

## Einstein's Heirs: Szilard and Sakharov

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In his book, *Science and Human Values*, Jacob Bronowski describes his stunning experience in visiting Nagasaki in November, 1945, to assess the damage wrought by the atomic bomb. He urged an action:

When I returned from the physical shock of Nagasaki,...I tried to persuade my colleagues in governments and in the United Nations that Nagasaki should be preserved exactly as it was then. I wanted all future conferences on disarmament, and on other issues which weigh the fates of nations, to be held in that ashy, clinical sea of rubble. I still think as I did then, that only in this forbidding context could statesmen make realistic judgments of the problems which they handle on our behalf. Alas, my official colleagues thought nothing of my scheme; on the contrary, they pointed out to me that delegates would be uncomfortable in Nagasaki.

Sixty years later, mankind remains addicted to war. Modern prophets, many scientists among them, have cried out against the vast resources squandered on weapons and the appalling massacres committed in the name of patriotic, religious, or tribal loyalties. But like the ancients, prophets for peace today are still typically ignored or reviled as impractical visionaries.

Yet scientists have a special responsibility to join in efforts to overcome complacency and despair, "to light a candle rather than curse the darkness." We are privileged to take part in probing the wonders of nature, and thereby likely to be keenly aware of inspiring prospects as well as ominous dangers. In this essay, I want to pay homage to Leo Szilard and to Andrei Sakharov, scientists with humanistic passions for peace akin to that of Albert Einstein. Both had prominent roles in the development of nuclear weapons. Both tried mightily but in vain to persuade politicians and the public to avert a nuclear arms race. Both left political testaments of enduring value. These support what I deem to be major lessons that should be drawn from history since Nagasaki.

## Szilard: The Voice of the Dolphins

An émigré to the United States from Hungary, by way of Germany and England, Leo Szilard (1898–1964) was among the first to conceive of a nuclear chain reaction and to recognize what it would mean for the world. As a student in Berlin, where he received his Ph.D. in 1922, Szilard had adopted Einstein as a mentor. Later they collaborated on several inventions, and even patented a novel refrigerator. At the University of Chicago, Szilard developed with Enrico Fermi the first self-sustaining nuclear reactor. Soon after, Szilard proposed and helped draft the historic letter sent in 1939 by Einstein to President Roosevelt, which urged undertaking the atomic bomb project. In 1945, Szilard led the small group of physicists who opposed dropping atomic bombs on Japanese cities. He helped launch the Pugwash conferences in 1957; by bringing together Western and Soviet scientists, these had a significant role in promoting treaties to restrain nuclear weapons. Szilard also founded, in 1962, a political action committee, then a novel idea. This is the Council for a Livable World, which has helped elect more than eighty US Senators committed to work against the arms race.

In his efforts to foster sensible initiatives, Szilard wrote a series of fanciful stories. Most striking is one in which he recast the ancient tale of the Delphic Oracle into a modern allegory, titled *The Voice of the Dolphins*. In this fable, published in 1961, Szilard speaks from the perspective of a historian 25 years later. He describes how in 1963 a joint Russian–American Biological Research Institute came to be set up, “having no relevance to the national defense or to any politically controversial issues.” It was located in Vienna and staffed by some of the most able young molecular biologists from both countries. Molecular biology was then a most exciting new research frontier. Thus it was startling when the first scientific papers to come from the Vienna Institute turned out not to deal with molecular biology but with the intellectual capacity of dolphins.

Soon it was established that dolphins were indeed far smarter than humans. Within a few years, the dolphins had mastered known science and shown great creativity in devising key experiments that led to dramatic advances in molecular biology. Five successive Nobel Prizes for medicine were awarded to the Institute for those advances, greatly enhancing the prestige of the dolphins. The Institute also pro-

duced a bioengineered form of a common algae, which it patented and marketed under the name Amruss. This was marvelous stuff, a source of cheap food with pleasant taste and excellent nutritive qualities. Moreover, Amruss also proved to markedly depress human fertility.

Amruss royalties made the Institute rich. It expanded by recruiting social and political scientists to work with the dolphins. It also purchased television stations in cities all over the world. These stations developed a major program for discussion of political problems, called "The Voice of the Dolphins." The program did not advocate particular solutions but was devoted to clarifying the real issues and indicating options and novel approaches suggested by the dolphins. Aided by their prestige and by judicious use of Amruss investments, these approaches proved successful. By 1988 a general disarmament is achieved. However, the Institute is disbanded after a virus epidemic kills all the dolphins. The staff departs to new research institutes, set up in the Crimea and in California, but does not equip them with dolphins. In his final paragraph, Szilard concludes:

There were, of course, those who questioned whether the Vienna Institute had in fact been able to communicate with dolphins and whether the dolphins were in any way responsible for the conspicuous achievements of the Institute...It is difficult to see, however, how the Institute could have accomplished as much if it hadn't been able to draw on considerably more than the knowledge and wisdom of the Russian and American scientists who composed its staff.

This ironic twist is the hopeful moral. Szilard's message is that humankind can marshal its own wisdom to overcome tragic folly. But we must develop a mutual trust in our capacity and conviction that it can and must be done. Szilard would surely have been astounded by the abrupt political transformation of Eastern Europe in 1989. It occurred about when he imagined, although in a way unanticipated by him or any scholar or political leader. Yet it exemplifies an essential aspect of Szilard's fable, with added irony. TV proved a key factor, by showing the Western world to people behind the Iron Curtain. Without benefit of any formal program, TV generated a collective awareness that served as the Voice of the Dolphins.

## Sakharov: Courageous Voice for Reform

Andrei Sakharov (1921–1989) was born into a family of Russian intellectuals. His father was a physics teacher and author of popular science books and teaching texts. During World War II, Sakharov worked in a munitions factory. At its end, he began graduate studies at the Physics Institute of the Academy of Sciences in Moscow. He received his Ph.D. in 1947 for fundamental theoretical work in nuclear physics. Recruited into the Soviet hydrogen bomb program, and imbued with what he termed “a war psychology,” he worked assiduously on the project, came up with key ideas, and became a chief designer of the Soviet H-bomb. He soon came to realize the immensity of the threat posed by such weapons and in 1958 urged that testing of nuclear bombs be halted – to no avail. As the Cold War and arms race accelerated, Sakharov “felt a growing compulsion to speak out” because I shared the hopes of Einstein, Bohr, Russell, Szilard, and other Western intellectuals that notions [of open society, convergence, and world government], which had gained currency after World War II, might ease the tragic crisis of our age.

In June, 1968 Sakharov published a bold manifesto, *Progress, Coexistence, and Intellectual Freedom*. He urged disarmament and an end to the Cold War and proposed steps to remaking the Soviet Union. Among these were instituting democracy, including freedom of expression and abolition of censorship, scientific exchanges, reform of economic and social systems, curbs on the power of security forces, limiting the defense against external threats, and full disclosure of crimes of the Stalin era. He also argued for an evolutionary coexistence of socialism and capitalism. His manifesto coincided with the “Prague Spring,” and Sakharov endorsed its theme of “Socialism with a human face.” In July, the New York Times brought Sakharov to world attention by devoting three pages to printing his *Progress*. Western reaction was strongly positive and widespread; within a few months, the English edition of *Progress* had sold 18 million copies. The Soviet response was expressed in swift denunciation of Sakharov and the invasion of Czechoslovakia in August to suppress the “Prague Spring.”

Sakharov was undaunted. He continued to campaign against nuclear testing and ideological distortions of science as well as to urge drastic economic and political reforms and to protest the persecution

of other dissidents. For his *Progress*, Sakharov had chosen an epigraph from Goethe's *Faust*: "He alone is worthy of life and freedom who each day does battle for them anew." Years later, in his *Memoirs*, he commented on this choice: "The heroic romanticism of these lines echoes my own sense of life as both wonderful and tragic."

Even after Sakharov received the Nobel Peace Prize in 1975, Soviet officials remained implacable and did all they dared to slander and persecute Sakharov. When he opposed the Soviet military invasion of Afghanistan, he was banished in January 1980 to Gorky. For six years there, he was vigorously harassed by the KGB. Then, in December 1986, came the dramatic phone call from Mikhail Gorbachev, inviting Sakharov and his wife, Elena Bonner, to return to Moscow. There he continued voicing his appeals. After the abrupt political upheavals that ended the Soviet Union and reshaped Eastern Europe, a few months before his death, he was elected to the new Soviet Parliament. Many of the reforms he had long urged became official objectives of *perestroika*.

At a memorial commemoration of Sakharov held in Cambridge, I was much impressed with an aspect emphasized by Elena Bonner. She pointed out that, prior to his election to the new Soviet Parliament, ordinary citizens had a viciously distorted notion of Sakharov and his ideas. For 30 years, they had known only the caricature created by the official press. But the sessions of the Soviet Parliament were shown in full on TV. To the amazement of Elena Bonner, within two weeks the public view of Sakharov had changed to one of admiration and trust. This again exemplified the power of TV to serve as the Voice of the Dolphins.

### **Beyond Nagasaki**

Only about a quarter century after Nagasaki, in the Vietnam war, the world's richest and militarily most powerful nation was defeated, after a long, bloody struggle, by a country with a population ten-fold smaller and a per capita income at least seventy-fold lower. In a sequel a decade later in Afghanistan, the world's other military superpower was likewise defeated. In both cases, lack of understanding of the indigenous culture proved to be a severe handicap for the invaders. As in earlier history, these defeats of proud and powerful

nations had profound impact, still unfolding, on their internal politics. In contrast, the astoundingly rapid collapse of the Iron Curtain and the Berlin wall and the subsequent political restructuring of Eastern Europe were nearly bloodless. That huge transformation was not imposed from without, but resulted from internal political pressures that built impetus for spontaneous reform.

Sixty years after the bombing of Nagasaki, the likelihood that a nuclear weapon will again be exploded on a city seems higher than ever. This ghastly prospect is the consequence of failure to curb proliferation and terrorism, now spurred by the Iraq war. The situation is very different from that faced twenty-five years ago; then, in the name of Cold War deterrence, more than 50,000 nuclear bombs were deployed, enough to destroy every sizable city in the United States and the Soviet Union several times over. Yet much that is still relevant can be found in a collection of essays, *The Final Epidemic*, published in 1981 as a joint project of the Council for a Livable World Education Fund and Physicians for Social Responsibility. Most valuable today are current issues of the *Bulletin of the Atomic Scientists*. Launched soon after Nagasaki, with Albert Einstein and Leo Szilard among the original sponsors, it is the premier forum for global security analysis.

As the world will need more and more energy generated from nuclear reactors, opportunities for terrorists to acquire fissionable material will grow. An excellent recent book, *Megawatts and Megatons*, treats both power reactors and weapons, including extensive discussion of the crucial need to enhance security measures and arms control. In this era, a much-heightened level of international cooperation has become essential. At present, this is impeded by refusal of the United States government to ratify either the Comprehensive Test Ban Treaty or the Nonproliferation Treaty. Ratification would help create an attitude of shared concern. That attitude is important for obtaining reliable intelligence, the most vital safeguard against terrorism.

Szilard's visionary fable suggests a pragmatic way to transcend such myopia of individual governments. A worldwide TV/radio/web network could be established to function like his Voice of the Dolphins. It would operate under the auspices of the United Nations, or perhaps a coalition of nongovernmental organizations, broadcasting in many languages. It could be funded by a tiny tax on defense budg-

ets. It would make use of existing broadcasting capabilities where they exist and create them elsewhere. It would also develop, subsidize, and distribute where necessary receiving equipment to people lacking them. In addition to regular programs dealing with issues of global concern, including medical and environmental as well as security issues, the network could broadcast news, cultural and educational programs, extending from elementary to university level. Much suitable programming could be adapted from existing facilities but would have to meet criteria of objectivity and broad perspective, like those specified by Szilard. The role of his dolphins would typically be performed by expert panels convened by science academies, heirs of Einstein.

An apt benediction was given by Andrei Sakharov in accepting his Nobel Peace Prize:

(...) We should not minimize our sacred endeavors in this world, where, like faint glimmers in the dark, we have emerged for a moment from nothingness (...). We must make good the demands of reason and create a life worthy of ourselves and of the goals we only dimly perceive.

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Dudley Herschbach, born in 1932, is a Mathematician and Chemist. His research is devoted to methods of orienting molecules for studies of collision stereodynamics, means of slowing and trapping molecules in order to examine chemistry at long deBroglie wavelengths, reactions in

catalytic supersonic expansions, and a dimensional scaling approach to strongly correlated many-particle interactions, in electronic structure and Bose-Einstein condensates. For his work he received the Nobel Prize for Chemistry in 1986.

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