

capable of seeing anywhere or anything in the Soviet Union from space as often as it desires, he adds, a short-range Soviet mobile missile, the SS20, was not sighted until several years after its deployment.

Others note that, even if enough reconnaissance satellites could be developed and deployed to survey mobile missile deployment areas constantly in all types of weather, at a cost of billions of dollars, the resulting system would be so unwieldy as to be virtually useless. As Douglas Rekenhalter, a former official of the Defense Mapping Agency, notes in a recent article in the *Journal of Defense and Diplomacy*, "the concept of reconnaissance over large expanses of the earth's surface with very high-resolution systems is flawed because of the manpower requirements needed to process and interpret the remotely sensed data." Automation is still "many years away from implementation," he notes, and data processing from state-of-the-art nonphotographic sensors can take hours, not minutes.

Despite some interest in solving the problem with advanced warheads, Colonel Richard Rene, chief of the Air Force Advanced Strategic Missile Systems program, says that he too is skeptical that it can be done anytime soon. "We probably won't have the ability to perform a real-time target update and discrimination involving a warhead until about 20 years from now, unless you make an RV [reentry vehicle] the size of a B-1," he says. "Even then, there is some doubt that it will be practical. In fact, the problems of detection and communications are so serious that no real money is being spent on them as yet and no work on hardware is under way—just a few paper studies."

Meanwhile, the debate rages within the Administration over whether the proposal for a mobile missile ban should be modified. A source close to the Geneva negotiations who favors the change emphasizes that "there is a fundamental dilemma that the military has yet to come to grips with. It has to do with being comfortable with the idea that you can't destroy Soviet missiles in their prelaunch phase. Those whose job it is to attack find this very troublesome. It may even conflict with present strategic guidance, which demands that any plausible Soviet attack be rendered unsuccessful, presumably at least in part by the destruction of Soviet reserves. But it really is more stabilizing for Soviet systems to be survivable; ours, too." Clearly, he adds, "there will be a fair amount of turbulence, as people try to think this through." ■ **R. JEFFREY SMITH**

This is the third and last article in a series on mobile missiles. The first two appeared in the issues of 6 and 27 June.

U.S.—Soviet Exchanges—Redefining Coexistence

A new group of cooperative programs has been unveiled, but in science and technology some old problems endure

IN Washington on 5 August the United States and Soviet Union announced agreement on 13 new exchanges covering a range of cultural, educational, and scientific contacts. In Berkeley, California, 3 days later mathematicians at their international congress met to protest the absence of Soviet colleagues who had accepted invitations but were prevented from attending by their government's refusal of permission to travel.

The two occurrences reflect the crosscurrents that persist as the United States and Soviet Union try to stabilize the rocky relations that developed in the late 1970's. The flurry of exchange initiatives came as a follow-up to an agreement by President Reagan and General Secretary Gorbachev at their summit meeting last November to expand exchanges and contacts between citizens of the two countries.

Cooperation in science and technology has been a mainstay of the U.S.—Soviet exchange menu over the years, but has become much more controversial than cultural and educational exchanges. On the American side, concern is rising about the leak of technology of military and economic value through the exchanges and questions about the Soviet stance on human rights and scientific freedom issues have not been resolved. So, despite encouragement from the top, activity in the science exchanges has been slow to pick up.

A major reason is that the United States is insisting that the exchanges follow a new model that better serves the U.S. interests than the exchanges of the 1970's. Perhaps the clearest statement to date of the Administration view came in May testimony by John P. McTague, then acting director of the White House Office of Science and Technology Policy, before a joint hearing of the House committees on Science and Technology and Foreign Affairs.

McTague emphasized that the revival of exchanges marked a "resumption, not an expansion, of cooperation," and said it did not signal a return to the pre-1979 era of U.S.—Soviet relations. A major question for the United States said McTague is, "how do we structure and manage U.S.—Soviet [sci-

ence and technology] cooperation in order to achieve our national goals, protect our strategic national security interests, and not repeat the mistakes of the 1970's?" McTague observed that "the Soviets for a time were extremely successful in tapping into our R&D effort by cutting separate deals with individual agencies that often were not in the overall national interest."

U.S. critics of the exchanges say that in the 1970's the Soviets largely set the agenda. They were particularly energetic in pursuing cooperation in projects involving technology in which the United States led, while the United States often appeared willing to engage in cooperation for cooperation's sake. Furthermore, the structure of the exchanges made it difficult for the United States to achieve balance throughout the exchanges. Eleven intergovernmental agreements for cooperation in science and technology originated with the 1972 Brezhnev-Nixon summit meeting and were negotiated separately over 2 years. Individual U.S. agencies and their Soviet counterparts played the major parts in shaping activities under the agreements. No central coordinating authority for the agreements as a whole was provided. Therefore, U.S. officials found there was no mechanism to enable them to exert negotiating leverage in one agreement to gain what they wanted in another.

Now, McTague said, "In particular we are concerned that a hasty 'Geneva bandwagon' approach to future U.S.—Soviet cooperation, similar to the approach of the 1970's, will encourage our technical agencies to expand or develop new programs in a piecemeal fashion without proper policy-level coordination to ensure that new initiatives complement and are consistent with our nation's R&D policies and national security considerations. At present there is no such integrated national science and technology policy to underpin our separate agreements and to direct the process of how we pursue S&T cooperation with the Soviets."

To fill this gap, the interagency Federal Coordinating Council for Science, Engineering, and Technology has been given the task of developing a government-wide policy to guide agency activities in the science

exchanges. The council's newly revived committee on international science, engineering, and technology is responsible for coming up with recommendations by year's end.

As for the criteria to be applied henceforth, the United States will want to be certain that the projects have scientific value for this country and that strategically sensitive technology is not lost. Deborah Wince, an OSTP staff member involved in the effort, points out that in light of Gramm-Rudman spending constraints, it is necessary for U.S. agencies to pick projects that are technically valid and rate a high priority in helping them with their missions. Emphasis will also be placed on "access," says Wince. In the past, American scientists engaged in the exchanges frequently reported that arrangements to visit research facilities in the Soviet Union or to meet top-rung Soviet scientists broke down. U.S. negotiators will seek guarantees that such commitments will be observed in future.

Participation was also at issue at the International Congress of Mathematicians that wound up a week-long meeting in Berkeley on 11 August. Congress president Andrew Gleason of Harvard says that of 33 Soviet mathematicians who had accepted invitations to speak at the meeting 14 did not appear.

Over the years, the denial of permission by the Soviet government to allow travel outside the Soviet bloc has been the subject of periodic protests at international scientific meetings. Mathematicians at the Congress scheduled a meeting on 9 August to express concern about the absence of invited speakers. The plan was to petition the International Mathematical Union, the parent organization, to investigate cases of official restriction of attendance and report to the mathematics community.

One of the meeting organizers had been told by a Soviet delegate that his delegation would be represented at the 8 August meeting to make their own points. There had been reports that the U.S. State Department had blocked visas for Cuban, Nicaraguan, and Iranian mathematicians who sought to attend the meeting. Gleason says that there were a few cases in which visas were delayed, but that after representations were made to the State Department, there was "a visa for everybody." The Soviets did not participate in the discussion.

Those backing the petition say they will not be content with collecting signatures at the meeting. One of the organizers, Herbert Clemens of the University of Utah, says that because the congress is held every 4 years, momentum gained by past protests on the freedom of travel has been lost between meetings. The intention this time is to main-

tain the effort to persuade the union to deal with the issue in preparing for the meeting scheduled for Kyoto in 1990.

The matter of participation also figures in negotiations between officials of the U.S. National Academy of Sciences (NAS) and their Soviet counterparts over renewal of meetings between American and Soviet scientists. The NAS administers a program of private exchanges that parallels the intergovernmental exchanges in science and technology. The academy program included meetings and symposia as well as visits and research cooperation by individuals until 1980, when the NAS council decided to suspend the meetings and symposia portion, attributing the action to the Soviet restriction of physicist Andrei Sakharov to the city of Gorki.

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A new agreement creating the basis for restoration of the meetings program was signed on 1 April after year-long negotiation (*Science*, 18 April, p. 315). Topics for discussion and the terms of the meetings are to be discussed at a meeting of officials of the NAS and Soviet academy this fall.

The rationale for action on the exchanges was provided by President Reagan 2 years ago when he enunciated the theme of developing a "better working relationship" with the Soviet Union in order to make progress on outstanding issues between the two countries such as arms control.

Cooperation in science and technology peaked in the heyday of détente in the middle 1970's, but the United States progressively reduced activity in response to the Soviet invasion of Afghanistan in 1979, the imposition of martial law in Poland in 1981, and the shooting down of a Korean airliner by Soviet planes in 1983. In that year, Reagan directed a cutback in the program. Four of the 11 intergovernmental agreements in science and technology were terminated and exchange activity went down to an estimated 20% of the 1979 level.

Policy began to shift more than a year before the Reagan-Gorbachev summit when Reagan suggested a reinvigoration of some science and technology bilaterals. Last year, new projects were agreed to under the agreements on housing and environmental protection and the agreements on oceans research and atomic energy were renewed.

The exchanges announced on 5 August

were developed under the the so-called people-to-people exchange rubric that characteristically provides for individual projects rather than programs of exchanges. Some of the new exchanges are of substantial scientific interest, such as an agreement between the University of Alaska and the Soviets for joint research on how northern peoples adapt to cold, but most of the agreements are for cultural events or for educational contacts involving young people.

The broad question of whether Gorbachev's leadership will mean a more liberal Soviet stance on human rights and scientific freedom issues remains murky. The past year has seen the emigration to Israel of Anatoly Shcharansky and travel by Yelena Bonner, the wife of the embattled Soviet physicist Andrei Sakharov, to the West for medical treatment. And since the beginning of the year, several Jewish scientists whose applications to emigrate had been long rejected have been allowed to leave the Soviet Union. Organizations in this country active on human rights and scientific freedom issues, like the Committee of Concerned Scientists and Scientists for Sakharov, Orlov, and Shcharansky, however, say there is no evidence that these decisions are more than isolated cases.

In preparing for a new round of exchanges, tough bargaining is in prospect and the United States will have to change some ingrained habits. At Geneva, the heads of state made a particular point of advocating international cooperation in research on development of fusion energy sources.

The fusion initiative has been greeted by some critics as an example of what McTague termed the Geneva bandwagon approach. The Soviets came up with the proposal shortly before the summit. They appear to be less interested in collaboration on theoretical work in the field than in an engineering project to build a fusion power plant that could have a \$4-billion price tag. The critics suggest that the U.S. Department of Energy might like the project because it would entail a heavy, long-term commitment to fusion energy development. The State Department is portrayed as being primarily concerned with advancing programs like the President's Strategic Defense Initiative and as acquiescing to the fusion proposal on political grounds.

The new U.S. agenda for exchanges boils down to paying close attention to national security interests and the scientific quid pro quo while at the same time forwarding human rights and scientific freedom concerns. The Soviets, of course, have their own priorities and it is not clear how hard it will be to arrive at what both sides consider fair exchange. ■ JOHN WALSH