The Human Dimension:

The Interpersonal Nature of Lab-to-Lab Cooperation

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Volume II continues the inside story of a partnership between US and Russian nuclear weapons scientists and engineers that over nearly 25 years has helped to avert some of the greatest nuclear dangers resulting from the sudden break-up of the Soviet Union. The dangers facing the world after the Soviet Union collapsed in 1991 were urgent. We characterize these issues as four "loose nuclear dangers": loose nuclear weapons, loose nuclear materials, loose nuclear experts, and loose nuclear exports. In Volume I, Russian and US nuclear scientists and engineers describe their remarkable efforts to keep Russia's nuclear weapons and its nuclear materials safe and secure during the turbulent times following the Soviet break-up.

This volume contains two major sections that demonstrate that the cooperative efforts of US and Russian scientists and engineers were directed at more than preventing potential dangers. The first section, Brain Drain and Defense Conversion, deals with joint efforts to convert a part of the Russian nuclear weapons enterprise to civil production. During a time of deep cutbacks in the nuclear weapons programs, these efforts focused on creating economic opportunities outside the military/defense sector for highly skilled but underemployed specialists of the Russian nuclear complex. The second section, Collaborations in Fundamental Science, delves into the core activity of the lab-to-lab partnership, namely, joint theoretical and experimental research at the scientific frontiers to create new knowledge and provide the scientific foundation for stockpile stewardship under a comprehensive nuclear test ban.

The volume concludes with a short but pivotal section on the history and future prospects of nuclear weapons stockpile stewardship. The papers in this section highlight the inherent strategic, political, and technical complexities of maintaining the existing nuclear stockpiles in a no-test environment, which we refer to as stockpile stewardship. They describe the technical work and scientific advancements achieved in pursuit of nuclear weapons stockpile stewardship on both sides. They also demonstrate the similar motivations that drive nuclear experts in both the United States and Russia—the mission to create an effective and safe nuclear deterrent in order to maintain global peace.

Two major themes in this volume—defense conversion and science collaboration—each in its own way, highlight the interpersonal, human anchor of the collaborations, what we call the human dimension. The personal relationships and trust that were built in pursuing the lab-to-lab endeavors were integral in creating effective cooperation to prevent nuclear catastrophe. Each of these two sections provides a different lens through

which to view the interaction between the laboratories, but both demonstrate that these cooperative measures were as much about people and relations between two countries as they were about the safety of nuclear warheads, protection of fissile materials, or ingenious experiments and theoretical developments.

The stories of defense conversion efforts in Russia show how seeing the Russian nuclear complex through the eyes of its own nuclear weapons specialists re-framed their American colleagues' understanding of the threat of brain drain. This inspired them to devise programs to focus not only on job creation but also to recognize that the people themselves are critically important to meet nuclear safety and security challenges. In other words, if nuclear workers are constantly stressed to the breaking point, nuclear safety and security cannot be achieved. The narratives in the section on science reveal how a defining human quality—*curiosity*—provided a driving force for science collaborations. The second section also demonstrates how the opportunity to work side by side and to discover shared motivations and values bred trust.

Exploring the Human Dimension

In this volume, we bring to life historian and author David Holloway's comment in *Stalin and the Bomb*—"[I]t is in the human dimension of nuclear history that one has to look for hope that the nuclear danger can be overcome."[1] But, what exactly constitutes the human dimension and how were the relationships between the Russian and American nuclear workers developed? The strong personal relationships between them were based on mutual respect for each other's technical skills and on the willingness to listen to each side's perspective. And this, in turn, helped develop trust and open greater space for creativity and flexibility in pursuing mutual goals.

Scientists from both countries wanted to create new knowledge, develop new technologies, ensure the safety and security of nuclear weapons and materials on both sides, and prevent the proliferation of nuclear weapons, especially their use by terrorists. The dangers and the urgency to realize these goals were at times seen differently by Russian and American scientists, reflecting each side's economic and political realities as well as cultural, historical, and institutional differences. The close working relations, the hundreds of visits to each other's laboratories and cities, and the social times spent together allowed scientists to better assess and understand these differences and to better inform their governments of the most productive paths for cooperation. The ability to tackle some of the most sensitive nuclear dangers, in which government-to-government efforts had often stalled, was in no small part a result of these interpersonal relationships.

The personal relationships developed surprisingly quickly. In Volume I, we recount that Viktor N. Mikhailov, the leader of the technical delegation to the Joint Verification Experiment (JVE), remarked after the successful JVE in Nevada on August 17, 1988, "I can tell you they are excellent experts, very friendly, very warm people. We have cut a window into their hearts as well." The scientific leader of VNIITF, Evgeny N. Avrorin, recounts meeting Americans during the reciprocal JVE at the Semipalatinsk Nuclear Test Site in September 1988. "We met the American scientists with some caution but

[1]David J. Holloway, *Stalin and the Bomb: The Soviet Union and Atomic Energy, 1939-1956*. Yale University Press, 1994.

without hostility. Joint work soon revealed that we were much alike in professional skills and in the responsible attitude to the work we were assigned to do. It was gratifying to find in our partners some very appealing personal qualities such as goodwill and sense of humor (and sometimes self-irony). Upon further acquaintance we saw that we shared a lot in our relations to the family, children, and grandchildren. Both sides respected the inevitable restrictions related to secrecy and soon came to a clear understanding of the boundaries not to be crossed. I cannot remember either Americans or us trying to abuse trust."[2]

VNIITF Scientific Director Evgeny N. Avrorin presents Russian memento with inscription "From Russia with Love" to LANL Director Siegfried S. Hecker in April 1993 at 50th anniversary of the founding of the Los Alamos Laboratory.

In April 1993, only 14 months after the historic exchange visits of the directors of the nuclear weapons labs to each other's laboratories, the scientific leaders of the two Russian nuclear weapons institutes were invited to Los Alamos to participate in the 50th anniversary celebration of the founding of the Los Alamos laboratory. Avrorin presented a memento featuring a piece of a dismantled SS-11 missile that had been aimed at the United States. The fragment was mounted on a serpentine base with the inscription *"From Russia with Love"*—referring, of course, to the James Bond film of the same name. The close relationships developed during the early years of scientific collaboration between hundreds of scientists, engineers, and other professionals of the laboratories from the two sides have endured over 25 years. These relationships built up a reservoir of goodwill, which has served both sides well through the ups and downs of the political interactions between Washington and Moscow. That reservoir of goodwill can help rejuvenate nuclear cooperation even in these difficult political times.

In our work on *Doomed to Cooperate*, talking to the scientists and engineers involved in the collaboration, gathering them to participate in round table discussions and conferences to provide material for the book, conducting interviews, studying the archived notes, and reading and re-reading the papers, we found that time and time again scientists, engineers, and government officials on both sides emphasized the essential role of trust and the value of personal relationships in molding initial contacts into an enduring and committed partnership. Trust accumulated gradually. While it is impossible to quantify the benefits of the trust so established, we believe it was an invisible "deliverable" of the entire program and should be teased out as a separate piece of the story. In this way, the subtle and yet essential human dimension can take its place alongside the technical, political, diplomatic, institutional, and other significant aspects of the nuclear cooperation. We believe that the friendships and the mutual trust forged in tackling crucial nuclear security issues

[2] Evgeny N. Avrorin, "Personal Reflections of Three Former Nuclear Weapons Lab Directors," in the front matter of Volume II.

constituted the fabric of the lab-to-lab cooperation. The remarkable sense of fellowship in scientific exploration comes through in the historic notes written during the beginning of cooperation and more recent discussions alike.

The emotional response that the partnership has evoked among its many participants on both sides of the ocean, in our mind, originates from several sources. First of all, the emotive power of the story arises from the nature of the historical moment when cooperation began. The lab-to-lab connection came about as the nuclear weapons professional community's response to the tectonic shift in the post-World War II international system and the new global security environment. To borrow the lines of Russian poet Fyodor Tyutchev, "Blessed is he who visited this world in its fateful minutes!"[3] The nuclear weapons communities of the US and Russia were blessed to visit this world in its fateful minutes—and partake in a high council to shape the future.

At the time when intergovernmental diplomatic protocols were outpaced by the rapidly cascading challenges of the Soviet breakup, which bore extremely serious implications for nuclear safety and security on a global scale, individuals in their professional capacities took action, devised new solutions, and pushed institutions and officials to take action. Under conditions of high uncertainty and a host of challenges, this required the US and Russian lab and government leaders to put forth some of the finest human qualities of foresight, smart thinking, empathy, and lots of tenacity and courage. As political science professor and author John W. Kingdon[4] pointed out, it is also during these times of uncertainty or political chaos that the epistemic community—a network of knowledge-based experts, scientists, and engineers in this case—is most effective. It is during these times that policy windows open and governments facing uncertainty are most receptive to new ideas.

For some 40 years before the scientists from each side exchanged the first handshake, the labs on both sides played parallel roles in providing the very means of the nuclear deterrent for their nations locked in the Mutually Assured Destruction (MAD) relationship. Their parallel roles produced striking similarities in the structural makeup of the two nuclear weapons communities: each nation established three main laboratories with similar breakdown of specializations and a similar sequence of growth. More importantly, the laboratories on both sides shared an underlying vision of their role and duty. They housed a deep sense of mission as the makers and stewards of the very source of their nation's hard power. Their dedication to making increasingly more effective weapons stemmed from a perception of the existential threat posed by the nuclear capability of their adversary.

At the same time, their products, humanity's most destructive weapons, were also the material embodiment of their makers' intellect and passion for knowledge. By virtue of their expertise, the American and Soviet/Russian bomb makers belonged to an elite scientific club that shared a highly exclusive trade. In this high-stake, intellectually challenging pursuit, the other side was the inevitable reference group. Our contributors' stories convey how on each side of the ocean, nuclear scientists studied open publications and conference

[3] Fyodor Ivanovich Tyutchev, "Tsitseron" ("Cicero"), 1830, Translated by Alla Kassianova. "Blessed is he who visited this world/In its fateful minutes!/He was called by the all-gracious gods/ As a companion to their feast/ A witness to their highest vistas,/ He was admitted to their council/ And like a living god while there/ Drank immortality from their cup!"
[4] John W. Kingdon, *Agendas, Alternatives, and Public Policies,* Boston: Little, Brown, 1984, p 166.

abstracts to assess the technical prowess of their invisible counterparts in specific fields of scientific enquiry.[5] The emotional depth of this curiosity, spurred by decades of intense intellectual competition, comes through in the words of Viktor Mikhailov, the chain-smoking, tough-talking leader of the Russian nuclear weapons complex. On the way to the JVE at the Nevada Test Site in 1988, he was thinking of the many nights he had spent on the Soviet *polygons* (the Soviet test sites) wondering how his American colleagues worked. "I was as excited as I had been in my youth when looking forward to a date with a girl. My dream had come true."[6]

When nuclear scientists did get a chance to come together face to face, the overriding impression was the shock of self-recognition. Evgeny Avrorin had occasion to exchange views with the American nuclear pioneer, Edward Teller, during Teller's visit to VNIITF in 1994. Discussing what motivated Soviet and American scientists to build the bomb, Avrorin named three reasons: to defend against the Americans, to make another world war impossible, and because it involved interesting physics. In Teller's view, the Americans had identical motivations. Many lab-to-lab stories capture the excitement of discovering that visitors from across the ocean understood each other immediately without sharing a common language. In addition to mutual curiosity, the Russian scientists were especially motivated to pursue the opportunities opened by the lab-to-lab programs because they had worked in greater international isolation imposed by the excessive secrecy of the Soviet nuclear program. Many of the Russians—active collaborators in the lab-to-lab activities—shared the experience of German Smirnov, the chief designer of the Institute of Automatics (VNIIA) who, as a recent graduate, was welcomed to his new job with the following injunction: "You won't need to speak a foreign language; any contacts with foreigners are forbidden, and you will never travel abroad."[7]

Because nuclear weapons laboratories in the United States and Soviet Union/Russia were world-class scientific establishments, fundamental science was a natural focus of the early interaction. It was the least potentially problematic area of activity from the perspective of the US and Russian governments for collaboration between the nuclear weapons labs. Shared passion for science provided a firm ground for the recent adversaries to relate to each other as colleagues. Contributions to the Cooperation in Fundamental Science section of this volume bring back the enthusiasm of the early exchanges despite being written many years later for this book. We present here just one of the accounts that rings with such excitement:[8]

"All week long, Monday through Friday from 9 am to 5 pm, we met with representatives of the working groups, both theoreticians and experimentalists, in their respective fields of explosion physics, shock waves, and materials studies. They shared results of their

[5] On the American side, we felt ourselves to be at a disadvantage. There were many fewer open Soviet publications and they were difficult to access. Moreover, they appeared to always be missing some key description of an experiment or a theory. The papers were also written in a very indirect style, making them difficult to decipher. A common American complaint was that one needs the Soviet authors to understand their papers. With lab-to-lab cooperation, we did indeed get access to many of these authors as recounted by Siegfried Hecker in "Cooperation in Plutonium Science," in Chapter 8 of this book.

[6] V.N. Mikailov, *Ya - Yastreb (I am a Hawk)*, Moscow: FGUP "ISS", 2008, p.66.

[7] Said during personal discussions between Siegfried S. Hecker and German A. Smirnov in preparations for writing this book.

[8] Georgy N. Rykovanov, et al., "Scientific Collaboration between VNIITF and the US Nuclear Weapons Laboratories," in Chapter 8 of this book.

recent research projects to look for points of common interest. After the meetings, back at the hotel, half the night we spent on digesting the day's worth of information and on preparing comments for the next day. And, all of next day we did it all over again—with new specialists, new results, and new questions. It is hard to imagine a more intellectually stimulating way to pass the time."

The lab-to-lab connection gave its participants a once-in-a-lifetime chance to tackle burning scientific questions of the day with the new energy of pooled brain power of the world's two most advanced nuclear weapons science communities. Joint teams were formed in the areas of complementary scientific strengths; and some collaborations lasted for almost two decades. Today, the scientists say that they are convinced that through collaboration they have achieved far more than could have been accomplished alone. For example, the pulsed-power collaboration described by Lindemuth and Reinovsky[9] and Garanin[10] combined a keen understanding of high energy-density physics on both sides, with world-class explosive compression generators from Russia with the most sophisticated diagnostics from the Americans to achieve a world record high magnetic field. The two participating institutes, LANL and VNIIEF, have conducted more than 25 joint experimental campaigns and myriad theoretical, analytical, and manuscript projects. The joint experimental, theoretical, and computational endeavors have resulted in more than 400 papers presented at international conferences or published in conference proceedings and archival technical journals.

The note that is struck in practically every account in this book, however, deals with the most simple and, at the same time, most fundamental discovery that every participant in the scientific collaborations made at one time or another, and that is the value of the basic elements of human lives. It was the gradual familiarity with the non-scientific sides of everyday life—meeting each other's families, visiting homes, exploring natural monuments and making cultural outings, throwing feasts, and sharing hopes for the future of children—that provided meaning to their workplace pursuits and solidified the professional bonds. In our interviews with the authors who contributed to this book, we repeatedly encountered the comment, "This experience changed my life."

It was in that experience that the human dimension played its part. The totality of professional and personal interactions under the lab-to-lab umbrella built a cache of mutual trust and understanding that eventually allowed scientists from both sides to expand the collaboration from the non-weapons science arena to the more sensitive issues directly related to their nuclear weapons responsibilities. Those were predominantly issues within the Russian nuclear complex, stemming from the enormous challenges of modernizing infrastructure, safeguarding fissile materials, disassembling large numbers of retired warheads, and downsizing production facilities, all during the economic crisis of post-communist transition and insufficient government funding for the scale of the problems. The lab-to-lab ethos of mutual respect and trust helped Russian and US lab

[9] Irvin R. Lindemuth and Robert E. Reinovsky, "The LANL-VNIIEF Collaboration in Pulsed-Power-Based High-Energy-Density Physics: An American Perspective," in Chapter 8 of this book.
[10] Sergey F. Garanin, "The LANL-VNIIEF Collaboration in Pulsed-Power-Based High-Energy-Density Physics: A Russian Perspective," in Chapter 8 of this book.

scientists and engineers to reframe the problems as public safety and nonproliferation issues that could affect the well-being of people globally rather than being defined by any national affiliation. The lab-to-lab connection created a sense of responsibility in both sides beyond a nationally bound mission and allowed them to transcend suspicions about the other's motives in order to address shared problems.

The lab-to-lab experience proved to be so emotionally rewarding for is participants because it combined the chance to work with a former adversary for a meaningful cause with a deeply internalized loyalty to their original mission. This is how the members of a joint Russian-American project team who developed parallel solutions for real-time monitoring of nuclear warheads[11] expressed this sentiment:

"It was a professionally motivating and exciting time for those involved when the technical and political goals were aligned, and this unity resulted in getting the right people, collaborating on big problems, and achieving critically needed solutions."

We end this introduction with a quote from Yuli B. Khariton, the person who oversaw the building of the first Soviet bomb and was scientific director of VNIIEF for 46 years. His words capture the spirit of the human dimension.

"Conscious of my participation in remarkable scientific and engineering achievements, which led to mankind's possession of a practically inexhaustible source of energy, today, at a more than mature age, I am no longer sure whether mankind has matured enough to possess this energy. I realize our participation in the terrible death of people and in the dreadful damage inflicted upon the nature of our home, the Earth. Words of repentance can certainly change nothing. Please God, those who come after us will find the ways, find in themselves the firmness of spirit and determination, in striving for the best, not to do the worst."[12]

[11] Greg Mann, Andrey Sviridov, and Konstantin Zimovets, "TOBOS: A Nuclear Warhead Container Security System," in Chapter 3 of this book.

[12] "The J. Robert Oppenheimer Memorial Committee presents a special memorial address / by Academician Yuli Borisovich Khariton," Los Alamos, N.M.: The J. Robert Oppenheimer Memorial Committee, July 1995, p. 9.