

# ANDREI SAKHAROV AND THE NUCLEAR DANGER

**F**or over forty years, nuclear weapons were a major concern of Andrei Dmitrievich Sakharov. A brilliant physicist whose work was instrumental in the creation of the Soviet hydrogen bomb, Sakharov was led by his concern about the dangers of nuclear weapons and

the threat of nuclear war to become a courageous activist for peace and disarmament, as well as for human rights (A 1989 talk by Sakharov is reprinted in *PHYSICS TODAY*, July 1999, page 22; for more on Sakharov, see *PHYSICS TODAY*, August 1990, which was a special issue devoted to him; also see the American Institute of Physics's Center for the History of Physics on-line exhibit on Sakharov at <http://www.aip.org/history/sakharov/>). In his lifetime he saw the problems and dangers associated with creating such massively destructive weapons through the highly refracting lens of the cold war. That war is over. The Soviet Union no longer exists. But great dangers remain, albeit mutated into new forms. We still face grave perils.

As I see it, there are four basic principles that Sakharov held constant as his thinking evolved apace with the changing political and strategic circumstances of the cold war. My purpose in this article is to see how these principles apply in today's post-cold war world, with a new strategic and political landscape and with rapidly advancing and more widely accessible technologies. More than a decade after Sakharov's death in 1989, his thinking remains relevant to the most pressing contemporary issues in peace and disarmament.

The four principles that I derive from Sakharov's writings and my discussions with him are, briefly stated: 1) deterrence is inescapable; 2) strategic parity is essential; 3) negotiations are of primary importance; and 4) trust, developing from cooperation and openness, is a prerequisite for progress.

## Sakharov's four principles

Sakharov's first general principle, the inevitability of deterrence, is based on his concern that any use of nuclear weapons would amount to "collective suicide." Indeed, he frequently emphasized that "a large nuclear war would be a calamity of indescribable proportions and absolutely unpredictable consequences, with the uncertainties tending toward the worst." The principle of deterrence is stated clearly in his open letter to me of February 2, 1983, entitled "The Danger of Thermonuclear War."<sup>1</sup> In this letter, which he considered his most detailed public statement on the consequences of nuclear conflict, he asserts, "Nuclear weapons only make sense as a means of deterring nuclear aggression by a potential enemy, i.e., a

**A decade after Sakharov's death, his guidance remains relevant to the nuclear perils we face in today's post-cold war world.**

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nuclear war cannot be planned with the aim of winning it. Nuclear weapons cannot be viewed as a means of restraining aggression carried out by means of conventional weapons."

Sakharov pointed out that NATO's strategy during the cold war years contradicted the principle of deterrence. At that time, the Soviets were credited with possessing an overwhelming superiority in massed conventional forces in Europe, and NATO's doctrine called for early reliance on nuclear weapons to blunt an assault from the east by those forces. Today, with the Soviet Union and the Warsaw Pact a grim memory of the past, the imbalance of conventional military strength has shifted in the opposite direction and raises new issues to which I will return shortly.

A second principle embraced by Sakharov is that of strategic parity, that a balance in both nuclear and conventional forces should be a precondition for making progress toward nuclear weapons reductions. Sakharov's commitment to the principle of parity goes all the way back to 1948, when he joined a research group developing thermonuclear weapons. As he wrote in his *Memoirs*<sup>2</sup> in 1989, "I had no doubts as to the vital importance of creating a Soviet superweapon—for our country and for the balance of power throughout the world." There, and on a number of other occasions, Sakharov wrote of the importance of balancing the capitalist bomb with a socialist bomb. Later, Sakharov was led by his growing concern about the harmful effects of atmospheric nuclear testing and by his passionate opposition to Soviet abuses of human rights to become a courageous and outspoken dissident. Through it all, he continued to insist on the necessity of strategic parity for progress in controlling nuclear weapons and the arms race, and for eventually achieving the long-term goal of disarmament. Sakharov's position is well summarized in a letter he wrote to me in 1981 from Gorky<sup>3</sup>:

I consider disarmament necessary and possible only on the basis of strategic parity. Additional agreements covering all kinds of weapons of mass destruction are needed. After strategic parity in conventional arms has been achieved, a parity which takes account of all the political, psychological and geographical factors involved, and if totalitarian expansion is brought to an end, then agreements should be reached prohibiting the first use of nuclear weapons, and, later, banning such weapons.

Sakharov's third principle was the importance of diplomatic negotiations, to avoid a direct nuclear conflict, reduce the size of nuclear arsenals, and reduce the dangers associated with nuclear weapons. He stressed this theme repeatedly. For example, in his book *My Country and The World*<sup>4</sup> he emphasized the importance of "disarmament talks, which offer a ray of hope in the dark world of suicidal nuclear madness." The strength of his commit-

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ment is nowhere more evident than in his statement during the first year of his exile to Gorky: "Despite all that has happened, I feel that the questions of war and peace and disarmament are so crucial that they must be given absolute priority even in the most difficult circumstances. It is imperative that all possible means be used to solve these questions and to lay the groundwork for further progress. Most urgent of all are steps to avert a nuclear war, which is the greatest peril confronting the modern world. The goals of all responsible people in the world coincide in this regard, including, I hope and believe, the Soviet leaders . . ."

Whereas Sakharov insisted on giving "absolute priority" to questions of peace and disarmament, he also emphasized the importance of fighting for human rights and freedom. Both campaigns must be fought with equal vigor, he insisted, just as one fights with both fists and walks with both legs. He himself did so with total disregard of the consequences to himself.

Sakharov's fourth principle, building trust, was cast in the context of the cold war confrontation between the West and the Soviet Union. In an interview with *Time* magazine that appeared in March 1987, he asserted that international security and real disarmament are impossible without greater trust, built on cooperation and openness between nations of the West and the Soviet Union. He also emphasized the critical importance of human rights and democracy, saying, "Without a resolution of political and humanitarian problems, progress in disarmament and international security will be extremely difficult, if not impossible."<sup>5</sup>

## A changed world

The post-cold war world is very different from the one that Sakharov was concerned with when he developed and applied the four basic principles of deterrence, parity, negotiations, and trust. No longer is the dominant concern the prospect of a nuclear holocaust, triggered by mistake, misunderstanding, or miscalculation in a confrontation between the two superpowers. Instead, there are growing concerns about terrorism in a world with one superpower and a growing number of emerging powers—some unstable, some poor, and many with access to advancing technologies of biological and chemical weapons of indiscriminate destruction. Notwithstanding these changes, I believe that the four basic principles of Sakharov remain just as cogent for addressing issues of war and peace in today's world as they were when he relied on them over a decade ago. In the words of a physicist, they are invariant over time. Let us now look at several contemporary issues to see how Sakharov's thinking applies today.

Throughout the cold war, the mutual hostage relationship implied by the principle of deterrence was generally but reluctantly accepted by the nuclear powers and their allies. Accepting that there was ultimately no defense from nuclear attack involved considerable discomfort, because it ran counter to the fundamental human instinct to defend our families, ourselves, our friends, and our society. Serious efforts were made to escape the mutual hostage relation through new formulations of strategic policy or technological fixes. Nevertheless, it was broadly—if not unan-

imously—agreed that such a quest was futile: It was beyond scientific and technical reality to build an effective nationwide defense against a massive attack by one of the two superpowers, each possessing many thousands of nuclear weapons.

Sakharov fully recognized the futility of antimissile defense in the context of the cold war and argued strongly against deployment of an antiballistic missile (ABM) system. He repeatedly said that an effort to construct a protective shield against massive nuclear attack would be both illusory and provocative. In his *Memoirs* he summarizes a study he did with colleagues at "the Installation"—the secret city where he was a leader of Soviet nuclear weapons development—during 1965–67, just prior to his formal break with the Soviet government:

In the course of many heated discussions, I, along with the majority of my colleagues, reached two conclusions which, in my view, remain valid today:

1. An effective ABM defense is not possible if the potential adversary can mobilize comparable technical and economic resources for military purposes. A way can always be found to neutralize an ABM defense system—and at considerably less expense than the cost of deploying it.
2. Over and above the burdensome cost, deployment of an ABM system is dangerous since it can upset the strategic balance. If both sides were to possess powerful ABM defenses, the main result would be to raise the threshold of strategic stability, or in somewhat simplified terms, increase the minimum number of nuclear weapons needed for mutual assured destruction.

Sakharov spoke out on the "practical impossibility of preventing a massive rocket attack" in his first public essay,<sup>6</sup> in 1968: "The experience of past wars shows that the first use of a new technical or tactical method of attack is usually highly effective even if a simple antidote can soon be developed. But in a thermonuclear war the first blow may be the decisive one and render null and void years of work and billions spent on creation of an antimissile system." He also emphasized what he called "the instability introduced by such a system if started by one side." These two arguments were the basis of many of the writings on this subject in the West during the cold war, and I, with many other scientists, found them decisive. I heard him argue them persuasively in his Moscow apartment in March 1988 to five leaders from the US Senate, including the current Secretary of Defense, then Senator William Cohen, who had challenged him on this question.

Today, of course, the situation is very different and some of Sakharov's arguments against antimissile defenses are no longer compelling. The Soviet Union no longer exists, and Russia currently lacks the resources necessary to



THE 1975 NOBEL PEACE PRIZE, commemorated in this 1991 Swedish postage stamp, was awarded to Sakharov for his "fearless personal commitment to upholding the fundamental principles for peace between men."

develop and deploy powerful nationwide ABM defenses. Fear of the danger of a massive nuclear attack on the US homeland has been replaced by concerns about very limited attacks. These concerns are spurred by the rapid development and proliferation of missile technology in many areas of the globe, together with emerging threats from nations seeking nuclear, biological, and chemical weapons. Whereas deterrence between advanced nuclear powers remains broadly accepted as unavoidable, the new problem is to find a way to protect against threats of very limited attacks by new members of the nuclear, biological, or chemical weapons club. Can't we do better against a very limited threat, both to deter or discourage attack, and to provide some defense? And can we accomplish this without simultaneously stimulating a new arms buildup, or foreclosing prospects for further reductions in existing arsenals of many thousands of nuclear warheads? This is a tall order, a terrific challenge.

My guess is that Sakharov today would support efforts to develop some protection against very limited threats, based on a realistic assessment of what technology can and cannot do. This would be consistent with his views back in 1967, as Elena Bonner pointed out in a letter to *The New York Times* on 27 October 1999. But before modifying the 1972 ABM Treaty, I think Sakharov would insist that there be an understanding between the US and Russia that honored all four of his principles. This means recognizing that mutual deterrence between the two countries remains inescapable so long as both nations possess large numbers of nuclear weapons. It means there should be no initiatives on either side to seek a military dominance that could disrupt stability in their current relationship, which now mixes cooperation with competition. It means that primary importance should remain with ongoing diplomatic efforts, rather than taking unilateral steps to abrogate the ABM Treaty. Unilateral action would almost certainly shatter the structure of the arms control dialogue in which the nations are now engaged, a dialogue that provides the political basis for the continuing efforts to reduce nuclear arsenals and to develop an effective nonproliferation regime. Finally, there is no substitute for cooperation and openness as a prerequisite for progress.

The two newest members of the nuclear club, India and Pakistan, probably view nuclear deterrence differently from the US and Russia in defining their security interests. However, there is one simple fact they cannot escape: As neighbors with a long common border, both would suffer an almost unimaginable disaster if either were to use nuclear weapons. In their search to avoid nuclear conflict and improve stability in their confrontational relationship, their diplomatic efforts to resolve conflicts and maintain peace have become more important than ever.



DRELL AND SAKHAROV at the Lepton Photon Symposium at Stanford University in 1989.

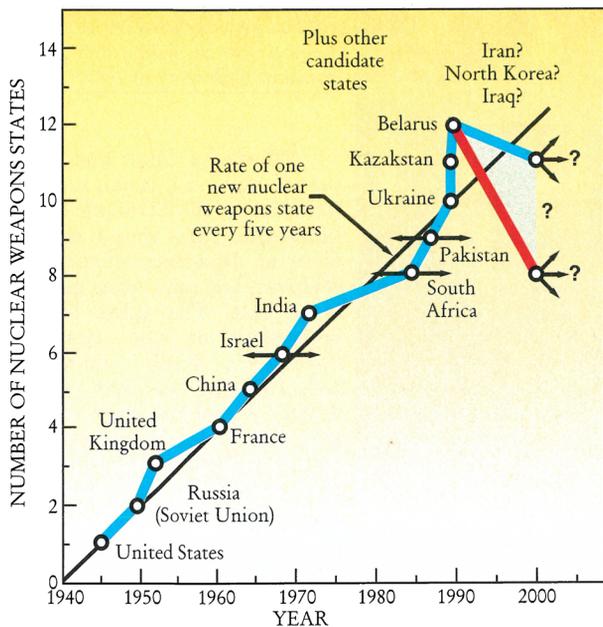
Efforts to limit and then reduce US and Russian nuclear weapons at the Strategic Arms Limitation Talks were a centerpiece of diplomacy during the cold war, but have since ground to a halt. The talks looked promising at the time of Sakharov's death, when the reductions of the first round, START I, had just been negotiated, but a decade later we are still at START I levels. The further reductions of START II have not been achieved because of continuing reluctance on the part of the Russian Duma to ratify that treaty. The US has not been very helpful in this effort: Although it has been evident since the demise of the Soviet Union and the collapse of the Russian economy that Russia is unable to sustain even the force levels and mix of START II, we have rigidly insisted that they must ratify that treaty

before we will sit down and work out the still lower limits for START III. [Note added in proof: The lower house of the Duma finally ratified START II on 14 April 2000, with the condition that the US does not renounce or unilaterally violate restrictions of the ABM Treaty.] Sakharov would certainly be very pleased by one provision that is at the heart of START II, namely the deMIRVing of land-based missiles, that is, limiting them to one warhead per missile. He called for removing vulnerable silo-based missiles,<sup>1</sup> as a threat to stability, as long ago as 1983. I have no doubt that Sakharov would be profoundly disappointed by the lack of progress in the START process, and would be urging renewed efforts to move the process forward.

Just as Sakharov castigated NATO for its policy of early first use of nuclear weapons against overwhelming Soviet nonnuclear forces during the confrontation between NATO and the Warsaw Pact, he surely would be saddened to find that, today, the policy has not disappeared but rather has been reversed. It is now Russia that has adopted a doctrine of early first use of nuclear weapons in critical situations against large-scale aggression involving conventional forces. This reflects Russia's lack of confidence in its own current conventional forces. Surely NATO is not about to invade Russia, but the situation will be more stable when strategic parity removes excuses, or a perceived need, for Russia to rely on nuclear first use for its homeland defense.

### Building trust and cooperation

Sakharov would surely support, and urge expanding, modern initiatives to build trust and cooperation between the US and Russia. I have no doubt that he would encourage and support US cooperation in helping Russia safeguard its nuclear weapons and material, as well as the ongoing US-Russian government-to-government discussions for sharing information to help provide early warning of a



nuclear missile attack. This information sharing is a very good idea to pursue more broadly with all interested countries. Confidence in access to early warning information is a purely defensive measure that will enhance stability by reducing fear of a preemptive first strike.

Sakharov would almost certainly also support the Chemical Weapons Convention that has now been brought into force with carefully crafted safeguard provisions, and the ongoing efforts to complete protocols for effective compliance with the Biological Weapons Convention.

Nuclear proliferation was a major concern of Sakharov. I am confident that he would strongly endorse the 1995 extension of the nuclear Non-Proliferation Treaty (NPT) for the indefinite future by 187 of the nations of the world, plus the effort to give it a more effective verification system. The extended treaty is a major success of negotiations, and shows the broadening of the principle of parity in a multilateral world through its offering of positive and negative security assurances by and for all signatories. The positive assurances are a guarantee by the nuclear weapons states of "nuclear umbrella" protection to nonnuclear weapons states, and the negative assurances are a pledge not to use nuclear weapons against nonnuclear weapons states. The NPT provisions for sharing the benefits of nuclear energy, while putting any activities capable of producing fuel for nuclear weapons under international inspection, constitute a critical step in the effort to increase cooperation and trust among nations.<sup>7</sup>

A commitment by the nuclear powers to cease all nuclear test explosions became an essential part of the NPT bargain in 1995, when worldwide support was obtained for the indefinite extension of that treaty at its fifth and final scheduled five-year review. Such a commitment to negotiate a comprehensive test ban treaty (CTBT) is written in the preambles to both the Limited Test Ban Treaty of 1963 and to the NPT of 1970.<sup>7</sup>

The issue of nuclear testing was one of longtime concern to Sakharov. In his lifetime, he spoke passionately and repeatedly against atmospheric nuclear testing because of the potential impact of its radioactive fallout on the health of people—particularly children—by means of accumulation through the food chain. The futility of his

THERE WAS A STEADY SPREAD OF NUCLEAR WEAPONS capability, at the rate of one new nuclear weapons state every five years, throughout the cold war. During the past decade, South Africa and the three newly independent states Belarus, Kazakhstan, and Ukraine have abandoned their nuclear weapons capabilities, but concern remains about the future course of Iran, Iraq, and North Korea. The Non-Proliferation and Comprehensive Test Ban Treaties provide the diplomatic framework for current efforts to cap further proliferation.

strong opposition to such atmospheric testing in the Soviet Union, following the USSR's abrogation of the moratorium in 1961, was a major factor in his disaffection with and public opposition to the Soviet government. However, Sakharov's support for a comprehensive test ban was muted in a January 1987 interview in the *Literaturnaya Gazeta*,<sup>8</sup> where he said, "The problem of banning underground nuclear testing seems to be secondary compared to other problems of nuclear disarmament." We cannot know for sure whether or how strongly he would be supporting a CTBT today. However, in view of Sakharov's stated concerns about proliferation and the fact that a ban on testing has now become central to achieving widely shared nonproliferation goals, I think it likely that he would favor CTBT ratification today.

I regret the recent failure by the US to ratify the CTBT, and comments by Sakharov in the last interview before his death<sup>9</sup> strongly suggest he would too:

I think that our country may run political risks for the sake of a very significant goal. It may declare a permanent halt of nuclear tests, which would only be resumed if there is a drastic change in the world's political situation. . . . We can be firmly convinced that our action will make it politically necessary for the Western countries to take reciprocal steps. And the consequences will be of tremendous character. . . . We can [make] all the systems function excepting . . . the last step of the nuclear blast, if we replace the nuclear fuel by any passive substance. . . . The nuclear explosion will occur inevitably if we replace the passive substance by plutonium and [highly enriched uranium]. This control is absolutely reliable. And we can accomplish it under conditions maximally approaching the combat ones. And we can be absolutely sure that in case of need, everything will operate trouble-free.

I fully share that technical judgment, and draw the further conclusion that the United States needs no additional explosive testing to maintain confidence in our deterrent. The necessary data—which is the coin of the realm—is being obtained from the comprehensive stockpile stewardship program now being pursued.<sup>10</sup>

In order for the CTBT to be ratified by the nuclear weapons states (as France and the United Kingdom already have done), these states will have to satisfy themselves that they can maintain their deterrent under such a ban. They will also need to be convinced that the treaty is effectively verifiable; that is, no significant new military threats to their security can be developed clandestinely or under the guise of stockpile stewardship. To achieve this level of confidence, treaty negotiators will inevitably have to extend the boundaries of cooperation and openness (or transparency) in their respective stewardship activities.<sup>11</sup> The increased need for openness should present no genuine barriers to progress, given the advanced level of coop-

eration already developed during the past decade between the US and Russian nuclear weapons communities in their joint efforts for safer material protection and better control and accountability in Russia. It would also be consistent with Sakharov's fourth principle, increased trust.

### A new approach is necessary

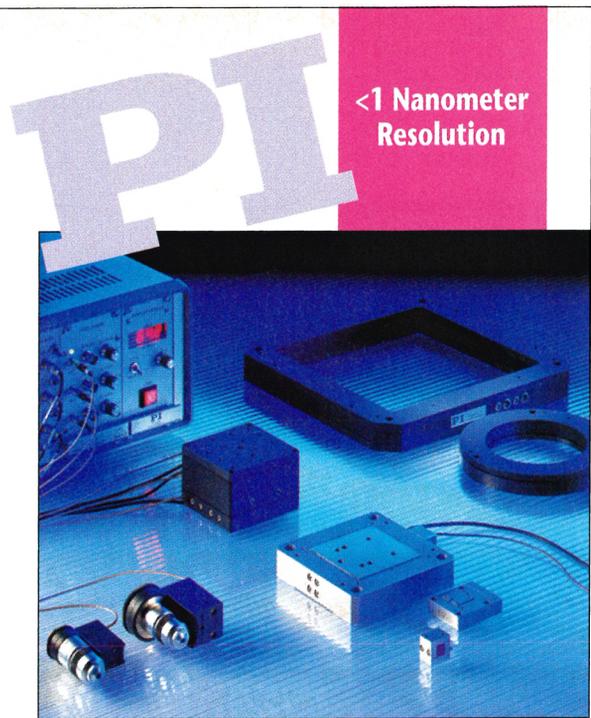
At the dawn of the nuclear age 55 years ago Einstein warned: "The unleashed power of the atom has changed everything save our modes of thinking; we thus drift toward an unparalleled catastrophe." I will close with Sakharov's updated version of that warning as expressed<sup>12</sup> on his first visit to the US, in December 1988. In referring to his work on the hydrogen bomb in 1948, he noted:

I and the people who worked with me at the time were completely convinced that this work was essential, that it was vitally important. At that time our country had just come out of a very devastating war in which I personally had not had a chance to take direct part, but the work in which I became involved was also a kind of war. In the United States, independently, the same kind of work was being carried out. The American scientists in their work were guided by the same feelings of this work being vital for the interests of the country. But, while both sides felt that this kind of work was vital to maintain balance, I think that what we were doing at that time was a great tragedy. It was a tragedy that reflected the tragic state of the world that made it necessary, in order to maintain peace, to do such terrible things. We will never know whether it was really true that our work contributed at some period of time toward maintaining peace in the world, but at least at the time we were doing it, we were convinced this was the case. The world has now entered a new era, and I am convinced that a new approach has now become necessary.

That is Andrei Sakharov's challenge to us as we enter the 21st century.

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