowledged that there are not enough proved reserves in the delta to justify early construction of this line. But in response to NEB inquiries the company has submitted preliminary studies which suggest that, if the Mapleleaf pipeline were routed across the Yukon Territory along the Dempster Highway, instead of down the Mackenzie Valley, it could be tied in with the Alcan system. The resulting cost savings, Foothills has said, would be such that Mackenzie gas could be delivered to Canadian consumers at prices competitive with those possible with an Arctic Gas pipeline.

Contract Archeology: New Source of Support Brings New Problems

Until recent years, American archeology has been a highly individualistic pursuit, conducted for scholarly ends rather than to serve national interests.

But federal environmental laws and new measures designed to preserve cultural resources are rapidly expanding the scope of the profession. Government agencies involved in land management and public construction projects are hiring archeologists right and left. States have been creating and expanding offices for historic preservation and archeological survey work. And academic archeologists are finding themselves, in the words of Charles Cleland of Michigan State University, in the midst of "politicizing and businessizing of what had traditionally been a real esoteric ivory tower profession."

"Contract archeology" is what it's all about. It is the fast-growing arm of what, these days, is called "cultural resource management." It involves hiring archeologists to survey land destined for disruption by federal construction projects and, if the sites are thought to contain important information about human history and prehistory, to take measures to preserve the sites or excavate them.

In the past couple of years enough federal money has been available to rescue many ancient artifacts that otherwise would have been destroyed or inundated, or lost to the world of knowledge through the rapacity of looters. In New Mexico, for example, the government has put $30,000 into the salvage of several 17th-century Navajo settlements which otherwise would have been flooded when it became necessary to raise the level of a reservoir created by the Abiquiu Dam. In Tennessee, University of Tennessee archeologists are engaged in a $100,000 project to preserve

artifacts from Cherokee villages at the site of the Tennessee Valley Authority's Tellico Dam. Even though construction has been halted because of the fuss over the threatened extinction of snail darters, preservation is required to protect artifacts from swarms of vandals.

"Salvage archeology" used to convey the image of a last-minute emergency operation where archeologists hurled themselves in front of oncoming bulldozers to rescue what they might. Now, it is increasingly becoming incorporated in the early stages of federal projects, mandated by law, and enmeshed in what is for archeologists a whole new world of budgets, bids, deadlines, and bureaucratic paperwork.

These developments have been a big subject of discussion and debate among archeologists. Last year members of the Society for American Archaeology organized a new group, the Society for Professional Archeologists (SOPA), to concern itself with the problems offered by the new opportunities and to set ethical and professional standards for archeologists involved in contract work. It also arranged procedures to investigate any contracts where there was evidence of unprofessional or unethical conduct.

SOPA's first big job came this year when the Kansas City *Times* published a wordy four-part series, the first of which was entitled "Archaeologists hit rich vein of federal funds." The articles implied that archeologists were having a field day with money made available for salvage in a 1974 federal law, known as the Moss-Bennett Act, which stipulates that up to 1 percent of the cost of a federal construction project may be used for preservation of significant archeological data. The series specifically picked on a contract between the University of Missouri at Columbia and the state highway commission for salvage of Indian artifacts in the path of a new interstate highway. Just what was found under this $45,000 contract has not yet been reported by the two archeologists, but reporter James Fisher uncovered what he thought were quite a few irregularities, including sloppy management of expenses and failure of the archeologists to clean up the site and fill in some holes after they left.

Although the articles contained no allegations of outright fraudulence, they created an extraordinary stir among archeologists around the country. SOPA's grievance coordinator, Edward B. Jelks of Illinois State University, was promptly dispatched to Kansas City to get to the root of the matter. Jelks told *Science* he didn't want to comment because his investigation was not complete. But so far, he indicates, it appears that the contractors were guilty of little more than some administrative sloppiness.

Nonetheless, archeologists have been bothered by the series. Unlike Medicaid doctors and highway contractors, they are unaccustomed to being accused of ripping off the federal government, and they are intensely concerned about getting this new line of endeavor off properly.

Meanwhile, the National Park Service's Interagency Archeological Services Division, which has responsibility for policy guidance on contract work, is attempting to make coherent sense of the half-dozen or so laws that relate to archeological preservation and salvage in federal construction projects.

Laws to protect antiquities on federal lands date back to the beginning of this century, but funds for salvage and preservation have been pitifully scant until the last few years. In 1960 the Reservoir Salvage Act gave the Interior Department responsibility for preserving archeological data in areas affected by dam construction. Additional mechanisms for inventorying and surveying federally owned antiquities were supplied in the National Historic Preservation Act of 1966, which created the National Register of Historic Places (in the Park Service) and the President's Advisory Council on Historic Preservation, and instructed each state to appoint a State Historic Preservation Officer.

In 1969, along came the National Environmental Policy Act (NEPA) which required historical as well as environmental resources to be taken into account in environmental impact statements. The next noteworthy measure was Executive Order 11593, signed by President Nixon in 1971, which detailed agency responsibilities under the prior laws and specifically ordered the Department of the Interior, through the Park Service, to develop criteria and policies for evaluation of important properties and determination of eligibility for the National Register.

Although agencies have been required, under NEPA, to conduct archeological surveys prior to construction, there hasn't (until recently) been any money to speak of for "mitigation"—that is, for preservation or salvage of threatened sites. What there was all came from the Park Service's archeological program, since the Interior Department was the only agency technically authorized to spend money—about $1.5 million a year—for this purpose.

It was not until 1974 that significant sums became available for mitigation, supplied by the Moss-Bennett Act, an amendment to the reservoirs act that is formally known as the National Historic Preservation Act. This was the first time that federal agencies were authorized to apply their own money for archeological mitigation.

The Moss-Bennett measure does not, as some have thought, automatically set aside money for salvage on any federally supported project. A site qualifies under this legislation only after various layers of officialdom have determined its eligibility for the National Register, and the advisory committee has the last word on that. Even then, according to Park Service archeologist Rex L. Wilson, "Our present policy is to take all prudent and feasible measures to keep archeological remains threatened by Federal projects in the ground—not dig them up."

Actual salvage work, then, occupies a fairly small portion of the estimated $10 to $25 million the federal government now spends on archeology related to federal lands and projects.

Still, the new laws are giving a new dimension to this traditionally poverty-stricken profession. Charles McGimsey of the Arkansas Archeological Survey, one of the chief lobbyists for the Moss-Bennett law, estimates that $20 million is being spent this year on public archeology, compared to $3 million in 1971. The Arkansas survey now has 17 archeologists and a $500,000 program—up from about $10,000 10 years ago. And the federal laws have stimulated the evolution of a whole new group of archeologist-administrators.

Some archeologists are concerned that hauling the discipline out of its ivory tower and bending it to public service will result in pollution of the profession if proper safeguards are not instituted. Fred Kinsey of Franklin and Marshall College stated this position in a paper delivered to a conference last year. "Almost overnight archaeology has become a business," he stated. "Most of us are not equipped by experience, training, temperament and nature to do this." Kinsey expressed the fear that "excessive contract archeology will, in the long run, produce shoddy archaeology. . . . We will be diverted from creative archaeology which will result in a generation of sterile field work devoid of theory and purpose. The final report will be the goal because that is when we are paid off in full."

Most archeologists aren't as worried as Kinsey, but they are concerned about quality control. There is general agreement that better ways must be found to ensure qualified people get the jobs. There are maybe 3000 professional archeologists in the country and untold numbers of amateurs. Until now there has been no particular need to set objec-

tive criteria to define an "archeologist." SOPA has addressed itself to this matter by setting minimal standards of education and experience for professional archeologists, standards for report writing, and a code of ethics.

Contract archeology calls for a "new kind of archeologist," says Cleland, one who knows about contracts and negotiations and who is prepared to do directed research as opposed to investigating a broad theoretical problem.

"Archeologists are used to flying by the seat of their pants," says Thomas F. King of the Park Service. He explains that the federal laws come at a time when there has occurred a basic shift in the discipline away from "particularistic" investigations toward looking at a particular site as part of a broader settlement system. This type of research calls for a good deal more advance planning, and selective sampling of sites rather than wholesale excavations. In the old days, says McGimsey, an archeologist conducted a survey, then dug. Now, more selectivity is called for, decisions have to be made about what level of archeology is appropriate, whether testing or complete excavation is called for, and what the significance of a site is. The trend in archeology, as in surgery, is toward more thinking and less digging, and this, says King, is just the kind of archeology the historic preservation program needs.

Park Service archeologists are still trying to formulate regulations that will bring all the relevant laws in synchrony with each other, and are having a hard time getting federal construction and land management agencies to do things the way they recommend. The Soil Conservation Service, for example, doesn't think the Moss-Bennett law applies to the SCS because "we don't own the land." SCS's Gerald Lanman complains that projects are held up because "If there's any indication an Indian has been there they [the Park Service] say the site's important." The Army Corps of Engineers, on the other hand, has jumped on the bandwagon and has hired 30 archeologists over the past few years. Larry Banks of the Dallas office says the corps alone has spent $5 million for salvage in the past 15 months.

If the government had all the money it needed to keep pace with all the land disturbance going on it wouldn't be able to find anywhere near enough qualified archeologists. Even now, with the modest increments in funding, qualified professionals are in short supply. But archeologists are scrambling to shape up for the new opportunities. While some may consider that doing work on contract, on a site not of their choosing, may be tedious, unromantic, and riddled with paperwork. McGimsey finds the whole field "challenging and exciting." He predicts "the majority of archeology will be done on contract in the next 10 years if we do it right," and "most of the major advances" in the field will occur under contracts.—CONSTANCE HOLDEN

RESEARCH NEWS

Blood Clotting: The Role of the Prostaglandins

The discovery late last year of a new prostaglandin that appears to prevent formation of blood clots has begun a new chapter in the story of these potent regulatory chemicals. The recent discovery complements an earlier finding of a thromboxane (thromboxanes are close chemical relatives of the prostaglandins) that is extremely effective in causing blood platelets to clump and arteries to constrict, both effects that should promote blood clotting. Since the new prostaglandin has exactly opposing effects, the emerging picture is that the balance between the activities of the two agents may determine whether or not a clot will form.

The findings are of potentially great clinical significance because heart attacks and strokes are often caused by abnormal clot formation. Investigators hope that a better understanding of how the prostaglandins affect clot formation will lead to the development of new drugs that prevent clots. For example, the structure of the prostaglandin has been determined, and it may be possible to synthesize a stable analog that mimics its action. Aspirin, an old drug that is now known to block prostaglandin synthesis, is already being tested in a clinical study sponsored by the National Heart, Lung, and Blood Institute (NHLBI) to see whether it can protect against heart attacks (see box, p. 1075).

Investigators have known for some time that the prostaglandins affect the aggregation of platelets in the test tube. Platelet clumping in response to blood vessel injury is one of the first steps of clot formation. However, investigators found it difficult to work out the exact role played by the prostaglandins in the living animal. The body makes several prostaglandins, and some of them promote platelet aggregation, whereas others inhibit it. Investigators simply did not know enough about where and how the agents were synthesized and what controls the synthesis to determine which are physiologically important in regulating blood clotting.

A development that helped to clarify the situation—and that of prostaglandin biochemistry in general—was the discovery a few years ago of the prostaglandin endoperoxides. Then, in 1975, Mats Hamberg, Bengt Samuelsson, and their colleagues at the Karolinska Institutet in Stockholm identified the thromboxanes (*Science*, 21 November 1975). Both the endoperoxides and the thromboxanes were hard to find and are still hard to study because they are very unstable.

The endoperoxides, now designated PGG_2 and PGH_2, are key intermediates in the synthesis of several prostaglandins and the thromboxanes (Fig. 1). They are formed by the enzyme cyclooxygenase from arachidonic acid, a common fatty acid present in fats and other lipids. The enzyme is inhibited by aspirin and related compounds such as indomethacin, which thereby block the synthesis of all the prostaglandins and thromboxanes formed from PGG_2 and PGH_2.

Although platelets clump when they are exposed to endoperoxides, the Karolinska group thinks that much, and possibly all, of this effect can be attributed to the fact that endoperoxides serve as a source of the thromboxane called TXA_2. Samuelsson and Hamberg have shown that TXA_2 is an extremely potent aggregator of platelets. In addition, the investigators have evidence that the agent is identical with "rabbit aorta contracting substance" originally described by John Vane and Priscilla Piper, then at the Royal College of Surgeons in London. Both materials contract rabbit aortas, have similar half-lives, and are formed in platelets from endoperoxides.

The enzyme that synthesizes TXA_2 (thromboxane synthetase) has been iden-