Russian-American Collaboration

the transition to peacetime work

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John Shaner of Los Alamos; 88-year-old Yulii B. Khariton, Chief Scientist at Arzamas-16; Alexander Pavlovskii; and Los Alamos Director Sig Hecker in Rus-

The week of November 11, 1992 was a historic occasion at Los Alamos. After a year of intense preparation, which involved cutting through bureaucratic impediments and political hesitation, members of the nuclear-weapons program at Los Alamos sat down with our counterparts from the former Soviet Union to talk science and to explore the possibilities of conducting joint experiments on topics of scientific interest. By the end of the week, we laid down plans and signed an agreement, which was subsequently approved and funded by our respective governments, to allow scientists who have worked for decades on opposite sides of the superpower struggle to join together in collaborative ventures of mutual benefit.

Joint ventures of this nature had been proposed informally as early as 1989, but the possibility took on increased significance after the dissolution of the USSR in December of 1991. Government officials in the United States became concerned about the stability of the former Soviet Union's nuclear-weapons establishment and the future of their weapons scientists. Clearly, the scientists needed support in order to carry out the expected reduction of the nuclear-weapons stockpile. Stable support would also lessen the possibility that their emigration to foreign nations would open up opportunities for nuclear proliferation.

In response to these concerns and at the request of the Department of Energy, we at Los Alamos and scientists at Lawrence Livermore National Laboratory began to investigate how we might help our Russian counterparts. Through a series of visits beginning in November, 1991, it became clear that the establishment of scientific collaborations on concrete, well-defined, non-military projects of mutual interest would not only engage the minds of the ex-Soviet weapons scientists but also shore up their legitimacy and stature in the eyes of their government and lead to the stable funding of the nuclear-weapons laboratories in the former Soviet Union.

The significance and urgency of beginning such collaborations should not be underestimated. United States visitors to Russia have been told that unless something significant happens soon, some nuclear-weapons scientists may be forced to leave Russia in order to support their families. Pay for even senior researchers is sporadic and decimated by inflation. Everyone farms for survival, and the first signs of malnutrition are becoming evident among the populations of the hitherto secret, and still closed, cities that are the sites of the nuclear-weapons laboratories. Although the United States cannot hope to maintain entire cities, we can have a major influence on the

"IN HOPE OF A WORLD WITHOUT 'US' and 'THEM'"

Sig Hecker with Boris Litvinov, the premier Russian nuclear weapons designer at Chelyabinsk-70, in February 1992.

Front page of December 12, 1991, newspaper from Arzamas-16 discusses visit by Nerses Krikorian (l) and Dan Stillman of Los Alamos (c) with Alexander Pavlovskii (r). This was the first visit by Western scientists to a nuclear-weapons laboratory in the former-Soviet Union.

Sig Hecker and Livermore Director John Nuckolls bid farewell to Russian scientists at Arzamas-16 airport, February 1992.

Irv Lindemuth (l) and Bob Reinovsky (r) with Pavlovskii at the Zababakhin Scientific Talks in Kistym, Russia (near Chelyabinsk-70) prior to visiting Arzamas-16 (January 1992).

relatively small group of experts (perhaps a few thousand) who have an intimate knowledge of nuclear weapons and who thus constitute the greatest threat to nuclear nonproliferation.

As in the United States, the former Soviet Union had two major nuclear weapons-design laboratories: the All-Russian Institute of Experimental Physics in Arzamas-16, which is approximately 400 kilometers east of Moscow, and the All-Russian Institute of Technical Physics in Chelyabinsk-70, which is at the base of the Ural Mountains. Arzamas-16 was the birthplace of the first Russian fission and thermonuclear weapons and is sometimes called "Los Arzamas" by the Russians to highlight its similarity to Los Alamos. During nearly five decades of Soviet nuclear-weapons development, many of the brightest graduates from universities all over the USSR were assigned to those two institutes and given the

best equipment and living conditions available. In addition to nuclear-weapons development, the Russian weapons institutes had extensive basic-research programs, which in some areas were ahead of anything known in the West.

One particular technology developed at Arzamas-16 is related to the production of very-high magnetic fields and electric currents. In the Soviet Union, this work was started by Andrei Sakharov in 1951 as part of a program to achieve thermonuclear fusion. As a privileged member of the Institute, Sakharov was able to direct some of the most creative young people entering the laboratory to develop high-magnetic-field generators; among that group was Alexander Pavlovskii. During the 1950s and 1960s this program made extraordinary strides. In fact, some Russian achievements as far back as 1967 exceed the best capabilities of Western laboratories even today. Although high-magnetic-field generators were originally developed for possible military applications, Sakharov soon recognized that strong electric currents and magnetic fields offer fascinating opportunities for basic scientific research into the atomic structure of solids, high-pressure chemistry, and even high-energy particle accelerators. This interest remained with Sakharov throughout his life. Just before his death he told a colleague that seeing the development of this technology was "his fondest wish."

During more than forty years Alexander Pavlovskii and Vladimir Chernyshev led research teams in the fields of pulsed power and high magnetic fields. The technology they have developed is now routinely used to produce magnetic fields of 17 megagauss. They have also demonstrated routine use of 200-megajoule pulsed-power generators and have performed up to 200 high-energy pulsed-power experiments per year. These superb experimental capabilities have led to a myriad of applications in atomic and plasma physics, microwave generation, lasers, high-pressure chemistry, hydrodynamic studies, and more. Max Fowler pioneered the development of pulsed-power experiments at Los Alamos beginning in 1952, and he made many significant achievements. As a result, Los Alamos has the only U.S. counterpart to many components of this massive Russian program.

Chernyshev (l), Younger (c), and Pavlovskii (r) sign agreement for collaboration.

Gradually, the Soviets working in this area convinced their government to allow carefully screened publications of their work and even to allow their participation in some international conferences, but before 1987 they were not permitted to tell us where they lived or worked. After the fall of the Soviet Union, their participation in conferences increased dramatically and the Russians began revealing the remarkable breadth and depth of their accomplishments. Because of our contact with them at conferences and through publications, Los Alamos scientists were the first Westerners to be invited to visit Arzamas-16 for scientific discussions. Through a series of four technical meetings in 1992, some in Russia and some in the United States, a collaboration has been established between Los Alamos and "Los Arzamas" to jointly explore the basic scientific applications of high magnetic fields and electric currents.

The specifics of the initial collaboration are set down in an agreement signed at Los Alamos by Pavlovskii, Chernyshev, and me. The agreement calls for conducting experiments in Los Alamos and Arzamas-16 using teams from both laboratories. In the first experiment, Los Alamos scientists will participate in the design, assembly, and testing of a superhigh-current electromagnetic generator perfected by Chernyshev. This experiment will be conducted in Russia in July, 1993. Next, four ultrahigh magnetic generators developed by Pavlovskii will be purchased, transported to the United States, and used to study the properties of high-temperature superconductors in experiments to be conducted in Los Alamos. Both sides expect that the scientific data derived from this work will foster more ideas for further collaboration. We believe that agreements such as the one signed at Los Alamos represent historic opportunities to "beat swords into plowshares" by encouraging scientists to turn their attention from weapons development toward scientific applications that promote economic growth. It is appropriate that this first step took place at Los Alamos, the birthplace of the atomic age, and involved Arzamas-16, the institute that developed the first Russian nuclear weapons. ■