ducing a synthetic crude oil from a low-grade material (10 to 20 percent bitumen by weight) that looks like sticky dirt. There are other large petroleum deposits in the area, including more than 100 billion barrels of heavy oil, a lighter and less viscous material officially defined as any oil heavier than 20° API* that still flows into production lines at a profitable rate. Oil from the sands does not flow unless heated or diluted. The tar sands are more interesting, however, because they are the poorest quality petroleum resource being developed anywhere in the world. They stand at the economic frontier, and yet they are attracting many investors.

The two running plants are essentially strip-mine operations linked by conveyor belts to rudimentary refining systems (or "upgrading" equipment, in the industry term). The bitumen is washed out of the sand with hot water and sodium hydroxide, purified, and blended with lighteners to produce a synthetic crude oil, which is put into a pipeline built expressly for the tar sands. The product is usable in most refineries. Both mines are located in the Fort McMurray area, about 300 miles north of Edmonton, atop the most accessible and highest-quality sands in the immense Athabaska field. Construction of the first plant, known as Great Canadian Oil Sands (GCOS), 96 percent owned by Sun Oil of Philadelphia, began in 1964. Capital investment amounted to $300 million or more in today's dollars. It began producing 50,000 barrels of synthetic crude oil or syncrude daily in 1968, and is just now beginning to make a profit. Work on the second plant began in 1967, although construction did not begin in earnest until the early 1970's. After a series of economic and political misadventures, the plant, christened Syncrude Ltd., opened on schedule in the fall of 1978. It is designed to produce 129,000 barrels a day, when fully expanded, and its owners predict that, with luck, it will produce its current full capacity of 100,000 barrels a day for a month or two this summer. Its cost was $2.2 billion to $2.5 billion, meaning that to double the output of GCOS, Syncrude needed seven times the capital. The next plant of this kind, called Alsands Ltd., will be an approximate replication of Syncrude and will cost even more, at least $4 billion.

Before looking at the economics of

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*The American Petroleum Institute (API) maintains an index of the quality of crude oils based on a simple viscosity test. The tar sand oil has an API rating of 8° to 10°; one Venezuelan heavy oil (Bachequero) is registered at 16.8°; and Saudi Arabian light (Berri) at 38.8°.

Briefing

What to Do With Leaking Weteyes

The Army is coming under increasing pressure to neutralize 894 nerve gas ("Weteye") bombs that have been in storage at Rocky Mountain Arsenal since 1969.

The bombs are all that remain of the nation's air-to-ground nerve gas capacity. They were scheduled for demolition in 1973, but the Navy, which owns the bombs, decided to keep them when it was learned that new binary nerve gas bombs would not be coming on line to replace them.

Plans were made instead to move the bombs to Tooele Army Depot in Utah because of the risk from overflights at Denver's Stapleton Airport (the arsenal is located at the end of a runway). However, last year it was discovered that four of the bombs were leaking. Following the issuance of a supplemental environmental impact statement, the bombs were scheduled to be moved this month, but a pretransfer inspection revealed leakage in six more bombs. So the Army has again delayed action pending assessment of the new development.

The bombs have become exceedingly unpopular and practically everybody except the Department of Defense (DOD) wants them neutralized. The Environmental Protection Agency has written the Army asking for a public reassessment of the transfer plans, and Utah Governor Scott Matheson was about to go to court to ask for a restraining order to prevent shipment to his state when the Army announced its postponement.

Representative Pat Schroeder (D-Colo.) and Senator Gary Hart (D-Colo.) have for some time been trying to get the Army to decommission the bombs. The DOD claims they are still needed as a "deterrent" to Soviet chemical weapons—as an Army spokesman in Denver told *Science*, "Since we've had a deterrent no one has used chemical agents against us."

This is quite true, as no one has used chemical antipersonnel agents since World War I. Schroeder points out that the bombs are Korean War vintage and would not fit into any modern battle scenario. "We'd only use them in Europe," says Schroeder, but the Europeans will not let us store the bombs on their soil. Besides, if they wanted nerve bombs they could make them themselves. "There's nothing mystical about poison gas," she observes, "they're not like nuclear weapons."

The bombs in question are 20 inches in diameter and 103 inches long and weigh 851 pounds each in their shipping containers. They are filled with nerve agent GB (for German type B sarin), developed but never used by the Germans during World War II. The agent kills a human being in seconds.

Public opinion in Utah and Colorado is running strong against the proposed bomb transfer. "The only thing worse," says Schroeder, "would be an announcement they're going to do it in a DC-10."

Modified Surgery for Early Breast Cancer

There is no scientific evidence that a radical mastectomy gives any better results than a modified one for early breast cancers, according to the consensus meeting held on 5 June at the National Institutes of Health.

The daylong meeting, featuring the opinions of an international panel of eight breast cancer experts, also concluded that segmental (removal of the lump) mastectomy and primary radiotherapy may be sufficient treatment for very small cancers, but that more research was needed.

In this country 107,000 cases of breast cancer among women are diagnosed each year. Of these, 85 percent are early (stage one and two) cancers. Yet about 30 percent of mastectomies performed are radical ones, involving removal of underlying chest muscles.

Bernard Fisher of the University of Pittsburgh reported the results of a 5-year study of 1680 patients who were randomly assigned simple or radical mastectomies. No significant differences between survival rates of the two groups were noted, even when those whose cancers had spread to lymph nodes had only a simple mastectomy plus radiation.

Umberto Veronesi, head of Italy's National Cancer Institute, offered evidence that in early cancers segmental

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mastectomy plus radiation was just as effective as radical mastectomy. Fisher is in the second year of a similar study, in which he is comparing the results of simple mastectomy with those of segmental mastectomy and segmental mastectomy followed by radiation.

IQ Tests for Reactor Operators

The Tennessee Valley Authority (TVA) is making a bid to become the nation's leader in selection and training of nuclear reactor operators in the wake of the accident at Pennsylvania's Three Mile Island plant.

A new set of recommendations has been made by a six-member task force. They will apply to the three units operated by TVA at Brown's Ferry as well as 14 more reactors planned or under construction in three states.

In addition to various organizational measures to promote safety considerations, the report calls for extending the training period for reactor operators from 2 to 3 years, and for the introduction of "stringent intelligence testing." TVA already routinely gives personality tests to job applicants as part of their medical clearance. Applicants also take a General Aptitude Test battery that measures mechanical aptitudes. In order to become licensed, would-be operators also have to pass the Nuclear Regulatory Commission examination and oral and written TVA examinations.

The task force decided that these measures are still inadequate for predicting an operator's performance on the job. From now on, "intelligence will be stressed as one of the most important characteristics of superior reactor operators." The report says "intelligence distinguishes those who have merely memorized a series of discrete manual operations from those who can think through a problem and conceptualize solutions based on a fundamental understanding of possible contingencies."

A TVA personnel officer says that no particular test has been selected, but one will be within the next 2 months. Operators currently employed will be tested and retrained. Asked what TVA would do if a competent operator did poorly on an IQ test, the personnel officer admitted that would pose a "substantial problem." However, a TVA psychologist said the scores of current employees would be used to help establish minimum standards for new applicants.

General intelligence testing for job applicants—that is, tests not directly related to job performance—is very controversial and their use has become highly circumscribed in recent years. But according to a psychologist whom TVA has consulted, "IQ testing is definitely on its way back."

David G. Powell of TVA says the "toughening up" of training and selection procedures is designed to "raise operators to a more professional status"—also to reduce the dropout rate from training programs, which stands at about 20 percent.

Although the nuclear industry is generally talking these days about the need for more stringent personnel procedures, *Science* did not learn of any other specific changes. A call to Metropolitan Edison, the company that runs the Three Mile Island plant, did not produce any new information.

Lawyers Alerted for Skylab

The National Aeronautics and Space Administration has a team of lawyers ready to speed to any place in the world to assess and facilitate damage claims lest a piece of Skylab, now expected to fall between 4 and 28 July, cause injury to life or property.

This is all part of plans formulated by an interagency working group that includes the departments of Defense, State, and Justice, the Federal Aviation Agency, and the Federal Emergency Management Agency.

According to NASA administrator Robert A. Frosch, existing treaties and agreements cover all possible contingencies. According to a 1972 treaty, the United States is liable for any damage caused by U.S. space vehicles abroad. American citizens, however, would have to file for damages under the federal Tort Claims Act. A showing of negligence would be required for any claims exceeding $5000.

According to the North American Air Defense Command (NORAD), some 2594 objects have "decayed from space" since 1974, 627 of which were expected to survive reentry. As the reusable space shuttle commences operations, though, said Frosch, "debris prospects for the next 5 years are expected to be somewhat less."

Deaf Nurse Loses in Supreme Court Plea

In a setback to the handicapped, the Supreme Court ruled on 11 June that federal law does not contain any requirement that educational institutions make "substantial modifications" in their programs to accommodate handicapped students.

The plaintiff was Frances Davis, a 46-year-old licensed practical nurse from North Carolina, who claimed that she was illegally excluded from the registered nurses' training program at Southeastern Community College because she is deaf. Hers was the first Supreme Court case relating to section 504 of the Rehabilitation Act of 1973, which states that no "otherwise qualified handicapped" person can be excluded from federally funded education programs.

The court took a narrow view of section 504, saying that a ruling favorable to Davis "would prevent an institution from taking into account any limitation resulting from the handicap, however disabling." The unanimous opinion, written by Justice Lewis F. Powell, asserted that Davis "could not participate in Southeastern's nursing program unless the standards were substantially lowered." He claimed that "the ability to understand speech without reliance on lipreading is necessary for patient safety" and that "nothing less than close, individual attention by a nursing instructor would be sufficient to ensure patient safety. . . ."

Davis's supporters contend that these assumptions have already been proven groundless by the fact that there are a number of deaf nurses, and doctors too, functioning competently around the country. One civil rights lawyer says the outcome of the case indicates the need for a much more specific law, modeled on HEW's regulations pertaining to section 504, which were largely ignored by the court.

Constance Holden