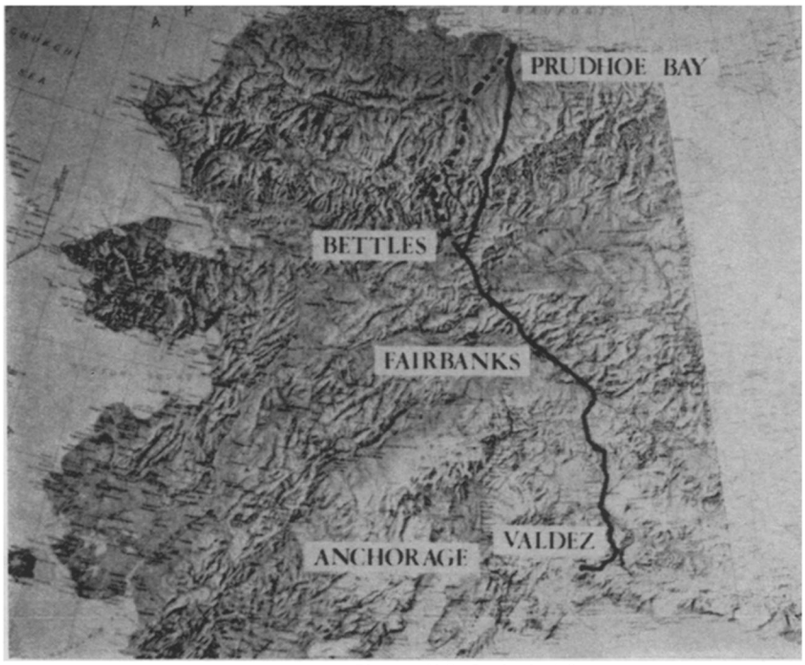
Getting set for a black gold rush

Three oil companies are eager to build the 800-mile Trans-Alaska Pipeline, learning as they go

by Edward Gross



Photos: U.S. Geological Survey

Proposed route of the 800-mile Trans-Alaska Pipeline.

Hot oil. Between 100 billion and 300 billion barrels of it from the North Slope of Alaska. Up to 2 million barrels a day down 800 miles of steel pipe from Prudhoe Bay on the Arctic Ocean, down the Sagavanirktok River, through the Chandalar Pass of the Brooks Range, down the Dietrich Valley, under the Yukon River, through Fairbanks, on across the Alaska Range, close by the Copper River, clipping the Chugach National Forest and into the south Alaskan seaport of Valdez.

That is the plan for the Trans-Alaska Pipeline. Waiting eagerly for the go-ahead from the U.S. Department of the Interior to build it are its three owners: Humble Oil & Refining Co., Atlantic Richfield Co. and British Petroleum Corp. And it looks as if they'll get it. In January, Interior Secretary Walter J. Hickel, former governor of Alaska, officially thawed the land freeze imposed to protect the land rights of the natives by predecessor Stuart L. Udall. Hickel's step paved the way for issuance of a permit to build the 48-inch pipeline. The permit is hanging until some still pending engineering questions are answered—not comprehensively, but at least to his satisfaction.

To this end, Interior has listed 50 stipulations that must be met (SN: 10/25, p. 377). They require, for example, that the builders, the Trans-Alaska Pipeline System, Houston, Tex., provide oil spill containment dikes around storage tanks, plans for oil spill clean-ups, and corrosion-resistant pipe. The builders also must not interfere with fish migration, must clean up waste, conduct studies aimed at the prevention of permafrost damage and employ erosion control techniques.

The builders have agreed to live with these requirements. But there is some question about their ability to guarantee the Alaskan landscape.

Prof. Edward E. Cooper of the University of Tennessee finds the stipulation requiring that "all practical means" be taken to avoid injury to the permafrost to be too vague. Others, he says, have too little basis on arctic experience to insure sound design.

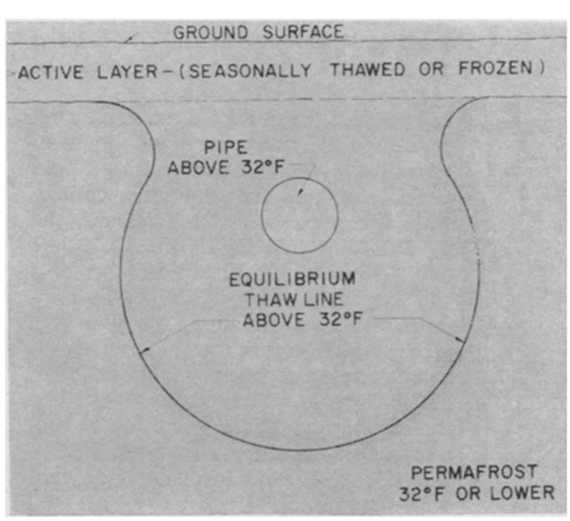
"The stipulation practices called for are, as far as I know, not practiced in the Arctic at present, and their utility and practicality are therefore unknown," he declares.

Nobody has ever done what the engineers designing the Trans-Alaska Pipeline are faced with: the need to carry hot oil through the Arctic. The Trans-Alaska Pipeline, expected to be completed in 1972, will carry 600,000 barrels of oil a day down across Alaska. Five pumping stations along the line will propel the oil, and eventually 12 stations will pump two million barrels a day. The oil will start out at about its wellhead temperature of 160 degrees F., and by the time it reaches its terminus at Valdez, the temperature will be 100 degrees F.

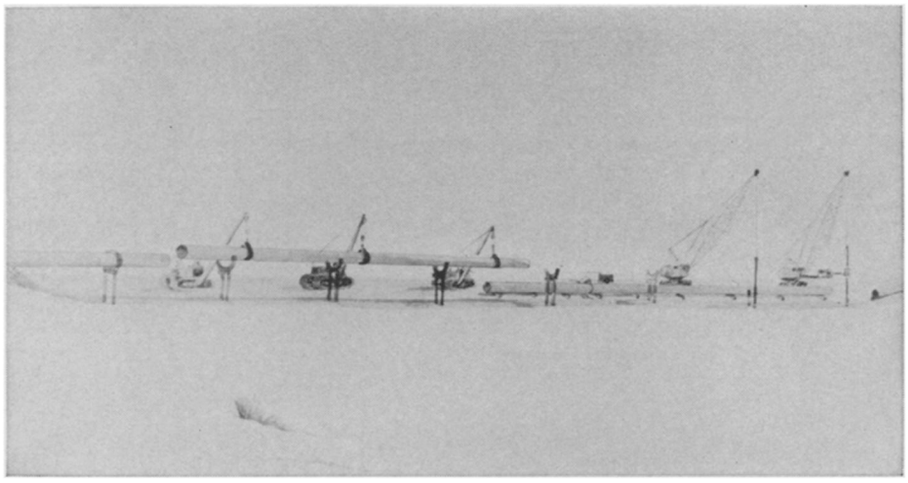
To a large extent the engineers are feeling their way, which Interior accepts as inevitable. But opponents of the line—mainly conservationists—are less willing. They contest the builders point by point, and point out that for nearly all of the 800 miles, the line will pass through permafrost, the perpetually frozen ground below the surface, varying in thickness from a couple of hundred feet to 1,000 feet, and about which little is known. The oil's heat, they fear, will thaw the permafrost, including its thick ice lenses.

The results could be disastrous. Differential settling, where the unequal

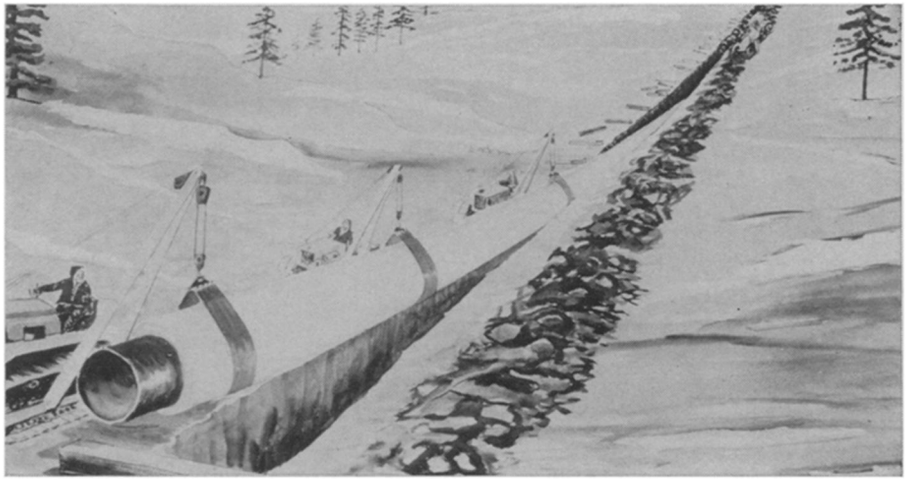
Ice formations will be in the soil.



The oil will radiate a heat bulb.



Soil with high moisture will require above-ground pipeline supports.



Where conditions permit, insulated pipe will be buried 4 to 10 feet deep.

melting of permafrost causes different stresses along the length of the pipe, could rupture it, spilling millions of gallons of oil over the land. Or the heat can exacerbate the natural process of solifluction, the slow creep of earth down a slope. The result could be a massive land flow that could break the pipe as well as alter topography.

The designers admit that they can't yet design their way out of all the problems. There will be some melting of the permafrost, and the ground in contact with the pipe will tend toward the fluid. As a round figure, they calculate that a thaw bulb with a 25-foot radius will extend out from the pipe. To minimize the heat radiation, the pipe will be insulated on the outside. The insulator has not been finally selected, but the plastic, polyurethane, looks like the leading candidate so far. A protective coating of metal or plastic will be placed around the insulation to ward off corrosion.

Since corrosion is an important factor in pipeline breaks—accounting for 25 percent of them—some breaks logically can be expected from it. For this reason and because the pipe will be subjected to extremes of heat in the summer and cold in the winter, the builders have constructed it of a special low carbon steel alloyed with vanadium and columbium.

To combat breaks that are probably inevitable, the pipeline will be equipped with electronic sensors that detect unusual oil pressure changes. In the event of a break, these sensors activate an automatic cutoff system that closes valves in the pipeline. Although the sensors work in microseconds, relaying their information by microwave, the valves are ponderous—30 feet high and weighing 60,000 pounds—and it takes several minutes to completely close them.

Where a break occurs will determine the extent of damage done by the oil. Should it occur at the top of a hill, little oil will get out. Should it occur in a valley, however, all the oil above it will flow out. In some cases, if the break is small enough and in the right location, the oil remaining in that section can be drained back into tanks at the pumping station.

There is the nagging fear, however, that all the valves and cutoff apparatus will come to nought if a big earthquake hits as it did in 1964.

But the builders believe experience elsewhere is in their favor.

"This same situation is common to the whole west coast of North America, on which many pipelines have been located and satisfactorily operated for a number of years," says George Hughes, project director for the pipeline. He singles out California as a prime example. Its seismically active San Andreas fault has produced no such massive pipe breaks as the TAP critics fear.

But the question is: How relevant is California experience?

Louis C. Pakiser Jr., of the National Center for Earthquake Research, at Menlo Park, Calif., does not think it is. "I don't think you can transfer the earthquake experience in California to Alaska. I think the nature of the faults and the seismic activity are quite different. In general, the earthquake hazard in Alaska is potentially much larger than in California."

Current estimates are that for all but 40 or 50 of its 800 miles, the pipe will be underground, somewhere between 4 to 10 feet. The pipe will be buried where "the soils are determined to have sufficient bearing capacity to support the pipe and its contents in the thawed condition," according to a statement by the Trans-Alaska Pipeline System. In the 40 or 50 miles where the soil has a high moisture content and thawing could be hazardous, supports will be sunk into the frozen permafrost to elevate the pipeline.

But those are the builder's estimates, and in some quarters they are regarded as optimistic, if not downright Pollyannish. Dr. John C. Reed, executive director and senior scientist of the Arctic Institute of North America, disputes the 40-mile figure. Says Dr. Reed, "I think more will have to be above ground. I can't give a number, but 40 seems much too small to me."

Where the pipeline must go above ground, construction work in elevating it will be carried out from gravel pads. Gravel will also be used as the base for the pumping stations, which will be elevated three to five feet above ground. Where the line runs along a river, gravel will be placed under it to provide insulation.

All of this worries Tom J. Cade of Cornell University's section of ecology and systematics. "Along the Sagavanirk-

tok River, construction will require more than three million cubic yards of gravel per mile," he says. "Does that much gravel exist in the flood plain on this river? What would the removal of three million cubic yards of gravel per mile of river do to the river?"

In general, the builders maintain there is enough gravel in the rivers, or available elsewhere in natural rock formations, to suit their needs. But how much they can take from the streams has still to be decided. The Bureau of Land Management has not completed its inventory. Dale Andrus of the bureau says not all of the streambed gravel the builders are counting on may be made available by the bureau. If it will have to be obtained at the expense of stream channels or general environment, they may have to look elsewhere.

Besides the concern about harm to the physical environment, conservationists fear for the wildlife. Dr. James E. Morrow, zoology professor at the University of Alaska, worries that the pipeline could reduce fish runs, thereby cutting native food supplies and threatening some salmon with extinction.

He adds, "However, I believe that these problems can be avoided if proper precautions are taken during construction of the pipeline." He suggests such things as not constructing during spawning runs, replacing gravel in proper order (the stone and gravel dug last should go back first) and not disturbing soil-stabilizing vegetation on river banks.

Dr. Morrow admits that such restrictions may make construction "a little more difficult" and costly in the short run.

Besides threatening fish, the pipeline, and its accompanying feeder lines and roads, will pass through nesting areas of birds and cut across caribou trails. All of which should give the builders pause, say the conservationists, until all the facts are known.

Or put another way, the conservationists are not asking for an outright ban on the system. "Most conservationists accept the fact that the oil will have to be extracted and transported to market," says Cade. But, "I oppose any further development of these fields, including the laying of pipelines, construction of roads, railroads or any other major projects on the North Slope itself until we know precisely what we are about."

This may well be more than can be delivered now. Even the pipeline builders admit that all the answers are not in yet for all the 800 miles of the line's length. Even after the permit is given, information gathering will still be going on. Construction will proceed in sections and when one section is finished, the next one must be ready to go. Says Hughes, "We will have all the information when we get to it."

But that construction will stop if the information is not forthcoming is doubtful. The outcome, says Steward M. Brandborg, executive director of The Wilderness Society, may be, ". . . serious changes in the character of the country, [that] could gravely alter patterns and populations of wildlife upon which many native Eskimos and Indians depend for food and shelter, and would introduce significant risks of depreciation of the land and waters by accidental discharges from oil leaks or other ruptures of the pipeline."

Or Alaska may be lucky. "It is perfectly possible," Dr. Morrow contends, "that the construction of the pipeline would have no deleterious effects. It is certainly possible that the pipeline can be built in such a way as to produce no undue or long-lasting damages." □