Sagdeev in (Arms) Control

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It is an understatement to say that Roald Sagdeev is a man of many parts. I first heard of him from my long-time friend and colleague, Marshall Rosenbluth, with whom I had been a graduate student at the University of Chicago and with whom I worked at Los Alamos on the first hydrogen bomb, MIKE, and on the "snowplow model of the z-pinch."

I was a founding member of the National Academy of Sciences' Committee on International Security and Arms Control (CISAC) created in 1980 primarily to hold semi-annual meetings with our counterparts of the Soviet Academy of Sciences. Because of the enormous differences in structure and scope of the Academies on the two sides, there were various asymmetries in the situation, but as scientists we hoped to build on the foundation laid by Paul Doty of Harvard University and his SADS (Soviet-American Disarmament Studies) group of which I was also a member, together with other worthies such as Jerome B. Wiesner, Marshall Shulman, and John Steinbruner. Doty, Wiesner and Steinbruner would become CISAC members.

In fact, CISAC was to hold what are now called Track-2 meetings, with sponsorship moved from the American Academy of Arts and Sciences to the U.S. National Academy of Sciences. We had had several meetings, with Marvin L. Goldberger, physicist and President of Caltech as CISAC chair, when Marshall Rosenbluth, all too briefly a member of CISAC, suggested that our activity would benefit greatly from the presence of Roald Sagdeev, whom Marshall knew well from plasma physics and who had moved from Novosibirsk to Moscow to head the Space Research Institute, IKI. By that time,

Evgeny P. Velikhov had assumed the leadership of the Soviet Academy's counterpart to CISAC. As Sagdeev recounts it, turning up somewhat late for the meeting in Moscow, when he returned from a long trip there was on his desk a request from Velikhov that Sagdeev show up that morning for the meeting with the American CISAC delegation.

Marshall was perceptive, and Sagdeev was indeed a leader of the activities on the Soviet side—intelligent, earnest, and persistent. In 1986 he became head of the Soviet counterpart group to CISAC.

I worked with Roald intermittently over the years, both in our regular CISAC meetings until he emigrated to the United States, and in Pugwash, especially the Pugwash sessions on nuclear weapons in Europe, usually held in Geneva.

The 1980s were an important time for arms control, with many perilously disruptive tendencies that included President Ronald Reagan's "Star Wars" speech of March 23, 1983, in which he announced the Strategic Defense Initiative, calling for *"the scientific community in our country, those who gave us nuclear weapons, to ... give us the means of rendering these nuclear weapons impotent and obsolete."*

When Mikhail S. Gorbachev took office as General Secretary of the Communist Party of the Soviet Union March 11, 1985, as I was about to go to Moscow I heard from wise heads in Washington that Gorbachev would be just one of the succession of party

Secretaries and that nothing much would happen under his watch. In reality, when I reached the Presidium of the Soviet Academy, I found changes already evident—there were no cognac bottles or glasses on the conference table at 10 a.m., and, indeed, alcohol was not served at the reception that evening. This Gorbachev meant business!

Indeed, attacking alcoholism in this way was not a good idea. According to Sagdeev[1] (p. 267) *"The well-publicized moratorium on drinking and alcohol seemed to many of us, from the very beginning, a futile and ridiculous move. Arbatov was so outraged with the measure that, after taking part in the Victory Day Parade on May 9, 1985, as a war veteran, he wrote an emotional personal letter to Gorbachev urging him not to sign the prohibition law. Aganbegyan still thinks that the very first serious blow to the Soviet economy, which finally led to an enormous proliferation of budget deficits, came from that ill-thought-through vodka moratorium. Even at the expense of the ruined budget, it did not achieve its main goal: to reverse the old rooted drinking habits of the population."*

Gorbachev, through his "glasnost" and "perestroika" (openness and reorganization), intended nothing less than to revolutionize the Soviet enterprise.

In this it was clear that he could not count on the Soviet bureaucracy, the "nomenklatura," to help him: people in this class were likely to lose their jobs and influence and privilege if

[1] *"The Making of a Soviet Scientist, My Adventures in Nuclear Fusion and Space from Stalin to Star Wars"* by Roald Z. Sagdeev, edited by Susan Eisenhower, John Wiley and Sons (1984)

Gorbachev were to succeed, and if they allied themselves with him and he failed, things could go even worse for them. For most of them it was a lose-lose prospect.

Like Eisenhower when he became President in 1953, Gorbachev felt that he could not depend on the military or the foreign-policy establishment in critical areas such as military technology and especially nuclear weapons. So Gorbachev quickly assembled an informal group of four advisors, (the Gang of Four) consisting of Georgi (Yuri) Arbatov, Evgeny M. Primakov, Roald Z. Sagdeev, and Evgeny P. Velikhov. Arbatov and Velikhov were already working with Gorbachev at the time he rose to the post of General Secretary.

We are all familiar with the rocky road to the peaceful dissolution of the Soviet Union and the creation of Russia, but that is not the story here. CISAC and its counterpart still exist, with varying degrees of influence on the two sides, and the Russian Academy of Sciences is strongly supportive, with RAS Vice President Nikolay P. Laverov as head of that activity for the Russian Academy. Excellent and powerful people are involved, as indicated by the participation in a recent meeting in Moscow:

Exactly who has done what in arms control is more difficult to pin down than is the case with scientific discoveries and publications, complicated by the advice given me in 1953 by Jerry Wiesner, in 1961 to become President John F. Kennedy's Science Advisor and head of the President's Science Advisory Committee. He observed that "you can either get something done or get credit for doing it, but not both," an aphorism with more truth

than poetry. Roald's book is helpful in this regard. I had read it and even reviewed it for *Physics Today* in 1984, but I read the book once again and found it fascinating.

In his chapter, "Trust But Verify," Roald tells the inside story of the inflation of the possibility of detection of nuclear warheads at great distances-- in particular for the verification of cruise missiles-- that led to Gorbachev himself announcing at the Soviet Embassy in Washington the capability to control nuclear-armed cruise missiles. This seemed to reflect the conviction of Valery Barsukov in 1987 that neutrons escaping a nuclear warhead could be detected[2] at a distance of 10 km-- a result uncritically conveyed to Gorbachev by Velikhov. At that time Sagdeev and Frank von Hippel of Princeton University were co-heads of a joint program of the Federation of American Scientists (FAS) and the Committee of Soviet Scientists (CSS) on various aspects of verification of arms control or disarmament agreements. This culminated in the remarkable "Black Sea Experiment" of 5 July, 1989, involving a Soviet cruise missile with nuclear warhead in its launcher on the cruiser *Slava*, described in some detail today by participant Frank von Hippel, and in which Steve Fetter was a key player.

Involved on the U.S. side were also Thomas B. Cochran, Alex De Volpi, Steve Fetter, William Higginbotham, Marvin Miller, Robert Mosley, Christopher Paine, R. Prilutsky, Jeremy Stone, Theodor Taylor, Valerie Thomas and David Wright.

[2] (indirectly, through their capture on atmospheric A-40, to form radioactive A-41 of 109 minute half life, and the advection of the air parcels.)

Other Soviet participants included Academician Spartak Belyaev, General Vladimir Belous (ret.), V. A. Frolov, Andrei Kokoshin, Victor Kravetz, Valentin Lebedev, Alexei Mitrophanov, Academician Karl K. Rebane, Stanislav Ridinov, S.N. Rodionov, and Alexander Sanin.

This highly successful experiment in on-site verification technology showed the expected limited range of detection, but, unexpectedly, the ability to determine significant design details of the nuclear warhead itself.

I remember, particularly, several personal interactions with Roald. The first was in the course of preparation for understanding of the potential for directed energy weapons (DEW) to be used as a space defense against ballistic missiles . Before the unheralded Star Wars speech, there had been small programs of the Defense Advanced Research Project Agency (DARPA) and some testimony in Congress, in which DARPA leaders were deflecting political enthusiasm for deployment of such weapons. As a result, CISAC and its Soviet counterparts decided to put such technology on the agenda for discussion and perhaps for arms control, asking whether such capabilities could be even as realistic as nuclear-armed antimissile systems, which Hans Bethe and I first publicly evaluated in a March 1968 *Scientific American* article.[3] At a CISAC meeting in Washington in March 1983, we had good presentations from either side and informal discussions as to how to

[3] "Anti-Ballistic-Missile Systems," by H.A. Bethe and R.L. Garwin, *Scientific American*, Vol. 218, No. 3, pp. 21-31, March 1968. http://www.fas.org/rlg/03%2000%201968%20Bethe-Garwin%20ABM%20Systems.pdf

characterize and potentially to limit high-power lasers on orbit, for instance to avoid their possibly destabilizing effect on strategic stability.

I remember discussing with Roald the very high peak power of totally innocuous lasers that might be used in orbiting or passing by an airless moon or asteroid, while ablating a tiny bit of material for mass-spectrometric analysis as it passed the space probe. Very high instantaneous power, but no significant energy or possibility of damage to a nuclear warhead. Yet if diplomats were to negotiate some detailed agreement, it was vital that such harmless tools so valuable for understanding our world not be barred by at Treaty.

Our CISAC meetings were sometimes punctuated with drama, as during the session in Washington on January 13, 1982 at the National Academy of Sciences, when an Air Florida 737 crashed into the 14th Street Bridge over the Potomac River, killing 78 people.

After discussions of DEW at our session in Washington on March 16-19, 1983, a brief unease arose when our Soviet colleagues found it incredible that the CISAC group had no inkling that President Regan would announce the Strategic Defense Initiative on March 23 of that year. In fact, prominent scientists invited to the White House for the President's speech had no idea either that the President was entertaining such ideas and Hans Bethe, for instance, was dumbfounded.

This detailed CISAC interaction served both American and Soviet scientists very well, particularly when Gorbachev was seriously considering options of matching or countering the U.S. SDI.

I show some of the front matter from a 04/21/1984 document, “A SPACE-BASED ANTI-MISSILE SYSTEM WITH DIRECTED ENERGY WEAPONS: STRATEGIC, LEGAL AND POLITICAL IMPLICATIONS,” produced by Committee of Soviet Scientists for Peace, Against Nuclear Threat. Here is a copy of the inside cover of that document.

This Report has been prepared by the Working Group of the Committee of Soviet Scientists for Peace, Against Nuclear Threat consisting of the Heads of Groups: Deputy Chairman of the Committee of Soviet Scientists, Academician R.Z. Sagdeyev (Director of the Institute of Space Research of the USSR Academy of Sciences), Deputy Chairman of the Committee of Soviet Scientists A.A. Kokoshin, D.Sc. (History), Deputy Director of the Institute of USA and Canada Studies of the USSR Academy of Sciences;

experts: A.G. Arbatov, D.Sc. (History), Sector Chief at the Institute of the World Economy and INternational Relations of the USSR Academy of Sciences; A.A. Vasilyev, Cand.Sc. (Technology), Department Chief at the Institute of USA and Canada Studies of the USSR Academy of Sciences; V.I. Shevchenko, D.Sc. (Physics and Mathematics), Deputy Director of the Institute of Space Research of the USSR Academy of Sciences; O.F. Prilutsky, Cand.Sc. (Physics and Mathematics), Department Head at the Institute of Space Research of the USSR Academy of Sciences; V.G. Rodin, Chief Project Designer of the same Institute; S.N. Rodionov, Cand.Sc. (Physics and Mathematics), Senior Research Associate of the Institute; and R.R. Nazirov, Cand.Sc. (Technology) Senior Research Associate of the Institute.

A mathematical model for studying the scientific and technical aspects of the issue under review (Appendix I)

This was printed at IKI, in 140 copies, listing R.Z. Sagdeev as Deputy Chair of the CSS, tkboth of whom were important participants in our CISAC dialog.

This document, in order to be published in the Soviet Union in those days, depended entirely upon published papers, both American and Soviet, but nonetheless provides useful insight into the analysis and thinking of the Soviet industry, military, and scientists at that time

There is more!

Sagdeev writes,

"*One particular episode I remember with some feeling of vindication. At a small meeting in Gorbachev's Kremlin office, an official from the Soviet Space industry, Alexander Dunaev, the president of Glavcosmos Agency, noticed Gorbachev's genuine involvement in strategic thinking. Seizing the moment, Dunaev said, 'Dear Mikhail Sergeyevich, I completely understand your concerns. Trust me. We are losing time while doing nothing to build our own counterpart to the American SDI program.' I almost died from suppressing my laughter. A lot of people, not only the Gang of Four, but Marshal Akhromeyev also apparently tried to influence Gorbachev not to copy the SDI program. At the time, Akhromeyev was probably the best expert on that strategic issue.*

‘Perhaps Dunaev was simply fulfilling instructions from Big Oleg, his minister. This brief episode gives at least a clue as to why we Russians were, as many in the West thought, overescalating the anti-SDI rhetoric. In my own frame of reference, I always had in mind the potential danger that could arise if Big Oleg, Dunaev, and other similarly influential members of the military and industrial sectors in our own country were to involve us in a nonstop escalation of an SDI budget at that time at the expense of the deteriorating strategic stability and our economy.

‘Speaking to a seminar of political scientists and strategic analysts in Paris, I even confessed that ‘if Americans oversold SDI, we Russians overbought it.’ Jim Hoagland, then Paris correspondent for the Washington Post, asked whether we could quote me. Wishing to stay on the safe side, I asked that my name not be mentioned in the final article. Reference was made to an anonymous ‘Russian official.’

‘Yes, we paid too much attention to SDI, but I believe we did so for a good purpose. At least it saved the country a few billion rubles.”

Naturally, U.S. agencies were closely observing scientific/technical activities in the Soviet Union at this time. Here is a March 1985 CIA analysis paper released in July, 1996[4],

“SOVIET DIRECTED ENERGY WEAPONS—
Perspectives on Strategic Defense
March, 1985

[4] www.foia.cia.gov/Reagan/19850305.pdf

Last year, a group of scientists published a technical report critical of space-based weapons. The report was prepared by a working group of the Committee of Soviet Scientists for Peace, Against Nuclear Threat and headed by Academician R. Z. Sagdeyev, Director of the Institute of Space Research of the Soviet Academy of Sciences. We believe this report was written and disseminated to serve as a propaganda tool against the SDI. The report was made widely available in the West, but it has apparently been given little attention within the Soviet Union. The report asserts that space-based systems are too technically complex, expensive, and easily counter-measured to be worthwhile. The report examines only the hydrogen fluoride chemical laser in detail; neutral particle beams, x-ray lasers, and excimer lasers are barely discussed. Ground-based terminal defense systems and space-based kinetic-energy weapons are omitted.

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* "A Space-Based Anti-Missile System with Directed Energy Weapons: Strategic, Legal, and Political Implications," Committee of Soviet Scientists for Peace, Against Nuclear Threat, Moscow, 1984.

The Soviets probably wish that the March 23rd announcement had never been made and that they could pursue their own research on strategic defense without real competition from the US. With the advent of the SDI, the Soviets are faced with a mobilization of efforts on strategic missile defense in the US and their actions of late are intended to persuade the US to drop it. The Soviet lobbying and criticism of the SDI is the cheapest and least risky approach to undermining congressional and public support for the SDI.

The Soviets have not admitted to their own efforts in SDI-counterpart activities. And they may never do so. But perhaps we are now on the threshold of an alternative Soviet line of attack--to compete with the US.

> -- Nikolay Basov declared in January that Moscow would have 'no technological difficulty' in matching the US SDI program.

And from what we have observed thus far of Soviet capabilities in directed energy research, development, and testing, his claim is not without foundation.

In the United States government, although our CISAC Committee was meeting with Sagdeev, Velikhov, Kokoshin and others in regard to directed energy weapons, including lasers in space, the CIA assessment, at least, ignored the possibility that the Sagdeev-Kokoshin document was intended to dissuade the Soviet government from pursuing such an expensive and clearly ineffective program. Velikhov and Sagdeev were a potent force against the Soviet counterpart to SDI.

I recall also in 1987 or 1988, after the failure of the Gorbachev-Reagan in Reykjavik October 1986, that Sagdeev and Velikhov cornered me at the blackboard of our Pugwash session in Geneva on nuclear weapons in Europe and pinned me down on a specific number of nuclear weapons that I would advocate for U.S. and Soviet armories. We sketched the arguments and the possibilities, and that was the origin of my paper in the *Bulletin of the Atomic Scientists* [5] in which I proposed that within a year the Soviet Union and the United States each reduce its nuclear weapons holdings to 2000, and in the next year undertake demilitarization of the weapons so that there would be only 1000 weapons or weapon-usable-material equivalents on either side.

When I saw Sagdeev and Velikhov in Hamburg in October, 1986, at a large meeting in which we discussed and made presentations on weapons in space and space arms control, I found them both well versed on the Chernobyl disaster of April 26, 1986. I had

[5] "A blueprint for radical weapon cuts," by R.L. Garwin, *Bulletin of Atomic Scientists*, pp. 10-13, March 1988. http://tinyurl.com/26cj2rx

participated in a National Academy study to review the safety of Department of Energy reactors in the light of Chernobyl, and I was familiar with the video prepared from a simulation at IKI of the evolution of the cataclysm at Chernobyl. Roald writes (p. 292) *"In the Space Research Institute, while helping the authorities simulate the events leading to the disaster with the help of black market Western computers, we knew the attempt to make the [reactor] controller the scapegoat was a blatant lie. However, a dangerous cloud started to gather around the father of the failed system, but we knew that the hours of the old fox Alexandrov, the official supervisor of nuclear energy engineering and science, were numbered."* Those were the black market computers that I verified for both sides:

> In October 1987, when I was on one of several visits to IKI, I had noted that there was publicity about IKI's having acquired computers that could not be legally sold by U.S. entities to the Soviet Union. This did not mean that IKI had broken U.S. law by acquiring the computers outside the United States, but there was interest in determining exactly which computers these were. So Sagdeev suggested, and I agreed, that I be videotaped opening the rear of the cabinet of several of the cabinets of the computers in operation, and reading off the computer model and serial number. The videotapes were then provided to the U.S. government, but I don't know what was done with them.

I knew that Velikhov had been involved with attempting to tame the burning graphite core after the explosion at Chernobyl, but I had not realized the extent to which he directed and participated, even to flying on helicopters right over the maw of the reactor with its

exposed red-hot core, to guide the dumping of sand and lead onto the core. And I learned from Roald's book that he and his family landed in Kiev three days after April 26, for Roald to give a lecture on the Halley Comet mission, *VEGA*, and only when the wind shifted and fallout began to raise the radiation level in Kiev did they return to Moscow, where their shoes were scrutinized and taken away for study.

Roald's involvement in arms control and international security came at a price, and not just potential displeasure from the military and its industry. In his book (p. 320) reveals his judgment that it contributed to the tragic loss of the Phobos probes sent to encounter a close moon of Mars. He writes, *"It is true that we were the customers; nevertheless, we should have been much more insistent when dealing with the aerospace industry. What happened was obvious contributory negligence from our side. In 1986 and 1987 during the most critical period of preparation, I was more and more absorbed by political activities, including arms control assessments and the summits. Somehow I had underestimated the importance of fighting internal 'wars' instead of external ones. Too much energy had gone toward arms control and to the fight against forces that wanted to establish a Soviet SDI system. Not only I, but the institute as a whole, had been filled with euphoria over the success of the VEGA mission as well as the flight of high-energy scientific telescopes onboard the station MIR—the first to detect hard radiation from the famous supernova in 1987. We had lost some of our vigilance."*

We were, of course, delighted to have Roald become a member of the American scientific community, but it was a substantial loss to our effectiveness to lose him from the Soviet (now Russian) team on international security and arms control.

I close this presentation with the last paragraph of the foreword by Carl Sagan to Roald's book,

"*This autobiography casts light on little-known and very important corners of the former Soviet Union. It reflects the author's lucidity, humor, and sober judgment. It is a fair reflection of an extraordinary man and an extraordinary career. I wish there were more people like him at the right hand of every national leader.*"