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Introduction

If we compare the planet with a communal apartment, we occupy the dirtiest room.

—Aleksei Yablokov,
environmental adviser to President Boris Yeltsin

For seventy years, the notion of development and progress in the Soviet Union was symbolized by the factory with its chimneys thrust into the sky, pumping out fulsome clouds of smoke. These clouds, always streaming out of the picture, evoked images of productivity and output. History has now shown that many of the achievements of the Soviet economy were never more than images. The smoke, however, was real. Cities once touted as the centers of Soviet industrial accomplishment—Magnitogorsk, Novokuznetsk, Astrakhan, Komsomolsk-on-Amur—have now been revealed (thanks to glasnost) as having terrible environmental problems. Other cities not usually associated with the Soviet heavy industrialization drive—Yerevan, Yalta, Baikalsk, Kiev—also suffer severely. “Until recently, Krivoi Rog was described as the Iron Heart of the Land of Soviets. Now it is generally admitted that this heart is chronically ailing,” commented a reporter for the evening news program “Vremya.”¹ “For a long time, Podolsk has been called the industrial center of the Moscow area,” lamented several residents in a letter to the daily newspaper *Rabochaya tribuna* (Worker Tribune): “We do not want to be proud of this.”²

Claiming itself to be the vanguard of socialism, the Soviet government sought unfettered, rapid economic growth and military might—a quest that befouled both air and water, impoverished the country’s farms, and poisoned the land with toxic waste and radioactive fallout. For almost three-quarters of a century, the truth about what was happening to the environment remained obscured by the triumphs of Soviet development

and the bold righteousness of the Soviet regime. However, just as the process of glasnost and political reform initiated in the 1980s revolutionized the Soviet people's perceptions of their society, so too has it revolutionized their perceptions of their physical environment. Communism's dirty secrets are being uncovered by government officials and environmentalists alike, and each discovery adds to a list of staggering problems.

In the 1980s, air pollution levels in over one hundred cities across the former Soviet Union periodically exceeded air quality standards by a factor of ten. Fifty million citizens lived in these cities during that time. Over one-third of Moscow's population—3.5 million residents—now live with excessive air pollution. Lead, carbon monoxide, and nitrogen oxides from automobile traffic had turned the capital's Garden Ring road into the "Black Ring," noted officials at a press conference in 1989.³

Air quality in industrial centers such as Nizhnii Tagil and Bratsk became so severe that drivers frequently had to turn on their headlights during the day in order safely to negotiate city streets. Situated in Russia's Ural Mountains industrial region, Nizhnii Tagil is the home of the V. I. Lenin Metallurgical Combine as well as numerous enterprises related to the iron and steel industry. In the heyday of Soviet power, the combine's twenty-six furnaces churned out steel by the millions of tons. Among other goods, the combine produced one-quarter of the train rails for the Soviet Union. The Communist Party awarded medals to plant workers for their great contribution to the cause of industrialization; plant managers went on to climb the ladders of the Party and government hierarchy.

As the combine broke records for producing steel, the plant's stacks belched out pollution in great proportion—1.5 tons for every citizen of Nizhnii Tagil. "A monstrous cloud of toxic smog hangs over the city," wrote the labor daily *Trud* (Labor) in 1990. But, the paper noted, "The difficult process of reassessing the values which were sanctified for decades is under way here." Commented one worker: "Ne zhelezom yedinom zhivem" (We do not live by steel alone).⁴ On the occasion of the plant's fiftieth anniversary, managers shut down an aged coking battery, but the smog did not lift. The following year, residents of the city decided to erect a monument not to the shock forces of Communist labor but to "the victims of the ecological terror."⁵ "People are dying for metal," concluded *Trud*.

The situation was similarly dismal in other locations. The writer of a letter to the popular weekly magazine *Novoe vremya* (New Times) from the Baltic town of Ventpils, Latvia, described life with a local petrochemicals plant built with assistance from an American firm:

Do you know that in the kindergartens of Ventspils the teachers instruct the children how to don gas masks. . . . Every resident of Ventspils has a gas mask; in case of an accident the following recommendations have been worked out: sensing a chemical smell, people must run in the direction opposite of the wind to a predetermined meeting place. But the wind usually blows from the West—we most likely will have to run into the sea.⁶

Water pollution is equally as severe as air pollution. Large and small rivers alike have been choked with sewage, petroleum products, phenols, heavy metals, and agricultural runoff. Uncontrolled dumping by the Gagarin machine-building plant in Komsomolsk-na-Amure, for example, has resulted in accumulations of zinc, chromium, and copper up to 15 times government standards in the Amur River as it flows to the Pacific Ocean. Stocks of caviar-producing sturgeon in the Volga River, the Mississippi of Russia, have plummeted, the result of severe water pollution coupled with aggressive dam building and overfishing. Once-popular resorts on the Baltic and Black Sea coasts are quiet during the summer months because untreated industrial and municipal waste has rendered the water unsafe for swimming. Interviewed by the daily newspaper *Trud*, the USSR's chief public health officer warned in 1989: "I personally would advise [holidaymakers] to put aside planned trips to the sea, and to go to some other rest spot."⁷ In many regions, including large cities such as St. Petersburg, residents are advised to boil their tap water; poorly equipped and overworked treatment plants cannot remove an ever-increasing slate of contaminants.

Broad swaths of Russia and Kazakhstan have become infertile desert. To boost food supplies and compensate for the shortcomings of collective agriculture, the Soviet regime promoted the extensive mechanization of agriculture and pushed farming into fragile pasture lands in these areas. The government also supplied farmers with ample stocks of agrochemicals at virtually no cost and with minimal guidance in their use. The result was widespread soil as well as groundwater contamination. According to the Soviet government in 1989:

The total annual load of pesticides in regions of Krasnodar Krai and in the Tajik [Republic] exceeds the national average by 3–5 times; in the Moldavian SSR it is 9–10 times, and the Armenian and the Turkmen [Republics] are 20–25 times [the national average]. In the regions of maximum pesticide use, the incidence of illness among children less than six years old is 4.6 times higher than in areas using the least chemicals (with a predominance of skin diseases, problems of the digestive tract, lung ailments, disruption of metabolic processes, and retardation of physical development).⁸

In Central Asia, the Aral Sea is fast becoming the Aral desert. In one of humanity's greatest land-use disasters, four-fifths of the water that feeds what was the world's fourth largest lake has been diverted to support the region's cotton monoculture. As a result of fulfilling their "socialist duty" to produce cotton, however, 3 million people have had no choice but to drink water saturated with agricultural chemicals leaching into their water supplies.

Five years after the disaster at Chernobyl's reactor No. 4, there were 4 million people still living in territory tainted by radioactive fallout—2.2 million in Belarus alone. One-third of that republic's territory was contaminated, most of it agricultural land. Even where contamination was significant, the land continues to be farmed because of lack of an alternative source of income or food.⁹ In Minsk, the Belarusian capital, the Red Cross frequently makes rounds of the city's stores and markets to assure that food is free of radioactivity.

But Chernobyl was not the only contributor to the list of radioactive contamination problems. More than forty years of gross negligence and bad luck in the race to build nuclear weapons resulted in contamination that, cumulatively, makes the radioactive fallout caused by the 1986 nuclear accident at Chernobyl pale in comparison. In the late 1940s and early 1950s, high-level radioactive waste from the top-secret Mayak nuclear weapons production complex in the Ural Mountains city of Chelyabinsk-40, was dumped, untreated, into a local river and then into a nearby reservoir. A 1957 explosion in a waste storage tank at Mayak subsequently spewed radioactive material across the countryside, forcing officials to wipe contaminated villages off Soviet maps. Total accumulated radiation in the region has been pegged at 1 billion curies—twenty times the contamination produced by Chernobyl. Ironically, the products of the Soviet nuclear weapons program wrought destruction not on its enemies abroad but on citizens at home. After studying these events, Thomas Cochran of the U.S. Natural Resources Defense Council concluded: "This has got to be the most polluted spot on the planet."¹⁰

But the contaminators were not concerned solely with military purposes. The land has been riddled with the scars of 120 nuclear explosions conducted for "peaceful purposes."¹¹ A product of bad science and aggressive lobbying by the nuclear weapons producers, such explosions were intended to create huge underground cavities for storage of hazardous waste, to squeeze oil deposits up to the surface, and to prospect for minerals. Many such tests failed. An explosion designed to cap a blowout at a gas well in the Pechora region of northern Russia went awry in 1980 and only worsened the leak, which eventually took six years to remedy.¹² In 1971, three explosions were conducted in northern

Perm oblast (region) as part of an experiment to divert the course of a river. Instead, the project created a lake of contaminated water the local population learned about only two decades later.¹³

Several hundred miles to the north of Pechora lies Novaya Zemlya, a frozen archipelago that served as the USSR's second nuclear weapons test site. In 1991, *Komsomol'skaya pravda*, a newspaper with a reputation for probing investigation, revealed that the region also served as a dumping ground for radioactive wastes, in violation of international conventions:

In the period 1966–1986 sailors from the Murmansk shipping line regularly deposited radioactive wastes near Novaya Zemlya. A large number of containers of radioactive waste were sunk in the bays of the northern archipelago along the Kara Sea. In one of the containers was the reactor of the atomic icebreaker *Lenin*, which was decommissioned in 1969. After being dumped, several containers remained floating. Sailors had to punch holes in them and wait until they sank. . . . Liquid radioactive wastes were released even closer: they were poured out into the western Barents Sea, right in the very same quadrants where trawlers fish.¹⁴

More than seventy years of industrial development have not only left a staggering list of environmental problems but also sapped the vitality and spirit of society. Commenting on the state of the famous Kuzbass coal-mining and industrial region of Siberia, Aleksei Yablokov, a prominent Russian environmentalist and adviser to Boris Yeltsin, noted:

I visited Kemerovo recently. The situation is very alarming there. Up to 75 percent of industry in the city stands idle on windless days in order that people can breathe. People have started to leave the city quietly. If things go on like this, there will be no housing problem in the Kemerovo region in five or ten years. . . . The question arises: what is the purpose of our lives? Do we live so that a factory can fulfill and overfill its plans?¹⁵

During an official visit to the republics of Bashkiriya and Tatariya in Russia in 1990, Boris Yeltsin observed:

Both regions seem to be in the worst ecological situation. And this problem, sadly, is worse than the food situation, although the food situation is thoroughly bad. . . . People are being poisoned when in Bashkiriya 460,000 tons of pollution hazardous to humans are emitted and in Tatariya 600,000 tons are emitted; that makes one million tons in one area. It's suicide!¹⁶

As Yeltsin's statement and the reports cited here indicate, the cost of environmental degradation in terms of human health has been high, and

this expense has contributed to a public health crisis the region's underfunded medical infrastructure has been ill-equipped to handle. "About twenty percent of illnesses are caused by the deteriorating state of the environment," noted two specialists in the respected weekly newspaper *Argumenty i fakty* (Arguments and Facts) in 1990.¹⁷ Only 23 percent of Soviet children under the age of seven were determined to be "practically healthy" at the close of the 1980s, and studies indicate that the prevalence of nervous disorders, allergies, and illnesses of the intestinal tract among children doubled from the 1970s to 1980s.¹⁸ Unfortunately, it may prove impossible to ascertain the source of many of these maladies: Doctors rarely kept detailed medical records and officials frequently falsified data in order to hide this undesirable part of Soviet history.

MAPPING THE DAMAGE

To help analysts and policymakers evaluate the seriousness of environmental conditions around the country, a team of researchers led by Boris Kochurov of the Russian Academy of Science's Institute of Geography defined three states of degradation: conflict, crisis, and catastrophe. The first category, conflict, refers to areas principally affected by a form of environmental degradation that is usually reversible. Agricultural lands make up a large share of the conflict zones. Widespread overgrazing, intensive cultivation, and clear-cutting operations, for example, may have upset the chemical balance of the soil and contributed to erosion, desertification, and compacting of the topsoil. Such activities have caused a noticeable decline in the productivity of the land in parts of the central *chernozem* (rich black earth belt) and northern Kazakhstan (see Map 1.1). Water pollution can also contribute to problems in conflict zones, such as has happened in the Black, White, Azov, and Caspian seas, and in Lake Onega, northeast of St. Petersburg.

The second category, crisis, refers to regions in which the destructive activities of the economy have so affected the local ecosystem that, even under strict protection, its recovery would take decades or even centuries. In some situations, conditions are so serious that they present a health threat to people living in the area. Crisis regions include many lakes and rivers that have been choked with wastes and contaminated

runoff, such as Lake Baikal, Lake Ladoga (St. Petersburg's principal source of drinking water), and the Volga River. Portions of the *chernozem* region and much of Moldova are also in a crisis state caused by overcultivation and chemical contamination of the soil.

The worst category—catastrophe—characterizes regions where conditions are so severe that specialists have written them off as irreparable. The fault for the status of these areas lies with the common Soviet practice of clustering industrial operations, a practice that resulted in extraordinary levels of air and water pollution. The destruction of the landscape from mining and agricultural industries also created such severe conditions. Forty-five regions of the Soviet Union fall in this category, accounting for 3.3 percent of all Soviet territory. Areas classified as catastrophic are Karakalpakistan in the Aral Sea region, the lower Volga region, Siberia's Kuznetsk Basin, Ukraine's Donets Basin, Russia's south Urals industrial belt, and many densely populated conurbations.

In 1988, these three categories of environmental degradation described 16 percent of the entire territory of the Soviet Union—or an area roughly the size of the state of Alaska. And 26 percent of the Soviet population were living in 123 major cities located within these regions.¹⁹

Although much of former Soviet territory remained relatively undeveloped, Map 1.1 illustrates that nature rarely escaped unscathed. One factor contributing to the environmental problems of the undeveloped region is its geography, which makes it particularly vulnerable to degradation. Although the vegetation of Siberia has adapted well to the harsh climate, it has not been very tolerant of anthropogenic disruption from the development that has occurred or from pollution such as acid rain and snow. Because much of the region under consideration is located in high northern latitudes (Moscow and Krasnoyarsk sit on the same latitude as the south coast of Hudson Bay) low temperatures and a lack of sunlight slow down the natural processes of growth, purification, and regeneration. Several passes by a truck will break the permafrost, allowing water below to well up and turn the area into a swamp—damage that may take nature a century to heal. Air pollution problems are not confined to the industrial and urban centers concentrated in the western region; pollution produced there tends to precipitate on land, on Russian territory in particular, as the prevailing winds carry it to the east. Some topsoil, such as that found in the virgin lands and the steppes of Central Asia, often is thin and susceptible to erosion. Moreover, the Eurasian plain possesses the world's largest expanses of farmland having no natural barriers—such as trees or shrubbery—to hold back the wind and rain.²⁰ Intensive cultivation, overgrazing, and excessive logging thus only intensify the land's vulnerability.²¹

Given all this evidence of environmental degradation, the ultimate question that arises is this: Which areas of the former Soviet Union have remained relatively unscathed and healthy? When asked this question by a journalist, presidential adviser Aleksei Yablokov found himself at a loss for examples:

You are the first to ask such a question. Usually, people ask about unfavorable regions, and I have become used to ticking them off. Of course, there are places barely affected by economic activity . . . one could, perhaps, include several regions of Karelia. Perhaps some regions of Belorussia, not disturbed by land improvement schemes. Probably, a part of Lithuania. It is very bad almost everywhere in Ukraine. Southern Ukraine is, in general, a zone of ecological catastrophe. The Black Sea is in a very bad state. At one time, Transcarpathia [western Ukraine] was in good condition, but heavy [air] pollution loads coming from Poland, Czechoslovakia, [and East and West Germany] have changed the picture. It is bad everywhere in Moldavia. The northern Caucasus region is heavily saturated with agricultural chemicals. Perhaps several border areas in the Caucasus have maintained their natural state. It is a catastrophe in Kalmykia and in the northern Caspian Sea region. Several desert regions may be preserved, but it is impossible to live there for other reasons. The Altai and Sayan regions are relatively clean. Several regions in eastern Siberia and the Far East have been preserved—small bits of Ussuri taiga remain there. Kamchatka has remained partly undisturbed. As you see, it's not much.²²

THE ORIGINS OF ENVIRONMENTAL DESTRUCTION

For seven decades, the Soviet Union based its environmental protection strategy on the premise that collective ownership and central planning free of “selfish interests” would provide the “optimum solution” for protecting the environment.²³ Slogans such as “all for the good of man” reinforced a modernist and anthropocentric worldview that the USSR’s boundless riches were ripe for exploitation. A preoccupation with industrial development arose, in part, from what economist Jan Winiecki has called “grandiose Marxian dreams of an economy as a single factory.”²⁴ Big was better, huge was best, and science solved all the problems. Such a worldview was manifest in such “projects of the century” as the Great Stalin Plan for the Transformation of Nature, BAM (the Baikal-Amur Main Railway), Nikita Khrushchev’s Virgin Lands Program, and the plan championed by Leonid Brezhnev to divert the flow of Siberian rivers.

In this glorious culture of transformation and modernization, tractors and cranes became the subjects of arts and letters. In a cycle of poems entitled “Bratsk Dam,” Yevgenii Yevtushenko writes of mining ore in Magnitogorsk:



Source: Institute of Geography, Russian Academy of Sciences.

Map 1.2. Regions of Environmental Degradation Within Former Soviet Union.

And trucks were charging about like beasts,
and wheelbarrows thumping, and frozen flags
were slapping with red ice.

And although the earth was like cast iron,
thousands of Sonkas were digging,
thousands of Sonkas were singing,
singing the song of the Commune.²⁵

Environmental degradation, in the Soviet view, was an illness inextricably associated with bourgeois development and social and political conditions in the capitalist world. Wrote one analyst in 1980: "Like other global problems, those of ecology have a social origin, their solution largely depending on the character of the social system. . . . The socialist states and the communist parties proceed from the conviction that the socialist system offers the optimal possibilities for resolving these problems."²⁶ The official dogma about the infallibility of the Soviet system was so pervasive that many became blinded to reality. Said Yevgenii Velikhov, a physicist and leading member of the Soviet Academy of Sciences: "Before the Chernobyl explosion, many important specialists and political figures believed that a nuclear reactor could not explode."²⁷

In line with the Communist Party and its ideology of economic growth through industrial development, the principal objective of the economic planners was to promote the speedy growth of heavy industry. Resources were channeled accordingly. A slogan popular during the initial stages of industrialization exemplifies the predatory attitude of Soviet economic planners that was to continue long afterward: "We cannot wait for favors from nature; our task is to take from her."²⁸ To meet the leadership's ambitious goals for industrial development, planners relied on increasing the quantity of inputs such as land, energy, and labor (i.e., *extensive* methods) rather on using resources more efficiently (i.e., *intensive* methods), thus exacerbating the strain on the environment.

One of the trademark features of the Soviet economy was its high concentration of industrial activities in a few very large enterprises that were often clustered in compact geographical regions. This concentration was encouraged by both central planners and industrial managers for several reasons. First, planners thought that the larger the size of the plant, the greater the efficiency of production. Second, weary of the high costs (manifested in uncertain delivery and the low quality of supplies) of transacting in the Soviet market, managers supported vertical integration of industry to extreme degrees. Third, industrial ministries favored large, high-visibility projects over smaller, specially targeted investments in

order to move funds rapidly and meet the central planners' targets. Fourth, planners wanted to simplify the process of managing such a large economy—a priority that became progressively more important as the economy grew increasingly complex. Finally, planners sought to reduce transportation costs by locating industries close to the local natural resources they would consume.

This phenomenon of industrial concentration (both by factor and by geography) resulted in the “threading” of several ecological loads on a compact territory, giving rise to what governments have often officially declared “ecological disaster zones”: pollution hot spots of exceptional intensity.²⁹ In addition to plaguing the traditional industrial centers of Ukraine (Donetsk, Krivoi Rog, Dnepropetrovsk), the south Urals (Chelyabinsk, Ufa, Yekaterinburg, Nizhnii Tagil, Magnitogorsk), and Siberia (Novokuznetsk, Krasnoyarsk, Kemerovo), these environmental hot spots are also found in such remote regions of the country as around Irkutsk and southern Sakhalin Island.³⁰ This situation is epitomized by the case of Norilsk—sulfur dioxide emissions from the Russian city's smelters exceeded total sulfur dioxide emissions for all of Italy in the 1980s.

A second feature of the Soviet economy was the USSR's propensity for allowing the industrial infrastructure to become aged and dilapidated. The distortions caused by the Soviet planning and price systems made it more profitable for firms to invest in new projects than to spend money to modernize existing plants and equipment.³¹ As a result, 40 percent of the economy's physical plants had been declared “worn out” at the end of the 1980s.³² Many industrial plants date back to the heyday of Soviet industrialization in the 1930s, when everything—human lives as well as nature—was sacrificed for the cause of Soviet economic achievement. Many factories in the Ural Mountains and Siberia were hastily moved to the region from the west during World War II, and more came from Germany after the war. More than half the blast furnaces in the Soviet Union at the time of its demise were over fifty years old; still operating were many antiquated and inefficient open-hearth furnaces.³³ A survey conducted by the Moscow city environment committee revealed that not one enterprise in the capital “complied with contemporary environmental regulations”—a result of numerous plants having been built “decades and centuries ago,” noted TASS.³⁴ One decrepit Siberian soap factory built by a cooperative in the early 1920s was described in *Izvestiya* as “looking like a museum of the history of technology.”³⁵ On a 1991 visit to the Rezina Production Association, a Moscow enterprise that produces rubber products, two U.S. researchers noted:

To walk around [the] production departments is to be transported back to the last century. They are dark and dingy and the noise from the antiquated machinery can be deafening. The technology is so old—some of it harkens back to pre-World War II days—that many of its own employees liken it to an industrial museum. . . . We were told that when representatives of the German conglomerate, Krup, visited Rezina, they were so amazed that machinery made in their factories in the 1920s and 1930s was still in good working order, that they asked to buy it in order to take it back to Germany for their museum.³⁶

Because the nuts and bolts of the region's industrial infrastructure were aged, overtaxed, and poorly maintained, reports of things breaking down or blowing up were frequent: Trains derailed, spilling dangerous cargoes; storage lagoons leaked, letting toxic wastes escape; and sewage systems broke down, casting raw waste into rivers and lakes.³⁷ In Russia alone up to 700 large-scale leaks occur along the nation's oil and gas pipelines, resulting in an estimated loss of 7–20 percent—i.e. tens of millions of tons—of all oil produced.³⁸

A third distinguishing feature of the Soviet economy was its great militarization. Over the decades, the Soviet government consistently diverted a massive share of available resources to build up the nation's large military-industrial complex as it waged a cold war with the United States and its allies, countered perceived threats rising from China, and projected its power into the Third World. Western estimates of the share of the Soviet economy accounted for by the defense sector in the 1980s range from about 15 to 25 percent and even higher; Aleksei Yablokov asserted that the real figure is on the order of 50 percent. (The rate in the United States during the same period was about 5 percent.)

As in the West, defense-related activities proved to be some of the most environmentally damaging—from groundwater contamination by industrial solvents used in the aerospace industry to radioactive and toxic contamination from unsafe storage and disposal of chemical, biological, and nuclear weapons. Playing on the Soviet regime's obsession with national security and secrecy, the military-industrial complex ignored the most important environmental concerns and resisted interference by any proenvironmental interests. According to one estimate, the USSR Ministry of Defense directly controlled 42 million hectares of land, or 2 percent of Soviet territory.³⁹ Speaking about Murmansk, a principal Navy port reported to be experiencing severe problems managing and disposing of radioactive and toxic waste, the head of the Soviet environment agency commented in 1990: "We simply do not know what's going on there."⁴⁰ Thus, the combination of widespread hazardous activity and

extreme secrecy led to catastrophic environmental disasters such as those at Chelyabinsk.

Added to the problem-producing features of the economy was the fact that the safeguards for keeping the Soviet system from producing grandiose, ill-suited, and ecologically hazardous projects in the Soviet Union's quest for industrial development were minimal at best. To win support for pet development projects, government ministries often bribed scientists by putting them on the payroll or by awarding their research institute desirable contracts. Scientists in turn did more than merely pander to developers' interests: For example, the USSR Academy of Sciences often supported big, ecologically destructive development projects (such as the St. Petersburg flood-control dam) in order to curry favor with political leaders and maintain the academy's prestige.⁴¹ Many projects were required to undergo environmental impact assessments, but the assessment process was not stringent. At times, specialists involved in the design of a project also served on its environmental assessment panel.⁴² According to one environmental authority, "[A]ll the activities largely were directed at lowering the estimated cost of construction. Other aspects simply weren't examined."⁴³ Cutting costs usually translated into cutting out the pollution controls.⁴⁴ Because the state was the ultimate property owner in the system, it assumed liability for environmental mishaps and thereby encouraged high-risk and hazardous development.⁴⁵ Under these conditions, Soviet endeavors such as the unique scheme to produce petroleum-based livestock feed, the use of nuclear devices for mining and excavation, and the construction of record-sized hydroelectric stations and chemical plants were approved without significant consideration of potential negative effects.

Often, a ministry would press ahead with a project before the impact assessment was conducted, thereby taking advantage of inertia in the bureaucratic process. Even if the project was found to be environmentally unsound, the fact that work already had commenced virtually ensured the project's survival. As Liya Shelest, a Russian environment official, commented about the giant Astrakhan gas complex built in the 1980s: "Even with our imperfect laws, the complex should not have been started up without the permission of the state commission [on environmental certification], but it has been running for five years. We do not have enough power to put it out of business."⁴⁶ Ultimately, if a concept was important enough to gain high-level political support, all potential opposition was effectively stifled. Even in the exceptional case of audible dissent—for example, scientists' concern about the fate of the Aral Sea when the government mounted its massive irrigation plans for Central Asia in the 1950s and 1960s—the leadership remained unswayed. "As we

say, the Soviet Union is an exceptional country,” proclaimed Russian Deputy Prime Minister Gennadii Fil’shin in 1990: “Exceptions were given to build a lot of polluting enterprises.”⁴⁷

The Soviet system also lacked the guide of market prices to assist its planners and project designers in their decisionmaking. As a centrally planned economy, the USSR set its prices administratively, according to political prerogatives rather than market forces. The price of a commodity therefore rarely was logically related to its actual cost of production. A thousand kilos of steel produced by the Nizhnii Tagil Metallurgical Combine grossed only 150 rubles—enough to buy just twenty kilos of apples at the local market.⁴⁸ Such a system meant that indicators of a project’s viability—cost of inputs, return on investment, efficiency, and so on—were skewed. Because a large share of earnings were sent back to Moscow, local enterprises had little incentive to boost efficiency or to conserve resources. Moreover, such natural resources as land, forests, and minerals were allocated to enterprises at virtually no real cost to the user, eliminating any incentive to use them wisely. The state sold oil to its industries for about nine rubles a barrel—less than the price of a liter of vodka. Water for irrigation was provided virtually free. The end result was a perverse economy that tended to maximize the use of inputs at great cost to the environment.

Pervasive arbitrariness and lack of economic legality characterized the Soviet system rendering an economy that was not, despite official rhetoric, centrally planned, but merely centrally managed. Thus, although natural resources were in theory collectively owned (and collectively protected), the state in reality assigned extensive property rights to firms to allocate and use (and abuse) resources granted to them as long as they fulfilled the plan.⁴⁹ According to one environmental activist, enterprise managers came to approximate “czars” who controlled vast domains and who felled forests or fished out seas as they saw fit.⁵⁰ “Where natural resources are concerned, each department is interested only in using them to achieve its own goals,” commented Yablokov. “Three powerful industries manage [Yakutiya territory]: diamond, gold, and coal producers. These industries behave as predators, taking no account of the natural environment and the people inhabiting this area.”⁵¹

The Soviet regime did mount an environmental protection effort once growth in the Soviet economy began to decline and the costs of large-scale waste and environmental degradation increased. In the late 1950s, the Communist Party and government began passing a number of resolutions and laws outlining fundamental principles for protection of land, water, air, and wildlife and mandating specific conservation projects, such as those to protect Lake Baikal and improve environmental quality

in Moscow. These documents set out admirable objectives, but they did little more than demonstrate the Communist Party's good intentions.

Over the years, bureaucrats toiled to encode detailed environmental regulations that were among the strictest in the world. The commitment to the environment remained solely on the books, however. The greatest obstacle to improving environmental quality proved to be the regime's development imperative. Criteria used to measure how well ministries and departments fulfilled their plans centered on quantitative indicators, such as tons of cement produced or hectares of land irrigated. As a result, managers routinely ignored quotas and guidelines for resource conservation and environmental protection. Because the leadership encouraged growth at any expense, ministries, enterprise managers, and workers understood that even flagrant disregard for environmental regulations and guidelines would be tolerated as long as the enterprise succeeded in generating its planned output. The Ministry of the Coal Industry, for example, devoted all of its resources to the production of coal; the more coal consumed by the economy, the bigger the ministry's budget, staff, and land allocations. Success for the ministry was equated with delivering a certain tonnage of coal to the state; of no concern to planners—and subsequently to managers—was how the coal was procured and what happened to the environment in the process. Issues such as controlling water pollution or restoring sites once excavation was completed ranked as minor concerns.

Another failing point of the government's effort to protect the environment was that responsibility for carrying out the government's modest environmental initiatives was divided among several ministries and state committees that often had priorities other than protecting the environment. One department was made responsible for collecting data, another for conducting the analyses, and a third for enforcement. Up to twenty-six separate state committees and ministries participated in the design and implementation of environmental regulations. In the case of Lake Baikal, over forty-five institutes affiliated with different departments and ministries conducted research on the ecology of the region. This arrangement frequently led to bureaucratic prerogatives pitting one agency against another. And in a society obsessed with secrecy, the sharing of information was anathema.

In addition, all environmental agencies were chronically underfunded. As a result, important functions such as monitoring and enforcement were delegated, without oversight, to the polluting ministries themselves. Referring to "monstrous violations" of government regulation by the fishing ministry, the Soviet environmental chief commented in 1989: "It studies [fish] resources with the assistance of its own research

institutes, establishes its own fishing plan, catches the fish itself, and monitors itself."⁵² As in every country, self-regulation led to abuse.

For any of the environmental regulations to have worked, the Soviet regime would have had to adopt detailed statutes enabling government agencies effectively to enforce them; it never did. Because of the low priority of environmental issues in the Soviet judicial system and the imprecise nature of Soviet environmental laws, judges frequently refused to hear such cases brought before them. Administrative approaches to environmental protection proved insufficient because enforcement agents typically were far weaker politically and financially than the polluters they were trying to control. Administrative sanctions issued by local governments could be disregarded by enterprises protected by powerful central ministries; in many cases, the local authorities themselves overlooked administrative sanctions because their informal responsibility was to ensure that local enterprises met the production quotas.

Even when the main form of punishment—monetary sanctions—was used against violators, the effects were only marginal because fines were either nominal or were picked up by the ministries; enterprises and individuals incurred virtually no material penalty for not obeying environmental regulations.⁵³ Money allocated to factories for the purchase of pollution abatement equipment often went unspent, and when equipment was installed, managers often refused to operate it as needed. The reason was simple: They frequently found it easier simply to continue paying fines for exceeding the emission standards than to interrupt production to install and maintain control technologies. In fact, enterprises' annual subsidies often included funds earmarked to pay fines. The result was a variation on the concept of a revolving bank account: Fines for environmental degradation went from one government pocket to another.

The net result was that environmental protection existed in name only. Noncomplying enterprises, backed by their ministries in Moscow, enjoyed privileges and rights over natural resources (including the right to pollute them) that were almost inviolable. These conditions created an incentive structure for industrial managers that supported production at the expense of public health and the environment. As two prominent economists concluded, the government's laws, decrees, and resolutions "were vague, others were simply not fulfilled; in the best of circumstances they were treated as pious wishes."⁵⁴

Many Soviet people recognized the deplorable state of their environment, but there were no channels through which to influence the leadership's policies. The many informal environmental groups that existed were denied significant input into the political process. The idea of oppo-

sition from an independent environmental lobby threatened the official myth that the Soviet state, led by its infallible Communist Party, was capable of impartially incorporating within its policies the interests of all its citizens. The absence of any countervailing political force deprived the system of the corrective means needed to move it off its destructive path.

For seven decades, the system held. Soviet leaders congratulated themselves on pushing their country to the forefront of the world's industrial and military powers. Because success was measured in terms of output, there was much to celebrate: The USSR boasted that it was the world's largest producer of crude oil, natural gas, iron, steel, nickel, rubber, fertilizer, and tractors. Moreover, tanks, warplanes, and rockets rolled off assembly lines by the thousands. Soviet physicists designed nuclear reactors to power their cities and a fleet of submarines and icebreakers. In an extraordinary effort to overcome the challenges of nature, engineers threw dams across the strongest rivers, cut irrigation canals through the desert, and forced railway lines across the frozen tundra.

As the cases described here clearly indicate, however, many of these achievements turned out to be liabilities. The net result of the Soviet development model was an economy trapped on a treadmill of consumption and providing little output of social value: Coal was mined to produce steel, which was used to build machinery, which was used to mine coal.⁵⁵ And as the decades passed, the treadmill dragged the economy down.⁵⁶ The climb to a preeminent position in the world came at devastating cost to the environment and taxed the vigor of the economy, the people's health, and, ultimately, the legitimacy of the Soviet regime.

THE ROLE OF GLASNOST

Many observers point to the 1986 accident at Chernobyl as the precipitant of a radical change in the Soviet worldview. Some argue that Chernobyl alerted the leadership and the public to the frightening level to which the state of the USSR had deteriorated.⁵⁷ Others have linked the nuclear disaster to the Gorbachev administration's subsequent, more flexible stance in international arms control negotiations.⁵⁸ Still others believe the international community's strong reaction to the accident taught the Soviet regime about the need for openness and transparency in managing its affairs and thus led to the fateful policy of glasnost. In a 1987 article outlining the Soviet Union's proposal for a comprehensive system of international security, for example, Gorbachev wrote: "They say that one thorn of experience is worth a whole forest of instructions. For us, Chernobyl became such a thorn."⁵⁹

The ideological constraints of the *perestroika* regime had muted public discussion of environmental matters, but the new era of openness, democratization, and decentralization of authority rapidly created conditions that often encouraged political actors to emphasize the degree to which environmental quality had deteriorated. The Gorbachev regime's initiation of the policy of *glasnost* in 1987 was predicated on the hope that public criticism of the status quo would help motivate the leadership's reform agenda. Indeed, discussion in the media of the USSR's widespread ecological problems often pushed the limits of openness in the early years of *glasnost* and built public pressure for radical political and economic changes. It was not until 1989, however, that the public began to hear in graphic detail and directly from their own leaders how troubled their country was. Much of the credit for this sudden advance in *eco-glasnost* can be tied to the elections for and the convening of the first USSR Congress of People's Deputies. As political leaders became more outspoken, the media picked up the lead and began probing deeper into the problems.⁶⁰

Despite the advances of *glasnost*, however, there still was (and the problem remains for the new republics) a serious lack of accurate information. On the issue of biodiversity, Aleksei Yablokov commented: "We lose several animal and plant species each year. What is most dangerous is that we do not know exactly how many species we are losing. Approximately 2,500 species were endemic to Lake Baikal. We have not seen 600 or 700 of these species for the past 30–40 years."⁶¹

This lack of information, both in baseline and time-series data, is most disturbing in the area of epidemiology. Medical workers who were poorly trained, overworked, and underpaid in the Soviet system rarely kept detailed records of their patients. Where public health conditions were extremely bad, authorities frequently banned the collection of data and the maintenance of health registries rather than face embarrassment and possible reprisals from an outraged public. "We have no statistics here because we have no tradition of keeping them," said Dr. Nikolai Kolmakov, director of the local hospital in Nikel, a Russian metallurgical town where the life expectancy is reported to be just forty-four years.⁶² Referring to the fallout of Chernobyl, a physician from Mogilev, Belarus, told Radio Liberty in 1988: "A growing number of people are suffering from weakness, hair loss, and impotence. Although lab results clearly show these to be the result of radiation sickness, no mention of this will be made in the official diagnosis."⁶³ A physician from Dushanbe, Tajikistan, reported to Radio Liberty that radioactivity from military research and uranium mining in the region had led to "a leap in leukemia cases,"

prompting officials to forbid diagnoses of cancer and anemia. "In this case," the physician concluded, "perestroika precedes glasnost."⁶⁴

Environmental agencies have moved to eliminate this shortcoming by mandating *pasportizatsiya*—the tallying of which enterprises are producing which wastes and pollutants—a process begun in the late 1980s.⁶⁵ The task will be a large one: Over 7,000 industrial enterprises, almost one-third located in Russia, had no documentation of their emissions as of the beginning of 1990.⁶⁶ And the government agencies and ministries that have collected data have not done a thorough job. Of the 117 foundries counted in a 1989 survey conducted by Moskompriroda, the Moscow city environmental agency, only 32 were previously known to officials and had been included in their statistics: "The remainder somehow are working on an illegal basis," concluded A. I. Kudin, the agency's chairman.⁶⁷ Such circumstances are likely to continue in the future: A lack of funds has forced environmental agencies to rely on self-reporting by firms, and absent is the threat of an audit.

In addition, the task of conducting accurate and comprehensive environmental observation is complicated by the lack of accurate, standardized monitoring equipment (especially automated technologies) and the rudimentary state of the information and communications systems. The region's geography doesn't help matters. Officials often must venture out to distant monitoring stations to gather samples and then transport them back to the regional office, a trip that may cover thousands of miles or require the use of a boat or helicopter. If not handled properly, samples and reagents may degrade or become contaminated, skewing the final results. As in the rest of the system, quality control is lax and poorly paid staffers are likely to cut corners. As a result of such conditions, data that have been obtained are often incomplete or inconsistent: "Currently, we obtain disturbing information only when something has gone wrong," commented Igor Gavrilov, Russia's environment minister and deputy prime minister in 1991.⁶⁸

Finally, much of the information that is collected either is not pertinent or is published in a nonusable format. Reflecting the isolation and ideological subjectivity of past decades, methodologies do not correspond with international practice. For instance, data on the development of in-plant, closed-cycle recirculating water-supply systems are extensive, whereas data on pollutants released into waterways generally are given only in global terms of sewage released, which are sometimes broken down into partially treated and untreated. The specific types of pollutants released, as well as their rates, concentrations, and sources, remain insufficiently documented. In sharp contrast to the past, however, officials of the new republics now candidly and humbly admit that they

frequently did not know what was going on inside the USSR or even their own locales, and they often are turning to the West for assistance.

Despite these serious shortcomings in the collection of environmental data, enough information was available in the system to convince both citizens and leaders alike that the state of environment in many parts of the country was alarming, if not catastrophic. This realization, in turn, led many to question the health of the Soviet Union. In a frank and emotional exchange with the country's cultural leaders in November 1990, President Gorbachev recounted a conversation with Eduard Shevardnadze during a winter walk just prior to Gorbachev's promotion to the General Secretaryship in March 1985. They were comparing observations on the state of the Union, and Shevardnadze turned to Gorbachev, concluding, "It had all gone rotten." Noting his justification for launching perestroika, Gorbachev commented five years later: "Everything was indeed rotten to the core, and it is the people who are suffering most. That a vast country with such intellectual potential, with such attachment to and love for the land, with such resources . . . should be in such a condition!"⁶⁹ Thus, the destruction of nature had come to serve as a solemn metaphor for the decline of a nation.

Notes

1. Central Television, "Vremya," September 3, 1990, as translated in FBIS-SOV-90-174, p. 40.
2. *Rabochaya tribuna*, February 11, 1990, p. 1.
3. TASS, September 20, 1989.
4. *Trud*, July 18, 1990, p. 2.
5. *Komsomol'skaya pravda*, March 22, 1991, p. 1.
6. *Novoe vremya*, No. 49, 1990, p. 3.
7. *Trud*, July 25, 1989, p. 3.
8. USSR State Committee for the Protection of Nature (hereafter abbreviated USSR Goskompriroda), *Sostoyanie prirodnoi sredy v SSSR v 1988 g.* (Moscow: VINITI, 1989), pp. 131-132.
9. Of the roughly 70,000 square kilometers of Belarusian territory that received radioactive fallout, 3,000 square kilometers (about 4 percent of the total) were taken out of cultivation. *Sovetskaya Belorussiya*, June 19, 1990, p. 1. See also a summary of the report of the USSR Gosplan expert commission on the accident in "Chernobyl'skaya avariya—velichaishaya katastropha zemli," *Energiya: Ekonomika, tekhnika, ekologiya*, No. 7, 1990.
10. *New York Times*, August 16, 1990, p. 3.
11. Testimony of First Deputy Chair of USSR Council of Ministers Vladilen Nikitin before USSR Supreme Soviet, Radio Moscow, March 28, 1990.
12. *Argumenty i fakty*, No. 2, 1990, p. 7.
13. *Rabochaya tribuna*, November 11, 1990, p. 4; Radio Moscow, April 22, 1990.

14. *Komsomol'skaya pravda*, September 28, 1991, p. 1. See also *Izvestiya*, October 29, 1991, pp. 1, 7; *Pravda*, December 7, 1991, p. 4; Matthew J. Sagers, "Nuclear Waste Illegally Dumped at Sea Off Novaya Zemlya," *Soviet Geography*, December 1991, pp. 706-707.

15. Olga Papkova, "Putting a Fish Near a Goldfish Bowl," *New Times*, No. 33, 1988, p. 39.

16. Central Television, "Vremya," August 8, 1990.

17. *Argumenty i fakty*, No. 15, 1990, p. 1. The data were collected by the All-Union Central Research Institute for Occupational Safety. Presumably alluding to the same data, A. I. Kudin, chairman of the Moscow City Committee for the Protection of Nature, said in late 1989 that "one-fifth of all Muscovites' illnesses are related to the state of the environment." *Vechernyaya Moskva*, December 23, 1989, p. 2.

18. See, for example, USSR Goskompriroda, *Sostoyanie . . . v 1988 g.*, p. 132. The study of children's health was conducted by the Institute of Hygiene and Illness Prevention Among Children and Adolescents.

19. Boris I. Kochurov, "Na puti k sozdaniyu ekologicheskoi karty SSSR," *Priroda*, No. 8, 1989, pp. 10-17.

20. Lester R. Brown and John E. Young, "Feeding the World in the Nineties," in Lester E. Brown et al., *State of the World 1990* (New York: Norton, 1990), p. 74.

21. For more on the relationship of geography to nature in the USSR, see Charles E. Ziegler, *Environmental Policy in the USSR* (Amherst: University of Massachusetts Press, 1987), ch. 1.

22. Vladislav Larin, "Opasnoe neponimanie," *Energiya: Ekonomika, tekhnika, ekologiya*, No. 4, 1990, p. 3.

23. V. Granov, "The Ideological Struggle and Ecological Problems," *International Affairs*, No. 12, 1980, p. 93.

24. Jan Winiecki, "Large Industrial Enterprises in Soviet-Type Economies: The Ruling Stratum's Main Rent-Seeking Area," *Communist Economies*, Vol. 1, No. 4, 1989, p. 365.

25. Yevgenii Yevtushenko, *Bratsk Station and Other New Poems*, trans. Tina Tupikina-Glaessner, Geoffrey Dutton, and Igor Mezhakoff-Koriakin (New York: Anchor Books, 1967), p. 64. Sonka is a seventeen-year-old who leaves her village to work in the ore pits of Magnitogorsk. For a compelling discussion of the linkage between ideology, culture, and the environment, see Douglas R. Weiner, *Models of Nature: Ecology, Conservation, and Cultural Revolution in Soviet Russia* (Bloomington: Indiana University Press, 1988).

26. Granov, "Ideological Struggle," p. 87, cited in Eric Green, *Ecology and Perestroika* (Washington, DC: American Committee on U.S.-Soviet Relations, 1990), p. 51.

27. Yevgenii Velikhov, "Chernobyl Remains on Our Mind," in *Voices of Glasnost: Interviews with Gorbachev's Reformers*, Stephen Cohen and Katrina Vanden Heuvel, eds. (New York: W. W. Norton, 1989), p. 162.

28. Green, *Ecology and Perestroika*, p. 1.

29. A. T. Khrushchev, *Geografiya promyshlennosti SSSR* (Moscow: Vysshaya shkola, 1990), p. 37.

30. For more on threading and problems associated with the distribution of Soviet industry, refer to S. B. Lavrov, "Regional and Environmental Problems of the USSR: A Synopsis of Views from the Soviet Parliament," *Soviet Geography*, September 1990.

31. Alec Nove, "The Investment Process in the USSR," *Bericht des Bundesinstituts für ostwissenschaftliche und internationale studien*, No. 53, 1989, p. 13.

32. Khrushchev, *Geografiya promyshlennosti SSSR*, p. 9.

33. V. N. Bol'shakov and O. F. Sadykov, "Kontsepsiya formirovaniya regional'noi sistemy ekologicheskoi bezopasnosti (na primere Urala)," *Vestnik Akademii Nauk SSSR*, No. 11, 1988, p. 97. Likewise, much of the pollution control equipment simply is worn out; half of installed air pollution controls were over ten years old in 1987. USSR Goskomstat, *Okhrana okruzhayushchei sredy*, p. 89.

34. TASS, September 6, 1991.

35. *Izvestiya*, July 16, 1989, p. 2.

36. Michael Burawoy and Kathryn Hendley, "Strategies of Adaptation: A Soviet Enterprise Under Perestroika and Privatization," University of California, Berkeley-Duke University (Durham, NC) Occasional Papers on the Second Economy in the USSR, No. 29, June 1991, p. 6.

37. In its annual review of the state of the nation's economy, the Soviet government reported that 2,000 accidents having "a serious negative effect" on the nation's land, water, and air were recorded by the government in 1989. *Izvestiya*, January 28, 1990, p. 3.

38. Aleksei Yablokov, "Zayavlenie dlya pressy," *Tsentr Obshchestvennoi Informatsii po Atomnoi Energii Informatsionnyi Byulleten'*, No. 3, 1992, p. 5.

39. *Pravda*, January 11, 1991, p. 3. Not included in this figure is territory controlled by thousands of defense-related industries.

40. *Sovetskaya kul'tura*, No. 31, 1990, p. 3.

41. *Izvestiya*, August 7, 1990, p. 3.

42. In the case of the Siberian river diversion plan, G. V. Voropaev, director of the USSR Academy of Sciences Institute of Water Problems, served as the head of the USSR Gosplan commission that reviewed the viability of the project; his institute played a key role in the plan's development. See N. F. Glazovskii, "Malen'kie khitrosti bol'shikh proektov," *Nash sovremennik*, No. 1, 1987, p. 122; and Robert G. Darst, Jr., "Environmentalism in the USSR: The Opposition to the River Diversion Projects," *Soviet Economy*, July-September 1988, p. 236.

43. Petr I. Poletaev, "Vosstanovit' garmoniyu prirody i cheloveka," *Zdorov'e*, No. 6, 1989, p. 1. Such a narrow focus, notes Poletaev, a deputy chairman at USSR Goskompriroda, was in line with the phrase repeated often at the time: "The economy must be economical."

44. In a speech to the First USSR Congress of People's Deputies, Mikhail Gorbachev noted: "We, in order to lessen the cost of construction, continue to support projects that are unfit from the perspective of ecological safety." Gorbachev went on to recount a story he heard from a deputy from Komsomolsk-na-Amure: In order to ameliorate a furniture shortage plaguing the Far East, the central government spent \$20 million to import machinery for a new furniture factory there; but the government did not buy the associated pollution

control equipment. “Who needs such economizing?” Gorbachev asked. “In Komsomolsk-na-Amure, demonstrations already are being held on account of this.” See *Pervyi s’ezd narodnykh deputatov SSSR: Stenograficheskii otchet*, Vol. 1 (Moscow: Izdatel’stvo Verkhovnogo Soveta SSSR, 1989), pp. 444–445.

45. Roland N. McKean, “Products Liability: Implications of Some Changing Property Rights,” *Quarterly Journal of Economics*, Vol. 84, No. 4, 1970.

46. Liya Shelest, first deputy chair of RSFSR Goskompriroda, presentation at conference on Democratic Federalism and Environmental Crisis in the Republics of the Former Soviet Union, Moscow, August 1991.

47. Mike Edwards, “Siberia: In from the Cold,” *National Geographic*, March 1990, p. 27. For more on the subject, see Philip R. Pryde, “The Soviet Approach to Environmental Impact Analysis,” in Fred Singleton, ed., *Environmental Problems in the Soviet Union and Eastern Europe* (Boulder, CO: Lynne Rienner, 1987). As Darst, *Environmentalism in the USSR*, points out, grandiose and ecologically ill-suited projects have been pursued elsewhere, namely the water management schemes in the western United States. How the Soviet and U.S. processes have differed is in the opportunities for open, independent, and critical assessment—the relative democracy of each decision process.

48. *Trud*, July 18, 1990, p. 2.

49. See, for example, Joseph S. Berliner, *Factory and Manager in the USSR* (Cambridge: Harvard University Press, 1957); David Granick, *Management of the Industrial Firm in the USSR* (New York: Columbia University Press, 1954); John H. Moore, “Agency Costs, Technological Change, and Soviet Central Planning,” *Journal of Law and Economics*, Vol. 24, October 1981, pp. 189–215.

50. DJ Peterson, “Property Rights and the Environment in Centrally and Post Centrally Planned Economies: The Case of the Soviet Chemicals Industry,” unpublished manuscript, May 1992. The term “tsar” was used by Andrei Ivanov-Smolenskii, coordinator for conservation programs, USSR Social-Ecological Union, to describe the manager of a fishing enterprise located in the Arctic port of Dikson. Personal communication, Los Angeles, October 1991.

51. Aleksei Yablokov, Presentation at conference on Democratic Federalism and Environmental Crisis in the Republics of the Former Soviet Union, Moscow, August 1991.

52. Mikhail Dubrovskii, “Zashchita Vorontsova,” *Poisk*, No. 28, 1989, p. 4.

53. In 1989, for example, the government brought 479,000 individuals to “administrative accountability” and fined them a total of 11.4 million rubles—an average of less than 24 rubles per person. USSR Goskomstat, *Press-vypusk*, No. 226, June 7, 1990.

54. Konstantin G. Gofman and Nikolai P. Fedorenko, “Ekonomicheskaya zashchita prirody,” *Kommunist*, No. 5, 1989, p. 31, cited in Green, *Ecology and Perestroika*, p. 5.

55. This observation was made by Andrei Piontkowskii, a chief researcher at the USSR Academy of Science Institute of Systems Studies and consultant to reformist parliamentarians, during a presentation at the Council on Environmental Quality, Washington, D.C., August 1990.

56. Wrote one Soviet researcher, "More and more resources are going towards maintaining or slowing the decline in output of [natural resources], not increasing it." Forty percent of all capital investment went to the energy sector in 1986 in that year, energy development claimed 65 percent of Soviet pipe production, 20 percent of all other steel output, 15 percent of copper and aluminum production, and about the same share of cement and machinery output. A. Arbatov, "Problemy obespecheniya ekonomiki SSSR mineral'nykh syr'ym," *Voprosy ekonomiki*, No. 1, 1987, p. 34.

57. See, for example, Philip R. Pryde, *Environmental Management in the Soviet Union* (New York: Cambridge University Press, 1991), chs. 1 and 3.

58. William C. Potter, "Soviet Decisionmaking for Chernobyl: An Analysis of System Performance and Policy Change," report submitted to the National Council for Soviet and East European Research, December 1989, p. 83.

59. See Gorbachev's speech "Reality and Guarantees for a Secure World," *Pravda*, September 17, 1987, as translated in *International Affairs*, No. 11, 1987, p. 8.

60. Melissa Dawson, "Politics and the Press in the Soviet Union: The Press as a Fourth Estate in a Centralized System," unpublished manuscript presented at Trilateral Graduate Student Conference on the Post-Soviet Era, Santa Monica, CA, May 1992.

61. Aleksei Yablokov, presentation at conference on Democratic Federalism and Environmental Crisis in the Republics of the Former Soviet Union, Moscow, August 1991.

62. *Guardian*, January 11, 1991.

63. Radio Liberty, Soviet Area audience and opinion research, *Soviet Background Notes: Unevaluated Comments by Recent Emigrants*, SBN 5-88, December 1988, p. 4.

64. Radio Liberty, Soviet Area audience and opinion research, *Soviet Background Notes: Unevaluated Comments by Recent Emigrants*, SBN 2-88, April 1988, p. 5.

65. In its 1990 long-range environmental program, USSR Goskompriroda called for air pollution inspections of all cities and industrial sites in the Soviet Union by 2005. See "Gosudarstvennaya programma okhrany okruzhayushchei sredy . . .," *Ekonomika i zhizn'*, No. 41, 1990, insert page 5.

66. *Zelenyi mir*, No. 1, 1990, p. 3. In 1990, Nikolai Vorontsov, the head of the Soviet environmental agency, estimated there were a total of 2.2 million "polluting enterprises and industrial objects" in the USSR. Novosti Press Agency, October 5, 1990.

67. *Vechernyaya Moskva*, December 23, 1989, p. 2.

68. Igor Gavrilov presentation at conference on Democratic Federalism and Environmental Crisis in the Republics of the Former Soviet Union, Moscow, August 1991.

69. *Izvestiya*, December 1, 1990, p. 4.