

## *Report:*

# REEXAMINING BRAIN DRAIN FROM THE FORMER SOVIET UNION

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Prior to the breakup of the Soviet Union, scientists, engineers, and technicians in the Soviet defense sector were strictly controlled. Those with access to state secrets had almost no opportunities to travel abroad, even to Eastern Europe. Other contacts with foreign firms were subjected to stringent centralized oversight, when they were allowed at all. But Soviet military scientists and engineers traditionally had been among the highest paid individuals. Those living in closed cities enjoyed even greater benefits in order to compensate them from their almost total isolation from the rest of the world.<sup>1</sup>

By the late 1980s, however, funding for Soviet science began a steep and steady decline due, among other reasons, to Soviet budget problems and Gorbachev's *perestroika* policies, which lessened the traditional Soviet emphasis on military power. This descent sharpened significantly with the December 1991 breakup of the country, the dissolution of the central planning apparatus, and beginning of a period of hyperinflation. Runaway inflation (about 30 percent per month) undercut the former Soviet Union's early efforts to pacify disillusioned scientists by raising salaries in closed cities, providing additional government funding for science, and alleviating tax burdens. In addition, "[s]ome of the measures taken by the Russian government were not well thought out."<sup>2</sup> Scientists in the military-industrial complex, in part because of their formerly privileged status, were especially disillusioned with the turn of events.

With the virtual disappearance of official restrictions on emigration, under-funded and jobless scientists began to look for opportunities to recoup their crumbling

economic prospects abroad. State responses to these tendencies were inadequate and ill-prepared, as none of the Soviet successor states had effective policies, programs, or institutions in place to mitigate the migratory tendencies of its elite personnel. Indeed, the few Soviet agencies that had been in place to track such movements were primarily concerned with the ethnic, rather than the professional, character of migrations. Some Soviet agencies did track the movement of their personnel independently, but these data are incomplete and inconclusive.<sup>3</sup>

Ironically, during the few years leading up to the Soviet Union's collapse, Western governments and human rights organizations put significant pressure on the Soviet Union to liberalize its emigration and immigration policies, which it did on May 30, 1991, with the passing of the "Law on the Procedures of Exit from the USSR and Entry to the USSR for Citizens of the USSR" in the Supreme Soviet. The law entered into force on January 1, 1993. While the law liberalized entry and exit procedures, it also was supposed to prevent anyone with access to state secrets from emigrating for at least five years (with the possibility of extension).<sup>4</sup>

The absence of a centralized institution in the Soviet Union to track exit patterns complicates current efforts in the post-Soviet states and abroad either to quantify the diffusion of expertise or to gain much qualitative data. However, as a result of the international community's growing level of awareness to the risks associated with the proliferation of Soviet weapons expertise, a significant cache of data has emerged in open sources since 1991, including in-country reports, insti-

tutional studies, government documents, surveys, articles in academic journals, newspapers, and magazines, and wire service reports. The maps on the following pages represent an initial effort to present some of the available data from reported cases. These maps do not attempt to analyze or evaluate existing information, but do categorize it into two basic trends: evidence of emigration abroad and evidence of "internal" brain drain (i.e., scientists leaving military industry but remaining in-country).

Initial findings suggest that a mass exodus of scientists and engineers from the post-Soviet states has not occurred. While the data suggest that the scope of emigration in recent years (1990 to present) exceeds past emigration flows significantly, the former Soviet Union most likely is experiencing what other more politically open countries have already experienced—the development of an equilibrium between the number of scientists that stay at home and those who decide to market their skills abroad. Notably, a survey of defense sector employees conducted in Russia in 1992—the first such survey to include inhabitants of closed cities—suggests that there is a strong correlation between a scientist's interest in opening his own business (ostensibly to improve his economic welfare) and his interest in working abroad (see Map 2).

The state secrets limitations on emigration from Russia, as well as general immigration restrictions in recipient countries, seem to play a significant role in reducing the scale of scientific emigration (see Map 2). Just as economic, social, and political factors within Russia and the other post-Soviet states play significant roles in determining actual emigration flows, these same factors in recipient countries (especially Western countries where the need for additional scientists is low) create absorption thresholds. Many scientists who would otherwise emigrate may be prevented from doing so because of such internal and external constraints. But a number of recently reported smuggling incidents, in which nuclear materials were diverted by workers from within Russian production facilities, underscores the threat idle or underpaid scientists pose to the international nonproliferation regime.<sup>5</sup>

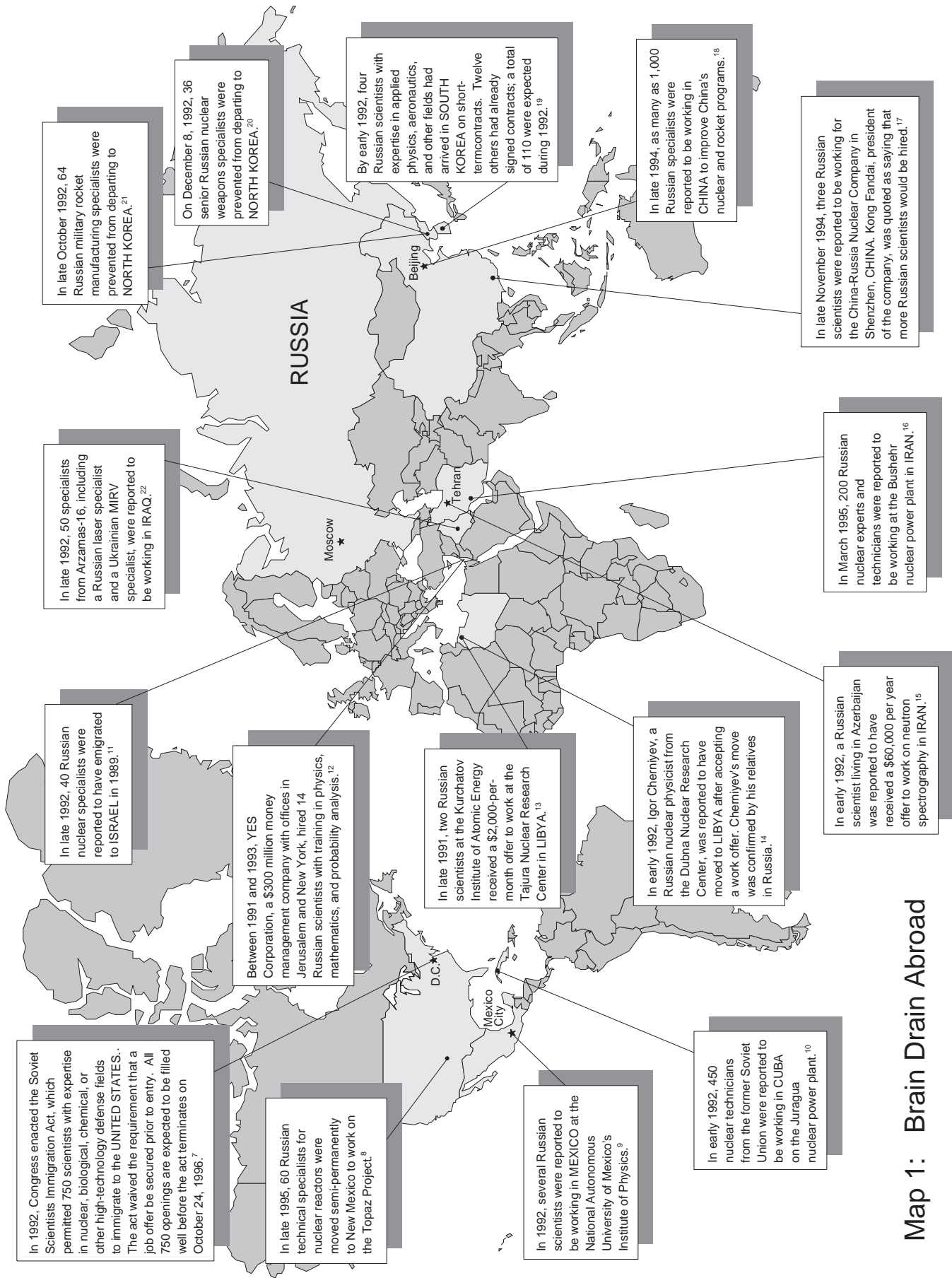
Interestingly, it appears that the most serious drain of expertise has occurred internally—a flow of scientists, engineers, and technicians out of science and defense-related sectors and into business or whatever sort of work will allow them to earn rubles (or dollars). This internal displacement of workers in scientific and defense-related fields is proportionally greater in Russia, but other newly-independent states (e.g., Belarus, Kazakstan, and Ukraine) have experienced similar up-

heavals. The movement of workers out of science and defense-related sectors and into other fields of labor has the potential to energize the former Soviet Union's fledgling market economies, especially if employment in those new fields generates hard currency. However, those who do not complete the transition and remain unemployed will pose a threat to the international nonproliferation regime as long as their scientific expertise lies dormant.

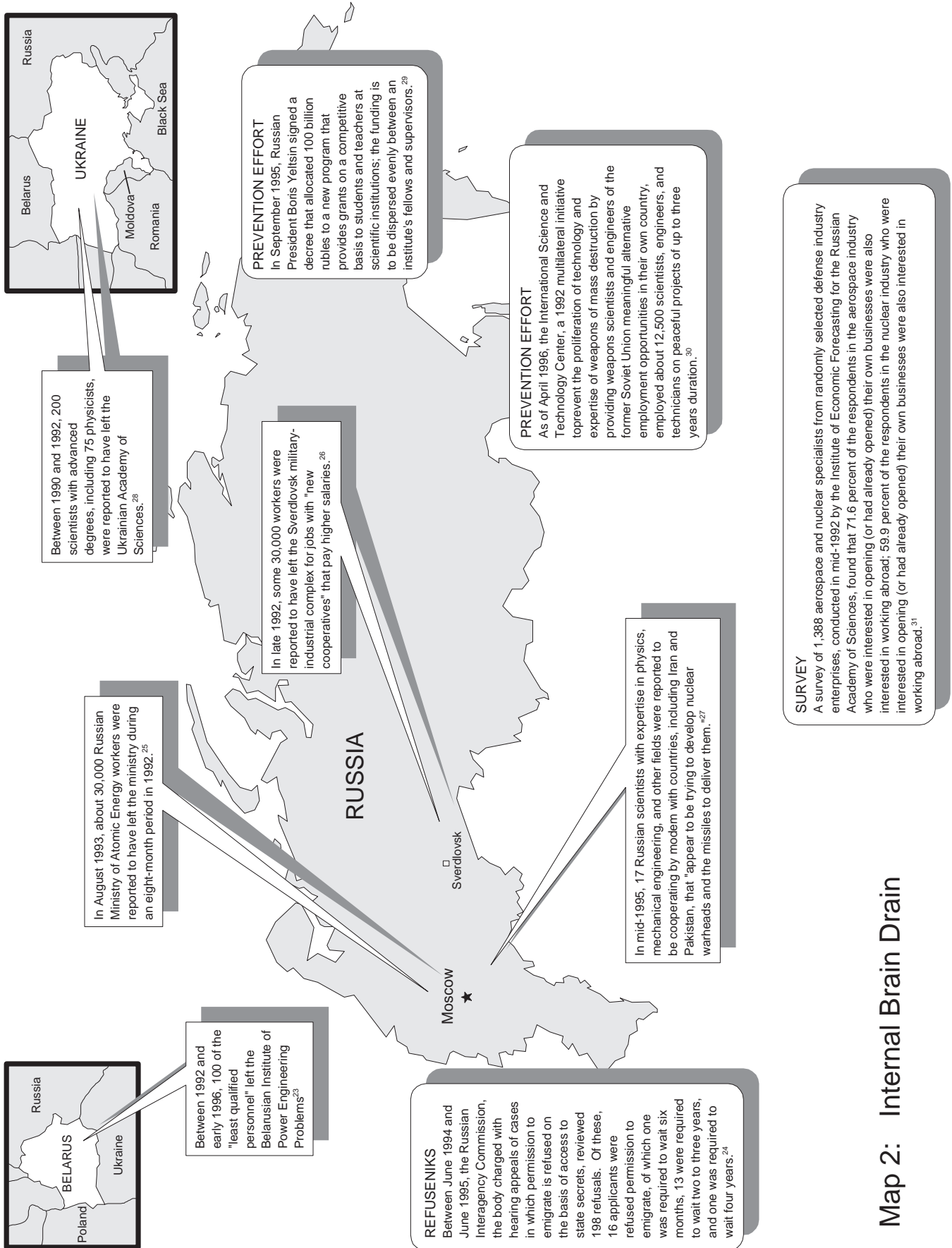
The migration of scientists, engineers, and defense workers from Eastern Europe and the former Soviet republics to Russia, as well as the inordinate dislocation of scientific workers from the far reaches of Russia's borders to central Russia, adds another dimension to the issue: namely, an overabundance of underemployed scientific workers focused in a region characterized by diminished opportunities in scientific and defense-related fields. The absence of opportunities creates a unique set of incentives for scientists to engage in diversionary activities. Similarly, lack of opportunities, combined with constraints on movement, can increase the likelihood that scientists will use whatever means are available to "market" their expertise. This is seen in the recent phenomenon of Moscow scientists "moonlighting by modem" for countries of significant proliferation concern (see Map 2).

Finally, while information from the sources gathered to date suggests that emigration abroad is occurring, in many cases the movement of specialists occurs within the confines of state-sanctioned projects or long- or short-term temporary work to countries that appear to be less threatening to the nonproliferation regime (see Map 1). In those cases where scientists work on projects in countries of concern (e.g., Cuba, Iran, and Iraq), the potential for diversionary activity beyond the scope of such projects certainly exists and merits further attention.

A U.S. government official, who works closely with this issue, stated recently that "for those few people who will be tempted to share critical information for money, there is little that can be done, regardless of whether that person is Russian, American, British, or any other nationality."<sup>6</sup> While this may be true, the timely implementation of programs both from within the former republics themselves and from without is helping to alleviate this problem. These include the International Science and Technology Center in Moscow, the International Science Foundation (funded by George Soros), the U.S. Civilian Research & Development Foundation for the Independent States of the former Soviet Union, the NATO Science Program, the



Map 1: Brain Drain Abroad



Map 2: Internal Brain Drain

American-Russian Biomedical Research Foundation, the Association of Scientific Societies of Russia, the U.S. Industrial Partnering Program, U.S. lab-to-lab activities, and others. Without these efforts to keep former Soviet scientists gainfully employed by creating collaborative (and independent) research opportunities and broadening cooperation among scientific institutions within the newly-independent states of the former Soviet Union, attendant proliferation risks assuredly would be more pronounced.

<sup>1</sup> See Mark Hibbs, "'Vulnerable' Soviet Nuclear Experts Could Aid Clan-destine Weapons Aims," *NuclearFuel*, October 28, 1991, pp. 4-5. "Nuclear Brain Drain So Far 'Theoretical,'" *Rossiia*, February 5-11, 1992, p. 8; in FBIS-SOV-92-028 (11 February 1992), pp. 7-8. See also Vladimir Zakharov and Vladimir Fortov, "Science Is Already In A Coma," *Izvestiya*, November 2, 1994, p. 4; in FBIS-SOV-94-220 (15 November 1994), pp. 30-31.

<sup>2</sup> Vladimir D. Shkolnikov, "Potential Energy: Emergent Emigration of Highly Qualified Manpower from the Former Soviet Union," Ph.D. dissertation, RAND Graduate School, September 1994, p. xiii.

<sup>3</sup> See Chris Bird, "Confusion Reigns as Russians Return Home," *New Scientist*, January 8, 1994, p. 9; Stanislav Simanovsky et al., *Brain Drain from Russia: Problems, Prospects, and Regulation* (Commack, NY: Nova Science Publishers, 1996), pp. 23, 48-49, 52, 57, 59, 77, 81; Tim Beardsley, "Brain Drain: Hard Times for Science in the Former Soviet Union," *Scientific American* (April 1992), pp. 17, 20; and William Potter, "Exports and Experts: Proliferation Risks From the New Commonwealth," *Arms Control Today* 22 (January/February 1992), p. 36. In October 1992, the Federal Migration Service of Russia (FMS) was established to tackle the growing problem of an in-pouring of refugees from strife-ridden regions within and outside Russia's borders. However, as Bird points out, tracking migration patterns in the former Soviet Union is a daunting and virtually impossible task due to the large number of refugees and migrants who move under duress. Generating reliable data therefore becomes very difficult and, as in the case of emigration statistics, estimates are most often used. For an example of a FMS statistical report see "Statistics: Migration Growth Has Almost Doubled," *Delovoy Mir*, April 18, 1995, p. 5; in FBIS-SOV-95-091-S (11 May 1995), pp. 24-26.

<sup>4</sup> Another irony is that the law places limits on the ability of the Russian State Statistical Committee to gather information on the positions found by emigrants abroad. See Elena Nekipelova, et al., "Emigratsiya Uchenykh: Problemy I Realnyye Otsenki," Center for Research and Statistics of Science of the Russian Ministry of Science, Technology, and Higher Education and of the Russian Academy of Science, 1993, pp. 27-28; in Shkolnikov, p. 1. See also Sarah Helmstadter, "The Russian Brain Drain in Perspective," *RFE/RL Research Report*, October 23, 1992, p. 58; and William C. Potter, "Nuclear Exports from the Former Soviet Union: What's New What's True," *Arms Control Today* 23 (January/February 1993), p. 8. According to Solon Arditis of ECOTEC Research and Consulting Ltd., in 1995 Russia established "an 'Institute for Immigration Controls' that [aims] in particular to train adequate personnel to assume immigration control functions at the main interpublic borders." See Solon Arditis, "Exchange of Experience between the Russian Federation and Southern European Regions in the Field of Migrant Reintegration Policies," *International Migration Review* (Winter 1995), p. 1050. However, by February 1996, U.S., Russian, and CIS officials were still reporting that "border control among nations of the former Soviet Union is nearly nonexistent."

ent." See Theresa Hitchens, "Experts: U.S. Nonproliferation Aid to CIS Is Not Enough," *Defense News*, February 19-25, 1996, p. 12.

<sup>5</sup> Correspondence to author from a U.S. government official, March 15, 1996.

<sup>6</sup> For example, see "Yaderniy Samogonshchik Popalsya," *Rossiiskaya Gazeta*, May 8, 1996, p. 1; Vyacheslav Kokhanov, "Uran-235 Tyanet Na Tsentner," *Komsomolskaya Pravda*, April 9, 1996, p. 3; Aleksei Tarabrin, "Okhotniki Smertelnogo Promysla," *Pravda (Ezhenedelnaya Gazeta)*, February 9-16, 1996, p. 3; and O. Kireeva, "Vse Khorosho, Chto Khorosho Konchaetsya," *Yantarny Krai*, January 25, 1996, p. 2. Another related problem is "the willingness of Russian and CIS companies, private citizens and even government leaders to pursue profit at the expense of arms control measures." See Hitchens, p. 12.

<sup>7</sup> Public Law 102-509, 102nd Congress of the United States of America, October 24, 1992. See also "Commonwealth and Baltic Scientists Immigration and Exchange Act of 1992," Report 102-881, Part 1, 102nd Congress of the United States of America, 2nd Session, September 21, 1992. See also Adam Treiger, "Plugging the Russian Brain Drain: Criminalizing Nuclear-Expertise Proliferation," *Georgetown Law Journal* (November 1993), p. 266. One expert on the brain drain issue says that "[a] defense specialist from the former USSR would not, in all likelihood, be able to practice his/her profession in the United States because of the security regulations... Thus one could not dismiss a scenario where a Russian weapons specialist who was somehow able to leave a closed city for the United States only to find himself deprived of opportunity to work in his professional field leaves the U.S. for a 'problem' country where he would be guaranteed such an opportunity." See Shkolnikov, p. xx.

<sup>8</sup> "Topaz Project In Jeopardy," *Post-Soviet Nuclear & Defense Monitor*, January 31, 1996, pp. 7-8. For an excellent review of the movement of Soviet scientists to the U.S. in the early 1990s, see Joyce Barnathan, et al., "The Soviet Brain Drain Is the U.S. Brain Gain," *Business Week*, November 4, 1991, pp. 94-100.

<sup>9</sup> Yuriy Kudimov, "Russian Physicists Working in Latin America," *Novoye Vremya*, August 9, 1992, pp. 26-27; in JPRS-TND-92-032 (9 September 1992), pp. 19-21.

<sup>10</sup> Frank Gaffney, "Risky Reactors in Cuba?" *The Washington Times*, April 28, 1992, p. F3.

<sup>11</sup> Yevgeniy Bovkun, "Nuclear Scientists Leaving CIS," *Izvestiya*, October 20, 1992, p. 7; in FBIS-SOV-92-205 (22 October 1992), p. 4. The actual number of Russian immigrant scientists now residing in Israel is much larger. Of the 950,000 Russians that have immigrated to Israel since the period of detente in the 1970s (750,000 since the late 1980s), 10,000 are scientists, 70 percent of whom are "working as truck drivers, bricklayers and in other jobs outside their fields." See Joseph Berger, "Question Mark In Israel Ballot: 'The Russians,'" *The New York Times*, May 29, 1996, pp. A1, A8.

<sup>12</sup> One of the hired Russian specialists is identified as "Sophia," a middle-aged expert in "aerospace deflection determination" who worked previously at the Research Institute for Applied Mathematics in Moscow. Another Russian employee is identified as "Mark," a computer engineer who worked at the "Sverdlovsk nuclear facility" prior to emigrating to Israel in mid-1991. Mark's employment history also includes work at two "leading Israeli software companies." See Neal Sandler, "Real Rocket Science Comes to High Finance," *Business Week*, January 17, 1994, pp. 69, 72.

<sup>13</sup> Lee Katz, "Nuke Knowledge Coveted," *USA Today*, January 8, 1992, p. 4A. Anatoliy Karpychev, "My Opinion," *Pravda*, January 21, 1992, p. 4; in FBIS-SOV-92-014 (21 January 1992), pp. 2-3. Yevgeniy Bovkun, "Nuclear Scientists Leaving CIS," *Izvestiya*, October 20, 1992, p. 7; in FBIS-SOV-92-205 (22 October 1992), p. 4. Heinz Vielain, "Nuclear Smuggling—Chancellor Kohl Sends Urgent Letter to Yeltsin," *Welt Am Sonntag*, August 21, 1994, pp. 1-2; in JPRS-TND-94-017 (8 September 1994), pp. 43-44.

<sup>14</sup> "Nuclear Experts Leave for Libya, Iran," *Der Spiegel*, February 24, 1992; in FBIS-SOV-92-037 (25 February 1992), pp. 3-4.

<sup>15</sup> *Ibid.*

<sup>16</sup> "Poverty Summit-Nuclear," Associated Press, March 12, 1995; in Executive News Service, March 12, 1995. See also Vielain, pp. 1-2.

<sup>17</sup> Reuter, November 29, 1994; "Russia Sharing Secret Nuclear Work," Executive News Service, November 30, 1994.

<sup>18</sup> Mikhail Urusov, "Russia Is Arming China," *Moscow News*, October 7, 1994, p. 8.

<sup>19</sup> *Hanguk Ilbo*, February 7, 1992, p. 1; in FBIS-EAS-92-073 (15 April 1992), p. 37.

<sup>20</sup> KBS-1 Radio Network, December 20, 1992; in FBIS-EAS-92-245 (21 December 1992), p. 32. Yonhap, December 21, 1992; in FBIS-EAS-92-245 (21 December 1992), p. 32-33.

<sup>21</sup> Yonhap, December 21, 1992; in FBIS-EAS-92-245 (21 December 1992), pp. 32-33. Kim Sok-hwan, *Chungang Ilbo*, January 13, 1993, p. 2; in FBIS-EAS-93-009 (14 January 1993), pp. 17-18. Yevgeniy Tkachenko, Itar-Tass, February 10, 1993; in FBIS-SOV-93-026 (10 February 1993), pp. 11-12.

<sup>22</sup> Bovkun, p. 7. Vielain, pp. 1-2.

<sup>23</sup> Michael Lysobey of the Center for Nonproliferation Studies, interview with Anatoliy Yakoushev, Deputy Director of the Belarusian Institute of Power Engineering Problems, Minsk, Belarus, April 19, 1996. According to Yakoushev, Belarus places no travel restrictions on the institute's employees; a nuclear scientist is only required to obtain a visa to visit "any country." Current Belarusian law places no further constraints on a nuclear scientist's travel abroad.

<sup>24</sup> "Emigration Laws and Policies of the Russian Federation," House Document 104-91, 104th Congress of the United States of America, 1st Session, June 30, 1995, p. 3. The nature of the state secrets that prevented their emigration is not given in the document.

<sup>25</sup> John Lepingwell, "Russian Nuclear Industry Problems," *RFE/RL Daily Report*, August 23, 1993.

<sup>26</sup> Hans-Henning Schroeder, "Conversion in the USSR: Procedures in Search of Planning," *Reports of the Federal Institute For East Europe and International Studies* (October 1992), pp. 37-39. The Sverdlovsk region is the site of uranium enrichment and processing and warhead assembly and dismantlement, and the site of one of the Soviet Union's biological weapons research, development, and production centers; the Soviet biological weapons program reportedly ceased in March 1992. Interestingly, in September 1992 (just prior to the reported flight of some 30,000 workers from the Sverdlovsk military-industrial complex), Russia pledged in a joint statement with the U.S. and the U.K. to reduce "the number of personnel involved in [its] military biological programs by 50 percent," and to reduce "funding for military biological research by 30 percent." See Milton Leitenberg, "The Biological Weapons Program of the Former Soviet Union," *Biological* (September 1993), pp. 187-191; and Martin Sieff, "Russia Opens Door To Biological Arms Checks," *The Washington Times*, September 15, 1992, p. A7.

<sup>27</sup> Alan Cooperman and Kyrill Belianinov, "Moonlighting By Modem in Russia," *U.S. News & World Report*, April 17, 1995, pp. 45, 48.

<sup>28</sup> Paul R. Josephson, "Russian Scientific Institutions: Internationalisation, Democracy and Dispersion," *Minerva* (Spring 1994), p. 4. See also "Ukraine Academy of Sciences at 'Edge of Abyss,'" *Post-Soviet Nuclear & Defense Monitor*, November 17, 1995, pp. 7-8. According to Viktor Zelensky, Director of the Ukrainian National Science Center, Kharkiv Physics and Technology Institute, the loss of scientists from the institute is more of a concern than the potential theft of nuclear materials. As of late May 1996, none of the scientists at the institute had been paid for four months. Of the 1,839 scientists working at the institute, about 150 worked directly on the Soviet weapons program. Emily Ewell of the Center for Nonproliferation Studies, interview with Viktor Zelensky, Director of the Ukrainian National Science Center, Kharkiv Physics and Technology Institute, Kharkiv, Ukraine, May 27-28, 1996.

<sup>29</sup> "Russia Sets Aside Funds to Retain Scientists," *Post-Soviet Nuclear & Defense Monitor*, January 11, 1996, p. 10.

<sup>30</sup> Joint Statement of the Governing Board Meeting (March 28-29, 1996) of the International Science and Technology Center, March 29, 1996. The project on which a scientist works may be extended beyond the three year limit. For a more detailed evaluation of the science center initiative's implementation, development, and current effectiveness, see R. Adam Moody, "A Case Study on the Cooperative Threat Reduction Science Center Ini-

tiative," in William Potter and John Shields, eds., *The Nunn-Lugar Cooperative Threat Reduction Program: Donor and Recipient Country Perspectives* (Cambridge, MA: MIT Press, 1996) (forthcoming). See also Glenn Schweitzer, *Moscow DMZ: The Story of the International Effort to Convert Russian Weapons Science to Peaceful Purposes* (Armonk, NY: M. E. Sharpe, 1996).

<sup>31</sup> Shkolnikov, pp. 48-49, 58-59.