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## Solid and Hazardous Waste

*The basic policy used to be to collect basically everything in sight and send it away—  
the farther away the better.*

—Moscow city official responsible for hazardous waste, 1991

*Rain is expected. Background [radiation] is normal.*

—Voronezh Weather Forecast

In January 1990, *Trud* reported that an ampule emitting dangerous levels of gamma radiation had been found in a heap of scrap metal located on the grounds of the Vtorchermet Production Cooperative in the Tajik capital of Dushanbe. The ampule was discovered by specialists conducting a routine survey of radiation levels across the republic. The report did not say whether anyone was affected by the radiation, but noted that contact with the ampule for just two or three hours would have caused radiation sickness and eventual death. How and when the ampule got there was unclear. Such ampules had been produced decades before for use in devices to monitor the water level in reservoirs, but they had not been registered anywhere, there had been no monitoring of their radioactivity, and no provision had been made for their proper disposal.<sup>1</sup>

Two months later, the Soviet government made an unusual concession to farmers in Kazakhstan: It promised to clear away space debris that had accumulated on their fields.<sup>2</sup> According to *Pravda*, 5,000 tons of metal debris—the remains of rockets launched from the USSR's Baikonur cosmodrome—had fallen on the republic over the past thirty years, creating “a considerable obstacle to agriculture.”<sup>3</sup> Two months later, a similar program was launched to clean up rocket debris that had fallen on the tundra from launches at the Plesetsk military cosmodrome near

Arkhangelsk. The military promised that from then on, “painstaking efforts” would be made to clean up after every rocket launch.<sup>4</sup>

These two events epitomize the paradoxical situation of solid waste management in the Soviet era: The USSR made great strides in producing many of the sophisticated and high-technology goods of an advanced industrialized society, but planners failed to develop a suitable and environmentally sound means to dispose of the associated high-tech by-products. Once created, waste was allowed to fall where it would.

Essentially, the issue of solid waste was treated as an afterthought for which little provision was made and for which few people were prepared to take responsibility. Of all the threats to the environment in the region, solid wastes, and particularly hazardous wastes, were the least documented. As a consequence of this ignorance, they may prove to be the most dangerous threat—to humans as well as to the environment. “Today, the most acute problem is neutralizing, utilizing, and disposing of hazardous industrial wastes,” Fedor Morgun, former chairman of USSR Goskompriroda, told the weekly *Argumenty i fakty* in 1989. “The main trouble is that instead of reprocessing and utilization, it is being carted off to dumps in increasing quantities. As a result, not only the soil but also the groundwater are being polluted. This is having a direct effect on people’s health.”<sup>5</sup> One year later, the Collegium of the USSR Prosecutor’s Office convened to look into the problem, and its conclusions were similarly pessimistic. The group noted that established regulations governing the disposal and decontamination of industrial and hazardous wastes were “not being adhered to strictly” and that “environmental laws were often grossly violated.” Such a state of affairs moved the Collegium, like Morgun, to assert that hazardous waste was “the sharpest problem” threatening the land and groundwater and, therefore, people’s health.<sup>6</sup>

## REPORTING ON WASTE ISSUES

Despite the magnitude of the problem, the issue of solid waste disposal has not commanded the level of public attention that other environmental issues, such as water and air pollution, have received. Reporting on waste disposal in the media, as illustrated in the anecdotes in this chapter, largely has been limited to stories about the discovery of illegally dumped hazardous wastes. One reason may be that the issue of solid waste management does not have the dramatic appeal of, say, the desiccation of the Aral Sea or the threat to Lake Baikal. Another factor is that unlike the United States or western Europe, most of the territory of the former Soviet Union has huge expanses of open space that provide

great opportunities to conceal discarded wastes, making the problem less visible to the public than other forms of environmental pollution. Government officials themselves often reveal their lack of knowledge of the generation and fate of solid wastes, as appropriate data have not been collected. Commenting on his first months as chief of the new environment agency, Morgun observed in 1988:

Recently, I asked leading specialists at Goskompriroda what would seem like an elementary question: "What is the volume, even the approximate amount, of urban household and industrial solid waste in our country?" No one could give an approximate figure, let alone an exact one. No one in the country ever had made such an estimate.<sup>7</sup>

The Soviet government took a belated step to remedy the situation in May 1990 when the USSR Council of Ministers Commission on Emergency Situations ordered state ministries to conduct a one-time inventory of the hazardous wastes they produced.<sup>8</sup> Oblast governments in Ukraine had begun to register and classify commercial wastes the previous year, but officials found that "some managers, risking liability, continue to conceal the quantity and type of wastes" their firms produced, reported *Stroitel'naya gazeta*.<sup>9</sup> In 1989, the Moscow city government formed Ekotekhprom, a public concern to build and operate hazardous waste treatment facilities for the city. Lacking sufficient information, managers of the firm decided first to inventory the types of wastes being generated in the city so that they could then determine how best to handle them.<sup>10</sup>

Finally, data on wastes produced by the military-industrial complex—wastes that in the West have proved to be some of the most dangerous and most problematic to treat and dispose of—were hidden by the veil of secrecy that obscured all defense activities under the Soviet regime. Environmentalists frequently charged that military officials classified information on hazardous waste to prevent public access to damaging reports. The desire for secrecy on this issue is understandable because the military feared a public backlash if its actions were disclosed.

In the summer of 1989, citizens rapidly organized and blocked the opening of the military's new chemical weapons-destruction facility in the central Russian city of Chapaevsk (see Chapter 7). Ongoing protests likewise have threatened the completion of a nuclear waste treatment and storage facility near Krasnoyarsk. Reports of the alleged dumping of chemical weapons and radioactive waste in the Kara and Barents seas have stirred public controversy in Murmansk and Arkhangelsk. On the Pacific coast, citizens have challenged the navy's plans to dismantle nuclear-powered submarines.

Often it is only after calamity strikes that a problem is unveiled and citizens are forced to confront the waste hazards accumulating in their own backyards. In May 1990, *Rabochaya tribuna* (Labor Tribune) reported that three coal mines in the eastern Ukrainian town of Gorlovka were closed after fifty miners were poisoned by a bluish substance seeping into a mine shaft at the Uglegorskaya mine.<sup>11</sup> This was not the first such incident in the region; the preceding December, three miners had died and hundreds of others had fallen ill after toxic chlorobenzene had seeped into a shaft at the nearby Aleksandr-Zapad mine. Preliminary tests indicated that chlorobenzene, benzene, styrene, phenol, acetone, and other compounds were present in the Uglegorskaya mine, and suspicion immediately was directed at a defense ministry explosives plant located 600 meters directly above.

A crew from the evening news program "Vremya" was allowed to visit the grounds of the secret defense plant and managed to take pictures of several evaporation ponds filled with toxic wastes. Standing before the foul-looking lagoons, Deputy Minister of the Defense Industry N. G. Puzyrev flatly denied that his plant was the cause of the miners' troubles, asserting that no toxic chemicals were being produced at the site. He did not, however, say they were not being used there.<sup>12</sup> Within several weeks, a special investigative commission revealed that waste from the plant had been "indiscriminately discarded for decades." Formaldehyde leaking from the plant combined with toxic wastes percolating through the soil to create the potent poison that struck down the miners.<sup>13</sup> According to Nikolai Surgai, chairman of an investigative commission sent to the region by the Ukrainian government, the mixture resulted in a concoction of 1,500 various compounds, "some of which were previously unknown."<sup>14</sup> None of the plant's managers was prosecuted for the incident, but the formaldehyde operation was scheduled to be shut down.<sup>15</sup> According to *Trud*, the situation, if not rectified, threatened the drinking water supplies of nine cities in Donetsk and Lugansk oblasts.<sup>16</sup>

Incidents such as these have produced fear in the bureaucracy of continued upheavals. Thus, government and military officials alike have been slow to release data on the generation and fate of hazardous wastes in the post-Soviet era.

## EXAMINING THE WASTE STREAM

Given the lack of available data, it remains impossible to say conclusively how much waste the region's economies produce, how it is

treated, or where it is disposed. According to a 1988 estimate by economist Nikolai Pirogov, a USSR Gosplan official responsible for recycling programs, the generation of solid wastes from all sources was approximately 9 billion tons annually.<sup>17</sup> This estimate probably included all forms of waste—from domestic and commercial refuse to wastes from industry, agriculture, and mining.

The most comprehensive official information published on solid wastes concerns common household refuse, or *bytovye otkhody*.<sup>18</sup> Because of the slow pace of innovation and the otherwise much-criticized neglect of the consumer goods and service sectors of the Soviet economy, the USSR did not experience an explosion of waste from surplus goods, elaborate packaging, and disposable products. Indeed, persistent shortages of such basics as paper, glass, plastic, and even food promoted a tradition of conservation at the individual level. Basically stated, consumers did not have much to waste. As a result, the Soviet economy produced an average of only 56–57 million tons of domestic and commercial waste a year in the late 1980s,<sup>19</sup> or about 195 kilograms of waste per capita.<sup>20</sup> Output ranged widely within the USSR—according to one report, from 160 to 240 kilograms per capita.<sup>21</sup>

In comparison, the United States (the world's greatest trash producer) created about 163 million tons annually, equaling about 655 kilograms per capita.<sup>22</sup> Table 5.1 illustrates the differences in the waste stream between the United States and the Soviet Union in the late 1980s. Of note is the large share of Soviet waste classified as food products, despite perennial food shortages. This phenomenon can be attributed to two factors: a smaller volume of plastic, paper, and metal discarded (a function, in part, of modest packaging practices) and a large share of food wasted in the processing and transport phase of the food chain.

In contrast, problems with industrial wastes are much more acute. The Soviet economy was notorious for its inefficiency, and inefficiency bred waste. Correspondingly, discussion of industrial wastes in the Soviet Union generally was framed in terms of resource conservation. In 1989, for example, mining and refining activities in the coal, fertilizer, building materials, and metal industries used just 39 percent of materials extracted, producing about 2 billion tons of detritus and costing the economy 6 billion rubles in lost resources.<sup>23</sup> Soviet metal refiners produced another 100 million tons of slag yearly.<sup>24</sup> The metal-working industry annually scrapped over 100 million tons of steel and iron—one-fifth of its input. Half of the scrap was composed of swarf because metal castings produced by Soviet enterprises tended to be very rough in form and this required extensive milling and grinding to bring a piece down to specification.<sup>25</sup>

TABLE 5.1 Comparison of U.S. and USSR municipal solid waste generation, disposal, and recovery, 1988

	United States	Russian Federation
Annual waste generation		
Total (million metric tons)	162.9	56.0 <sup>a</sup>
Per capita (kilograms)	655	195 <sup>a</sup>
Generation of waste by category (percent)		
Paper and cardboard	40.0	20–36
Glass	7.0	5–7
Metals	8.5	2–3
Plastics	8.0	3–5
Textiles	2.1	3–6
Rubber and leather	2.5	1.5–2.5
Wood	3.6	1–4
Food	7.4	20–38
Other	20.9	10–35.5
Disposal methods (percent)		
Recovery	13.1	1.3 <sup>a</sup>
Incineration	14.2	2.2 <sup>a</sup>
Landfilling	72.7	96.5 <sup>a</sup>

<sup>a</sup>1989 data for the Soviet Union.

Sources: Adapted from U.S. Bureau of the Census, *Statistical Abstract of the United States: 1991* (Washington, DC: Government Printing Office, 1991), p. 212. USSR Goskompriroda, *Sostoyanie prirodnoi sredy v SSSR v 1988 g.* (Moscow: VINITI, 1989), p. 64; USSR Goskompriroda, *Sostoyanie prirodnoi sredy i prirodookhrannaya deyatel'nost' v SSSR v 1989 godu* (Moscow: Institut Molodozhi, 1990), p. 32; TASS, May 21, 1990.

In Ukraine's coal-producing regions, industrial waste assumed particularly large proportions during the Soviet era. Mining operations occupied a total of 270 square kilometers of land in the republic—one-fifth of which has been marred by excavation and by more than 1.2 billion cubic meters of tailings and overburden, piled up in 1,600 heaps.<sup>26</sup> Loggers across the USSR discarded a reported 60 million tons of wood as waste at felling sites, and the timber industry scrapped 100 million cubic meters of wood yearly in the 1980s, bringing total losses in processing to 40 percent.<sup>27</sup> Similar problems faced agriculture: High rates of spoilage and waste during harvesting, storage, transport, and processing translated into at least one-third of the fruit and vegetable crops never making it to the Soviet dinner table. Similarly, 20–25 percent of the Soviet wheat crop and 10–15 percent of meat and dairy production traditionally was lost in processing.<sup>28</sup> The problem with industrial waste grew to such proportions that the Soviet government attempted to use nuclear devices to cre-

ate artificial craters in which to dump wastes from the Bashkir metallurgical centers of Sterlitamak and Salavat.<sup>29</sup>

Comprehensive data on the generation of hazardous waste were a closely guarded secret under the Soviet regime because many firms that created the waste were part of the defense industry. In 1990, the Soviet government conducted its first comprehensive accounting of toxic waste inventories and producers and pegged total output of toxic waste (*toksicheskie otkhody*) at 302 million tons that year—roughly equal to the volume created in the U.S., according to Soviet calculations. According to this survey, 80 percent of the toxic waste was generated by metallurgical enterprises (see Table 5.2).<sup>30</sup> Table 5.3 illustrates the volume of waste generated by type, according to the 1990 study.

## METHODS OF WASTE DISPOSAL

To paraphrase Gosplan's Pirogov, the attitude of most managers under Soviet central planning was that wastes were not the problem of those who created them. This mentality was reinforced by the uneven

TABLE 5.2 Generation and disposal of toxic waste by sector, 1990<sup>a</sup>

Sector	<i>Volume Generated (thousands of metric tons)</i>	<i>Percent Recovered and Safely Disposed</i>
Total	302,083	11.85
Ferrous and non-ferrous metals	241,500	9.8 <sup>b</sup>
Construction materials	11,100	4.5
Fertilizer	7,200	9.5
Chemicals and petrochemicals	5,900	32.3
Energy	5,300	33.5
Automobiles and farm equipment	3,800	17.2
Lathes and instruments	1,600	7.3
Electronics	400	3.8
Pharmaceuticals	400	25.0
Coal	300	30.0
Heavy machinery	200	20.0
Other	22,583	26.5 <sup>b</sup>

<sup>a</sup>Based on a survey of 10,300 enterprises. Data do not include air emissions or waste-water discharge to surface water.

<sup>b</sup>Approximate.

Source: USSR Goskomstat, *Okhrana okruzhayushchei sredy i ratsional'noe ispol'zovanie prirodnikh resursov* (Moscow: Informtsentr Goskomstata SSSR, 1991), p. 130.

TABLE 5.3 Generation and disposal of toxic waste by type, 1990<sup>a</sup>

Waste Type	Volume Generated	
	(thousands of metric tons)	Percent Recovered or Safely Disposed
Total	302,083	11.85
Lead and lead compounds	44,292	4.0
Nickel and nickel compounds	25,298	6.0
Arsenic and arsenic compounds	4,785	0.3
Inorganic fluorine compounds	1,816	0.8
Hexavalent chromium compounds	1,002	30.0
Waste from galvanic processing	958	26.0
Used solvents	205	22.0
Phenols and phenol compounds	197	53.0
Expired chemicals and pesticides	17	53.0
Mercury and mercury compounds	8	4.0
Other	222,752	14.1

<sup>a</sup>Based on a survey of 10,300 enterprises. Data do not include air emissions or waste-water discharge to surface water.

Source: USSR Goskomstat, *Okhrana okruzhayushchei sredy i ratsional'noe ispol'zovanie prirodnikh resursov* (Moscow: Informtsentr Goskomstata SSSR, 1991), p. 131.

manner in which the Soviet economy developed. Central planners ensured that the economy produced goods expected of an advanced industrialized economy, and little attention was paid to the environmental consequences of such production—in particular, to the proper handling and disposal of waste. Lacking strict regulation, Soviet enterprises did not have to pay appreciable costs to dispose of their waste material output. Thus, the Soviet Union acted as a major industrial power that managed its waste disposal as do less-developed nations.

According to Soviet practice, almost all solid wastes were landfilled, yielding an estimated total of over 50 billion tons of waste piled up on land occupying 1,400 square kilometers.<sup>31</sup> According to the government's 1990 survey mentioned above, the volume of toxic wastes accumulated totaled 6.7 billion tons.<sup>32</sup> Yet over half of the almost 6,000 official municipal and industrial landfills monitored by the Soviet government did not meet public health norms at the end of the 1980s. More than three-quarters of the landfills in noncompliance were located in Uzbekistan, Georgia, Moldova, Latvia, and Turkmenistan.<sup>33</sup> Commenting on urban landfills in Russia, USSR Goskompriroda concluded that "The majority . . . are in an unsatisfactory condition; substances from wastes get into the soil and contaminate ground and surface water." In Latvia,

for instance, leaching chemicals contaminated groundwater in a radius of up to 1.5 kilometers from landfills serving Riga, Jurmala, Daugavpils, and other cities. In addition to the poor preparation of landfills, contamination problems have been exacerbated by a lack of heavy machinery (such as crawlers and scrapers) to grade, compact, and cover the waste properly.<sup>34</sup>

In March 1990, *Sovetskaya kul'tura* (Soviet Culture) featured a story about the dismal fate of Ilinka, a small town encircled by the ash heap of a power plant and by a landfill serving the Far Eastern city of Khabarovsk. An investigation after a fatal accident at the site revealed that the landfill had been operating unmonitored for almost twenty years. Both domestic and industrial wastes—often containing dangerous and toxic substances—were being dumped indiscriminately. The city of Khabarovsk spent no money to ensure that the landfill was operated in a safe manner, and though a cooperative enterprise had been put in charge of the landfill in 1989, the incoming refuse continued simply to be raked about, without any attempt to classify or process it. Residents living as close as three hundred meters from the landfill were threatened by swarms of insects, noxious fumes, and contaminants percolating through the soil. In the words of *Sovetskaya kul'tura*: “It seems that everything was done against common sense.” The newspaper labeled the dump “a model ecological catastrophe,” but it was quick to point out that the situation was not uncommon but rather “a gloomy symbol of what is happening all over the country.”<sup>35</sup>

In February 1990, *Turkmenskaya iskra* (Turkmen Spark) filed the following report on a dump located ten kilometers outside of Ashkhabad, the republic's capital:

The dump for common refuse begins far from its official boundaries. All around in a radius of about one kilometer, trash, scrap metal, and rags are scattered about. [Truck] drivers from industrial enterprises and even local residents do not drive up to the dump proper, but discard [rubbish] all about. One and one half kilometers from the site, homes stand in the village of Choganly. But the dump has no borders and, therefore, no sanitary zone. Trash is everywhere. But not simply common trash. People often illegally dump industrial wastes containing toxic substances . . . even though they should be disposed in specially arranged facilities.<sup>36</sup>

As alluded to in the preceding passage, the press has carried news stories about the frequent discovery of improperly disposed hazardous wastes. The picture pieced together from such reports is, in essence, one of enterprises dumping their wastes wherever and however it is conve-



In August 1992, officials in the Siberian oblast of Tomsk began testing a prototype incinerator for liquid hazardous wastes. In the background, construction of the oblast's first hazardous waste treatment facility begins. Photo: DJ Peterson.

nient for them, with little monitoring by officials and no threat of prosecution for violation of environmental codes.

As in the case of the defense plant in Gorlovka, the general practice among plant managers has been to let materials accumulate on-site indefinitely because the plants often lack access to officially permitted treatment and storage facilities for wastes. A casual survey of the Soviet industrial landscape reveals factory grounds littered with discarded waste and disused equipment. In Kyrgyzstan, managers have no choice in this matter: "The fact that we have no waste sites and store everything in our factories is a serious problem," asserted one local parliamentarian in 1991.<sup>37</sup> Industries with the greatest accumulation of toxic wastes on-site include metal refining, asbestos, chemicals, electric power, and oil refining.<sup>38</sup> An option for unscrupulous managers is illegal dumping off-site; *Stroitel'naya gazeta* carried the following commentary on the subject:

It is possible to cite numerous examples of enterprises surreptitiously carting away to dumps and ravines or releasing into the sewers or directly into the water table highly concentrated inorganic toxics and heavy metal compounds, which migrate through the soil or water into our homes and into the food on the table. Indeed, how can it be any other way, when the public health service and committee for environmental protection still do not have lists of enterprises' wastes and their permissible concentrations? Spot checks reveal only the most grave violations.<sup>39</sup>

The Soviet government monitored about 6,000 landfills nationwide, but this clearly raises a question: How many dumps went unregistered or unmonitored? For obvious reasons, comprehensive data on illegal waste sites are unavailable, but the number probably runs into the thousands. The number of large abandoned dumps around Moscow alone has been estimated at about 100.<sup>40</sup> In the 1980s, the Russian capital averaged 6 million tons of industrial refuse generated yearly; of this, one-sixth was discarded untreated in unlicensed dumps because the waste did not meet the sanitary norms required for it to be deposited in landfills having proper permits.<sup>41</sup> The prime minister of Kyrgyzstan acknowledged in 1989 that in the republic's capital of Bishkek (formerly Frunze), "five hundred tons of highly toxic waste are stored without observing essential sanitary norms."<sup>42</sup> In its review of waste disposal practices, the Collegium of the USSR Prosecutor cited the chemical, petrochemical, electronics, and metallurgical industries as having the worst record for disposing of hazardous wastes. According to USSR Goskompiroda, metallurgical enterprises, the largest producers of hazardous waste, managed to "recycle or detoxify" (read incinerate or properly landfill) just 10 percent of the waste they produced.<sup>43</sup> As a result of such performance, the Soviet government estimated that every year enterprises illegally dump 170,000 tons of waste sludge derived from galvanic processing, 74,000 tons of petroleum-based waste, 39,000 tons of phenol compounds, and 11,000 tons of used solvents. In addition, illegally dumped hazardous wastes contained an estimated 688,000 tons of arsenic, 251,000 tons of chromium, 129,000 tons of nickel, and 41 tons of lead. Finally, the improper disposal of mercury vapor lamps alone added more than 11 tons of mercury to the environment.<sup>44</sup>

In 1972, the government began experimenting with waste incineration to a limited extent. Seven incinerators were built in Russia with imported technology and are located in Moscow (two plants), St. Petersburg, Vladimir, Nizhnii Novgorod (formerly Gorkii), Murmansk, Vladivostok, Sochi, and Pyatigorsk. Three have been built in Ukraine, in Kiev, Sevastopol, and Kharkov. About 2.3 percent of all solid wastes in the late 1980s was incinerated, compared with 14 percent in the United States.<sup>45</sup>



Final preparation of an interim landfill for solid hazardous waste in Tomsk oblast. The facility was built to mitigate the large volume of waste improperly stored at local enterprises while construction proceeds on the oblast's treatment facility. Photo: DJ Peterson.

More incinerators are under construction. Burning waste is a controversial issue, however: Although it helps alleviate the storage problem and can be used to generate steam, the by-products of incineration (fumes and ash), if not strictly controlled, can prove to be more of a pollution menace. Indeed, efforts to burn trash have resulted in serious problems: *Trud* reported that an incinerator located in the resort town of Sochi dumped wastes containing pollutants as high as 3,000 times the legal norm into the Black Sea.<sup>46</sup> Associated pollution control technologies were not purchased when the city of Moscow imported its two incinerators from France and Denmark; as a result, public health officials have required the incinerators to operate at low capacity in order to minimize their emissions.<sup>47</sup>

## WASTE RECOVERY AND RECYCLING

Resource reclamation and recycling under the Soviet regime did not reach the scale found elsewhere in the world (see Table 5.1). The reasons for this lag are closely linked with the causes of the Soviet economy's resource intensiveness and inefficiency. In short, the extensive input orientation of Soviet development focused on the acquisition of virgin raw materials rather than on conservation and resource recovery—a policy reinforced by subsidized prices for such inputs that discouraged enterprises from seeking alternative, recyclable resources. This practice was sustained by the image of plenty in the minds of planners and managers: of limitless forests and huge, untapped reserves of coal, oil, and other natural resources. Finally, the cost of waste disposal was insignificant. Laws against illegal dumping were haphazardly enforced, and the maximum fine for violating environmental regulations averaged only 500–600 rubles.<sup>48</sup> Some enterprise managers found it expedient to pay repeated fines for violation of environmental laws rather than handle their wastes properly.<sup>49</sup>

As the waste accumulated, however, the inefficiencies dragged down the economy. The Soviet government attempted to correct the situation by using administrative means. In 1980, it enunciated the first of a series of resource conservation initiatives, a comprehensive and detailed resolution entitled “On Measures for the Long-Term Improvement of the Use of Recycled Materials in the National Economy.” An excerpt illustrating the intent of the measure follows:

With the goal of the long-term improvement in the use of recycled resources in the national economy, the USSR Council of Ministers resolves that:

1. USSR Gosnab [the USSR State Committee for Material and Technical Supply], USSR Gosplan, USSR ministries and organizations, the Councils of Ministers of the union and autonomous republics, the [executive committees] of the oblast, city, district, and rural soviets of People's Deputies, [and] managers of associations, enterprises, and organizations consider as [their] most important task the fundamental improvement of [their] work to organize the collection and most complete use of all forms of wastes from production and consumption, and also by-products, [and] that they consider the use of recycled resources to be an important reserve in increasing the effectiveness of social production.

2. By 1981, 1985, and 1990, USSR Gosnab [state supply agency], Tsentrosyuz [rural trade organization], and the Councils of Ministers of the union republics implement the purchase of used paper, used textiles, used polymers, worn-out tires, and cullet in volumes as stipulated in Enclosure No. 1. . . .<sup>50</sup>

The effort achieved some success: Between 1981 and 1987, the volume of recycled slag, wood, and paper increased by 30 percent, recycled petroleum products grew by 60 percent, and the volume of coal ash put to use increased by 80 percent. According to the state statistical agency, resource recovery efforts saved the economy from consuming an additional 55 billion rubles worth of raw materials during the 1986–1989 period.

Nevertheless, the disincentives to recycling prevailed, and the increase in resource recovery barely managed to outpace growth in consumption. During the 1980s, for example, the volume of wasted lumber left in forests increased by 40 percent, despite intensive conservation efforts in the logging industry.<sup>51</sup> Consequently, the overall “waste content” (*otkhodoemkost'*) of the Soviet economy declined by a mere 1.8 percent.<sup>52</sup> In its 1989 survey, USSR Goskompriroda estimated that coal- and oil-fired power plants produced 110 million tons of ash annually. Only 13 percent of this ash—largely that from plants burning oil shale in the Baltic region—was put to constructive use. The rest reportedly was land-filled.<sup>53</sup> For comparison, about 27 percent of the paper and cardboard in the Soviet Union was produced using recycled materials in the late 1980s, about the same rate as in the United States; in Hungary, Britain, and Japan the rate was over 50 percent.<sup>54</sup>

The modest achievements of the Soviet government's program can be attributed to its “command-administrative” nature that allowed detailed directives to be subverted easily by uncooperative ministries and enterprises. Planning and plan fulfillment frequently were uncoordinated, prompting the ubiquitous Soviet-style production bottleneck. One such bottleneck created a “used-paper crisis” in the mid-1980s. In the 1980 law previously mentioned, the government mandated that all enterprises and government agencies collect their waste paper for recycling. But by mid-decade, it became apparent that not enough processing capacity could be brought on line in time to handle the mounting quantities of paper collected. “Every day a bonfire burns in the courtyard of our building,” reported the editor of *Mayak kommunizma* (Beacon of Communism), a local newspaper in Perm oblast. “The recycling center is not accepting paper for recycling and we have nowhere to store it.”<sup>55</sup>

In its attempts to teach good citizenship, the Communist Party drafted its army of youthful aspirants to help the government with its recycling efforts. Again, the command-administrative system took its toll; although marginally effective, the mandatory recycling drives, with their heavy political content, imbued weary participants with faint identity with their Soviet state or Communist Party and scant sympathy for nature. An

engineer emigrating from St. Petersburg related the following anecdote to Radio Liberty in 1989:

When our little granddaughter joined the Pioneers, she was instructed to gather 10 kilos of old paper, to sell 3–4 rubles worth of handicrafts (to be made by her), to take a bouquet of flowers to the Piskarev Cemetery, and to gather 80–100 kilograms of scrap metal. Since a small child could not do this on her own, the task inevitably fell to us. We took the flowers to the cemetery, and the entire family went out collecting old books and newspapers which we took in two trips to the collection center. Rather than producing and selling the handicrafts, we simply gave our granddaughter three rubles. The toughest part was finding 80 kilos of scrap metal. We were fortunate enough to find an old iron bed in the street, but we had to pay a handyman to take it to the collection point.

Children were more zealous about recycling in Moscow, a mechanical engineer from the capital told Radio Liberty:

Although the idea is for the children to help clean up the city by gathering bits and pieces of discarded metal, they have realized that it is far less trouble to get hold of some large metal object. Since large metal objects generally are not left on the streets, the children simply steal them. I worked at a hardware accessories factory, and old presses and other metal parts always were left lying about under the awning in our yard. Pioneers would get into the yard through holes in the fences and steal everything they could. When I caught them, they said: "But these are being thrown out anyway." During these scrap metal drives, production dropped since factory workers had to be stationed as guards in the yard. The Pioneers also uncoupled the sidecar from my uncle's motorcycle and loaded part of the metal fence from his house on to it before pushing it to the collection point. . . . The [police] do not interfere in these incidents and simply tell us not to leave things without supervision.<sup>56</sup>

Other reports indicate that some resource recovery efforts may have been detrimental to the environment. An environmental group from the Ural Mountains city of Kirovgrad wrote *Trud* about an enterprise that recovered copper from old wiring:

The insulation is burned and the copper remains. During this procedure, phenol and hydrogen chloride are released into the air. The resulting levels by which this exceeds the maximum permissible concentration is simply fantastic—from 20- to 750-fold.<sup>57</sup>

The challenge of disposing of municipal waste will only increase in the future as economic reform gathers momentum in the post-Soviet era

and the region's economies become commercialized. The end of government subsidies for raw materials will help provide effective stimulation to reduce unnecessary consumption of material inputs and to increase recycling and resource reclamation. After their legalization in 1987, the cooperative movement dramatically expanded the opportunity for recycling and resource recovery. In many instances, entrepreneurial workers at a state enterprise formed cooperatives to make use of valuable goods wasted at their place of work. In 1990, over 3,200 cooperative firms engaged in the production of everything from troughs for livestock farms to plastic packaging materials and toys, grossing over 1.2 billion rubles in the process.<sup>58</sup>

Despite these improvements, significant bureaucratic obstacles remained. Over years of operation, the Motorstroitel (Motorbuilder) enterprise, a Zaporozhye-based aircraft engine manufacturer, accumulated hundreds of tons of high-quality scrap metal. Motorstroitel had tried to sell the metal to local companies, including the state-owned Vtorchermet recycling enterprise, but the pieces were too big to comply with state standards and Motorstroitel had no means to cut up the scrap. In 1989, Motorstroitel negotiated a barter deal with an international-trading cooperative, Inzhener. In exchange for 200 tons of scrap metal, Motorstroitel received three Volvos, a Nissan microbus, 300,000 disposable syringes, and 1.2 million rubles. Amid claims that the firm had engaged in the "export of strategic minerals," it was charged with "destruction of socialist property" for illegally moving the scrap off its territory. After a two-year investigation involving the KGB, it was determined that Motorstroitel had not violated the law, and, indeed, the state netted a half million rubles on the deal.<sup>59</sup>

## RADIOACTIVE WASTE

Although official data on solid wastes are scarce, official information on the generation and fate of radioactive waste is for the most part unavailable—first because of poor monitoring, but more important, because of military secrecy. Secrecy and "national security interests" spell bad news for the environment, as has become starkly evident to U.S. citizens who have recently learned of decades of mishaps at U.S. nuclear weapons facilities. It is reasonable to assume that the Soviet military establishment experienced similar problems with its nuclear weapons programs.

As part of the response to the Chernobyl accident, the government began monitoring background radiation levels at 2,200 stationary meteorological stations across Soviet territory. USSR Goskompriroda reported in

1989 that with the notable exception of the oblasts in the Russian Federation, Belarus, and Ukraine affected by Chernobyl, “the radiation situation does not differ substantially with background levels.”<sup>60</sup> Published scientific studies also indicated that in the vicinity of nuclear power plants, radiation levels were within norm.<sup>61</sup> Despite this reassuring evidence, the Soviet media began to report isolated mishaps involving low- and medium-level wastes in 1989. Subsequent efforts by public health agencies to monitor radiation levels, often using detectors mounted on helicopters, uncovered even more problems. The anecdotal evidence brought forth to date suggests that the situation is alarmingly severe.

For example, in the town of Sillamae in northeastern Estonia, nearly 300 children attending two kindergartens suffered a loss of hair in 1989. When the story first broke in March of that year, the Soviet press agency, TASS, reported that specialists initially had suspected the cause to be natural radioactivity emanating from local shale deposits. Subsequent tests, however, revealed that background radiation in the town was normal. After months of speculation and controversy, the former director of the Baltiets enterprise, a local defense industry, revealed that his company had dumped radioactive wastes in the town. The two kindergartens were built over the dump, separated from it by only a thin layer of sand.<sup>62</sup>

In Kirovgrad, gravel from uranium mining was used for road construction, causing radiation levels to exceed health norms in twelve locations around the city.<sup>63</sup> In Brest, situated on the Polish-Belarusian border, a source of radiation was discovered only a few hundred meters from the ancient fortress located in the city center. Radiation levels in the area were reported in the media to be up to 900 microroentgens per hour—60 times greater than normal background levels. (The Soviet health standard is 18 microroentgens per hour.) Since the early 1960s, the location had been the site of a secret facility for transferring uranium ore coming into the Soviet Union from mines in Eastern Europe. According to Novosti Press Agency, the uranium arrived in open train cars and was transferred by hand “in a primitive fashion.” In the autumn of 1989, the transfer facility was relocated outside of Brest, and some soil from the site was removed and discarded outside of town.<sup>64</sup>

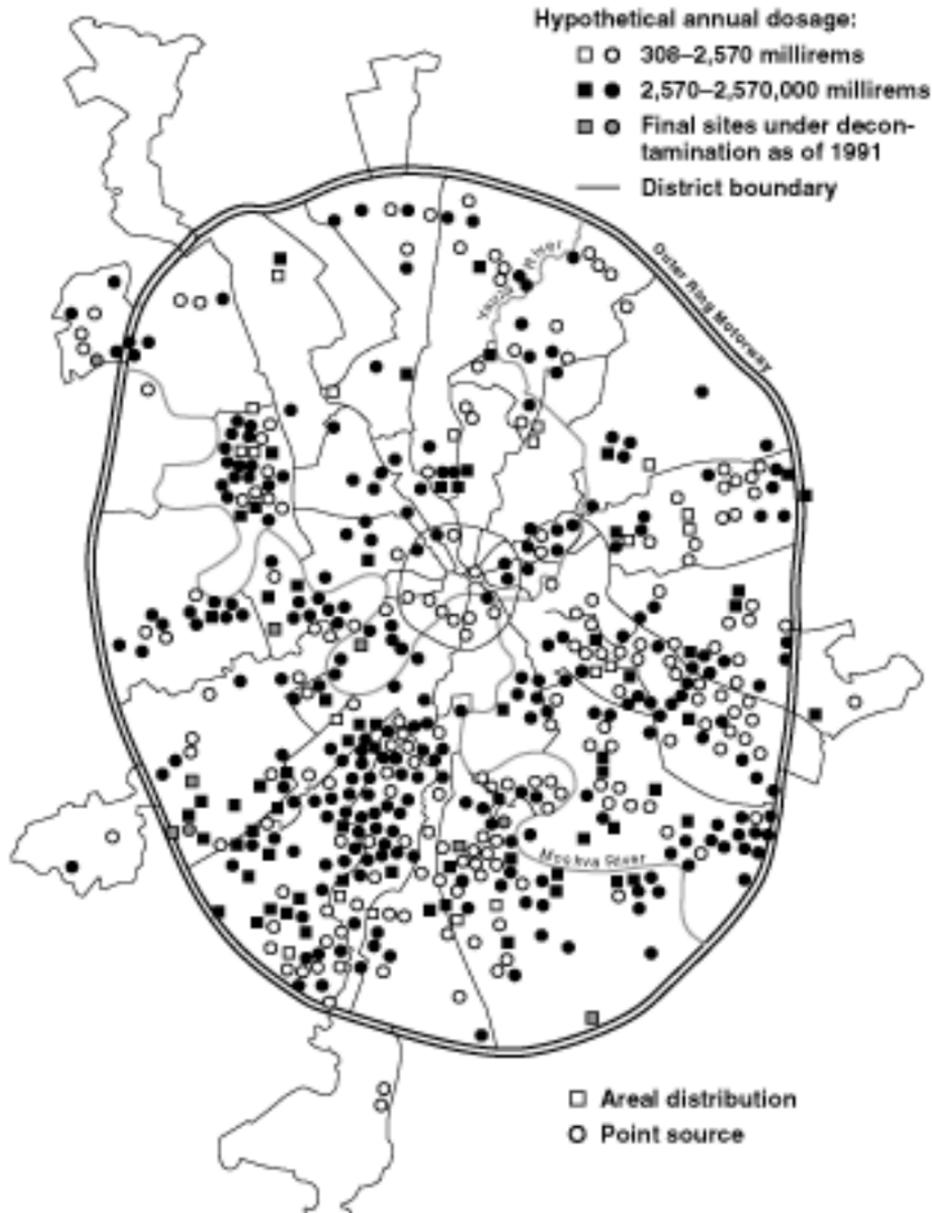
Twenty-six “radiation-related accidents” were registered in the Turkmen capital of Ashkhabad in 1989, according to the republican newspaper *Turkmenskaya iskra*. Fourteen of these incidents involved the misplacing of instruments containing radioactive components. A worker at a local medical research institute discarded 238 vials containing radioactive residues. This was only one of seven such violations at the institute caused by a “casual attitude” toward handling radioactive

materials and lax supervision by public health officials.<sup>65</sup> In the scientific research center of Novosibirsk, a helicopter survey of the city revealed 84 “radiation anomalies.” Again many sources were determined to be components from instruments “mindlessly and recklessly thrown away.” But other sources were “homemade”—enterprising locals had pilfered construction materials to build houses and the like. Why “hot” bricks, beams, and such items were radioactive was not explained. The city’s chief health officer added:

From the helicopter water mains that at one time had carried radioactive pulp to a factory were discovered in the Zarya 1 truck farm cooperative near the settlement of Pashino. Many years ago a kilometer of pipe was stolen from an enterprise and sold to the cooperative. The gardeners watered their plots with radium-226 remaining in the pipes.<sup>66</sup>

In June 1990, “No Trespassing” signs appeared in Moscow’s Izmailovskii Park warning passersby that decontamination work was under way in the area. As part of a routine survey, “acute sources of radiation” were detected. The reason: The popular park had served as a landfill for household and industrial wastes during the 1950s.<sup>67</sup> The park was not the only radioactive site found in the capital. Between 1982 and 1991, the Geo-ekotsentr concern, traversing the entire capital by car and by foot, discovered and eliminated approximately 600 radioactive sources. By 1991, only 15 remained to be decontaminated.<sup>68</sup> “As a result of someone’s carelessness [or] negligence, many radioactive sources, which are used in many branches of industry, turn up now and then in the most unexpected places,” commented a city council member studying the problem.<sup>69</sup> Included among those “unexpected places” were almost three-quarters of city schools: “Even experienced specialists were disturbed,” noted *Rabochaya tribuna*.<sup>70</sup> The newspaper published a previously classified map of Geo-ekotsentr’s work on its front page, creating a stir in the city (see Figure 5.1).

In most cases, the radioactivity was confined to an extremely small point and did not present a serious health hazard. But a half-hour exposure to a source at the upper end of the spectrum (2,570–2,570,000 millirems per year) could have produced a dosage in excess of the U.S. safety standard for one year.<sup>71</sup> Work with radioactive materials in Moscow dates back to the late 1940s, a period when there were no regulations governing the management of radioactive wastes. “People handled the problem simply,” commented *Moskovsk Pravda*: “Into the dump truck and go a ways.”<sup>72</sup> In many instances, radiation patches were found along city thoroughfares as well as highways leading out of Moscow,<sup>73</sup> but several sources also were discovered in residential districts. As the



Sources: *Soviet Geography*, March, 1991, p. 204, based on data in *Rabochaya tribuna*, January 30, 1991, p.1; *Vechernyaya Moskva*, February 18, 1991, p.1. Reprint courtesy V.H. Winston and Son, Inc.

Note: Points are extrascalar. This diagram assumes mean annual dose is equivalent to one-third maximum one-time dosage. Five hundred millirems per year is the U.S. health standard.

**Figure 5.1. Mean Annual Biological Gamma Radiation Dosage for Moscow at Sites of Above-Mean Background Radiation**

city rapidly grew outward in the postwar years, construction workers turned up long-forgotten dumps containing the hazardous materials.

Despite the number of radiation accidents in Moscow, the city does have radioactive waste disposal services. In 1990, the Radon Scientific Production Enterprise collected waste from over 1,300 businesses, research institutes, and hospitals in Moscow and neighboring oblasts. According to reports, the materials are trucked (with police escort) to a disposal facility near the city of Zagorsk where they are buried in lead and cement receptacles. Sixteen such facilities (*spetskombinat*) operated throughout Russia in 1990, and more were under development in Kazan, Ufa, and Chelyabinsk. The respected weekly *Pravitel'stvennyi vestnik* pointed out ominously, however, that many of Russia's storage facilities are "not sufficiently equipped with special technical equipment. They lack transport vehicles and measurement and dosimetric apparatuses."<sup>74</sup>

Notwithstanding Moscow's cleanup work—and there has without doubt been progress—uneasiness remains there and elsewhere about contaminated cities, and the media have been strong voices in the concern expressed. For example, in St. Petersburg, 1,500 radioactive "patches" were found, only a fraction of which have been decontaminated. "The situation is close to critical," reported Yu. N. Shchukin, chairman of the city's commission on radiation monitoring, in 1990. A radiation map of the city was drafted, but it was placed "under lock and key."<sup>75</sup> Reporting on the discovery of radioactive wastes in Tashkent oblast and Samarkand, a television newscaster mused, "Why are radioactive dumps multiplying?"<sup>76</sup> When it reported about a radiation incident at Dushanbe, *Trud* led with the query: "Is there a guarantee against 'micro-Chernobyls'?"

## **RADIOACTIVE WASTE: THE CASE OF THE SOVIET NUCLEAR WEAPONS COMPLEX**

One partial answer to these questions is the fact that despite improvements in access to environmental information, glasnost in the Soviet era largely failed to penetrate the military-industrial complex. The prevailing shroud of secrecy was most opaque when it involved the core of the Soviet defense structure: nuclear weapons. Referred to only by their numerical postal abbreviations, entire cities involved in nuclear weapons production were closed to all but those who worked there. Three major facilities located east of the Ural Mountains in Russia produced material for Soviet nuclear weapons: Chelyabinsk-40, Krasnoyarsk-26, and Tomsk-7. In the haste to build up its nuclear weapons arsenal, the Soviet leadership was willing to take great risks

and to sacrifice the environment as well as the public's health for the sake of national security. In the post-Soviet era, these nuclear cities have begun to emerge from behind the curtain and, in the process, have started to reveal their environmental woes. As one *Izvestiya* reporter concluded: "Nothing good came of the excessive secrecy."<sup>77</sup>

Five nuclear reactors at the Siberian Atomic Energy Station at Tomsk-7 produced nuclear material to be processed at the nearby Siberian Chemical Combine. The Tomsk-7 complex, located 15 kilometers northwest of the Siberian provincial center of Tomsk, first started operations in 1958 and served as the USSR's main processing facility in its waning years.<sup>78</sup> Over three decades, "127,000 tons of solid and 33 million cubic meters of liquid radioactive waste" produced at Tomsk-7 reportedly were stored underground in a sandy bed located 10–12 kilometers from the River Tom, a tributary of the Ob. According to the manager of the Siberian Chemical Combine (abbreviated Sibkhimkombinat), data on the radioactivity of buried wastes were classified, and total radioactivity in the region was unknown.<sup>79</sup>

Accusations of waste management problems at the complex date back at least to 1968, when a plant worker reported to the CPSU's Central Committee that managers had dumped "several tons of enriched atomic material into the reservoir."<sup>80</sup> At one point, a senior engineer responsible for monitoring the storage of "special produce" (*spetsproduktsiya*) reported radiation problems to General Secretary Leonid Brezhnev. Though A. Grigor'yev was rebuked for his bold action, officials apparently attempted to remediate the situation.<sup>81</sup> In 1991, workers at the Sibkhimkombinat alleged to *Izvestiya* that plant management had "discharged liquid radioactive wastes directly into the Tom for many years."<sup>82</sup>

In May 1990, *Izvestiya* reported that 38 people in Tomsk-7 were contaminated after consuming wild game tainted with radioactivity. Describing the situation as "very threatening," the newspaper noted that there were "contaminated reservoirs, open to all," including the wild game. A facility for storing radioactive wastes from the plant was not properly fenced off and allowed wild animals to enter the area. Whereas *Izvestiya* described the situation as a danger, local officials held to the traditional line: *Vse tam prekrasno* (everything there is fine).<sup>83</sup>

The Krasnoyarsk-26 complex, located on the Yenisei River 50 kilometers north of the central Siberian city of Krasnoyarsk, began to produce plutonium for Soviet warheads in the early 1950s.<sup>84</sup> Three reactors at the facility, known officially as the Order of Lenin Mining-Chemical Combine, were encapsulated in a massive cement structure 250 meters underground—secure from "a nuclear strike."<sup>85</sup> Despite these safety pre-

cautions, studies made thousands of kilometers to the north at the mouth of the Yenisei reportedly revealed high levels of radiation.<sup>86</sup> Another story, appearing in the environmental journal *Priroda i chelovek* (Man and Nature), alleged that gamma radiation levels in the Yenisei River at points below discharge from the Krasnoyarsk-26 facility were 120–150 times above normal.<sup>87</sup> Speaking with *Izvestiya* in November 1991, the director of Krasnoyarsk-26 denied any release of radiation resulting from an accident—a statement that did not rule out the possibility of radioactive by-products released as a part of regular operations.<sup>88</sup>

The tragic history of the Mayak enterprise near the city of Kyshtym in the Ural Mountains epitomizes the problem of handling nuclear waste and the potential for disaster. Mayak, located in the top-secret town of Chelyabinsk-40, formed the core of the early Soviet nuclear weapons program. Its reactors, code named “Object A” and “Object B,” started operations in 1948. They were the first industrial reactors in the USSR and provided the material for its first atomic bomb, detonated the following August.<sup>89</sup> Between 1949 and 1952, “several million curies” of untreated high-, medium- and low-level radioactive wastes from processing work at Mayak were released directly into the Techa River, a tributary of the Ob. Intense radiation levels immediately caused widespread fish kills along the course of the Techa. Eventually, traces of radioactivity showed up in the Arctic Ocean—nearly 1,000 miles downstream. Sensing that “something was not right,” in the measured words of Soviet Deputy Prime Minister Lev Ryabev, authorities fenced off the river with barbed wire and evacuated some 7,500 people from villages along its course.<sup>90</sup>

Next, the plant’s directors decided to divert wastes from the plant into nearby Lake Karachai. Because the small lake lacked an outlet, it shortly accumulated radioactivity totaling 120 million curies. (By comparison, an estimated 50 million curies of radiation were released by the accident at Chernobyl.) Standing on the lake shores for an hour without protection would result in a lethal dose of radiation.<sup>91</sup>

Engineers turned to a third disposal method—a series of 16 underground storage tanks made of cement. But on September 29, 1957, the cooling system broke down in one tank holding 70,000–80,000 tons of radioactive sludge. An uncontrolled fission reaction ensued, resulting in a massive explosion that blew off the tank’s cement lid and spewed 2.1 million curies of radioactive isotopes of cesium, ruthenium, and strontium as high as 1 kilometer into the atmosphere. The spray of radioactive materials precipitated over a swath of land over 100 kilometers long in Tyumen, Chelyabinsk, and Yekaterinburg (Sverdlovsk) oblasts—an area marked by 217 settlements and inhabited by 270,000 people. Ten thou-

sand people were permanently evacuated from some of the most dangerous locations; entire villages were razed and their names removed from the map.<sup>92</sup> Although the accident was the subject of a 1979 book by dissident biologist Zhores Medvedev published in the West, the event officially was confirmed by *Izvestiya* only in 1989—thirty-two years after the incident.<sup>93</sup>

In 1967, a severe drought plaguing the Ural Mountains region caused the level of Karachai to drop and to expose radioactive materials on the dry shores of the lake. Gusting winds subsequently picked up this material, dispersing 600 curies of cesium and strontium over about 2,000 square kilometers and affecting more than 40,000 people.<sup>94</sup> According to Petr Somin, chair of the Chelyabinsk regional parliament, a total of 437,000 residents of the area were exposed to radioactivity as a result of these mishaps, with chronic radiation sickness diagnosed in 935 cases.<sup>95</sup> Local environmental activists contend that in reality more people probably were afflicted over forty years of negligence, but doctors, while carefully studying victims' development, were forbidden to tell their patients that they had been exposed to radiation.<sup>96</sup>

In the 1970s, a new waste storage facility was constructed at Mayak, but even this facility reportedly has been prone to breakdowns of its cooling system and to regional power outages. Meanwhile, a half million tons of solid wastes have been buried in 200 "trench-type" storage facilities "lacking monitoring equipment."<sup>97</sup> The total radioactivity of liquid wastes confined in a parcel 30–40 square kilometers around Mayak has been pegged at 1 billion curies—20 times the radioactivity released by the Chernobyl accident.<sup>98</sup> Soil and groundwater down to a depth of 100 meters have been contaminated around Karachai, and the area of contamination has been spreading out at the rate of about 80 meters per year, threatening a reservoir supplying the city of Chelyabinsk.<sup>99</sup> In the late 1960s, workers started filling in Lake Karachai with rock and soil, and plant engineers expect to seal it over with concrete eventually by the mid-1990s, but a 1991 government commission concluded such an approach was "a crime" that threatened to exacerbate the leaching of radioactive isotopes into the groundwater.<sup>100</sup>

Before the USSR disintegrated, Soviet Deputy Prime Minister Ryabev claimed that 80 percent of the land contaminated by the explosion had been decontaminated and restored to "economic activity" by the end of the 1980s and that the remainder would be recovered by the middle of the 1990s. Forty years after the contamination of the Techa, *Moscow News* noted: "People continue to use the river and grow contaminated food which they eat themselves and ship to the city. Not a single large village has been evacuated, because it is too expensive to resettle large numbers

of people. Only small villages were evacuated and people were offered flimsy prefab constructions to live in.”<sup>101</sup>

To prevent the further spread of radioactivity down the Techa River, engineers built a series of dams in the region of Chelyabinsk-40 that created a cascade of several reservoirs. Today these reservoirs hold a total of 500 million cubic meters of radioactive water containing almost 200,000 curies of radioactivity. While the Mayak reactors were in operation, the contaminated water from these reservoirs was used as a coolant and through evaporation helped regulate their level. Now the reservoirs have become unstable, and many fear that without intervention, they may overflow their banks. To help resolve the situation, the nuclear power ministry started construction of the South Urals Atomic Energy Station in 1983.<sup>102</sup> Rising protests from around Chelyabinsk oblast, however, effectively stopped work on the project in 1989.

The official attitude toward nuclear waste characterized the general approach of the Soviet regime toward the environment: The vast reserve of nature was capable of accommodating and mitigating any form of pollution created by society. “Who knew it would turn out this way?” commented Mayak’s chief engineer on the original decision to dump radioactive waste into the Techa:

We reckoned that the river water would dilute the radionuclides to safe levels. We failed to take into account—we simply did not know—that the radioactivity would be absorbed by the silt on the bottom; it bound and concentrated two million curies of radioactivity in the upper course of the river. Knowledge about the atom among academics then was at the level of today’s tenth graders.<sup>103</sup>

## **PUBLIC OPINION AND THE IMPLICATIONS FOR WASTE MANAGEMENT**

The revelations under glasnost of such radiation catastrophes have led to a state of mind among the public dubbed “nuclear syndrome” and “radiophobia”—a state of mind characterized by the assumption that every health problem is related to radiation. “It seems that Novosibirsk is far away from Chernobyl,” noted *Izvestiya*, “but two or three months cannot pass without a rumor circulating the city about some form of radiation [problem] here.” When the meat ration in the Siberian city suddenly was raised from one to three kilograms per coupon, people were not happy but suspicious. Shoppers assumed the meat was radioactive because media reports had told of meat shipments originating from regions contaminated by Chernobyl. Tests by specialists reportedly revealed, however, that the food was not tainted.<sup>104</sup>

In May 1990, millions of dead starfish and other sea animals washed up on the beaches of the White Sea. Owing to the presence of several important navy bases in the region, speculation immediately focused there. Was the phenomenon the result of an accident aboard a nuclear submarine? Apparently not, concluded a team of investigators sent to the region, although the exact cause was not ascertained.<sup>105</sup> That summer, local residents concluded that suspicious tremors in the city of Dimitrovgrad were caused by the injection of liquid radioactive wastes into underground deposits on a reserve of the nearby Atomic Reactors Scientific Research Institute. A commission of international experts was called in to investigate; they concluded that the tremors were from explosions set off by prospectors searching for oil in the region.<sup>106</sup>

In Voronezh, the site of one of the oldest Soviet-built nuclear power stations, the local radio station broadcasts radiation levels during its morning weather forecast. Electronic signs installed on the city hall and train stations in Arkhangelsk indicate radiation levels in that city. Nevertheless, citizens remain skeptical and distrustful of such information. "Over the past two years, our newspaper has regularly informed its readers about background radiation in Moscow," noted the evening paper *Vechernyaya Moskva*. "If we do not mention a particular district for three or four days, distressed phone calls come pouring in from there asking: 'Did something happen here?'"<sup>107</sup> In the same way people in the United States engaged in a purchasing run on radon test kits in the 1980s, people in the former Soviet Union have been grabbing up as many radiation dosimeters as can be produced. After a profile of the Izotop enterprise and its "Bella" hand-held dosimeter appeared in a Ukrainian newspaper, the firm was inundated with orders—so many that it had to suspend accepting new orders for two years.<sup>108</sup> Despite these developments, only 5 percent of the population polled in 1990 expressed satisfaction with the amount of information available on radiation conditions.<sup>109</sup>

In a new effort to come to terms with the country's hazardous waste management problems, USSR Goskompriroda in 1990 called for the construction of special facilities "to store and to reprocess industrial toxic wastes," proposing that "no less than ten" be opened in Ukraine's Donets-Dnieper region alone by 2005.<sup>110</sup> Although these recommendations never were adopted by the Soviet government, they would have come under fire. Given past problems with the handling and disposal of hazardous wastes, citizens have organized to oppose the siting and operation of hazardous waste facilities in their communities. Similar to that in the West, opposition in the former Soviet Union has been based on the "not in my backyard" argument, under which local residents see little benefit and great hazard from having such a facility located nearby.

The demise of Soviet authority and the rise of citizen activism and regionalism have reinforced this trend.

For example, residents of the towns of Izhora and Tosno outside St. Petersburg have demanded the closure of the twenty-year-old Krasnyi Bor hazardous waste incinerator and storage facility, which serves 860 enterprises in the St. Petersburg region. The government had elaborated plans to increase the facility's processing capacity from 80,000 tons to 120,000 tons of toxic waste annually, but the local Izhora Green movement used the occasion to mount a vigorous opposition to Krasnyi Bor, citing the plant's numerous violations of existing environmental protection regulations.<sup>111</sup> In the provincial town of Zagorsk (renamed Sergiev Posad), the city council voted in 1989 to cancel a huge new facility proposed to process and store 100,000 tons of hazardous wastes per year. "The cleaning of Moscow at the cost of Zagorsk does not look very noble, especially since Zagorsk itself is in need of an ecological cleansing," wrote a group of residents.<sup>112</sup> The Kremlin had been considering siting a large nuclear waste storage facility on the Kola Peninsula. In the summer of 1990, the Murmansk oblast soviet asked Boris Yeltsin to move the project, scheduled to be completed in the mid-1990s, to the uninhabited island of Novaya Zemlya, site of a nuclear weapons test range.<sup>113</sup> In October 1990, the city soviet of nearby Arkhangelsk banned the production or import of any radioactive materials without the express consent of the local government; Arkhangelsk, they declared, was a "nuclear-free zone."<sup>114</sup>

At the First USSR Congress of People's Deputies, convened in May-June 1989, it was revealed that a decade-old secret project being built across the Yenisei from Krasnoyarsk-26 was to process and store wastes from commercial nuclear power plants. Initiated in the 1970s without public comment and consent, the project was planned to be the largest such facility in the world. As part of its operations, the reprocessing plant was to convert high- and low-level radioactive waste to liquid form to be pumped through a 2-kilometer pipeline (dubbed the "Krasnoyarsk subway") under the majestic Yenisei River and injected into a clay formation 700 meters underground on the other side. The reaction to the news of such a scheme being built near Siberia's largest city, with a population of over 1 million people, was "like an exploding bomb," wrote *Sotsialisticheskaya industriya*. Local authorities ordered an immediate halt to construction pending the outcome of an environmental impact study. Citizens' anger that such a project (estimated to cost 2 billion rubles) could be conceived and built under their backyards without prior consent virtually has ensured that it will not be completed as planned.<sup>115</sup>

The problem of nuclear waste disposal is exacerbated by the fact that the USSR was a waste importer. As part of its arrangements to build nuclear power plants in Eastern Europe, Finland, and Cuba, the Soviet government contracted to provide its clients with nuclear fuel and then to receive the spent material for reprocessing. Responding to citizens' accusations that Russia was being used as a nuclear waste dumping ground, the quasi-democratically elected Russian Congress of People's Deputies under the leadership of Boris Yeltsin passed a resolution calling for laws to be drafted prohibiting the burial of nuclear waste from abroad as well as from other Soviet republics.<sup>116</sup>

Public opposition to waste treatment and disposal schemes will force policymakers to reconsider the activities that contribute to the situation. The lack of ready disposal sites in Russia for radioactive waste, for instance, may force Lithuania and Ukraine to reconsider their reliance on nuclear power in the long term. But this will not solve the problem of handling existing waste. In an attempt to overcome public resistance to the construction of a large-scale decontamination facility to handle the Chernobyl cleanup, Viktor Bar'yakhtar, chair of the Ukrainian Academy of Sciences, pointed out: "It's not worth questioning the necessity of such a beneficial complex; we can't do without it."<sup>117</sup> Writing on the Krasnyi Bor scandal, a commentator noted the alternative to having no treatment facility at all: "The one million tons [of waste treated] would have ended up in forests, rivers, lakes, and on the bottom of the Gulf of Finland."<sup>118</sup>

## Notes

1. *Trud*, January 17, 1990, p. 3.
2. Radio Moscow, March 18, 1990.
3. *Pravda*, January 11, 1991, p. 3.
4. Radio Moscow, May 5, 1990.
5. *Argumenty i fakty*, No. 13, 1989, p. 1.
6. TASS, May 21, 1990.
7. "Vrachevat' rany zemli" (no author), *Politicheskoe obrazovanie*, No. 6, 1989, p. 34.
8. TASS, May 30, 1990.
9. *Stroitel'naya gazeta*, October 26, 1989, p. 2.
10. *Izvestiya*, July 26, 1989, p. 6. For more on Moscow's waste management program, see Semyon Feldman, "Digging for Gold," *Business in the USSR*, November 1990.
11. *Rabochaya tribuna*, May 8, 1990.
12. Central Television, "Vremya," May 10, 1990.
13. TASS, May 22, 1990; *Trud*, May 26, 1990.
14. *Izvestiya*, May 10, 1990, p. 6.
15. Central Television, "Vremya," May 22, 1990.

16. *Trud*, May 26, 1990. For more on the incident, see *Ogonek*, No. 26, 1990.
17. N. L. Pirogov, "Chto zhe delat' s otkhodami?" *Energiya: Ekonomika, tekhnika, ekologiya*, No. 12, 1988, p. 23.
18. The term *bytovye otkhody* (literally, everyday or domestic waste) is misleading. Although not defined, data on *bytovye otkhody* are probably based on the volume of waste collected by municipal services from residences and offices and from some commercial or industrial enterprises.
19. TASS, May 21, 1990. A figure of 56 million tons was cited at a meeting of the Collegium of the USSR Prosecutor's Office convened to examine problems with waste disposal. In its long-range environmental protection plan, USSR Goskompriroda pegged the volume at 57 million tons. *Ekonomika i zhizn'*, No. 41, 1990, insert page 1.
20. The Russian economy produced 27 million tons of trash (about 48 percent of the Soviet total), or 186 kilograms per inhabitant. USSR Goskompriroda, *Sostoyanie prirodnoi sredy v SSSR v 1988 g.* (Moscow: VINITI, 1989), p. 66; USSR Goskompriroda, *Sostoyanie prirodnoi sredy i prirodookhrannaya deyatel'nost' v SSSR v 1989 godu* (Moscow: Institut Molodezhi, 1990), p. 32.
21. D. N. Ben'yamovskii and E. M. Bukreev, "Zavod dvojnogo naznacheniya," *Energiya: Ekonomika, tekhnika, ekologiya*, No. 9, 1987, p. 29.
22. U.S. Bureau of the Census, *Statistical Abstract of the United States: 1991* (Washington, DC: Government Printing Office, 1991), p. 212.
23. USSR Goskompriroda, *Sostoyanie . . . v 1988 g.*, p. 82; USSR Goskomstat, *Press-vypusk*, No. 494, November 1, 1989.
24. Pirogov, "Chto zhe delat'," p. 23.
25. *Ibid.*; USSR Goskomstat, *Okhrana okruzhayushchei sredy i ratsional'noe ispol'zovanie prirodnykh resursov v SSSR* (Moscow: Finansy i statistika, 1989), p. 154; *Ekonomika i zhizn'*, No. 6, 1990, p. 17.
26. *Ekonomika i zhizn'*, No. 12, 1990, p. 14.
27. Pirogov, "Chto zhe delat'," p. 23; V. I. Naidenov et al., "Chem dal'she v les," *Energiya: Ekonomika, tekhnika, ekologiya*, No. 4, 1988, p. 17; *Ekologicheskaya gazeta*, Nos. 11-12, 1991, p. 6, cited in JPRS-TEN-92-008, p. 75. According to research conducted by USSR Gosplan, the Soviet forest products industry used just over one-quarter of all wood harvested. *Ekonomicheskaya gazeta*, No. 19, 1986, p. 2.
28. S. N. Bobylev and A. Sh. Khodzhaev, *Bor'ba s poteryami sel'skokhozyaistvennoi produktsii*, cited in T. S. Khachaturov and K. V. Papenov, eds., *Effektivnost' prirodookhrannykh meropriyatii* (Moscow: Izdatel'stvo Moskovskogo Universiteta, 1990), p. 80.
29. Radio Moscow, citing Interfax, February 21, 1990.
30. *Vestnik statistiki*, No. 11, 1990, p. 64. The study was conducted by USSR Goskomstat, USSR Goskompriroda, and the USSR Ministry of Health and covered 10,300 enterprises.
31. USSR Goskompriroda, *Sostoyanie . . . v 1988 g.*, p. 82; O. V. Gorbatyuk et al., "Fermentery geologicheskogo masshtaba," *Priroda*, No. 9, 1989, p. 72.
32. *Vestnik statistiki*, No. 11, 1990, p. 64.
33. USSR Goskomstat, *Okhrana okruzhayushchei sredy . . . v USSR*, p. 37.

34. USSR Goskompriroda, *Sostoyanie . . . v 1988 g.*, pp. 32, 34, 65.
35. *Sovetskaya kul'tura*, March 24, 1990, p. 4.
36. *Turkmenskaya iskra*, February 21, 1990, p. 4.
37. Anatolii Grebenyuk, deputy chair, Committee on Ecology, Supreme Soviet of Kyrgyzstan, presentation at conference on Democratic Federalism and Environmental Crisis in the Republics of the Former Soviet Union, Moscow, August 1991.
38. *Vestnik statistiki*, No. 11, 1990, p. 64.
39. *Stroitel'naya gazeta*, October 26, 1989, p. 2.
40. Feldman, "Digging for Gold," p. 96.
41. *Izvestiya*, July 26, 1989, p. 6.
42. *Sovetskaya Kirgiziya*, July 30, 1989, p. 2.
43. USSR Goskomstat, *Okhrana okruzhayushchei sredy i ratsional'noe ispol'zovanie prirodnikh resursov* (Moscow: Informtsentr Goskomstata SSSR, 1991), p. 130.
44. *Vestnik statistiki*, No. 11, 1991, p. 64.
45. USSR Goskompriroda, *Sostoyanie . . . v 1989 godu*, p. 32. U.S. Bureau of the Census, *Statistical Abstracts, 1991*, p. 212. Between 10 and 12 percent of refuse from Moscow is reportedly incinerated, Gorbatyuk et al., "Fermentery geologicheskogo," p. 72.
46. *Trud*, October 6, 1989, p. 4.
47. *European*, January 11, 1991.
48. Mikhail Galyatin, staff assistant, RSFSR Council of Ministers, presentation at conference on Democratic Federalism and Environmental Crisis in the Republics of the Former Soviet Union, Moscow, August 1991.
49. See, for example, *Stroitel'naya gazeta*, October 26, 1990, p. 2.
50. "O merakh po dal'neishemu uluchsheniyu ispol'zovaniya vtorichnogo syr'ya v narodnom khozyaistve," *Sobranie postanovlenii pravitel'stva Soyuz Sovetskikh Sotsialisticheskikh Respublik*, No. 7, 1980, pp. 163-172.
51. *Vestnik statistiki*, No. 11, 1991, p. 62. In 1990, 2.63 million cubic meters of lumber were discarded at the place of cutting.
52. Pirogov, "Chto zhe delat'," p. 24. Between 1981 and 1985, the volume of waste produced by the economy declined by more than 6 percent, but this improvement was largely negated in the following two years.
53. USSR Goskompriroda, *Sostoyanie . . . v 1988 g.*, p. 58. See also Khachaturov and Papenov, *Effektivnost'*, pp. 35-36.
54. USSR Goskomstat, *Okhrana okruzhayushchei sredy . . . v SSSR*, p. 156. It should be pointed out that until recently in the United States, the vast majority of recycled paper was made from scrap and defective goods that never made it out of the paper mills.
55. *Zhurnal*, Nos. 2 and 11, 1986; No. 12, 1987; and No. 12, 1988.
56. Radio Liberty, Soviet Area Audience and Opinion Research, *Soviet Background Notes: Unevaluated Comments by Recent Emigrants*, SBN 4-89, May 1989, pp. 4-5.
57. *Trud*, January 18, 1990, p. 1.

58. *Vestnik statistiki*, No. 9, 1991, pp. 7–8. In 1990, cooperatives in the resource recovery sector accounted for 10–15 percent of all cooperatives and about 2 percent of total cooperative income.
59. *Izvestiya*, June 28, 1991, p. 3.
60. USSR Goskompriroda, *Sostoyanie . . . v 1988 g.*, p. 35.
61. See, for example, A. E. Borokhovich and G. V. Shishkin, “Doza radiatsii po perimetru IAE im. I. V. Kurchatova,” *Atomnaya energiya*, No. 5, 1990; and M. Ya. Chebotina et al., “Tritii v zone Beloyarskoi AES imeni I. V. Kurchatova,” *Ekologiya*, No. 2, 1990.
62. United Press International (UPI), March 10, 1989; Reuter, March 11, 1989; *Vestnik narodnogo fronta* (Estonia), No. 8, 1989, p. 4; *Observer*, September 17, 1989.
63. Central Television, “Television News Service,” September 18, 1990, translated in FBIS–SOV–90–182, p. 46.
64. Novosti Press Agency, September 11, 1990; see also Radio Moscow, September 6, 1990, cited in FBIS–SOV–90–174, p. 86.
65. *Turmenskaya iskra*, February 27, 1990, p. 2.
66. *Izvestiya*, January 8, 1990, p. 2.
67. Radio Moscow, June 10, 1990.
68. *Rabochaya tribuna*, January 30, 1991, p. 3; *Moskovskaya pravda*, May 16, 1991, p. 3.
69. L. Matveev, chair, Expert Commission on Radiation Safety of Moscow City Soviet Commission on Ecology, in *Vechernyaya Moskva*, February 18, 1991, p. 1.
70. *Rabochaya tribuna*, January 30, 1991, p. 3.
71. Andrew Bond, “News Notes,” *Soviet Geography*, March 1991, p. 205. The radiation hazard was estimated by means of a rough translation of the Soviet measurement unit (microrentgens) into the U.S. measure.
72. *Moskovskaya pravda*, May 16, 1991, p. 3.
73. A total of 960 sources reportedly were found in Moscow oblast between 1982 and mid-1990. *Pravitel'stvennyi vestnik*, No. 34, 1990, p. 12. For reporting on radiation problems outside of Moscow, see *Rabochaya tribuna*, February 6, 1991, p. 2.
74. *Pravitel'stvennyi vestnik*, No. 34, 1990, p. 12.
75. “Safety Is Not Guaranteed,” *Sovetskaya trgovlya*, March 1990, as translated in JPRS–UPA–90–030, p. 79.
76. Central Television, “Television News Service,” April 25, 1990.
77. *Izvestiya*, August 1, 1991, p. 4.
78. Thomas B. Cochran and Robert Standish Norris, “Soviet Nuclear Warhead Production,” *Nuclear Weapons Databook Working Paper*, NWD 90-3, October 19, 1990, pp. 22–23.
79. *Izvestiya*, August 1, 1991, p. 4.
80. Radio Rossii, May 27, 1991, as translated in JPRS–TEN–91–012, p. 63.
81. *Izvestiya*, May 3, 1990, p. 6.
82. *Izvestiya*, August 1, 1991, p. 4.
83. *Izvestiya*, May 3, 1990, p. 6.
84. Cochran and Norris, “Soviet Nuclear Warhead Production,” p. 24.

85. *Izvestiya*, November 13, 1991, p. 6.
86. Aleksei Yablokov, presentation at conference on Democratic Federalism and Environmental Crisis in the Republics of the Former Soviet Union, Moscow, August 1991.
87. Mikhail Shutov, "'Metro' v preispodnyuyu," *Priroda i chelovek*, No. 3, 1991, p. 8.
88. *Izvestiya*, November 13, 1991, p. 6.
89. Cochran and Norris, "Soviet Nuclear Warhead Production," pp. 8–12. A total of five reactors operated at Mayak between 1948 and 1990, when the last finally was shut down.
90. *Argumenty i fakty*, No. 34, 1989, p. 8; *Moscow News*, No. 19, 1991, p. 10.
91. Cochran and Norris, "Soviet Nuclear Warhead Production," p. 16.
92. *Izvestiya*, July 12, 1989, p. 6; A. I. Burnazyan, ed., "Itogi izucheniya i opyt likvidatsii posledstviy avariinogo zagryazneniya territorii produktami deleniya urana" (part 1), *Energiya: Ekonomika, tekhnika, ekologiya*, No. 1, 1990, pp. 51–52; Cochran and Norris, "Soviet Nuclear Warhead Production," pp. 16–21. The area of land contaminated totaled 15,000–23,000 square kilometers. For a comprehensive series of articles on the accident, see *Priroda*, No. 5, 1990.
93. *Izvestiya*, July 12, 1989, p. 6. See also *Izvestiya*, October 5, 1990, p. 7; *Pravda*, January 12, 1990, p. 3; and *Krasnaya zvezda*, October 19, 1990, p. 2. See Zhores A. Medvedev, *Nuclear Disaster in the Urals* (New York: Norton, 1979).
94. Radio Moscow, October 5, 1990, translated in FBIS-SOV-90-195, pp. 35–36.
95. Petr I. Somin, chair, Chelyabinsk oblast Soviet of People's Deputies, in testimony to RSFSR Congress of People's Deputies, Radio Moscow, December 10, 1990, translated in JPRS-TEN-91-001, p. 90. Also Central Television, "Vremya," September 12, 1991; *Moscow News*, No. 19, 1991, p. 10.
96. Natal'ya Mironova, Chelyabinsk Ecological Fund, personal communication, Moscow, June 1991; *Komsomol'skaya pravda*, October 29, 1991, p. 4. According to conclusions drawn by a USSR deputy minister of health, no major deviations from the norm in illnesses or mortality were observed among the population studied who lived in the contaminated zones at the time of the 1957 accident or in subsequent years after their evacuation. A. I. Burnazyan, ed., "Itogi izucheniya i opyt likvidatsii posledstviy avariinogo zagryazneniya territorii produktami deleniya urana" (part 3), *Energiya: Ekonomika, tekhnika, ekologiya*, No. 3, 1990, p. 24. See also *Izvestiya*, July 12, 1989, p. 6. According to the Natural Resources Defense Council (NRDC), workers at Mayak in the early years received exceedingly "high exposures." Cochran and Norris, "Soviet Nuclear Warhead Production," p. 14, citing Boris V. Nikipelov et al., "Opyt pervogo predpriyatiya atomnoi promyshlennosti," *Priroda*, No. 2, 1990.
97. "USSR Ministry of Atomic Power and Industry commission to assess the ecological situation in the vicinity of the Mayak Production Enterprise," Moscow, 1990, cited by Natal'ya Mironova, presentation at USSR Nuclear Society conference on Radioactive Waste: Problems and Solutions, Moscow, June 1991; *Izvestiya*, March 3, 1991, p. 4.

98. Mironova, presentation citing USSR Ministry of Atomic Power and Industry commission. The figure of 1 billion curies was also reiterated by academician Anatolii F. Tsyb, head of the commission. Central Television, "Vremya," December 10, 1990.
99. Cochran and Norris, "Soviet Nuclear Warhead Production," p. 16.
100. TASS, November 14, 1991.
101. *Moscow News*, No. 19, 1991, p. 10.
102. The plant was designed to have three 800-megawatt fast-breeder reactors.
103. A. Suslov, cited in *Sovetskaya Rossiya*, April 20, 1991, p. 6.
104. *Izvestiya*, January 8, 1990, p. 2.
105. For more on the incident, refer to DJ Peterson, "An Environmental Disaster Unfolds," *Report on the USSR*, No. 27, 1990; *Pravda*, August 10, 1990, p. 6; and *Izvestiya*, August 29, 1990, p. 3.
106. *Izvestiya*, August 17, 1990, p. 6, and October 4, 1990, p. 6.
107. *Vechernyaya Moskva*, February 18, 1990, p. 1.
108. *Pravda Ukrainy*, July 7, 1990, p. 4.
109. *Vestnik statistiki*, No. 11, 1991, p. 65.
110. *Ekonomika i zhizn'*, No. 41, 1990, supp. pp. 2, 6.
111. See, for example, Yurii Porokhov, "Upravlenie spetstrans opytnyi poligon Krasnyi Bor," *Leningradskaya panorama*, No. 2, 1990.
112. *Ogonek*, No. 40, 1989, p. 3.
113. Helsinki Radio, July 2, 1990, translated in JPRS-TEN-90-007, p. 9.
114. TASS, October 22, 1990.
115. *Sotsialisticheskaya industriya*, July 23, 1989, p. 4. For more on the politics surrounding the Krasnoyarsk project, refer to *Komsomol'skaya pravda*, June 15, 1989, p. 1, and June 28, 1989, p. 1.
116. *Sovetskaya Rossiya*, June 28, 1990, p. 1.
117. TASS, December 18, 1989.
118. Porokhov, "Upravlenie."