



## PROLOGUE

# Atomic-Powered Communism

*Long live communism—the radiant future of all mankind.*

—A slogan of Soviet socialism

**L**ike many Americans, I am a child of the nuclear age. My first memories are of fallout shelters, mushroom clouds, and rockets capable of carrying nuclear warheads as well as astronauts. I grew up in a nuclear family. My father was a nuclear physicist who worked on reactor design. I got my first scar in Oak Ridge, Tennessee, home of the United States's effort to separate the fissile from nonfissile isotopes of uranium, when, as a three-year-old, I fell on a cinder block and cut my right knee. So I have been honored to visit nuclear facilities in Chernobyl, Obninsk, Severodvinsk, Kharkiv, Kiev, Moscow, Novosibirsk, and St. Petersburg to learn firsthand about the Soviet nuclear age.

My interest in Soviet atoms for peace programs grew out of one of the greatest misfortunes of the nuclear era: Chernobyl. Chernobyl touched me directly. As soon as we learned about the terrible accident, Western news media interviewed the experts about what happened. Because of my work in the history of Soviet physics, they broadcast interviews of me on radio and published fragments of my thoughts in newspapers. In various lectures and in the article I wrote over the next few weeks ("The Historical Roots of the Chernobyl Disaster"), I set forth my basic ideas about the unique way in which the Soviet system shaped steel, concrete, water, nuclear fuel, and the careers of scientists and engineers. Over the next few years, while engaged in other projects, I returned to nuclear themes, visiting the glorious sites of the Soviet atoms for peace programs; and I resolved to tell a story about the transformation of symbols of progress, truth, and hope into those of despair and

danger. This is a cautionary story of engineering hubris, and how the desire to change the world for the better sent a nation stumbling headlong into calamity.

One of the symbols of hope was Chernobyl. When completed, with ten reactors instead of the four that were built, the station would have powered Ukraine. I have since visited Chernobyl, warming myself on top of one of the reactor units that functions to this day and driving by the sarcophagus that entombs unit 4. That unit exploded because of a foolhardy experiment, ejecting a dangerous cloud of radioactivity into the atmosphere and spewing chunks of glowing uranium onto the ground nearby. I have lived in Kiev and watched friends grapple with the deadly legacy of Soviet nuclear engineering.

Another symbol of hope was Obninsk, site of the first reactor to produce electricity for a national grid in 1954, beating any United States effort to commercialize nuclear power by four years. The Obninsk reactor is located about two hours south of Moscow. A forerunner of the Chernobyl model and still in operation to this day, the Obninsk power reactor was a propaganda coup for the Soviet Union. It demonstrated the peaceful intentions of the nation on the heels of President Dwight Eisenhower's address to the United Nations calling for shared nuclear know-how in medicine, agriculture, transportation, and power generation for the benefit of all humankind. When I visited Obninsk in March 1998, a small leak of radioactive water, hastily mopped up in my presence, immediately canceled any hopes I might have had of warming myself upon that reactor.

This book is about how culture and politics shape the development of such large-scale technologies as nuclear reactors. In this case, these "peaceful" nuclear technologies will have an impact on our lives for decades to come. The Soviet Union has collapsed, but its nuclear establishment lives on in dozens of reactor and research sites, closed military cities, scores of institutes, thousands of scientists and engineers, and tens of thousands of other employees, most of them within Russian borders. Many of the scientists are world-class specialists in radiation chemistry, nuclear physics, and biophysics. Most are narrowly trained, staff members geared to producing the various technologies of the nuclear era: pumps, steam separators, batteries, centrifuges, screens, filters, fuel rods, reactors, isotope separation facilities, accelerators, and radioisotopes.

The founders of the nuclear industry intended it to be no different from any other industry where mass production techniques were engaged to produce standard equipment. They believed they could link together a series of simple technologies through complex processes they had tamed in the laboratory. Mid-level workers, who had mastered supposedly infallible technologies with only a basic understanding of nuclear physics, supervised the technologies. The workers acquired understanding through crash courses provided at technical institutes connected with the industry. This view of technology as infallible and manipulable by the simple worker was standard fare in the USSR for any branch of the economy: Legions of workers armed with rudimentary technology would eventually construct the "material-technological basis of communism." Yet was this the blind leading the blind?

The Soviet nuclear effort, like that in the United States, centered on military technologies. The goal was the mass production of light-weight, miniaturized warheads, several of which could be affixed to missiles or rockets of multikiloton and multimegaton yield. From the early days of the effort, physicists also considered nuclear technologies with applications in the civilian sector, for they wished their legacy to be connected with peace. The slogan was, "Let the atom be a worker, not a soldier." The physicists desired energy "too cheap to meter" through power-generating reactors. They sought new ways to produce nuclear fuel—plutonium—cheaply through liquid metal fast breeder reactors. They attempted to design a factory in which mass production of reactor vessels and components would keep capital costs down. They built small nuclear engines intended to power locomotives, rockets, airplanes, and portable power plants. The power plants would have extensive application in the far north and Siberia, making the USSR's extensive natural resources accessible even in the polar winter. They founded a design institute and factory to mass produce magnets, accelerators, and other tools for use throughout Russia, Ukraine, Georgia, Armenia, Kazakhstan, Uzbekistan, Latvia, Lithuania, and so on. They sterilized various food products with low-level gamma radiation to prevent spoilage and increase shelf life. They pioneered the so-called tokamak reactor in pursuit of fusion power. And they used "peaceful nuclear explosions" for various mining, excavation, and construction purposes. Nuclear technology was at the center of visions of a radiant communist future born in the Khrushchev era, but this technology's legacy of failure and radioactive waste suggests radiance of a different and dangerous sort.

Whether nuclear reactors or food irradiation programs, small powerful nuclear engines or factories spitting out huge concrete forms, liquid sodium or isotope separation equipment, each of these technologies developed significant momentum. As if divorced from human control, the programs expanded, feeding on resources of capital, manpower, institutes, and ore, from the time of their design in the Khrushchev era until the collapse of the Soviet Union after the death of Brezhnev. The reasons for this momentum are not hard to find. The politics and culture of the Khrushchev era contributed to the rapid growth of the nuclear enterprise. Here were men—physicists, Party members, engineers, almost exclusively men—trained under Stalin, committed to socialism, but hoping to avoid any repetition of the inhuman horrors perpetuated in the name of socialism under Stalin.

One way to avoid these horrors was to reform foreign policy to escape one of the dictates of Stalinist Marxism, the inevitability of war with the capitalist countries. What better way to achieve this than to stress peaceful applications of nuclear knowledge? Peaceful nuclear programs grew out of military ones, which already were extensive because of the cold war. The peaceful programs had foreign policy importance, because state leaders and scientists in the USSR, like those in France, the United Kingdom, and the United States, sought to demonstrate the peaceful intentions of the nation. Competition between the two superpowers was especially keen, as each nation strove to show that its scientists were first and best, and its social and political system the most advanced.

There were also domestic policy reasons for the USSR's embrace of "atoms for peace." Most important were the rise of Nikita Khrushchev to leadership and his identification with modern technology with Sputnik and nuclear power. This identification was evidence of the legitimacy of his regime to the Soviet citizen who had suffered through the Stalin era and had paid for Stalin's enlightened leadership with forced collectivization and industrialization, the purges, the labor camps, World War II, and thirty million deaths. The Khrushchev era involved significant political, economic, and cultural changes. Scientists were among the many members of Soviet society who benefited from greater openness during the so-called Thaw. This was still an authoritarian regime, to be sure, but scientists were expected to participate in the construction of communism and to share their great scientific achievements to improve the quality of life of the average citizen. Scientists, and especially physicists, gained great authority in this environment. Many of them, and most of the program and institute directors, were Party members. But whether or not physicists belonged to the Party, virtually all of them shared the view of Party officials that science had an integral role in the radiant future. So scientists were part of a new postwar technocratic elite. Absent a public who questioned the safety or efficacy of their inventions—mobile gamma irradiators for strawberries, reactors that moved around on tank treads—the scientists grew rather arrogant about their ability to use nuclear technology to change the environment.

The notion of autonomous, self-augmenting technology that so well describes the Soviet atoms for peace programs gained prominence in the writings of the French philosopher Jacques Ellul in *The Technological Society* (1964). Many writers have criticized the Ellulian notion of technological determinism for removing agency from human hands. There are ample reasons to present the evolution of Soviet technology from a determinist point of view. There was significant momentum: programs grew larger and larger; institutes expanded to thousands of employees and took on responsibility for building apartments and stores and schools for their workers; new technologies developed and were produced in new institutes. The centralized, bureaucratized, top-down Soviet system of management contributed to the momentum of the institutes and the technologies they designed and manufactured. Clearly physicists were the source of the new technologies. Some of them acquired great power as directors of single institutes that dominated scientific policy making through the centralized Soviet system. But they remained individuals with personalities: Igor Kurchatov, head of the atomic bomb project, who late in life sought atoms for peace because of his horror over multimegaton hydrogen bombs; Anatolii Aleksandrov, his successor at the Institute of Atomic Energy, who gained fame for submarine nuclear propulsion and infamy for the Chernobyl reactor design; Kirill Sinelnikov, Kurchatov's brother-in-law, who presided over the Ukrainian nuclear physics program; Aleksandr Leipunskii, who directed the liquid metal fast breeder reactor program. These nuclear physicists, who were also engineers and institute directors with great authority to command resources in support of still other applications, are central to this story of big technology run amok.

Atoms for peace was crucial to postwar Soviet society on one more count. Peaceful nuclear technologies had great cultural value as symbols of a modern, pro-

gressive, industrial nation. From the inception of the USSR, such leaders as Lenin, Trotsky, Bukharin, and Stalin had stressed the importance of technology in building communism and spoke about Soviet leadership in every area. But the citizen knew that claims of leadership were lies or exaggerations. With nuclear power, Lenin's promise that "Communism equals Soviet power plus electrification of the country" seemed to be more than empty words. The 5,000-kilowatt Obninsk reactor was one such major symbol of the communist future, for here was an indigenous technology that produced electricity for the citizen. Unfortunately, rather than Obninsk, the Chernobyl catastrophe has become the cultural icon of the bankruptcy of Soviet nuclear energetics and of Soviet political leadership generally. And rather than building communism, Brezhnev and his cronies had built an empire of large-scale technologies dedicated to increasing the power of the state but providing little to the average citizen in the way of comfort or hope for the future. The tongue-in-cheek slogan symbolizing this disaster, "Chernobyl—the peaceful atom in every home," became the essence of the Red Atom.

Some persons now may scoff at notions of nuclear-powered airplanes, irradiation of food to prolong shelf life of perishable goods, and portable nuclear reactors capable of producing electricity cheaply and safely on demand in the harshest Arctic winters. Others maintain that the goal of building reactor parks of a dozen 1,000-megawatt reactors was always impossible from the points of view of cost, technological know-how, and climate. But this is precisely what Soviet nuclear engineers, like their Western counterparts, strove to do. They nearly succeeded, given the willpower and vision of their leaders, and the nearly unlimited resources bestowed on them by Party officials, who believed with them that nuclear power was a panacea for the economic, social, and geographical obstacles they faced in achieving communism. Whether for poorly performing industry, inefficient agriculture, an undermotivated labor force, inadequate housing and medicine, or inaccessible resources, in the minds of most Soviet citizens the power of the atom was the key to building a modern society free from shortages and wants.

If the standard of living rose, if automation and mechanization freed workers from drudgery, and if electricity illuminated, heated, and cleaned the factory, then communism must be nearly achieved. And if in space with Sputnik and in atomic energy with the first peaceful nuclear power-generating reactors, the USSR had bested the United States to the punch, what better confirmation that the socialist system truly was better than the capitalist system? Atomic science gave great power to those constructivist visions of future communist society, perhaps greater than any other region of science and technology, for its applications in medicine promised longer life; in light industry, better food and perishable goods; in mining and metallurgy, more exact ways to locate and process valuable reserves; and above all else, in energy generation, the ability to provide electricity, anywhere, anytime, too cheap to meter. This constellation of personalities, economic and political desiderata, cultural factors, and technologies was atomic-powered communism.