fense Advanced Research Projects Agency (DARPA) as the lead federal agency in the area of superconductivity. The proposal would provide $80 million to DARPA, DOE, NSF, and NBS to conduct research related to manufacturing and processing technologies for superconductors.

The challenge that high-temperature superconductors present for American science and industry is formidable. "Japan is well prepared for exploiting this discovery and the field is well suited to Japanese talents and strengths," says Roland Schmitt, chief scientist at General Electric and chairman of NSF's National Science Board.

Schmitt, however, says that reports that foreign competitors are pulling out in front of the United States appear premature. While "the Japanese scientific community has made significant important contributions to this area," he contends, no new massive government R&D program has been undertaken.

"The fact is that the United States and Japan are reacting in the same way to this," says Schmitt, who was in Japan in March and April. In the university and government sectors, R&D work in high-temperature superconductors has been expanded through the use of discretionary funds and the redirection of research budgets.

Indeed, DOE officials say one important purpose of the conference was to emphasize to American executives and researchers that this race is still worth running. No country has a lock on this technology yet and it may take years to produce useful products.

Although no one country has a commanding lead in high-temperature superconductivity, OSTP's Graham felt compelled to deny embassy science attachés and foreign industrialists (*Science*, 31 July, p. 477) access to the conference. The decision drew some criticism. "We will be the ultimate losers" if such collaboration and cooperation are discouraged, noted Martin Blume, deputy director of Brookhaven National Laboratory (BNL).

A Japanese research team is working with scientists from the Massachusetts Institute of Technology at BNL now to analyze the structure of a lanthanum copper oxide ceramic. Nippon Telephone and Telegraph has provided the crystals that are critical to this research, which will benefit both countries.

Herman Postma, director of Oak Ridge National Laboratory, thought closing the meeting could produce a backlash in Japan the next time a delegation from the United States wants to visit scientists there working in the field. "None of the stuff going on at this meeting could be described as proprietary," said Postma. ■ **MARK CRAWFORD**

Nuclear Test Watchers Feel Political Heat

On 15 July the Soviet military shut down all three seismic monitoring stations run by the NRDC; the project resumes under new rules in August

ONE year after U.S. "citizen diplomats" signed a remarkable pact with the Soviet Union to monitor nuclear bomb tests, they are running into some of the obstacles that regular diplomats encounter—political flak from the Pentagon and harassment by the Soviet military. But they have devised some technical solutions that they hope will get them around the roadblocks.

The trouble began in February, according to Thomas Cochran, senior scientist for the Natural Resources Defense Council (NRDC), the environmental group that launched the monitoring program in May 1986.

The Soviet government had refused to accept some restrictive visa conditions set by the U.S. State Department for traveling Soviet scientists. As a result, in February the scientists were not allowed to visit seismic stations built by the NRDC in Nevada near the U.S. nuclear test site.

The Soviets had already allowed the NRDC to set up three primitive (surface seismometer) stations in the Soviet Union around their test site at Semipalatinsk. The main station is in Karkaralinsk, with secondary posts in Bayanaul and Karasu. In February, the Americans installed sophisticated, down-hole monitors but, because of shifting Soviet procedures, have had trouble getting a steady flow of data.

In return for allowing construction of these stations, the Soviets asked the NRDC to set up three similar posts in Nevada and California. The stations have been built and 4 months' worth of surface seismometer data have been collected. The Soviets have not been able to visit the stations in the United States, nor have they received data of the more discriminating down-hole variety. In this sense, argues Charles Archambeau, a University of Colorado seismologist who serves as the NRDC's adviser, the Soviets have lived up to their promises "better than we have." He feels an obligation to get the sophisticated "phase two" data to the Soviets as soon as possible.

Meanwhile, Soviet military officials have moved with growing aggressiveness to restrict the NRDC's access to posts near their own test site. Originally, the NRDC hoped to keep the seismic monitors running continuously. But when the Soviets resumed testing in February after an 18-month moratorium, they said the equipment would have to be shut off during tests. They also insisted on doing the shutdown themselves. A protocol was written out and signed, but "never followed," according to Cochran.

An officer from the Soviet test site flies out in a helicopter to close all three sites. The Americans stand back while he disables the equipment and seals off the buildings. "It's hard to know whether it's intentional or accidental," says Cochran, "but we've never been able to make arrangements to train this guy." As a result, the shutdown is often "too thorough." One scientist mentioned an incident in which equipment leads were quietly yanked, causing "a lot of trouble."

Jonathan Berger, a seismologist from the University of California at San Diego, operating manager of the program, says, "we are on line less and less time" because of the frequency of bomb tests. The Soviets have set off eight military and three "peaceful nuclear" explosions this year, while the United States has set off ten blasts.

Because of the tests, the NRDC was able to run its monitors for only 13 days in June. They have been shut off since 4 July. All three stations are equipped with sophisticated down-hole sensors, but they have never been run simultaneously. The most remote station (Karasu) has been out since 27 May.

Cochran remains hopeful, however, that the technical harassment and distrust can be beaten back. On 25 June, the NRDC negotiated a new agreement with the Soviets. The terms, Cochran says, should end most of the technical problems by January. What happens between now and then will be critical.

According to the agreement, the three original stations will be closed and the equipment removed to a distance of 1000 kilometers. Two new stations will be added to the network, bringing the total to five. So far, only one new site has been chosen, near

the town of Garm close to the Chinese border. The Americans pointed out that a U.S.–equipped seismic station in China—about 1000 kilometers from Semipalatinsk—is already running continuously. In view of this precedent, the Soviets have agreed to let the NRDC run the five new stations during bomb tests.

According to the Americans, members of the Soviet Academy of Sciences led by Yevgeniy Velikhov tried to extend the NRDC's permission to stay near Semipalatinsk through the end of the year. They were overruled by the military. "For reasons of reciprocity, they needed to move the U.S. team out of the test area on July 15th," Cochran says.

Despite recent setbacks, the NRDC team has collected fairly good background data on Semipalatinsk, essential for calibrating the noise-to-signal ratio for monitoring future tests. But it has been less successful getting information on the signal transmission qualities of the rock. The reason is that the down-hole monitors have not been allowed to run continuously, and the Soviets thus far have not made available detailed information on the time, yield, and location of local industrial explosions, which would enable scientists to make a detailed analysis of the signals. Some of this information may yet be provided.

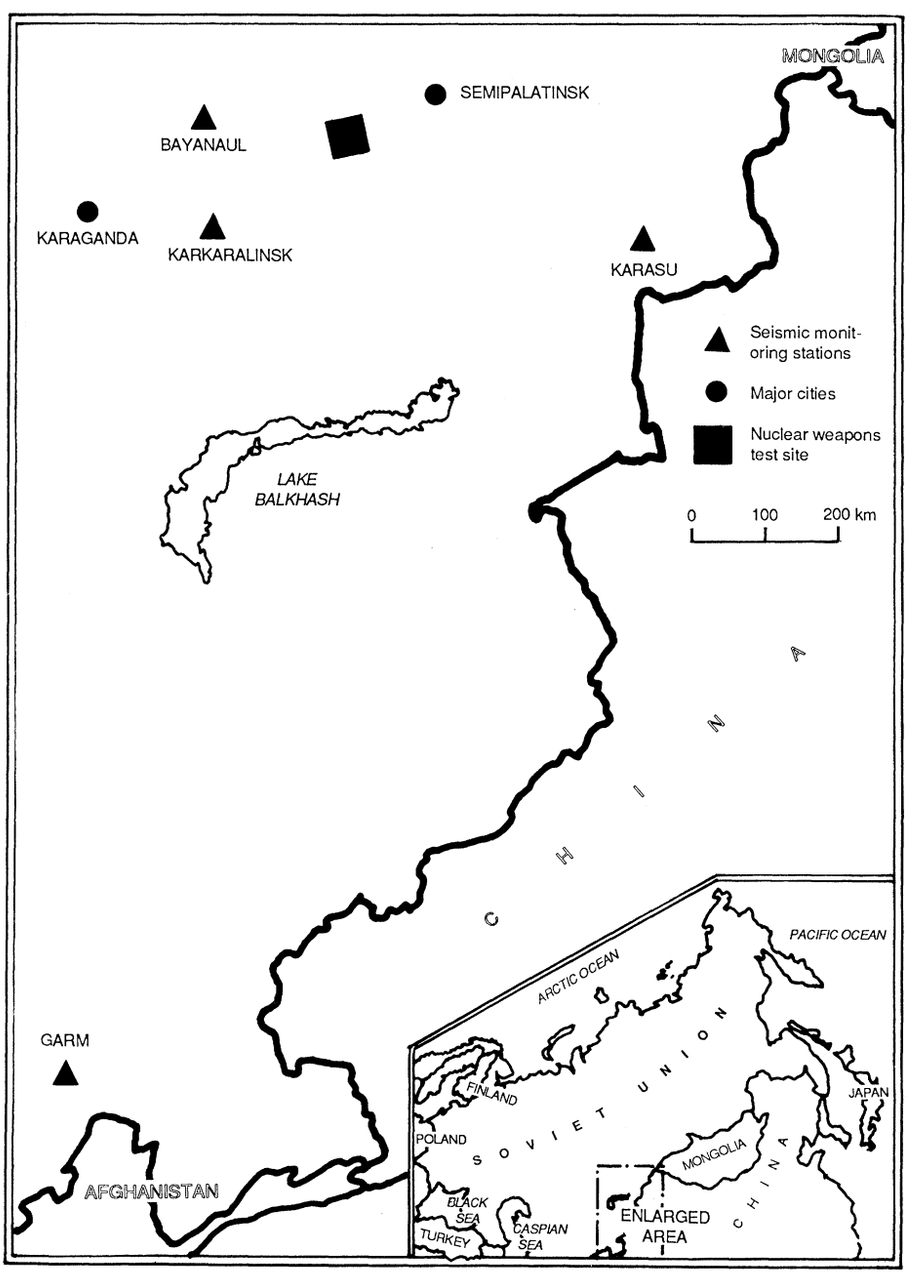
The scientists on both sides hope to get around the obstructions by running experiments of their own in September. The Soviet Academy of Sciences has agreed to cooperate with the NRDC in setting off a chemical explosion near Semipalatinsk, perhaps in the mining town of Karaganda, in the first week of September. With good data on the yield, time, and location of the blast, it should be possible to resolve much of the uncertainty about signal transmissions in the local rock. This information must be nailed down if a seismic monitoring scheme for enforcing a nuclear test ban is to gain wide acceptance. U.S. scientists will leave San Diego on 13 August to take part in the experiment.

"The problem is with the military camps in both countries," Cochran says. "My sense is that the U.S. Administration has misjudged the internal politics of the Soviet Union, and the U.S.S.R. has misjudged internal politics here." The prevailing U.S. view is that Soviet leaders are using the test ban idea merely as a public relations gimmick. Cochran says this overlooks the role of leaders such as Velikhov who are committed to developing peacekeeping technology. Similarly, some Soviet officials view the NRDC team with suspicion, thinking that the Americans take more than they give.

U.S. officials are partly responsible for the situation, Cochran says, because they seized upon a technical excuse to deny Soviet scientists visas to travel to the Nevada stations. The Soviet bureaucracy is retaliating in kind, he thinks.

U.S. officials say the visa dispute arises from a difference between the U.S. weapons establishment and the Soviet foreign office over the suitability of a test monitoring technology known as CORRTEX (for Continuous Reflectometry for Radius versus Time Experiments). This arcane dispute has been aired in the press (*Science*, 24 April, p. 383) and will be explored further in a major report by the Office of Technology Assessment this fall. U.S. officials argue that CORRTEX offers a better way for foreigners to monitor bomb tests than seismic devices do. Seismologists, understandably, doubt that this is so.

The U.S. Administration would like the Soviets to negotiate in Geneva on the use of this intrusive CORRTEX technology, which must be implanted near a test nuclear device to work effectively. The Soviets have been reluctant to engage in a debate on its value, although they did propose in April to study CORRTEX in an "exchange of experiments" in which each side would set off a blast on the other's property. It is hard to



Eleanor Warner

Seismic monitors. *Stations at Karkaralinsk, Bayanaul, and Karasu will be closed and five new ones (the first at Garm) will be built 1000 kilometers from the bomb test site.*

imagine American or Soviet military officers agreeing to a "bring your own bomb" project of this kind. Yet this is the subject of current negotiations.

Whether or not CORRTEX is a red herring, as Cochran argues, or a matter of genuine disagreement among experts, it is clear that the Administration is annoyed with the Soviets for having made a private agreement with the NRDC. U.S. State Department officials have said repeatedly that they would prefer to keep all discussions of test monitoring on a "government-to-government basis," and privately they complain that by cooperating with the NRDC, the Soviets are making an "end run" around the talks in Geneva. Those talks broke off for the summer on 20 July, reporting no significant progress.

Meanwhile, the NRDC thinks it has found a way to provide the Soviets with direct access to the seismic data from Nevada, even if Soviet scientists cannot get visas. They hope to install telemetry devices that will transmit the information instantaneously by satellite to Moscow.

By the fall, NRDC scientists should be receiving highly detailed information about the seismic features of the rock underlying the Semipalatinsk site, and the Soviets will begin getting high-quality seismic data from the stations in Nevada and California. Unless the military players intervene, many objections to using seismic signals for enforcing a nuclear test limit may be removed. It is also possible, however, that official distrust could choke the program before the seismologists get the information they need. ■ ELIOT MARSHALL

Bolivia Swaps Debt for Conservation

Purchase of portion of debt at discount by U.S. group permits creation of conservation buffer zone for reserve

BOLIVIA is the first developing country to agree to a plan under which its foreign debt is being reduced in return for action to preserve a specific tract of ecologically valuable land. Under an agreement negotiated with the Bolivian government, nearly 4 million acres of forest and grassland in the Beni River region in the Amazonian basin will be protected.

The financial crux of the agreement with Bolivia is the purchase by an American environmental group of $650,000 of Bolivia's external debt for $100,000, about 15 cents on the dollar. Under the agreement, Bolivia will be able to write off the entire $650,000. A market for such purchases exists because some heavily indebted developing countries may not be able to pay off their loans and commercial banks are therefore willing to settle for a percentage of the face value of the loans.

The loan funds involved in the agreement with Bolivia were held by private lenders. Major U.S. environmental organizations are urging Congress to pass legislation that would encourage government-backed international financial institutions such as the World Bank to experiment with such transactions, which would expand these novel debt-for-conservation exchanges.

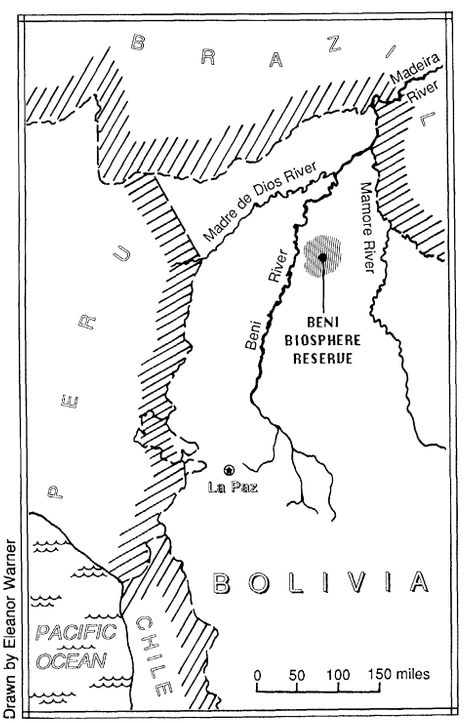
The key matchmaking role in the agreement with Bolivia was played by Conservation International, a Washington-based environmental organization acting through Citicorp Investment Bank, a Citibank subsidiary, which arranged the purchase from unnamed overseas debt holders. The $100,000 to finance the swap came from the Frank Weeden Foundation, a private family foundation based in San Francisco. Donald Weeden, director of the foundation, has indicated that the foundation has allocated a total of $300,000 for such projects. A group of environmental organizations are currently collaborating to negotiate a similar exchange in Costa Rica.

Proponents hope that the "debt-for-nature" swaps will be taken up by other Third World countries that have a heavy burden of foreign debt and are suffering rapid environmental degradation as a result of development projects poorly adapted to fragile tropical ecosystems.

The Bolivian government has agreed to protect by law three parcels of land adjoining the existing 334,000-acre Beni Biosphere Reserve that was created in 1982 as a model reserve to protect animal, plant, and water resources and native peoples. Part of the area covered by the agreement will be maintained undisturbed for research. Another portion will be used by the nomadic Chimane Indians and will be opened to carefully managed agricultural and forestry development.

An effort to apply the principle to the public sector has led to the introduction of bills by Senator Robert W. Kasten, Jr. (R–WI), and Representative John Porter (R–IL). The bills call on the World Bank and other multilateral development banks to allow developing countries to repay part of their debt by investing in conservation programs. The major provision encourages the banks to conduct pilot programs establishing "conservation easements" to protect tropical forests and wetlands in return for suspension or rescheduling of some or all of the country's debt repayments to the banks while the easements are in effect. Representative David R. Obey (D–WI) last week attached an abbreviated version of the measure to the House foreign operations appropriations bill.

One hurdle to the initiative is that the United States, although the largest shareholder in the World Bank and other multilateral banks, holds a minority position on



Buffer. *Shaded area around Beni reserve indicates newly purchased land.*