CONTROL OF NATURE

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Series Editors' Preface

THIS SERIES OF historical studies aims to enrich understanding of the role that science and technology have played in the history of Western civilization and culture, and through that in the emerging modern world civilization. Each author has written with students and general readers, not specialists, in mind. And the volumes have been written by scholars distinguished in the particular field. In this book Paul Josephson—well-known as one of the very few historians who has attained access to archives and interviewed scientists in the Russian physics community—draws on his expertise to address key questions about the relations among science, technology and political systems under the most extreme conditions.

The aim of this book on totalitarian science and technology is not just to lay out some basic historical information, which could only be a sample of the many complex developments that scholars are currently exploring. Still more this volume intends to show the chief questions and debates that inform current historical scholarship.

The current debates as presented here emphasize the "Control of Nature." While not excluding a discussion of how knowledge itself develops, how it is constructed through the interplay of research into nature with the values and beliefs of the researcher, this volume—like all the others in the series—looks primarily at how science and technology interact with economic, social, linguistic and intellectual life, in ways that transform the relationship between human beings and nature. In every volume we are asking the student to think about how the modern world came to be invented, a world where the call for progress and the need to respect humanity and nature produce a tension, on the one hand liberating, on the other threatening to overwhelm human resources and ingenuity. The scientists whom you will meet here could not in every case have foreseen the kind of power that modern science and technology now offer. But they were also dreamers and doers—as well as shrewd promoters—who changed forever the way people view the natural world.

MARGARET C. JACOB
ROSEMARY STEVENS
SPENCER WEART

Acknowledgments

I would like to acknowledge the help of several individuals in seeing this book come to fruition. Peg Jacob and Spencer Weart asked me several years ago to consider writing a textbook for this series. They encouraged me at every step of the way once I set forth the basic idea for this text. I welcome Spencer's thorough editorial work. Gene Rinchik helped with chapter 2. Paul Forman offered important comments on chapter 3. Tom Hughes provided detailed comments on chapter 4. Tom Gleason shared his manuscript on totalitarianism with me and encouraged clarification of my ideas on totalitarianism. Blair Ruble shared with me his work on urban planning in Moscow. Katie Lippa read chapter 2 carefully. Miriam Conant made suggestions on an early version of chapter 1. My son, Isaac, rarely insisted that I cross-country ski with him before 6:30 A.M., so that I could have some time to write in the mornings. I dedicate this book to my good friend and colleague Viktor Frenkel, with whom I have had the good fortune to share my work on the fate of scientists in the former Soviet Union for nearly two decades.

The reader need not be a practicing scientist or have extensive laboratory experience to make good use of this book. Some background will be assumed; in places I will provide discussion of various scientific disciplines necessary to full comprehension of the arguments. But inasmuch as I argue that science is socially and politically constructed, the task at hand for the reader is to understand what impact state policies in totalitarian regimes had on science that distinguishes it from the same discipline in another culture and polity.

Contents

Totalitarian Science

ADOLF HITLER AND Joseph Stalin enlisted scientists and engineers in their efforts to build strong states. They desired industrial power and military might. To these ends they underwrote expensive research and development (R and D) in scientific institutes. Hitler loved "superweapons." Stalin closely followed the Soviet atomic bomb project. Some of the scientists who toiled for Stalin were Nikolai Vavilov, an internationally renowned biologist who died in a labor camp while his brother became president of the Academy of Sciences, and Andrei Sakharov, father of the Soviet hydrogen bomb and later a political dissident. Hitler's stable of specialists included Werner Heisenberg, one of the founders of quantum mechanics.

When one thinks about science and technology in totalitarian regimes like Nazi Germany, horrible images of doctors undertaking concentration camp experiments on unwilling prisoners come to mind. Another image of the kind of science possible under a dictatorship is that of Lysenkoism in the Soviet Union, named after Trofim Lysenko, who controlled biological research from 1935 until 1965 and used his power to require the rejection of modern genetics. We recall how Andrei Sakharov and the leading Chinese theoretical physicist, Fang Lizhi, spent years in exile or under house arrest for openly criticizing their governments' human rights records (Fang 1990).

But are these cases representative of what constitutes science in totalitarian regimes, or are they anomalies? Several leading historians and sociologists of science maintain that science operates according to democratic principles. They claim that these principles prevent any members of the scientific community from establishing their views about the phenomena at hand as sacrosanct and ensure that scientific discovery is an adversarial and cumulative process that brings us ever closer to the "truth." In an essay published in 1942 directed in part against the anti-intellectualism of totalitarian regimes, Robert Merton

argued that the ethos of science, its universalism, communal character, disinterestedness, and organized skepticism, militated against particular dogmas of church, economy, and state. Twenty years later Michael Polanyi acknowledged that orthodoxy existed in science but called it a "dynamic orthodoxy." He argued that "the authority in scientific opinion remains essentially mutual; it is established *between* scientists, not above them," and that a "republic of science" existed to mediate disputes. Indeed, Polanyi, Karl Popper, and other philosophers of science wrote about this dynamic orthodoxy in part as an attack on pseudo-science, Lysenkoism, and so on (Merton 1973; Polanyi 1962; Popper 1945).

This view of science is hard to reconcile with the fact that in a number of totalitarian systems the science enterprise is dynamic. In the most prominent case, the Soviet Union, not only was society as a whole subjected to arbitrary one-party rule, but scientific institutions came to be dominated by scientific administrators whose administration might be characterized as "stagnant orthodoxy." Yet the USSR orbited the first artificial satellite (Sputnik), developed the Tokamak fusion reactor, and in a number of other fields supported scientists who were recognized as world leaders. In the last days of the Soviet regime, in comments before scientists who had gathered to consider the admission of new members and the transformation of the Academy of Sciences into a less elite institution, the academy's last president, Gurii Marchuk, attacked the notion that science is anything like a democracy, since "truth" is not decided by majority vote (Marchuk 1991).

This book aims at a balanced view of science in totalitarian regimes, going beyond mere attacks on their "pseudo-science." All governments have an impact on science and science policy. Since the rise of Western science in the years 1500 to 1800, the state has played an increasingly important role in the conduct of science (Dobbs and Jacob 1995). In the seventeenth century, rising nation-states underwrote honorific and research-oriented scientific societies and universities in England, France, Denmark, Germany, and Russia. By the late eighteenth century, they funded armaments, mining, and metallurgy endeavors. By 1900, governments recognized the importance of science for health, medicine, agriculture, and national defense. They set up land-grant colleges, geological surveys, meteorological services, and national standards facilities. In World War II the relationship between scientists and the state changed forever. Vastly increased government subsidies enabled scientists to develop radar and atomic weapons in national laboratories that after the war became a fixture throughout the world (Josephson 1991; Taubes 1986; Macrakris 1994).

In regimes like the United States, which may be characterized as liberal pluralist regimes, the impact of the state on science is none too subtle. When the U.S. federal government spent billions of dollars on the space race in the 1960s through NASA, or on Star Wars (the Strategic Defense Initiative) in the 1980s, it created demand for tens of thousands of scientists to be trained in such areas as aeronautical engineering, solid-state physics, and computer science and technology; many of them lost their jobs when the projects were cut back. It is the government that decides whether to permit fetal tissue research on aborted or stillborn fetuses in search of cures for various debilitating diseases, which some argue is no more moral than research on humans conducted by the Nazis. Others point to the case of J. Robert Oppenheimer, head of the American atomic bomb project, who was stripped of his security clearance for his vacillation about the development of the hydrogen bomb, as morally equivalent to Andrei Sakharov's treatment at the hands of Soviet leaders. And others criticize the effort of the Reagan administration to secure the right to prior censorship over government-funded research for national security reasons as similar to the behavior of Chinese scientific administrators toward Chinese scientists.

Based on a comparison of science under Hitler and Stalin, however, I will argue that totalitarian regimes have a unique impact on the careers and research interests of scientists and engineers. What is a totalitarian regime?[1] First, there is a monopoly on power usually manifest in one-party rule. A leader or tiny clique presides at the top of the party, with unquestioned and arbitrary personal power. Members of the ruling elite share a fiery commitment to transform society. One of the tools they use is a monistic belief system that encourages the individual to identify with state goals. This belief system, which includes mythical notions of right and wrong, justice and retribution, nationalism, fatherland and/or motherland, and love for the leader, is disseminated through centrally controlled media. The system appeals to instinct as opposed to reason, although claiming the latter. The state employs secret police who use terror, coercion, and violence to reach its aims. It alleges the presence of internal and external enemies to mobilize the masses (Gleason 1995). The future is a fundamental category in the name of which a murderous logic prevails: for example, the thousand-year Reich, or classless society and withering away of the state.

To confuse matters somewhat, totalitarian regimes have allowed some flexibility—individual initiative—in the economic sphere, but less in the political sphere. Nazi Germany had a market-capitalist sector and a state-controlled sector. Engineering in Germany of items not of interest

to the state (cameras, say, but not Volkswagens) proceeded largely as in the United States. The People's Republic of China now permits small-scale capitalism to prosper. The USSR had state ownership and control of the economy after brief experimentation with market mechanisms in the mid-1920s to encourage economic recovery from World War I and the Russian Revolution. Soviet leaders then imposed central planning with control over prices and over labor and capital inputs, while permitting initiative among some plant managers and even less private enterprise, notably small family plots of land. However, when individuals tried to organize to oppose state policies or to establish independent political parties, the totalitarian state in all cases acted quickly to destroy any potential for opposition.

These kinds of political controls and ideological constraints notwithstanding, science in totalitarian regimes has generally followed international research paradigms in terms of both focus and the methodologies that scientists employ. Pick up the scientific journals published in Nazi Germany or the Soviet Union, and you will find cutting-edge research in many fields. However, based on an approach in the history and philosophy of science that is called "the social study of science," I will discuss how economic desiderata, political exegencies, and ideological considerations shape the face of totalitarian science, its institutions, and the persons who carry out scientific research.

In chapter 2, which compares the biological sciences in Nazi Germany and the Soviet Union, I argue that a transformationist vision was central to science in these regimes, distinguishing their biological research from that done under other political systems. In the Soviet Union, biology would be used to revolutionize agriculture, to create a "New Soviet Man," even to tame nature within one generation. In Nazi Germany, biology would secure Germany's agricultural self-sufficiency. More important, applied through various race laws, Nazi biology would create a nation of pure Aryan gods whose Reich ruled the world. Granted, Soviet and National Socialist biology held widely different views on, for instance, the role of genetics in determining human qualities. But in both states science served utilitarian ends of transforming social, political, and cultural institutions, as well as nature itself, in short order.

In chapter 3, an analysis of the reception of relativity theory and quantum mechanics (often referred to as "the new physics") in Nazi Germany and the Soviet Union, I argue that the ideologization of science resulted in extrascientific forces coming into play to determine what was "good" science and what was "bad" science. In Nazi Germany and the Soviet Union, the ideologization of science led to the ostra-

cism of physicists who embraced the new physics. In the former, the basis of criticism was racial; in the latter, it was Marxian and class-based. In both cases, individuals who tried to practice science openly and honestly lost their jobs, were arrested, and in some cases were killed for their scientific beliefs.

The ideologization of science succeeds because of an activist state. Science in totalitarian regimes often moves ahead because of the intercession of the state and of extrascientific organizations and individuals that represent it, rather than relying on traditional measures of scientific excellence such as publication in refereed journals, peer review, grant applications, scientific citations, or membership in national and international scientific organizations. In normal practice, scientific disputes are aired openly, although egos may be bruised in the process. Competition between schools of research to determine the validity of a solution to a given scientific problem inspires the confidence of scientists everywhere that they are establishing "facts" independent of political or personal issues. Granted, in pluralist systems such as the United States, scientists go outside of these normal channels to air disputes in the political arena. Controversies over fluoridation of water, what constitutes a wetlands, whether Star Wars antimissile technologies will work, the extent of the greenhouse effect, and so on demonstrate that political, ideological, and economic forces shape scientific debates. But in totalitarian regimes, there are taboo subjects. Researchers who venture into those areas risk job security and personal freedom. Individual scientists, ideologues, and administrators gain the power to define "good" science in a way that proscribes academic freedom.

In chapter 4, I turn to analysis of the nature of technology in totalitarian regimes. Like biology and physics, the development of technology would appear at first glance to reflect objective engineering calculations about the most efficient means to achieve some end. All jets, rockets, automobiles, hydropower stations, and skyscrapers use similar materials and construction techniques and resemble each other physically. Yet there are two features that distinguish large-scale technological systems in totalitarian regimes from those in other systems. The first is that the state is the prime mover in technological development. In order to achieve the goals of economic self-sufficiency and military might, the state harnesses the efforts of engineers and scientists to its programs. It is the main force in shaping what areas merit study. But in exchange for funding, experts are held accountable to produce results, often as specified in national planning documents. Failure to meet targets may trigger personal reprisals.

A highly centralized and bureaucratized system of funding and monitoring ensures accountability. In a continuum from the autonomy of the individual scientists in setting the research agenda to accountability to the government, science in totalitarian regimes is firmly at the accountability end (Nicholson 1977). The state controls the purse strings of both public and private funds. This control extends to foundations that provide grants to individuals or institutes, and even to the wealth of private individuals. In the United States, since the first decades of this century, such organizations as the Carnegie and Rockefeller foundations along with private universities have contributed significant sums to scientists and their institutes (Kohler 1991). In Soviet Russia, such organizations disappeared with the rise of Bolshevism and the nationalization of property. In Germany, the Notgemeinschaft der deutschen Wissenschaft, a federally funded foundation that saved a number of German scientists from financial ruin during the interwar Weimar Republic years, was subjugated to Nazi power as the Reich Research Council (Forman 1974), and all universities took their orders from the Reich Ministry of Education.

Since the state is the prime mover, its projects acquire significant momentum that carries beyond the completion of the initial goal. Bureaucracies everywhere seem to take on a life of their own, becoming institutions in search of a mission. But the centralization of science policy in totalitarian regimes enables one institute or a few to gain unassailable power to define scientific orthodoxy. Owing to this momentum, it is more difficult to derail economically unfeasible and environmentally dangerous projects than in pluralist regimes. In pluralist regimes, "dynamic orthodoxy"—that is, competition among researchers in university, industrial, and national laboratories for priority in discovery—ensures that scientific and public concerns are aired openly. Dynamic orthodoxy gives individual scientists, their institutions, and professional organizations greater autonomy in setting the research agenda, adjudicating the "facts," and considering public health, environmental, safety, and other normative concerns.

The second theme developed in chapter 4 is that large-scale technologies in totalitarian regimes acquire an aesthetic based on gigantomania. Public housing, subway systems, and government buildings have a depersonalizing scale. Their "ideological skins," for example, the neoclassical facing of Nazi government buildings, are thick, overpowering, and intimidating. The gigantic structures reflect the effort of officials and engineers alike publicly to demonstrate the strength, glory, and legitimacy of the regime, and as such they become symbols of the present and the future.

Proletarian Science and Aryan Science

The transformationist vision of the biological sciences, the ideologization of the physical sciences, and the primacy of the state in technology were all expressed in the notions of "proletarian science" in the Soviet Union and "Aryan science" in Nazi Germany. Proletarian science and Aryan science shared an essential belief that national science is the only true science. "True science" implied service to state-determined goals. Aryan science and proletarian science were superior to the science practiced by members of the international scientific community in terms of methodology, philosophical implications, and research emphasis. Both stressed applied research at the expense of basic science. Both justified autarky (self-sufficiency, but in this case international isolation) in science. Scientific contacts between scientists at home and those abroad were sharply restricted—for example, the exchange of scientific articles and participation in conferences abroad—because the Nazi and Soviet governments feared ideological contamination of national science.

Proletarian Science, Marx, and Stalin

To be sure, there were significant differences between proletarian and Aryan science. Proletarian science was a class-based doctrine. According to the Soviet version of Karl Marx's theory of history, historical materialism, society inevitably passes through a series of stages until its ultimate transformation into communism. These stages are slavery, feudalism, capitalism, and socialism. In a revolution or transformation from one stage of development to another, say from capitalism to socialism, the entire immense superstructure of philosophical, legal, and political ideas and institutions that arises upon a given economic basis also undergoes change. What happens to science? If science is part of the economic basis, then many of its salient features carry over to the next stage because of its implicitly cumulative nature. If science is a system of ideas and hence part of the superstructure, then it too changes radically, and socialist science differs greatly from capitalist science. Internationalist notions of science were pushed into the background (Josephson 1981). The superstructural conception gave rise to the notion of "proletarian science" as distinct from "bourgeois science," in which such phenomena as Lysenkoism prospered. Soviet proletarian science emphasized applications for broad social purposes. It ridiculed the theoretical orientation of bourgeois science as divorced from the needs of the masses and "ivory tower reasoning" of little purpose. The absence

of the profit motive also distinguished proletarian science from bourgeois science. Soviet philosophers and ideologues debated whether science was superstructural or part of the economic basis, concluding only in the 1960s, when Leonid Brezhnev had become Soviet leader, that it was part of the basis. While under Brezhnev Soviet science became more international, strict controls over scientific contacts, attendance at conferences, and receipt of literature remained.

In addition to its own organizations and the KGB (secret police), the Communist Party organized a vast governmental bureaucracy to promote proletarian science within Soviet borders. These organizations monitored compliance with the ideological tenets of proletarian science. (The methodological uniqueness of proletarian science and its foundation in the Soviet philosophy of science, dialectical materialism, are discussed in chapter 3.) There were Party cells—groups of Party members meeting weekly and watching all activities—inside each research institute, industrial laboratory, and scientific association. The bureaucracy placed strict controls on access to Western scientific literature and contacts. Overt discrimination against such national minorities as Jews, Armenians, and Central Asians was widespread, especially concerning entry to universities and institutes or travel abroad. The treatment of such dissidents as the physicists Andrei Sakharov and Iuri Orlov indicates the extent to which the power of scientists was limited. (Orlov, long a believer in the human rights movement, became actively involved in opposition to Soviet policies precisely over the KGB's growing abuse of Sakharov in the early 1970s [Orlov 1991].)

Joseph Stalin gained power over the Communist Party and the Soviet Union in the 1930s, ruling until his death in 1953. He pushed breakneck industrialization and forced collectivization of agriculture on the Soviet Union in the 1930s. He set in motion the Great Terror in the late 1930s, as a result of which eight million citizens perished at the hands of the secret police. Stalin used all his sources of power to establish proletarian science. His government required planning of scientific research—what results could be expected and when?—to justify appropriations. Show trials were organized to condemn those who strayed from the newly established norms of scientific behavior. And by the end of the decade, the purges led to unimaginable damage to most scientific fields. The secret police were involved in the arrest of perhaps 10 percent of all physicists, 30 percent of all engineers, and most likely an equal number of biologists, many of whom perished in the Stalinist gulag (labor camps). But Stalin's proletarian science—applied, serving the masses, under central control, and ideologically pure—was firmly in place.

Aryan Science and the Führer (Leader) Principle

Hitler rose to power in 1933 during a parliamentary crisis. He had the assistance of conservative officials and right-wing military men who assumed they could control him to their ends. Quickly they learned that they were mistaken. The National Socialist Party used legal, illegal, and murderous tactics to destroy political opposition. Those who read Hitler's confessional autobiography and political diatribe, *Mein Kampf* (My struggle), knew quite well that he intended *völkisch* notions of racial purity and Aryan science to play a role in the Third Reich.

The natural unit of mankind in the German Reich was the *Volk*, a romanticized vision of the German peasant who, through organic ties to the soil, embodied the great German mission of constructing a worldwide civilization. The state existed to serve the *Volk*, a mission the Nazis believed that the Weimar Republic (1918–33), Germany's interwar experiment with parliamentary democracy, had betrayed (Gay 1968). All morality and truth was judged by its accordance with the interest and preservation of the *Volk*. The state reflected the "general will" of the people, so nothing in its laws could reject "*völkisch* tendencies."

Democratic government that relied on direct representation and universal suffrage could not succeed, since it assumed an equality within the *Volk* that did not exist. To a certain extent, scientists and engineers, like women, the working class, churches, and so on, gained access to power through the Führer. This was the "leader principle" that operated in all Nazi institutions and drew strength from the tradition of monarchic authoritarianism in Germany. In 1934, Hitler declared himself not only chancellor, but "leader." This meant he claimed not only constitutional powers but extragovernmental powers that required his followers to declare their allegiance to him. He expressed the true will of the *Volk*, so that any opposition or criticism was precluded. No interests or groups or ideas existed alongside him. "In place of conflicts and compromise, there was to be only the absolute enemy on whom the sights of the unified nation were fixed" (Bracher 1970, 340–44).

Since authority and power originated with Hitler, the fate of many projects depended upon him. Hitler supported Minister of Armaments Albert Speer's efforts to rebuild the center of Berlin as a monument to National Socialism and the expensive Nazi V-2 rocket program. But when scientists failed to get the führer's ear, their projects might languish, as the case of the Nazi atomic bomb project demonstrates. There was no question that Hitler intended the socially radical science of "racial hygiene" to achieve Aryan purity. He fully endorsed putting

homosexuals, Gypsies, and Jews to death. He believed that the infirm (the sick, dying, and unfit) drained resources from the healthy and strong Aryan. German doctors and biologists willingly helped the führer achieve this end. Hitler believed that Germany must find *Lebensraum* (literally, living space) in the east, lands that would be freed from inferior Jewish, Gypsy, Russian, and Polish inhabitants by the *Wehrmacht* (war machine), with the survivors enslaved to create an agricultural work force to feed the German nation. German science assisted in meeting these goals through anthropological, geographical, and biological studies under the rubric of *Ostforschung* (research on the eastern lands).

What impact did the leader principle, *völkisch* ideas, and *Lebensraum* have on science? Like proletarian science, Aryan science promoted autarky. Aryan science served the nation, not profit or international Jewish capital. Aryan science was applied and technical, its supporters claimed, not overly mathematical, theoretical, and formalistic. Of course, true science originated among Aryan people. Philipp Lenard, Nobel Prize–winning experimentalist in physics and firm believer in Aryan science, wrote a history of "great men of science" to demonstrate that these men were related by blood, in Aryan kinship, as much as spiritually (Lenard 1933). Finally, the leader principle operated in science, so that Nazi Party functionaries often dominated the setting of the research agenda and the hiring and firing of personnel.

The Accommodation of Scientists to Proletarian and Aryan Science

If Soviet and National Socialist scientists were often on the cutting edge of international science, how did they respond to proletarian and Aryan science? In both Nazi Germany and the Soviet Union, scientists were forced to accommodate a new regime. The accommodation of scientific and technical specialists to totalitarian rule creates a tension when specialists promote economic, social, and political policies based on what they believe are the objective and rational methods of their engineering and science. Do experts derive political power naturally by virtue of their special knowledge? Technocracy means rule by technical specialists. Technocratic movements found fertile soil both in pluralist democracies and in totalitarian regimes. They were prominent in the former in the early 1930s as a response to the Depression; experts believed they could plan production and consumption more rationally than governments and could avoid the inefficiencies of market mechanisms. In Nazi Germany and the Soviet Union, party offi-

cials feared perceived technocratic trends even when there had been no attempt by technical specialists to pursue political power.

After the October 1917 revolution installed the Bolsheviks in power in Russia, most scientists avoided political involvement or playing an active role in serving the regime. A large number emigrated, several died from starvation and the difficult conditions brought about by war, revolution, and civil war, and others just wanted to be left alone to do their work, despising the Bolsheviks. But the academic community's precarious financial, physical, and psychological condition forced it into an uneasy alliance with the government.

Technocratic trends grew among members of the All-Russian Association of Engineers in the 1920s. Yet both from above (Stalin and the highest reaches of the Party) and from below (workers who resented the authority of specialists in a workers' state), opposition to the engineers grew pronounced. In response, Stalin's party apparatus promoted *praktiki*, who "mastered" technology in their day-to-day experience, to work alongside technically trained specialists, hoping that the two groups would converge in attitudes and responsibilities. The Soviet government was committed to the embrace of the most modern science and technology. It borrowed technology heavily from the West but strived to see that new social relationships developed around it. Conflict between specialists and workers was both class-based and grew from the tendency of the *praktiki* to damage equipment owing to their ignorance of modern equipment and methods (Bailes 1978). The Party also sought to replace so-called bourgeois specialists with scientists of proper working-class social origin and Marxian worldview. This effort was abandoned when it turned out that working-class "scientists" were poorly prepared to handle modern science; many had difficulty even with simple fractions.

The Communist Party subjugated the Soviet Academy of Sciences, whose prestigious institutes were the center of basic research, to its control in the late 1920s. Academy members long tried to defend their status and autonomy, in part by resisting Communist Party pressure to change the academy's charter or add new members. The sources of independence included a long history, tradition, and a secret ballot for membership that enabled individuals to vote from conscience, not because of political pressure. At this time, the Communist Party insisted upon adding new positions in the social and technological sciences to be filled with Marxist scholars and tip the balance of control of the academy to Communists, and from then on it sought to control the election process by approving slates of candidates beforehand. This tactic did not always succeed: the academy never removed Sakharov as