only a few kilotons for "killing" enemy warheads at close range within the atmosphere. The accuracy of the Spartan ABM, designed for nuclear duels above the atmosphere, is being refined, and as its "miss-distance" declines from a few tens of kilometers, a much smaller warhead may suffice.

Weapons effects work would also continue, although possibly at some disadvantage; the radiation profile of small-yield devices generally is not the same as from large devices. Similarly, stockpile-sampling could also continue, although large thermonuclear weapons could not be fired at their full yield. While the military may find this unsettling, arms control advocates contend that any uncertainties in the reliability of the deterrent force tend to discourage thinking about preemptive "first strikes." Uncertainties felt equally by both sides are viewed as stabilizing.

Plowshare-type explosions for peaceful purposes, however, may be a source of problems. Most of the devices developed in the United States run 30 kilotons or more, and the Soviets' presumably are no smaller. Scoville, among others, notes that a plowshare program could be used as a cover for weapons work. Whether such work would significantly affect the U.S.–Soviet balance of power is a matter of disagreement.

Whatever the final form of the agreement now under study, it seems certain that nuclear testing will continue—fettered but not hog-tied.

Ironically, the United States and the Soviet Union came this far once before, only to fail. In the spring of 1960 only minor differences on a threshold test ban remained for the upcoming summit in Moscow that May. But the summit and the treaty went down in flames that spring, along with one of those troublesome "national means of verification," the U-2 aircraft piloted by Francis Gary Powers. Fourteen years later, the two governments appear ready to try again.

—ROBERT GILLETTE

Antarctica: World Hunger for Oil Spurs Security Council Review

A little-known government decision-making body, the Antarctic Policy Group, which is part of the White House's National Security Council (NSC) apparatus, is considering possible revisions in the historic 12-nation Antarctic Treaty in anticipation of the day when oil, gas, and minerals begin to be extracted from that continent. The review could result in the first major change in U.S. Antarctic policy in more than a decade.

Both the U.S. government and other nations that are party to the treaty are looking at this issue in preparation for negotiating possible changes in it at a forthcoming meeting in Oslo, Norway, next April. At the last biennial meeting of the treaty nations, one of them, New Zealand, proposed that the resource question be taken up. A unanimous vote of the 12 is needed to change the treaty.*

The Antarctic Treaty is something of an international benchmark. It bans emplacement of weapons and military activities in Antarctica; it requires free exchange of all scientific information gleaned about the continent. It has, in effect, reserved the continent and its surrounding waters for the twin purposes of scientific research and environmental preservation since it came into force in 1961.

But the treaty neither permits nor bans exploration for oil and minerals there. Officials are fearful that, if some preparation is not made, exploration for oil or minerals could lead to international conflict in this heretofore peaceable continent. At the moment, the treaty makes no mention of nonliving resource exploration and exploitation—although it facilitates preservation of the living resources, such as the seals, found in Antarctica. Hence, no one knows whether individual countries, or some international body, has the authority to issue licenses or resolve disputes over nonliving resources. At present any company that launched operations there would be working in a complete legal vacuum.

Another unresolved problem is that 7 of the 12 treaty nations have at some time or other made territorial claims in the Antarctic;† three of these claims overlap in one possibly mineral-rich region, the Antarctic Peninsula. A valuable sudden oil or mineral discovery could lead these countries to reassert their territorial claims. And, since the treaty explicitly holds all such claims in abeyance, such an assertion would weaken it drastically and open the door to international conflict over claims.

Herman Pollack, assistant secretary of state for international scientific and technological affairs, who heads the Antarctic Policy Group and the current review, is worried that these things may actually happen. "This is one treaty people haven't violated," he said. "We are considering what kind of proposal we would make as to how these parties would manage exploration and exploitation."

So far, no major oil or mining company has expressed serious interest in shoving off to the South Pole in search of greater wealth, although rumor has it that a nontreaty nation, Brazil, is interested in the possibility. However, no major find of these exploitable resources has yet been made, although a great number of commercially valuable minerals and fuels, from gold and diamonds to oil, are believed to exist there.

The technical problems of resource exploration and exploitation in Antarctica's harsh and dangerous environment are many. Nonetheless, scientists predict that technology for offshore drilling in the stormy, iceberg-ridden Antarctic waters and possibly for commercial mining could be available before a decade is over. After all, increased demand for new oil, at least, has spurred drilling in other unlikely places. Mortimer Turner, a veteran Antarctic geologist

* Parties to the treaty are Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Norway, South Africa, the Soviet Union, the United Kingdom, and the United States. Five other states have acceded to the treaty since it came into force in 1961.

† Australia, Argentina, Chile, France, New Zealand, Norway, and the United Kingdom have cut up Antarctica into pie-shaped pieces. The Argentine, Chilean, and British claims all overlap in an area including the Antarctic Peninsula, which is south of Cape Horn.

with the National Science Foundation's (NSF's) Office of Polar Programs, compares it to Europe's North Sea. "The North Sea wasn't a very promising place 20 years ago. If the oil industry wants to recover oil and gas in the Antarctic it can do so. But it will take a decade or two of technological development and a lot of money."

The State Department is keeping the NSC review administratively classified, despite the objections of some spokesmen. Robert Yoder, a recently retired Foreign Service officer whose expertise is in Antarctic affairs, explains that this secrecy is no different from that which precedes most U.S. negotiations abroad. But Richard A. Frank, who is in charge of international affairs for the Center for Law and Social Policy, a public-interest law firm, thinks otherwise. Frank is one of the few nongovernment experts who has participated in the review. "The whole idea that they shouldn't be forthcoming and talk to the American people and the press about what they're doing is ridiculous. For one thing, other governments know what they [the officials in the review] are thinking. To keep the American public ignorant of something foreign governments already know about is ridiculous."

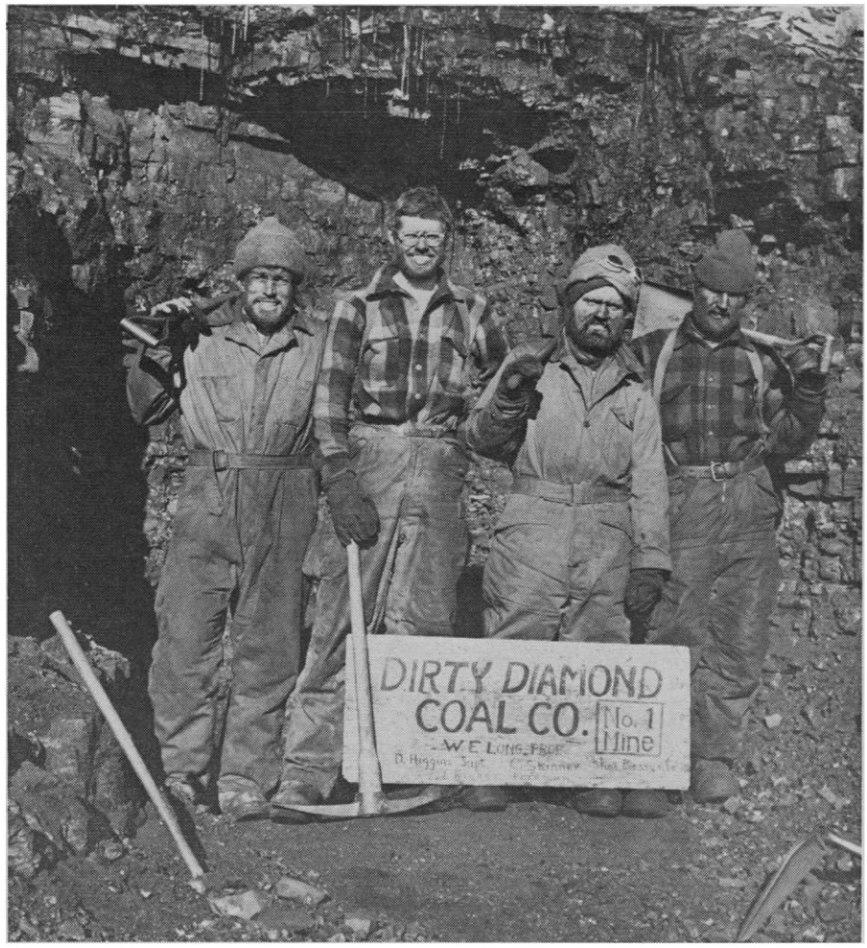
Frank notes that the State Department in some other international negotiations, including those on ocean dumping and the law of the sea, has filed environmental impact statements. Hence the department may also be required to file a statement on its proposed position on Antarctica. "Because of the ignorance about the Antarctic, we simply don't know the adverse environmental consequences of an oil spill down there. . . . Resource developers could change substantially and pollute this last, large natural ecosystem," he says.

Although the NSC study is secret, some aspects of it have leaked out. One is an estimate compiled by the U.S. Geological Survey (USGS) that the western Antarctic continental shelves alone could have potential resources of 45 billion barrels of oil and 115 trillion cubic feet of natural gas—amounts that are roughly equal to the proven reserves of the United States.

Also known are some of the options under consideration. According to Frank, the Federal Energy Office and the Department of the Interior are seeking to enable oil exploration of Antarctica's shelves. The State Department, on the other hand, is fearful that such development would end the era of peaceful cooperation there and favor a moratorium on all such activities. Another possibility said to be under review is an international organization charged with managing Antarctica's resources on behalf of the international community. The scientists have had Antarctica as their own demesne for well over a decade—thanks in part to the treaty—and tend to think of it as a place with only intellectual interest. But others who have involved themselves with the continent have fashioned another tradition—hope that it would prove mineral-rich and commercially valuable. Many early explorers were financed by persons or groups with a resource bent: Admiral Richard E. Byrd was funded by John D. Rockefeller, for example. Although these patrons were not rewarded by big mineral or fuel finds, they did succeed in being immortalized by geographical names like Rockefeller Mountains and Mobiloil Bay.

In fact, far from being a separate issue, the conduct of research in the Antarctic region is intertwined with the hunt for resources—since the scientists are the ones now doing the hunting. Part of the current interest in Antarctic oil arose in January 1973, when the *Glomar Challenger*, NSF's research vessel, found traces of ethane and methane near the middle of the Ross Sea, Antarctica's largest single continental shelf area, which is about the size of France. Ethane and methane are indicators of the presence of natural gas and are sometimes also found where offshore oil is.

There have been other interesting finds. The Lassiter Coast, part of the Antarctic Peninsula, has yielded evidence of porphyry copper similar to that found in the Andes. A rare geologic formation, called a basic layered intrusion, the Dufek Intrusive, is suspected of containing chromium, platinum, and other industrially valuable metals. It is similar to one of South Africa's richest regions, the Bush Veld. The Dufek Intrusive is part of the Transantarctic Mountains which, as they stretch across the continent, also



Ohio State University researchers who found coal in the Horlick Mountains, Antarctica, in the early 1960's, pose at the site of their discovery.

contain coal, ranging from low-grade to anthracite.

According to Arthur Ford of USGS, a Russian expedition has found iron deposits in another mountain range, the Prince Charles Mountains, which are on that part of Antarctica south of the Indian Ocean. "From estimates I've heard," Ford said, "it would be as large as any known deposit of similar material in the world." Gold has been found in Queen Maud Land, although the quantities and types examined are so far "of only scientific interest," Ford says.

Briefing

Soviets Mysteriously Cancel Jubilee

In a surprise move, the Academy of Sciences of the U.S.S.R. has "postponed," perhaps indefinitely, its 250th anniversary celebration which was scheduled to bring distinguished scientists from all over the world to Moscow from 14 to 26 May. The dozen or so American Nobel laureates and National Academy of Sciences (NAS) members who had planned to go received cables abruptly announcing the step only 2 weeks before the jubilee was to start.

The jubilee has been in preparation for months. According to informed Washington sources, the Russians have been renovating the elegant academy building in Moscow and relandscaping its grounds. The first part of the celebration, which was to involve hundreds of scientists, was to be in Moscow; it would then move to Leningrad to honor, among other people, Peter the Great, the 18th century czar who founded the academy.

Officials at the end of last week were reluctant to interpret the move by the Russians as a snub or as an indication of cooling relations. Nonetheless the action raised questions. NAS president Philip Handler said the cable that he received attributed the postponement to forthcoming elections to the Supreme Soviet, Russia's equivalent of the U.S. Congress. But the explanation is admittedly thin, since the elections are not held until mid-June and are about as controversial as electing the local dog-catcher.

Another explanation for the change was that the President of the Soviet Academy, Mstislav V. Keldysh, is widely rumored to have suffered a serious relapse. Keldysh has long had some circulatory disease whose exact identity is not known; it was serious enough last year, however, for famed Houston surgeon Michael DeBakey to have flown to Moscow to operate. Keldysh's infirmity leaves the Soviet academy virtually leaderless; two other prominent leaders, first vice-president Mikhail D. Millionshchikov and council member Lev A. Artsimovich, both died last year. According to this theory, Soviet authorities did not want a lot of foreign visitors in town to witness what will necessarily be a bloody battle for a successor in the event Keldysh dies or is incapacitated.

A third reason advanced was fear by the authorities that, instead of calling attention to the achievements of Soviet science, the jubilee would result in embarrassing incidents involving Westerners with Russian dissident and Jewish scientists. The Moscow dissidents are planning their nerviest protest yet—an international scientific seminar to be held in the apartment of Jewish physicist Alexander Voronel in Moscow 1 to 5 July. Titled "Collective Phenomena and the Applications of Physics to Other Fields of Science," it will offer at least 50 papers, co-sponsored by Tel Aviv University and the Committee of Concerned Scientists in New York. The committee has been urging the scientists going to the May jubilee to contact Jewish scientists in Moscow. But whether or not the authorities got wind of this planning, and balked at having their official invitations thus used, is not known.—D.S.

Schlesinger's R & D Funding Plan Attacked

One of the most powerful Senate arbiters of military research and development activities, Senator Thomas J. McIntyre (D–N.H.), has delivered a stinging attack on Secretary of Defense James R. Schlesinger's policies on the proposed 1975 military R & D budget of $9.3 billion.

McIntyre accused Schlesinger of taking a "smorgasbord" approach to military R & D and indicated that despite an explicit request from the Senate Schlesinger had refused to list priorities within the proposed package. "The assumption that we can afford or restrain a whole smorgasbord of strategic initiatives ignores the reality of bureaucratic momentum that makes most R & D efforts virtually tantamount to a decision to acquire a weapon system," McIntyre told the Electronics Industries Association on 1 May. McIntyre is chairman of the ad hoc subcommittee on Research and Development of the Senate Armed Services Committee, which is now reviewing the Pentagon's 1975 budget request.

In a wide-ranging speech that touched on the Administration's new counterforce strategy and that discussed SALT (Strategic Arms Limitation Talks) as well, McIntyre called for a policy of "greater selectivity" in military research. Such selectivity is "supremely critical when applied to strategic weapons," he said.

"The arms race has, in fact, become an R & D race—a vast proliferating chess game played in a room with cloudy mirrors with the future of the Planet Earth at stake.

". . . Selectivity in R & D is necessary because a program once initiated becomes most difficult to stop or substantially alter. It picks up momentum with each step in the R & D cycle. A service, or elements within a service, develop vested interest in programs deriving from R & D beginnings."

Aside from building up momentum within the services, McIntyre went on, research programs generate counter programs in the Soviet Union. "Each R & D effort triggers a set of countering R & D programs designed as hedges for a variety of contingencies.

"So, while the traditional arms race was linear in its growth, the R & D arms race expands geometrically."

McIntyre's attack could mean that the Schlesinger budget request is in trouble. Last week, the House Armed Services Committee cut his R & D request by $323.3 million. Since the Senate committee will probably make cuts too, a compromise version worked out between House and Senate may end up being lower than what the Secretary of Defense has been hoping for.—D.S.

These discoveries have aided researchers in concluding that west Antarctica is geologically similar to the mineral-rich mountain chains of the Pacific basin, which includes the Andes and the Rocky Mountains. Moreover, if, as is generally supposed, east Antarctica was once joined to South America, Africa, and Australia as part of the supercontinent Gondwanaland, it could be as rich as these in minerals. While none of the above finds has been substantial enough to warrant serious commercial interest, scientists think that it is just a matter of time before such a discovery is made.

The NSF has been redirecting its work in the Antarctic toward "the type of research that would give data that would be useful in finding resources," says Turner. Thus NSF research in McMurdo Sound, along the Ross Sea, has shifted from study of its volcanic history to its marine sediment history. A special study is planned of Seymour island, which is part of the continental shelf, in order to learn more about Antarctica's potentially valuable shelves. Capping this thrust at NSF, which Turner estimates has been going on for several years, was a proposal drawn up last winter during the government-wide crash search for new energy research projects. According to this proposal NSF, which sponsors some $3 million in research grants in the Antarctic per year, would sponsor a special, 5-year, $12 million program to make detailed estimates of the oil potential of the continental shelves.

Pollack and others hasten to point out that the prospects of resource recovery are nil in the immediate future, and that the NSC review is aimed at the long term. The land is 2 to 5 percent exposed; its ports are accessible for only a few months a year; and the industry which has started there, a Danish tourist voyage, is dependent on U.S. logistic support for its safety. Furthermore, Antarctica is a place where an airplane can hardly land safely because of hazardous conditions, and where human flesh can freeze in a matter of seconds if exposed to the elements. Thus any commercial operation there will have to overcome extraordinary hazards.

An economist with Resources for the Future, Inc., Neal Potter, in *Natural Resource Potential of the Antarctic*,‡ has written about the drawbacks. He said that some of the technology developed for oil and mineral exploration in the Arctic is not at the present time applicable in the Antarctic, and that the Antarctic has the additional disadvantage of having no inhabitants to guide prospecting expeditions to likely spots. Potter generally concluded that mineral and fuel recovery in the South Pole region will not be economically feasible in the near future.

But several USGS and NSF scientists are now referring to Potter's estimates as "conservative." His cost estimates, for example, have been dated by the dramatic rise in the price of fuel over the last year. Potter's study assumed that many of the metals found in Antarctica would continue to be in ready supply from other parts of the world; that too has changed as the major industrial nations face possible embargoes from traditional suppliers. As global market conditions change, some of the much-touted disadvantages of Antarctic exploration and exploitation have decreased.

It seems evident that the possibility of Antarctic oil and mineral development could have an impact on the scientific research done there, on the region's environment, and on the historic peace of the continent. It also begs the question of how interested the oil and mining companies really are in such a distant, expensive, and long-term endeavor. But despite the many interests that will be affected, it looks as though a new U.S. policy toward Antarctica will be formulated behind closed doors.—DEBORAH SHAPLEY

‡ N. Potter, *Natural Resource Potential of the Antarctic* (Lane, Burlington, Vt., 1969).

Kissinger on Science: Making the Linkage with Diplomacy

Science and technology may be stepping into a new and more important role in the conduct of American foreign policy. No substantive changes have yet occurred, but the public statements made by Henry Kissinger in the 8 months since he became Secretary of State evince a vigorous interest in using American science and technology as an arm of diplomacy.

Last month, for example, in an address to the United Nations session on development, Kissinger urged that we "now apply science to the problems which science has helped to create," and outlined four specific areas where science could contribute: agricultural technology, birth control, energy, and weather modification (see box for text of proposal).

Kissinger is also aware of the usefulness of American science in bilateral relations. He is said to be very interested at present in the kinds of contributions that technology can provide for Saudi Arabia and Egypt. In reviewing relations with Latin America, his first proposal, says an aide, was a science and technology committee. And access to American technology was of course a major inducement toward détente for the Russians and Chinese. According to Kissinger speechwriter R. Mark Palmer, Kissinger "thinks that Americans' ability to contribute money and run the world in the old-fashioned way of the 1950's and 1960's is now over. What we can contribute—and what the world wants—is our technological capabilities."

The science-related proposals in the Secretary's speech to the United Nations last month do not make many specific commitments, but Kissinger aides stress that the proposals will be implemented. "The Secretary took the speech very seriously and he hopes the scientific community will take it seriously," says Palmer. Before leaving on his latest trip to the Middle East, Kissinger directed Winston Lord, director of the State Department planning and coordination staff, and one of his few close associates, to develop a strategy for following up on the initiatives proposed in the speech, including those related to science and technology.

Lord declines to say what actions are envisaged, and it is too early to