

Originally Processed With FOIA(s):
2005-0336-F

FOIA Number:
2005-0336-F

FOIA MARKER

**This is not a textual record. This is used as an
administrative marker by the George Bush Presidential
Library Staff.**

Record Group/Collection: George H.W. Bush Presidential Records
Collection/Office of Origin: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: International Files - Country Files

OA/ID Number: 62068
Folder ID Number: 62068-006

Folder Title:
Russia - Reports [1992]

Stack:

Row:

Section:

Shelf:

Position:

0

0

0

0



Directorate of Intelligence

Economic Survey of Russia 1992



gross domestic product
deficit
foreign aid
savings
enterprise
unemployment
spending
debt
consumption
industrialists
income
output
foreign aid
prices
living standards
goods
poverty
wages
real income
construction
controls
labor
consumers
natural gas
demand
employment
inflation
deficit
layoffs
privatization
capital investment
services
shortages
machine
trade
economy
production
services
farms
investment
taxes
coal
energy
et
centives
decentralize
trade
statistics
imports
prices
exports
services
output
income
consumption
debt
unemployment
enterprise
savings
foreign aid
deficit
gross domestic product



Directorate of Intelligence

Economic Survey of Russia, 1992

This survey was prepared in the Economic Performance
Division of the Office of Slavic and Eurasian Analysis,
with a contribution from the Defense Programs Division.

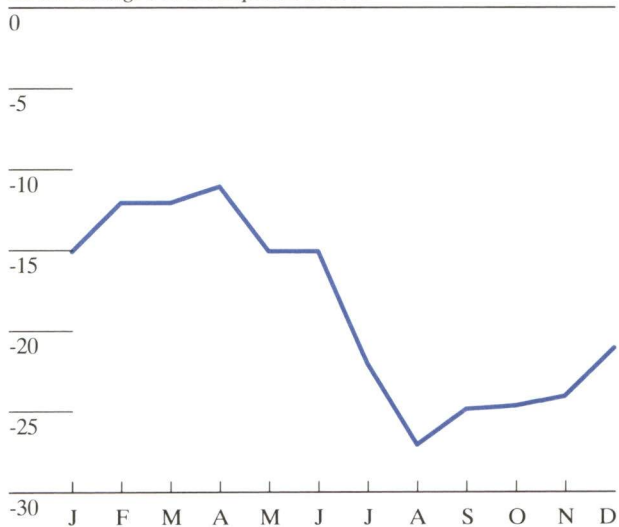
Contents

	<i>Page</i>
Summary of Key Developments	5
Output Falls and Unemployment Rises	7
Financial Stability Erodes	9
Living Standards Drop	11
Privatization Gains Momentum	13
Defense Conversion Effort Finds Incentive	15
Foreign Economic Relations Still in Turmoil	17



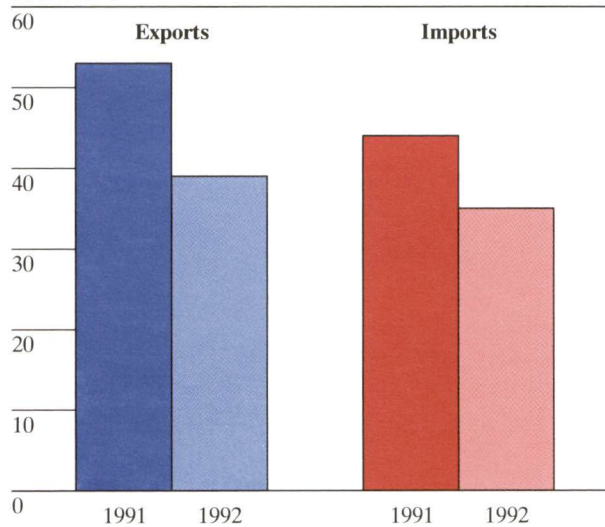
Industrial Output

Percent change over same period in 1991



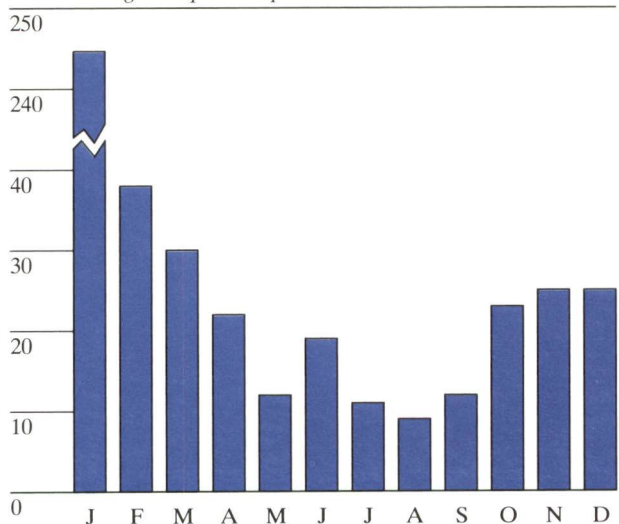
Foreign Trade

Billion US \$



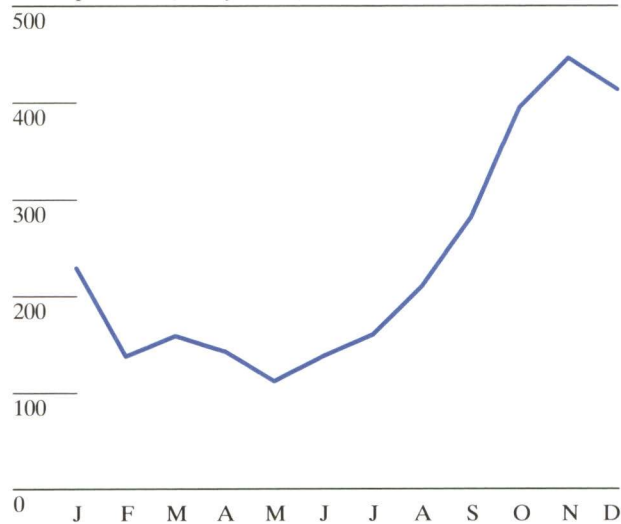
Retail Inflation

Percent change over previous period



Ruble Exchange Rate

Rubles per dollar (end of month)



Source: Russian official statistics.

Summary of Key Developments

President Yel'tsin's government made significant strides toward a market economy in Russia last year by freeing most prices, cutting defense spending sharply, unifying foreign exchange rates, and launching an ambitious privatization program. At the same time, there was an across-the-board economic decline largely reflecting government efforts to restructure the economy, shortages of essential imports caused by the breakdown in former Bloc and interstate trade, and reduced demand following the freeing of prices in January.

Output Falls Sharply but Unemployment Remains Low. According to Russian official statistics, the output of all goods and services in 1992 fell for the third consecutive year, with industrial production declining by almost 19 percent and agricultural output by 5 percent. The actual decline, however, may have been less steep, because industrial and agricultural enterprises had strong incentives to understate output to avoid taxes, and official statistics may not have fully captured the output of the growing private sector. Despite the large drop in output, unemployment at yearend stood at an estimated 3 to 4 percent of Russia's 74-million-person labor force; many people, however, are working shortened weeks or are on forced leave.

Financial Stabilization Elusive. The resurgence of high inflation toward yearend largely reflected the price that Russia was willing to pay for maintaining high employment in the face of falling output. Moscow's financial stabilization program got off to a good start at the beginning of last year but began to falter by midyear. Through spring, the Russian leadership followed tight monetary and fiscal policies, enabling it to sharply reduce the budget deficit and the monthly rate of inflation. Under pressure from industrialists and the Supreme Soviet, the government loosened fiscal policies in the second half. In addition, the Russian Central Bank relaxed its tight credit policy in July at the behest of new Acting Chairman, Viktor Gerashchenko. This loosening of financial policies led to a sharp increase in prices during the last quarter, and inflation reached about 2,500 percent for the year.

The Plight of Most Consumers Worsens. Russia's January price liberalization and a blossoming of private vendors filled shelves across the country with previously scarce food items and consumer goods, but wages lagged inflation, making such goods unaffordable for many consumers. Falling real wages forced most Russians to spend a larger share of their income on food

and to alter their eating habits. Indeed, many Russians reduced their consumption of higher priced meat, fish, milk, vegetables, and fruit, in favor of more bread and potatoes. As a result of higher spending on food, consumers reduced their consumption of nonfood goods and services.

Privatization Picks Up Steam. Despite a slow start and some rough going, the Russian Government by the end of 1992 scored some successes in its campaign to break the state's stranglehold on property and improve the environment for private businesses. More peasant farms were created than expected, the number of consumers purchasing goods from private traders rose sharply, the portion of the population working in the private sector increased to nearly one-fifth, and the nine-month-long slump in the privatization of small businesses was ended in the fall.

Defense Conversion Slow. Russia made little headway in restructuring the defense sector toward the production of consumer goods, but the number of defense plants attempting to do so increased markedly. Although the output of weapons fell sharply last year, most defense enterprises continued to encounter numerous difficulties developing and marketing new products, establishing new supply links, and securing resources for retooling. Moreover, total civil production by the defense sector fell in 1992 because of shortages of inputs and lower consumer demand caused by higher prices.

Bilateral Trade Plummets and Debt Remains a Problem. Ruptured ties with former trading partners, output declines, and sometimes erratic efforts to move to world prices and decentralize trade--foreign and interstate--took a heavy toll on Russia's commercial relations with other countries. For the second year in a row, foreign trade was down sharply, with exports falling by as much as 25 percent and imports by 21 percent. The drop in imports would have been much greater if foreign aid--worth an estimated \$8 billion--had not allowed the continued flow of essential imports. Trade with the Eurasian States continued to decline, and support for the ruble as a common currency eroded in the face of loose monetary policies and rapidly rising prices throughout the region. At the same time, Russia paid only a fraction of the \$20 billion due on the former USSR's roughly \$80 billion debt; debt rescheduling remains hung up because of a dispute between Russia and Ukraine over division of the former USSR's assets. Capital flight also remained a serious problem in 1992.

Russian Output Indicators



Change in Real Output, 1991-92

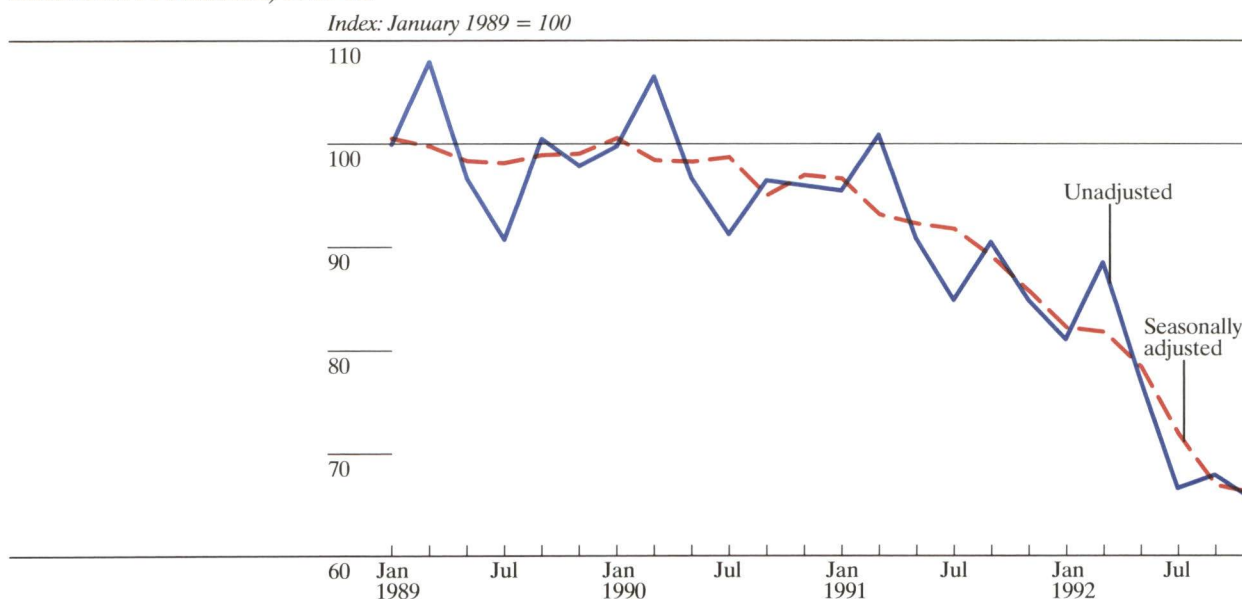
	<i>Percent change over same period of previous year</i>					
	1991	1992 ^b	I	II	III	IV
GDP	-9	-19	NA	NA	NA	NA
National income produced	-11	-20	-14	-22	-24	-20
Industry	-8	-19	-13	-14	-26	-22
Oil	-10	-14	-13	-13	-16	-14
Gas	0.5	-0.4	0	0	-2	0.5
Coal	-11	-5	-1	3	-8	-8
Agriculture ^a	-8	-5	NA	NA	NA	NA
Grain	-24	20	NA	NA	NA	NA
Meat	-8	-11	NA	NA	NA	NA
Milk	-8	-10	NA	NA	NA	NA
Transportation						
Freight	-8	-22	-13	-19	-28	-28
Passenger	-5	-12	-11	-9	-16	-12

^a Estimated, net of feed, seed, and waste.

^b Preliminary.

Source: Russian official statistics, except for agriculture.

Industrial Production, 1989-92



Source: Russian official statistics, presented as a percent change over the same period of the previous year, have been adjusted to show month over month trends.

Unclassified

338757 3-93

Output Falls and Unemployment Rises

The Russian economy in 1992 contracted for the third consecutive year, with gross domestic product (GDP) falling by 19 percent, according to Russian official statistics. As a result, GDP was only about two-thirds of the 1989 level.

Production Down. Industrial output dropped almost 19 percent in 1992, more than double the decline recorded in 1991, according to Russian official statistics. Although the slump in output was across the board, the machinery and equipment sectors were particularly hard hit because of the 70-percent reduction in military procurement and the 45-percent cut in capital investment. In the energy sector, oil output declined 14 percent, coal was down 5 percent, and natural gas was virtually unchanged from 1991 levels. Production of consumer goods was 15 percent lower than in 1991.

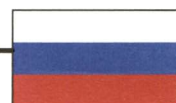
Overall agricultural output fell roughly 5 percent from the depressed 1991 level, according to our calculations, although the production of most crops was up last year. The drop largely reflected the continued decline in the production of meat, milk, and eggs brought about by shrinking livestock herds and the increasing costs of inputs that made some output unprofitable; meat and milk output fell last year to their lowest levels in nearly a decade. Russia harvested 107 million tons of grain--clean weight--in 1992, about 20 percent more than in 1991. Meanwhile, the decline in state production of potatoes and other vegetables was largely offset by increased output from private plots and urban gardens. The private sector, for example, accounted for some 80 percent of potato production.

The production declines probably were not quite as bad as official statistics indicate. The drop in output may have been less steep, because enterprises had strong incentives to understate output to avoid taxes and keep goods for side deals. Moreover, official Russian data probably failed to fully capture the contribution of the country's growing private sector. In many cases, the fall in output was actually a good sign; besides reflecting a reduction in military production, many goods had been

produced in excessive quantities. Indeed, price liberalization revealed the structural distortions that have accumulated over the years; the tremendous resource intensiveness of many sectors; and the poor quality, unprofitability, or even negative value added at many industrial and agricultural enterprises.

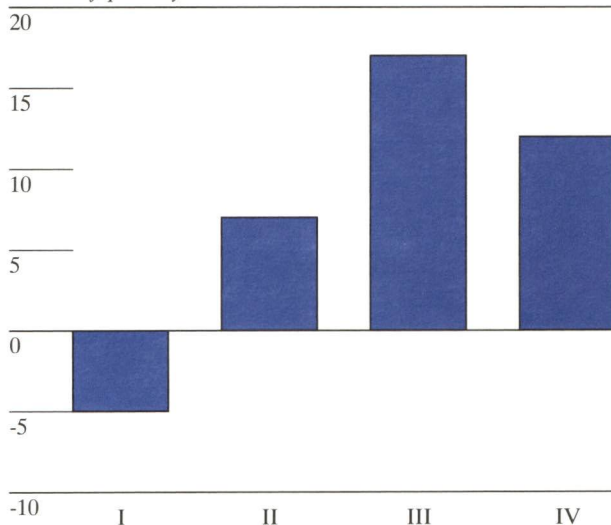
Investment Slashed. Investment spending was cut by almost half last year as part of the government effort to reduce the budget deficit. Government hopes that other sources of investment--mainly enterprise funds--would help offset cuts in state funding were not fulfilled. Many enterprises were financially strapped and had little money to spend on capital improvements or repair. Moreover, as Russian officials noted, private savings were insufficient, investment institutions poorly developed, and foreign investment low because of the country's political and economic uncertainties. The cut in investment spending took a particularly heavy toll on energy, machine building, agroindustry, and construction. Uncompleted investment projects continued to proliferate, adding to inflationary pressures.

Unemployment Climbs. Despite the large drop in output, unemployment remained relatively low in 1992. Using a Western definition of unemployment, by yearend the jobless rate had climbed to about 3 to 4 percent of Russia's 74-million-person labor force. Unemployment would have risen more sharply if enterprises and the government had not taken measures to limit its growth. Many enterprise managers placed workers on shortened workweeks or extended leave with pay, and most dipped heavily into working capital and investment funds to pay wages. Indeed, the high priority that enterprise managers assigned to keeping their workforces intact partially explains the ballooning of interenterprise debt last year. For its part, the government began easing tight credit and spending policies at midyear--a move that helped unprofitable firms to pay their workers. Central bank credits, in particular, were targeted at large industrial firms, in part, to ward off massive layoffs.



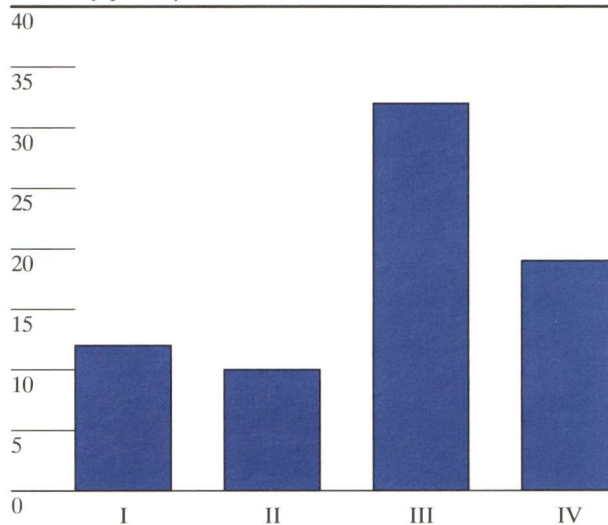
An Increasing Budget Deficit ...

Percent of quarterly GDP



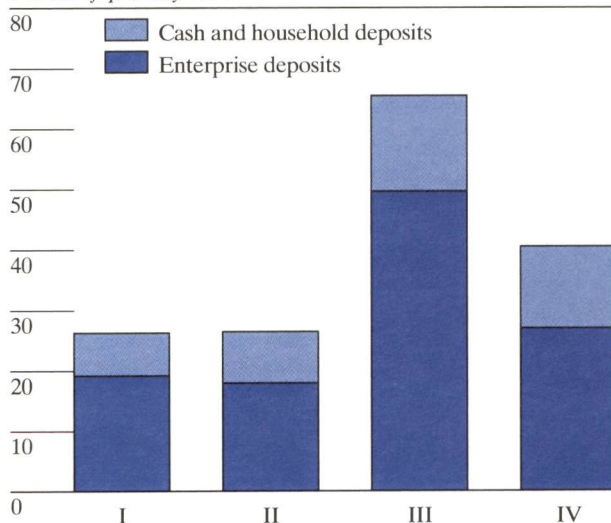
... and a Rise in State Credits ...

Percent of quarterly GDP



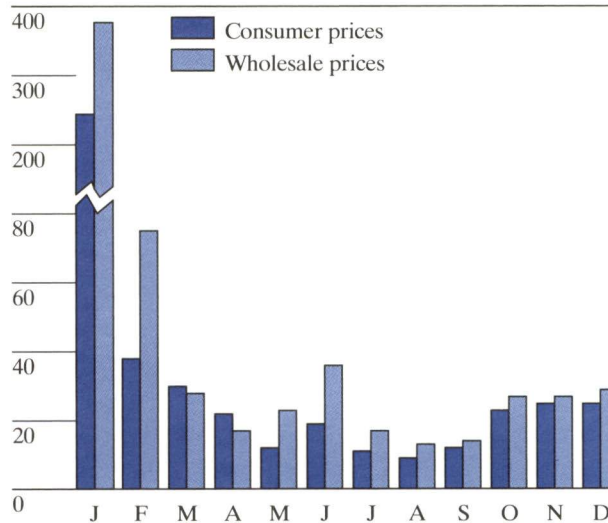
... Resulted in a Sharp Increase in Money Supply ...

Percent of quarterly GDP



... and Higher Monthly Inflation.

Percent



Source: Russian official data and CIA estimates.

Financial Stability Erodes

When the Yel'tsin-Gaydar government took over in 1991, it inherited an economy that was in severe imbalance:

- The budget deficit had reached approximately 20 percent of GNP, with the gap largely covered by the printing of money.
- Despite administrative controls, prices were rising at an accelerating rate caused by the rapid growth of the money supply and the sharp drop in output.
- Shortages of basic goods and food were rife.

Early Success. The government moved quickly to stabilize the financial situation by freeing most prices in January, cutting spending--particularly defense procurement and budget-funded investment--and overhauling the tax system. Besides helping to bring the demand for goods in line with supply, price decontrol allowed the government to reduce subsidies on food and other products. Meanwhile, tax reform, including the introduction of a new value-added tax, helped boost and stabilize government revenues despite implementation and collection problems.

The government's actions resulted in a sharp reduction in the budget deficit in the first half of the year and a steady decline in the monthly rate of retail price increases following the freeing of prices in January. By summer, the monthly rise in consumer prices had slowed to 10 percent. The inflation rate would have been even lower if the government had been able to restrict the growth of interenterprise debt. This debt climbed from 40 billion rubles at the end of 1991 to over 3 trillion rubles by 1 July.

Stability Slips Away. Under pressure from industrialists, regional leaders, and the Supreme Soviet, the government loosened fiscal policy last summer to help financially strapped enterprises, ensure collection of the fall harvest, raise pensions and budget-funded wages, and provide for essential imports. The Russian Central Bank, meanwhile, relaxed its tight credit policy in July to ease the buildup of interenterprise debts and to increase working capital at the urging of its Acting Chairman Gerashchenko.

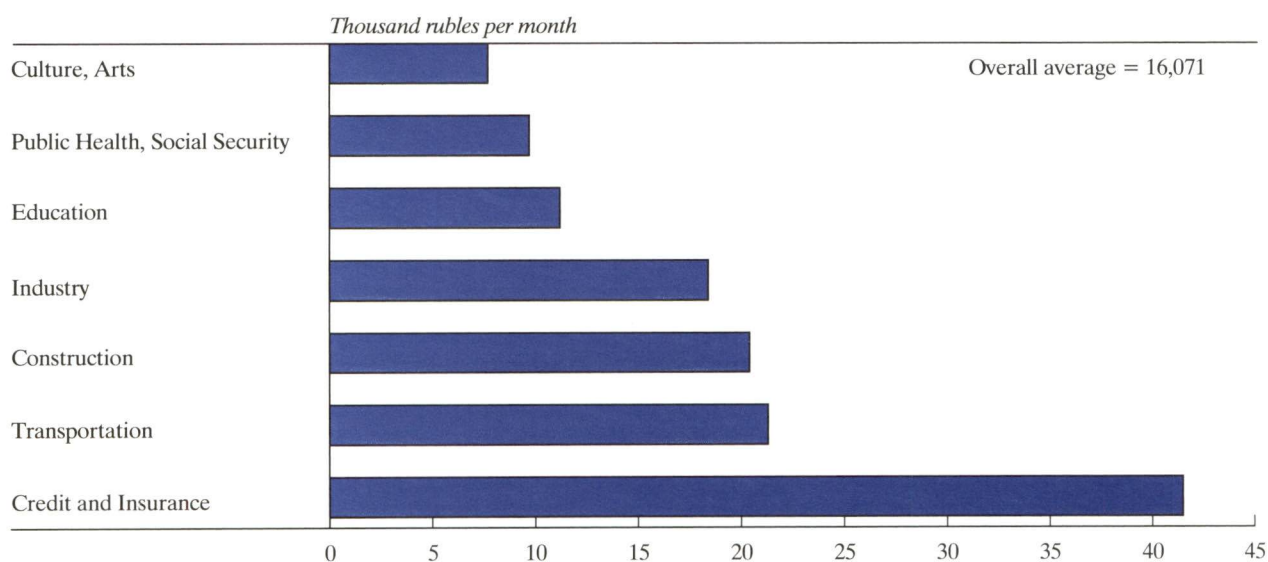
By September, the monthly inflation rate began to climb, compelling the government to try to tighten fiscal policy by sequestering expenditures. The government succeeded in running large budget surpluses in September and October by delaying state expenditures for investment and other uses. Success was short lived, however, because the budget apparently ran large deficits in November and December. Meanwhile, Central Bank credits to the economy and Eurasian states continued at a high level, and interenterprise debt reemerged despite rules designed to force enterprises to prepay for their purchases. During the fall, the overall money supply increased by an average of about 22 percent per month, roughly twice as fast as earlier in the year. As a result, monthly retail inflation rates hit about 25 percent per month during the fourth quarter. This contributed to the dramatic decline in the exchange rate of the ruble, which depreciated sharply against the dollar from July through December.

The failure of the government's monetary and fiscal policies to stem the decline in output contributed to Yel'tsin's replacement of Acting Premier Gaydar in December. His successor, Viktor Chernomyrdin, was viewed by many legislators as a pragmatic industrialist who would focus first on raising output and living standards. Chernomyrdin, however, has publicly said that achieving financial stability and reducing inflation are the most important immediate tasks.

Russian Consumer Welfare Indicators, 1992



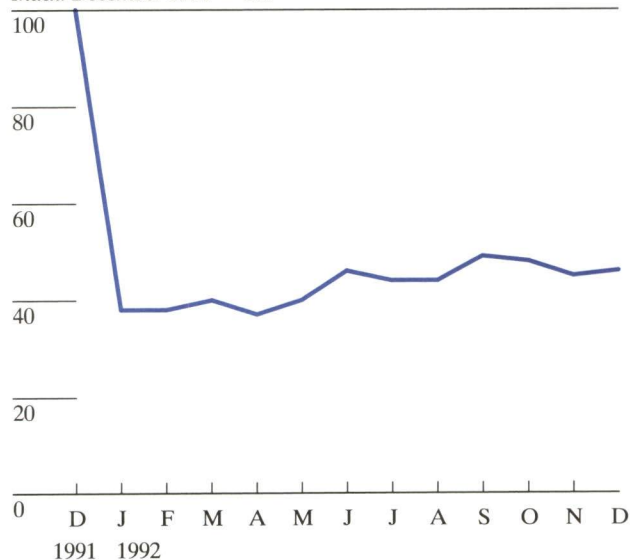
Average Wage by Sector, December 1992^a



^a Includes yearend bonus.

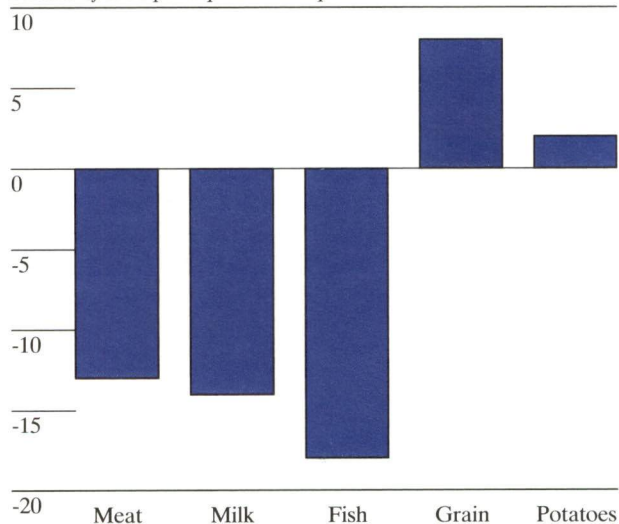
Real Average Wage

Index: December 1991 = 100



Shifting Consumption Patterns

Percent of 1991 per capita consumption



Source: Russian official statistics.

Unclassified

338759 3-93

Living Standards Drop

Russia's January 1992 price liberalization filled store shelves across the country with previously scarce food products and other consumer goods, but wages lagged inflation, making such goods unaffordable for many Russians.

Prices Rise and Real Wages Fall. Consumer prices increased by roughly 2,500 percent in 1992, but wages grew by only about 1,400 percent, according to Russian official statistics. Living standards fell the most in January, when following liberalization, prices jumped 245 percent while wages grew by only 31 percent. The gap narrowed somewhat by yearend, but average per capita real income for the year was still about one-third lower than in 1991. The real income of pensioners, low-income families, and workers in budget-funded government, education, and health care jobs fell the most. The minimum pension was raised twice in 1992 but failed to keep up with the Russian Government's calculated minimum subsistence budget. By December, about one-third of the population reportedly earned less than 4,000 rubles per month, the official "poverty line."

The gap between the rich and poor widened, offending many Russians' ingrained sense of equity. In 1991, the incomes of the top 10 percent of the population were five times higher than the poorest 10 percent; by yearend 1992, it was roughly nine times greater. The increase in the disparity between the lower and upper income brackets reflects both the slow growth in pensioners' incomes and the high earnings of persons working in the emerging private sector. The gulf in average pay among the middle-income brackets also widened last year; the average pay of public health and education employees--who account for the bulk of budget-funded employees--and industrial workers grew by about two-thirds in 1992.

Consumption Down. Falling real income reduced total consumption and forced most Russians to spend a much larger share of their income on food. The average family spent about 45 percent of its income on food in 1992, as compared with 35 percent in 1991. Pensioners, meanwhile, reportedly spent over 80 percent of their incomes on food by yearend 1992, up 15 percentage points from 1991. The drop in real income also forced many Russians to alter their diet by reducing

consumption of higher priced meat, fish, milk, vegetables, and fruit, in favor of more bread and potatoes. As a result, per capita consumption of milk fell by 14 percent, meat by 13 percent, and fish by 18 percent. In contrast, consumption of grain rose by 8 percent and potatoes by 2 percent. To help cope with the drop in real income, almost half of all Russian families now grow food at weekend homes and garden plots, according to a recent poll by the All-Russian Center for the Study of Public Opinion (VTsIOM).

Higher spending on food contributed to reduced purchases of other consumer goods and services. For example, sales of knitwear, sewn goods, hosiery, and cotton fabrics fell by over 50 percent, and sales of shoes, woolens, and silks fell by over 25 percent. Consumers now plan to buy only essentials--shoes, coats, and clothing--and forego purchases of furniture, appliances, and cars, according to the VTsIOM poll. Russians also spent 36 percent less on services last year.

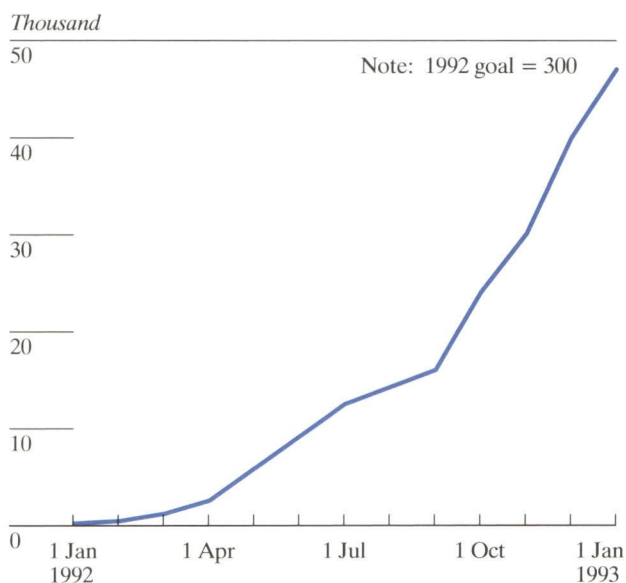
Food Availability Improves. Under price liberalization, scarce foods became available in stores and in farm markets throughout the country. Weekly government surveys showed that many basic foods--milk, beef, potatoes, onions, carrots, and cabbage--although high priced, were available in almost all of the 132 cities surveyed during most of the year. Farm markets also were well stocked, but prices were substantially higher. The weekly surveys, however, found shortages of pork, canned fish, rye bread, and some types of noodles in about half of the surveyed cities, particularly during the winter. Local price controls and high transport costs led to food shortages and rationing in some cities in the Urals, Siberia, the Far East, and the far north.

Housing Construction Declines. State and private construction of new housing was down almost a quarter in 1992, according to Russian official statistics. Most of the drop in the state sector--which accounted for 83 percent of total housing construction last year--stemmed from the cutback in government funding. The decline in the construction of private homes was caused by soaring costs that put such housing out of the reach of most Russians. Moreover, some citizens who could cover the exorbitant costs were stymied by shortages of building materials.

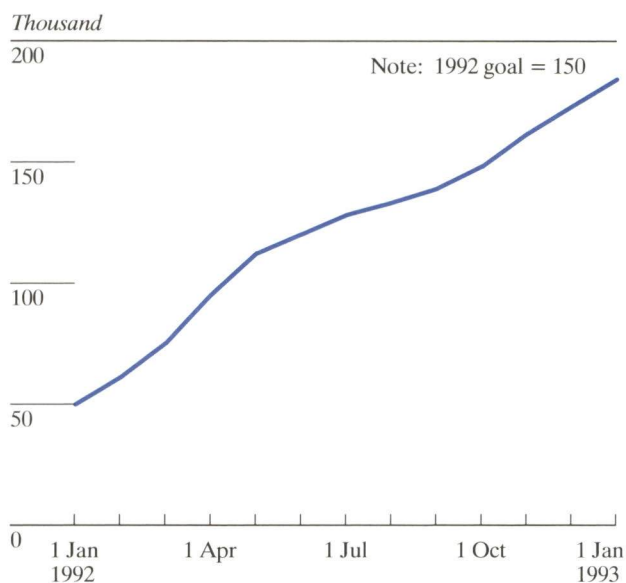
Russian Privatization Indicators, 1992



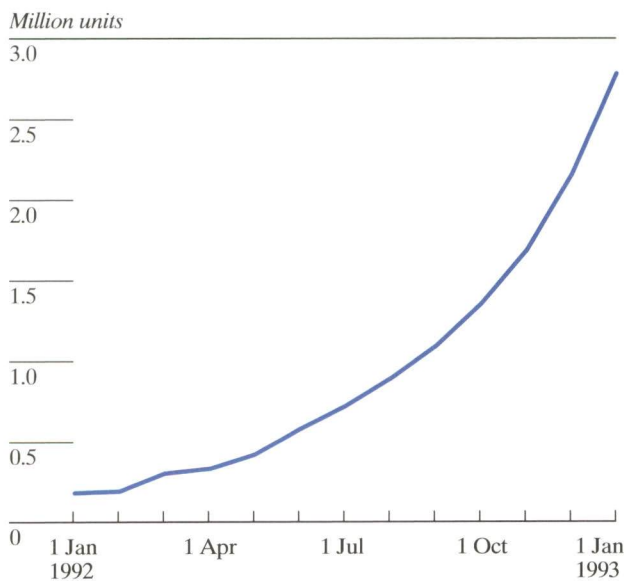
Small Businesses Privatized



Peasant Farms Created



Housing Privatized



Source: Russian official statistics and CIA estimates.

Unclassified

338760 3-93

Privatization Gains Momentum

The private sector assumed more importance in the Russian economy last year. According to official statistics, the volume of consumer goods purchased from private shops rose from a negligible amount in 1991 to more than 4 percent in 1992. Purchases from street traders who operated at open-air markets, street corners, and sidewalk kiosks were also up last year and accounted for 12 percent of total spending on consumer goods. Private-sector employment blossomed as well. Russian official data report that about 15 million people--approximately 20 percent of the labor force--were privately employed in 1992. In addition, one out of six Russians moonlighted in the private sector, and half of Russian families raised some of their own food.

Small Businesses Spotlighted. Yel'tsin, believing that it was necessary to create a large propertied class that would promote social stability and have a stake in economic reform, declared that "1992 would be the year of privatization." The government focused its efforts mainly on small businesses, delaying privatization of industry until 1993. Moscow reasoned that there would be little opposition to a change in ownership for small firms because they could be privatized quickly and consumers would benefit from the likely improvement in supplies. To this end, the government began a crash campaign to sell 60 percent of small shops, restaurants, and service establishments--largely through auctions. The selloff of small businesses was slow during most of the year, but picked up dramatically during the last quarter of 1992, when the government announced that citizens could use their 10,000-ruble privatization vouchers--which were distributed to all Russians

beginning in October--to buy these properties. By yearend, 47,000 firms--more than double the number in October and about 13 to 15 percent of those scheduled for privatizing--had been sold. Privatization proceeded at a particularly fast pace in the proreform cities of St. Petersburg, Nizhniy Novgorod, Vladimir, Orel, and Belgorod, where progressive local leaders were able to create a consensus for change.

Despite the accelerated pace late in the year, the government fell short of its 1992 privatization target. Privatization czar Anatoliy Chubays blamed paperwork problems, but the more important causes were that most Russians lacked the investment capital to buy businesses and were reluctant to take the risks of ownership. To the government's disappointment, virtually no foreigners sank their money into the new companies.

Privatization of Farms and Housing Up. The program to turn agricultural land over to independent farmers accelerated in 1992. The number of private farms more than tripled, to 184,000, far exceeding the government's 1992 target. Despite the rapid growth, however, these private farms accounted for less than 4 percent of Russia's agricultural land and production. Moreover, private farmers continued to be dependent on the state for inputs, machinery, and credit. The Russian Government, meanwhile, managed to turn 2.6 million dwellings--out of a state stock of about 33 million units--over to citizens last year, the vast majority for free.

Defense Conversion Effort Finds Incentive

In 1992, progress on defense conversion was slow. Enterprise managers, however, began to take conversion seriously in response to the Russian government's cut in weapons orders by roughly 70 percent. Yel'tsin also signed a conversion law in March 1992 that offers guidelines for shifting to civil production, but its impact has been limited by the leadership's continued indecision over which weapon programs and plants it needs to retain. In addition, economic reforms--especially price liberalization and privatization--have begun to force firms to restructure themselves to produce goods that are in demand.

Defense Sector Production Plummets. Russian officials publicly claim that the production of weapon systems fell by 50 percent or more last year. Some plants ceased production entirely, while others continued to manufacture arms without orders or customers. Mounting inventories made plant managers desperate to find foreign buyers. Although many officials looked to arms sales abroad to keep plants active and to finance conversion, hard currency sales were down by half last year.

Civil production by the defense-industrial sector also fell in 1992 because of a shortage of materials and declining demand caused by price increases. According to Russian official statistics, production of televisions, refrigerators, and washing machines--almost all of which are made by defense plants--fell by 15 to 25 percent. Most enterprises continued to face problems developing and marketing new products, establishing new supply links, securing resources for retooling, and attracting foreign aid and investment.

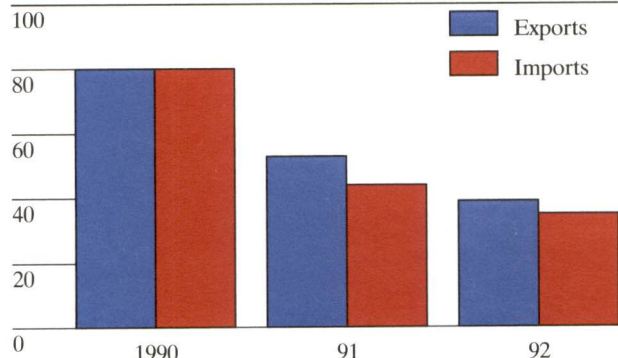
Financial Problems Formidable. Many financially strapped defense plants managed to keep operating by running up interenterprise debts and by relying on Central Bank credits--many of which were on preferential terms. In addition, defense enterprises diverted most of the 150 billion rubles the government earmarked last year to finance conversion to meet payrolls. These actions averted large-scale unemployment among Russia's 5 to 8 million defense-industrial workers, although, according to Russian press, roughly 600,000 defense workers left the sector primarily for higher paying jobs in the civil sector. Underemployment, however, was widespread, with many thousands of workers on extended leave and, reportedly, more than 400 defense plants operating only three to four days a week. In addition, over 2 million industrial workers were only partially employed, and at least half of these probably were in the defense sector.

Defense Industrialists Split. While a small--but growing--number of defense plant officials welcomed their new freedom and endorsed the government's economic reforms, including privatization, the worsening situation drove many defense industry leaders to join with other industrialists and call for a slowdown in the pace of economic reform. These groups lobbied the government to channel additional credits to unprofitable enterprises, including defense plants, to hold down unemployment, even at the risk of hyperinflation.



Foreign Trade

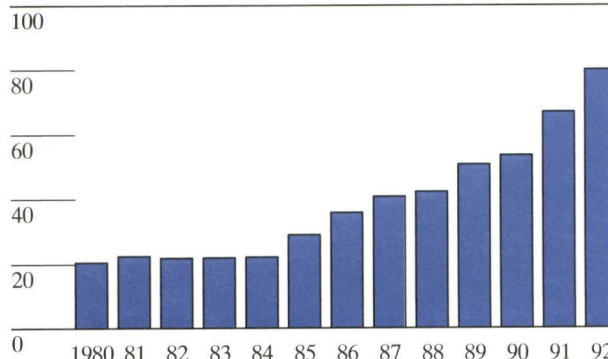
Billion US \$



Source: Goskomstat data. Excludes trade with former Soviet Republics and the Baltic States.

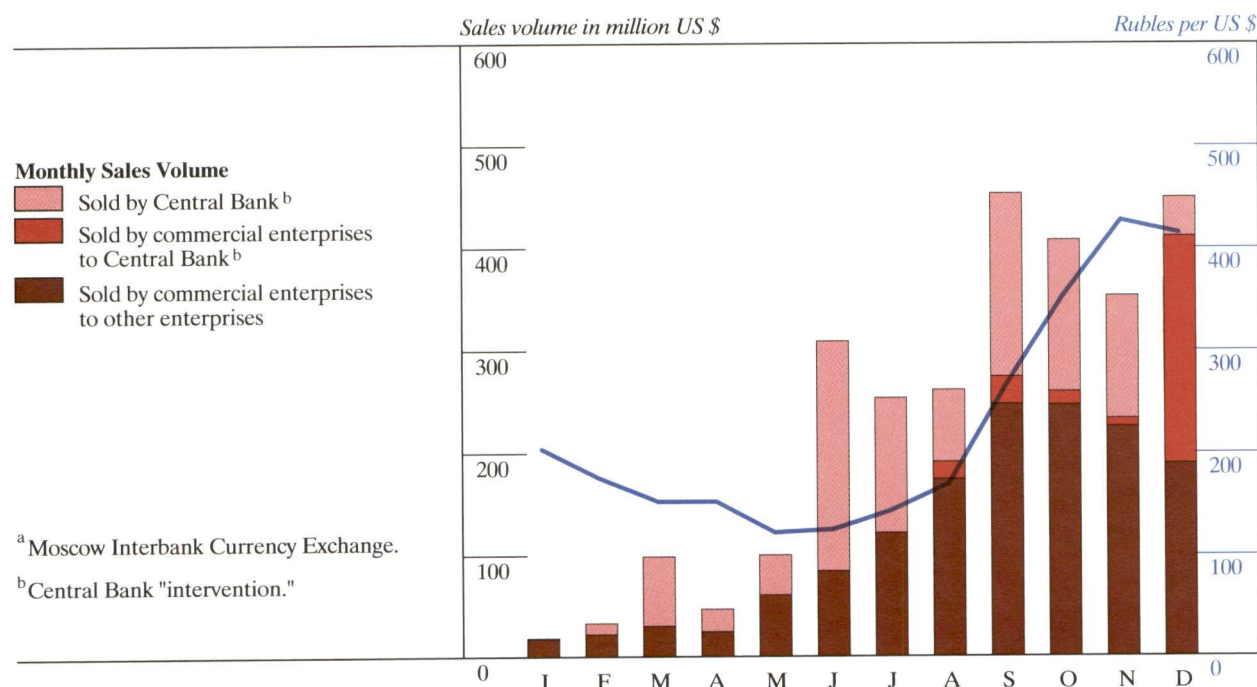
Estimated Hard Currency Debt of the States of the Former USSR, 1980-92

Billion US \$



Source: CIA estimate.

The Ruble/Dollar Exchange Rate ^a



Source: Central Bank of Russia.

Foreign Economic Relations Still in Turmoil

Russia's foreign trade in 1992 dropped sharply for the second year in a row. Moscow, meanwhile, made little headway on reaching a debt agreement with foreign creditors, and foreign investors remained cautious because of the country's political and economic uncertainties.

Foreign Trade Falls. Trade with countries other than the Eurasian states fell in 1992 by as much as 23 percent.¹ The decline primarily reflects falling Russian output, hard currency shortages, problems with transportation links through Eurasia, and difficulty financing trade with former CEMA partners. Russia's foreign trade regulations--hard currency surrender requirements, licensing rules, and tariffs--and Moscow's tendency to modify these rules with little advance notice also inhibited trade. A growing share of the country's foreign trade last year was conducted by Russian enterprises, and many skirted the government's trade rules by illegally exporting and importing various goods and by depositing as much as \$8 billion in export earnings in foreign banks.

The composition of Russian foreign trade in 1992 mirrored past years, with Russia largely a seller of raw materials and a buyer of manufactured goods and food. Sales of oil and natural gas earned Russia around \$20 billion, or almost half of all export earnings. Other commodities such as chemicals, metals, and timber also were significant export items, while manufactured goods--including arms--probably accounted for less than 20 percent of Russia's total sales. On the import side, machinery and equipment comprised about 40 percent of Russian purchases and food, and agricultural products make up more than 25 percent.

Shifts in the regional pattern of Russian foreign trade occurred as some partners were hit harder than others by the drop in Russia's trade. Trade with Developed Western countries, for example, fell less than trade with other regions because of the West's willingness to pay cash for Russia's exports and to provide credits for many of Russia's purchases. Exchanges with Moscow's former CEMA partners, meanwhile, were down sharply, reflecting financing troubles that forced most trade to

take place on barter terms. And trade with most Third World regions plummeted; East Asia was the exception because of the strength of increased trade with China.

Hard Currency Debt Goes Unpaid. Russia was the only Eurasian state to make any payments in 1992 on the \$20 billion due on the debts of the former USSR. Moscow, however, was able to pay only about \$1.5 billion of its share of roughly \$12 billion because of weak export performance, continued capital flight, and a lack of foreign investment. In late 1991, Russia and seven of the other Eurasian states accepted joint responsibility for the foreign debt and set up a mechanism to service their individual shares through the Vnesheconombank (VEB). This arrangement, however, quickly broke down because the non-Russian states did not have significant sources of hard currency and refused to channel their payments through the Russian-controlled VEB. Russia has since concluded agreements with all of the Eurasian states except Ukraine to assume responsibility for their share of the debt in return for their renunciation of a claim on assets of the former USSR.

Toward the end of last year, Russia began negotiations with the Paris Club on a comprehensive debt rescheduling but was unable to reach a quick agreement because of differences over the amount of debt service to be paid in 1993. Negotiations were also complicated by Ukraine's insistence on retaining responsibility for its share of the debt and servicing it independently of Russia in exchange for receiving a proportional share of the assets of the former USSR. At yearend, the hard currency debt of the Eurasian states totaled an estimated \$80 billion.

Foreign Investors Still Wary. Foreign investment continued to play only a small role in Russia's economy in 1992, with inflows estimated at only a few hundred million dollars. Foreign investors were discouraged by Russia's lack of a sound legal system, the nonconvertability of the ruble, Moscow's inability to implement an IMF stabilization program, and the uncertain political climate.

¹ The State Statistical Committee, Goskomstat, reported that foreign trade fell by 23 percent in 1992. The Ministry for Foreign Economic Relations' figures show that foreign trade fell by 9 percent last year. The Goskomstat figures probably overstate the decline in foreign trade last year because of their failure to account for small enterprises and illegal activities. The Ministry's figures, however, probably understate the decline because they include some interrepublic trade.

Exchange Rate Falls as Inflation Rises. The ruble fell precipitously in value in 1992 because of high inflation and a flight to foreign assets. At midyear, the government unified the ruble rate by abolishing its administratively set official and special commercial rates, and began setting its new official rate on the basis of biweekly hard currency auctions in Moscow. Although the government intervened heavily at these auctions to support the ruble, loose monetary policies during the latter half of the year caused the ruble to fall to 415 rubles per dollar by yearend. As a result, at the end of December the ruble was worth about a third of what it had been at the start of 1992.

Ruble Zone Shrinks. In 1992, Russia's trade with other Eurasian states continued to decline, while support for the ruble as a common currency eroded in the face of loose monetary policies and rapidly rising prices within the ruble zone. The decline in ruble zone trade primarily reflected Moscow's efforts to move to world prices and decentralize trade coupled with production declines in the region. Moscow increased energy prices from 2,700 to 8,000 percent depending on each state's economic and political relationship with Russia. Because the other Eurasian states were unable to pay the higher costs, Moscow cut back sharply on deliveries of oil and other goods to limit its growing bilateral trade

deficits. Moscow's decentralization of interstate trade also forced the other Eurasian states to negotiate directly with Russian enterprises to purchase goods previously acquired through state channels. Russian enterprises producing goods readily marketable in the West, however, were increasingly reluctant to sell their products for rubles. As a result, most of the Eurasian states resorted to barter to carry out essential transactions. Growing payment arrears brought about by an ineffective banking system also contributed to the fall in trade across the region.

Russia became increasingly concerned last year that the credit emissions and large trade deficits of other Eurasian states were undermining Moscow's reforms and spurring inflation in Russia. Some Russian officials demanded that the other states abide by Russia's monetary policies or leave the ruble zone. Moscow at midyear began refusing to process trade payment orders from other Eurasian states unless bilateral trade was in balance. It also cut back on credits to Eurasian states running trade deficits. Moscow eventually eased these policies because they severely crimped trade. Four states--Estonia, Latvia, Lithuania, and Ukraine--left the ruble zone and issued their own currencies in the second half of 1992, and other Eurasian states are contemplating similar moves.

Status of the Ruble Zone

OUT

Estonia	The kroon national currency was issued in June 1992.
Latvia	The rublis coupon replaced the ruble in May 1992.
Lithuania	The talonas coupon replaced the ruble in October 1992.
Ukraine	The karbovanets coupon replaced the ruble in November 1992.

ALMOST OUT

Azerbaijan	The manat has been circulating in parallel with the ruble since August 1992.
Turkmenistan	The government plans to issue a new currency later in 1993.

STILL IN

Russia	A new ruble note is gradually replacing the old Soviet-style currency.
Belarus	The rubel coupon is being used in parallel with the ruble.
Moldova	The lei currency will be issued pending Russia's actions.
Georgia	The government has decided to leave the ruble zone, but no date has been set.
Kyrgyzstan	A national currency is being prepared for use later, but no date has been set.
Armenia	A national currency is being printed, but no date has been set for its release.
Kazakhstan	A national currency is being prepared, but the ruble is still in use.
Uzbekistan	Contingency plans for a new currency are under way, but the ruble is still used.
Tajikistan	The government is planning a parallel currency to be coordinated with the ruble.

gross domestic product
market
energy
investment
farms
incentives
shortages
services
capital investment
stabilization
labor
consumers
deficit
foreign aid
savings
enterprise
unemployment
coal
foreign aid
taxes
privatization
equipment
services
production
machine
trade
economy
coal
unemployment
demand
natural gas
employment
privatization
construction
shortages
living standards
demand
imports
controls
deficit
debt
gross domestic product
spending
inflation
layoffs
real income
spending
exports
debt
consumption
prices
industrialists
income
output
foreign aid
prices
living standards
deficit
wages
poverty

NATIONAL ACADEMY OF SCIENCES

2101 CONSTITUTION AVENUE, NW WASHINGTON, D. C. 20418

OFFICE OF THE PRESIDENT

March 13, 1992

MEMORANDUM

TO: Participants in March 3, 1991 Workshop on the Future of Basic Science in the Former Soviet Union

FROM: Frank Press *FP*

SUBJECT: Report of the Workshop

I would like to thank you on behalf of Guy Stever, Ash Carter, and myself for your contribution to the excellent discussions on March 3 concerning science and technology in the former Soviet Union. We have transmitted the report of the meeting to Dr. Allan Bromley. A copy is attached.

Because of the urgency involved in providing this report to Dr. Bromley, we were not able to circulate the cover letter and working group documents to you for review. The three chairs take full responsibility for the contents, which we believe represent a reasonable and accurate summary of the major recommendations and the views of most participants.

Obviously, this report represents an effort to set an agenda. It now remains for those of us in and out of government to work together in refining and implementing this agenda. We here at the National Academy of Sciences look forward to the task.

On behalf of my co-chairs, let me thank you once again for contributing to this timely and important effort.

Attachment



Reorientation of the Research Capability of the Former Soviet Union

**A Report to the Assistant to the President for
Science and Technology**

REORIENTATION OF THE RESEARCH CAPABILITY OF THE FORMER SOVIET UNION

A Report to the Assistant to the President for Science and Technology

Results of a Workshop on March 3, 1992

Co-Chairmen of the Workshop

Frank Press
Guyford Stever
Ashton Carter

Chairmen of the Working Groups

Ashton Carter, Weapons Scientists and Engineers
James Wyngaarden, Basic Research
Gerald Dinneen, Commercialization of Technologies
Alvin Trivelpiece, Multidisciplinary, Problem-Oriented Research

National Academy of Sciences
National Academy of Engineering
Institute of Medicine

National Academy Press
Washington, D.C. 1992

The National Academy of Sciences is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Frank Press is president of the National Academy of Sciences.

The National Academy of Engineering was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Robert M. White is president of the National Academy of Engineering.

The Institute of Medicine was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Kenneth I. Shine is president of the Institute of Medicine.

The National Research Council was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Frank Press and Dr. Robert M. White are chairman and vice chairman, respectively, of the National Research Council.

Support for this project was provided jointly by the Carnegie Corporation of New York and the National Research Council.

Available in limited supply from:

Office for Central Europe and Eurasia
National Research Council
2101 Constitution Ave., N.W.
Washington, D.C. 20418

Printed in the United States of America

NATIONAL ACADEMY OF SCIENCES

2101 CONSTITUTION AVENUE, NW

WASHINGTON, D. C. 20418

OFFICE OF THE PRESIDENT

March 13, 1992

Dr. D. Allan Bromley
Assistant to the President for Science and Technology
Executive Office of the President
Office of Science and Technology Policy
Washington, D. C. 20506

Dear Dr. Bromley:

As you requested, we brought together on March 3 approximately 120 leaders of the U.S. science and engineering community to consider how to preserve the basic science capability of the former Soviet Union (FSU). At that meeting, working groups were constituted in four areas: weapon scientists and engineers, basic research, commercialization of technology, and interdisciplinary problem-oriented research (e.g., health, ecology, energy, polar, etc.). Attached are the reports of these four working groups along with the list of attendees.

As co-chairs of the meeting, we are providing in this letter a summary of the key recommendations and observations drawn from the discussions. Because of the urgency of providing this response, we have not circulated this letter to the attendees for review prior to sending it to you. We take full responsibility for the contents below, and believe that they represent a reasonable and accurate summary of the major recommendations and the views of most participants. More complete details are provided in the working group reports.

Preservation and Reorientation of FSU S&T Is in the U.S. Interest

Scientists and engineers in the FSU will play a key role in the economic revitalization necessary for a successful transition to open and stable market-driven democratic societies, which is in the economic and security interests of the U.S. New scientific and technological challenges in civilian areas for FSU specialists can help divert technical talent away from military pursuits. Achieving U.S. goals of shrinking and redirecting the FSU military R&D effort and developing the S&T component of the civilian economy will require providing new opportunities for both FSU weapon scientists and non-weapon scientists, especially in collaborations with American scientists. These opportunities for collaborative efforts will also allow FSU specialists to help expand frontiers of knowledge in areas of direct interest to the American scientific community and to U.S. business.

Time Is of the Essence

Without opportunities and financial support to address technical challenges, FSU S&T human capabilities are being rapidly eroded through an external and internal "brain drain." Of special concern, temptations are increasing for FSU military scientists to look abroad for opportunities to use their capabilities. Many of the best S&T facilities which are standing idle may soon atrophy. The window of opportunity for U.S. commercial interests to draw on FSU S&T achievements may close as other countries select the best commercial targets. The new FSU leadership will soon be making critical decisions in areas such as research priorities, intellectual property rights, and education accreditation and related policies; and there are one-time opportunities to influence these decisions. The U.S. can play a leadership role among western countries in revitalizing FSU science and technology if we act quickly. Cooperative projects with U.S. scientists and engineers will encourage FSU specialists to remain in place and to help in building a civilian market-oriented economy.

Summary of Key Recommendations

1. The national security, economic, and scientific interests of the U.S. can significantly benefit by expanded cooperative programs in the next several years that provide new research opportunities for critical FSU weapon scientists and the best FSU non-weapon scientists. The existing \$400 million that Congress appropriated pursuant to the Nunn-Lugar Act (the Soviet Nuclear Threat Reduction Act of 1991) within the Department of Defense (DOD) budget is an appropriate source for funding many of these programs this year.
2. Criteria for funding through the new International Science and Technology Center proposed by Secretary Baker and Foreign Minister Genscher should include a broad definition of "weapon scientists and engineers," including relevant specialists at academic and research institutes who have worked on Soviet military R&D efforts. Special attention must, of course, be given to those specialists with critical weapons knowledge and skills. Center-supported proposals that are collaborations of FSU weapon scientists, FSU non-weapon scientists, and U.S. researchers would be the most effective means for achieving U.S. goals of shrinking and redirecting FSU weapon R&D programs and in increasing the transparency of FSU weapon laboratories.
3. In addition to the funds available in this and future fiscal years for key FSU weapons scientists and engineers through the new Center, funding at least on the same order of magnitude should be made available for programs outside the Center for FSU non-weapon scientists and engineers. Thus, at least \$25 million for weapon scientists through the Center and \$25 million for non-weapon scientists through other programs are needed in this fiscal year; even more would be appropriate considering the urgency of the

situation and available opportunities. Expanded funding should be made available in future years as justified through reviews of the programs. Awards should be based on scientific merit and potential contributions to U.S. objectives.

4. The extramural research programs of the National Science Foundation (NSF), the National Institutes of Health (NIH), the Department of Energy (DOE), and the Office of Naval Research (ONR) offer the important opportunity of scientist-to-scientist collaborations, which can be implemented rapidly. U.S. researchers know the best specialists in the FSU in their fields who would make excellent research partners. Funds should be allocated to these agencies (from the \$25 million for non-weapon scientists) for use by their grantees for the purpose of direct scientist-to-scientist collaboration. U.S. researchers could provide travel funds, short term stipends, reagents, and spare parts from their supplemented grants. Joint publications would result from these activities.

5. A portion of the new funding for non-weapon scientists should also be made immediately available through the nine existing intergovernmental agreements that support civilian research and development (R&D) between the U.S. and FSU. This new funding would be added to existing cooperative programs of the NSF, NIH, DOE, USGS, EPA, NRC, NASA, and other federal agencies. This is an effective mechanism for near-term impact in terms of improving collaboration with competent scientists in the FSU on projects of interest to the U.S.

6. Existing procurement regulations and other administrative guidelines inhibiting research contracts from U.S. agencies to research units in the FSU should be reviewed and minimized. The recent contracts negotiated by DOE with FSU research institutes in fusion research and high energy experimental physics provide useful guidance.

7. The President's proposal for assistance to the FSU in agriculture, health, and energy should be strongly endorsed. The U.S. government should examine the science and technology (S&T) needs and opportunities, including R&D needs, associated with these assistance efforts.

8. The U.S. government should promptly modify the apparent restrictive policy concerning acquisition of advanced technologies and technical expertise from the FSU by American firms, including those with large DOD contracts. Reducing U.S. governmental impediments to appropriate activities of the U.S. private sector in the FSU can have immediate impact in terms of increasing collaboration with FSU scientists and engineers, reducing the FSU military industrial complex by redirecting many of its scientists and engineers to civilian projects, and promoting improvements in the economies of the FSU republics. The U.S. government should continue its related efforts to reduce unnecessary export controls,

particularly in the fields of computers and telecommunications, in close consultation and coordination with its CoCom partners.

9. Additional funding from anticipated foreign aid programs and the \$400 million could be effectively used to facilitate conversion of FSU non-nuclear military technologies to civilian applications through such mechanisms as providing venture capital for U.S.-FSU projects, supporting feasibility studies by U.S. firms interested in investing in conversion projects, and providing technical assistance to FSU firms that are assessing marketing and technical opportunities for reorienting military technology to civilian applications.

10. As part of the U.S. economic assistance program to the FSU, the U.S. government should consider high technology R&D as a target for investment support. Such an effort would build on the emerging entrepreneurial abilities of FSU scientists and engineers while stimulating high value-added commercial activity.

11. The U.S. should strongly encourage FSU authorities to promptly enact legislation concerning real property ownership rights and intellectual property rights; to eliminate tax on foreign currency coming into FSU to support S&T; and to continue on the path to ruble convertibility and privatization.

12. A special fund of \$50 million to \$100 million should be established to help replenish and refurbish equipment, journals, and books used in FSU laboratories of special importance. The U.S. should take the lead in obtaining the necessary funds from bilateral and multilateral assistance agencies.

13. The U.S. representatives to international organizations (e.g., World Bank, UNIDO, FAO, WHO, UNDP, OECD, NATO) should urge greater support through these organizations for FSU S&T.

14. American and FSU specialists should undertake evaluations of FSU capabilities in selected areas of science and engineering of particular U.S. interest to assist in targeting cooperative activities and in utilizing the capabilities of unique FSU facilities and data banks of special importance.

15. Significantly expanded cooperation in environmental R&D would support U.S. goals of sustainable growth in the FSU and would enhance international efforts to understand global change.

Past U.S. Efforts Provide a Point of Departure for Expanded Programs

Many intergovernmental S&T agreements are hindered due to uncertainties regarding FSU collaborators. Air fares for FSU participation inhibit business as usual, and some important aspects

of S&T are not being addressed. Nevertheless, some of these agreements, as well as the extramural programs of some agencies, provide mechanisms for identifying and funding programs of great importance, and the partnerships within the FSU can be sorted out very quickly. For example, the programs of NSF, NIH, DOE, and ONR are well-suited to respond to the needs of basic research of interest to U.S. scientists, while programs of mission agencies such as EPA, DOE, USGS, and NASA provide mechanisms for Americans to gain access in a highly cost-effective way to important FSU specialists and facilities of direct interest to the programs of these agencies.

U.S. businesses are prepared to take advantage of many technical opportunities in the FSU, but many hesitate due to uncertainties regarding U.S. policies on technology transfer as well as inadequacies in the legal/economic framework within the FSU. Meanwhile, competitors from Germany and other countries receive stronger financial incentives from their governments and are gradually establishing business alliances with many of the most promising organizations in the FSU.

The new Center for support of FSU nuclear weapons scientists should offer many opportunities for FSU specialists to redirect their activities to civilian purposes and thereby shrink the size of the FSU military R&D effort. It also provides a base for rapidly expanding cooperative programs in other areas of science and technology.

Many FSU S&T activities are linked to programs of international organizations in which the U.S. plays an influential role (e.g., World Bank, UNIDO, FAO, WHO, NATO, OECD), and these organizations are in a position to direct additional resources to the FSU with encouragement from the U.S.

Several major U.S. private foundations are interested in helping to preserve the science and technology community in the FSU, and they can launch new programs very quickly. Their resources are limited, but they should be encouraged and complimented for their efforts to select special niches for their support (e.g., providing journals and electronic mail equipment).

American scientific professional societies are also rising to the challenge and creating innovative programs to assist their colleagues in the FSU. The American Astronomical Society has raised funds from its members to provide small research grants to FSU astronomers. The American Association for the Advancement of Science, with support from the MacArthur Foundation, will be providing help in maintaining journal subscriptions. Individual American scientists are seeking mechanisms for donating their journals and used equipment to FSU colleagues.

The National Academy of Sciences, National Academy of

Engineering, and Institute of Medicine are examining ways in which they can contribute to the revitalization of FSU scientific and engineering capabilities. The National Academy of Sciences has already changed its long-standing cooperative program to ensure that FSU participants are selected on the basis of evaluations by their American colleagues. In addition, consideration is being given to: undertaking evaluations together with FSU colleagues of FSU capabilities in important fields of science and technology (including those of potential commercial importance such as materials), sponsoring workshops for FSU and American researchers to develop collaborative research agendas and proposals in selected subfields, and working with counterpart organizations in Europe to improve coordination of western initiatives. The American Academy of Arts and Sciences is also pursuing, through a recently-created special committee, ways in which it might help the FSU communities in the sciences, social sciences, and humanities.

Special Considerations for New Programs

Programs supported by the United States should be based on mutual benefit and should not simply be responses to the economic plight of FSU specialists and institutions. Programs should be a mix of: (a) collaborative projects developed jointly by FSU and U.S. researchers and/or teams of researchers with the projects selected competitively on the basis of merit and (b) targeted projects designed to preserve and utilize the capabilities of unique FSU facilities and data banks of special importance to U.S. science and technology interests. Coordination of bilateral approaches with activities of other countries and international organizations is important and synergistic, but should not slow down the U.S. response. Whenever possible, implementation should begin within the next several months. Programs should be subject to careful review after the first year, with attention both to technical payoff and financial accountability. If benefits of these programs to the U.S. are as high as we believe they will be, the programs should be supported with increased funding over the next several years.

Other Promising Approaches that Deserve Careful Study

The proposal of Representative George Brown to establish a binational science foundation between the FSU republics and the U.S. is a welcome initiative with the possibility for long-term mutual benefit. The Brown proposal deserves careful study by the U.S. government. The policies and activities of the Export Import Bank, OPIC, and the Trade and Development Program might offer greater incentives for American investments in the FSU. Expanded authorities of U.S. agencies to enter into contracts with FSU organizations, when such arrangements are particularly beneficial to the missions of the agencies, can be very important; and the administrative details need to be carefully worked out.

In conclusion, we appreciate very much your soliciting the advice of the U.S. science and engineering community on these important issues. We hope that the recommendations and comments in this letter and in the four working group reports will be helpful to you in developing U.S. initiatives to respond to challenges and opportunities provided by developments within the FSU S&T community.

We would like to thank for their efforts in leading three of the working groups: Dr. James Wyngaarden, Foreign Secretary of the National Academy of Sciences and Institute of Medicine (Basic Research Working Group); Dr. Gerald Dinneen, Foreign Secretary, National Academy of Engineering (Commercialization of Technology Working Group); and Dr. Alvin Trivelpiece, Director, Oak Ridge National Laboratory (Interdisciplinary Problem-Oriented Research Working Group). We would also like to thank for their help in organizing the meeting and preparing this report the Office of International Affairs of the National Research Council (Dr. William Colglazier, Executive Director; Mr. Glenn Schweitzer, Director, Office for Central Europe and Eurasia; Dr. Gary Waxmonsky, Associate Director, Office for Central Europe and Eurasia; and Peter MacDonald and Kathleen Trivers of their staff.) We are especially grateful to Dr. David Hamburg and the Carnegie Corporation which, along with the National Research Council, provided financial support for the meeting.

We believe that it is in U.S. interest to act immediately and aggressively. If we or the National Research Council can provide you with any further assistance, we would be pleased to do so.

Sincerely,



Dr. Guyford Stever
Commissioner
Carnegie Commission
on Science, Technology
and Government



Dr. Frank Press
President
National Academy
of Sciences



Dr. Ashton Carter
Director
Center for Science
and International
Affairs

REPORTS OF WORKING GROUPS

AND

PARTICIPANT LIST

Working Group on Weapons Scientists and Engineers

The working group addressed the US interest in programs of assistance and cooperation with weapons scientists and engineers (S&Es) in the FSU and considered how such programs might be structured for maximum effect. While the working group foresees and supports sustained programs of assistance and cooperation extending over years, the group's deliberations focused on first steps that could be taken immediately and urgently. The working group took particular note of the applicability of the Soviet Nuclear Threat Reduction Act of 1991 (the so-called Nunn-Lugar Act) to the support of such a program in this fiscal year.

The group encourages a broad view of military-related work, urging that it not be confined to nuclear weapons but encompass all military-related technical work in the FSU. Moreover, since one of the objectives of the programs of assistance and cooperation is to foster the reorientation of weapons scientists and engineers to peaceful civil work, programs should not be confined to weapons scientists only, but should extend to other types of projects covered by other working groups in this meeting.

Objectives

The working group noted that the objectives of the programs of assistance and cooperation discussed and the interests of the United States in such programs are broad and diverse. They are not completely encompassed by the familiar stereotype that involves somehow preventing an FSU "weapons scientist" from emigrating to a country that is the target of US nonproliferation policy, though that is surely an objective. The full range of US objectives includes:

1. To promote the shrinkage and reorientation to productive, peaceful purposes of weapons-related activities carried out in laboratories, institutes, and state enterprises of the FSU;
2. To stabilize the situation of weapons scientists and to anchor them in peaceful projects designed to benefit their own homeland so they are not tempted or forced to seek employment or military markets outside the FSU and thus to contribute to proliferation;
3. To assist the transition to democratic institutions and a market economy in the FSU by encouraging its S&E communities to conduct basic and applied research aimed at addressing pressing social needs and economic development;
4. To promote access and transparency in the hitherto closed weapons complex of the FSU;
5. To promote joint research of mutual benefit between S&Es in the FSU and American or other western partners; and

6. To demonstrate the respect of the American people and the international scientific community for the considerable technical capabilities of FSU S&Es.

General Characteristics of Needed Programs of Assistance and Cooperation

The programs should support projects that satisfy the above objectives and also the following criteria:

1. The projects are technically sound.
2. The results of research will address pressing social and economic needs of the FSU and/or are of mutual benefit to the FSU and the United States.
3. The proposing entities can demonstrate their ability to accomplish the work.

In terms of technical content, the working group judged that useful projects of technical assistance and cooperation could probably be devised in the areas of:

- secure and environmentally safe interim storage and eventual elimination of nuclear weapons and other weapons of mass destruction;
- storage and disposal of special nuclear materials;
- nuclear safety, including biological effects of low-level ionizing radiation;
- environmental monitoring and cleanup, including cleanup of military-related facilities;
- civil energy, transportation, and telecommunications;
- fundamental research and associated instrumentation in such fields as high-energy physics, nuclear physics, fusion, plasma physics, geophysics, and computer science; and
- social systems science, technology assessment, and public policy (similar to the types of studies conducted by the US Office of Technology Assessment or the International Institute for Applied Systems Analysis that are focused on the relationship of science and technology to society).

The working group believes that useful assistance and cooperation projects can take many forms and that it would be premature at this time to focus them on a single model type. Useful projects might involve collaboration of FSU weapons laboratories/institutes/enterprises with selected US Government

laboratories, industry, or universities; three-fold collaboration among FSU weapons and non-weapons establishments and US partners; and projects undertaken individually by FSU weapons establishments and monitored by US entities. (The group recommends that when there is no US partner in a project, a US monitor be named to certify that the work proposed is being accomplished.) Likewise, projects might be proposed by FSU laboratories or other institutions or proposed by individual scientists or groups, provided that they can demonstrate an ability to carry out work.

While both individuals/small groups and institutions in the FSU should be encouraged to develop proposals (and some groups might want to separate themselves from their institutions and establish new civil/commercial entities), maximum effect will be achieved if weapons-related institutions are engaged as institutions in some programs, and if cooperative programs contribute to reorienting their programs and infrastructures away from military work to peaceful purposes. Thus, unlike other types of assistance and cooperation discussed by the other working groups, collaboration with FSU weapons communities requires emphasis on involvement of institutions (and their accompanying infrastructures) in addition to individual investigators. There are good reasons for this difference: first, emigration abroad of engineers and technicians from the FSU weapons establishment is no less serious than the emigration of key scientists; second, the infrastructures of the weapons laboratories are very well developed (generally better than those of the civilian sector); third, in many cases the shrinkage of the FSU weapons program will be promoted better by involving entire institutions (key scientists and infrastructures) in non-military activities. Identification of joint, multilateral, or FSU-only projects worthy of support should take account of these special circumstances. The working group believes that there are indeed worthy projects that take this form.

However, the working group is aware of the necessity to embolden investigators to act independently of existing bureaucracy and management. Thus, US-supported programs should also emphasize projects proposed by individual investigators and by new civil/commercial enterprises spun off from military enterprises, and such projects with spinoffs should be encouraged in addition to institutional projects.

Starting the Process: Catalytic Efforts

The working group recognized the very fluid situation in the FSU, the historic isolation of FSU weapons-related scientists, and the fact that western scientists are just beginning to explore the scientific strengths and weaknesses of the former Soviet system. Thus early attention must be given to the processes of expanding access to the FSU weapons establishment, promoting contact between potential collaborators, and developing project proposals.

These catalytic efforts could begin immediately and could include grants to support problem-focused workshops, joint conferences, and site visits; conceptual design of projects, test beds, and pilot projects; and electronic mail and other elements of telecommunications infrastructure (e.g., direct links via satellite dishes located at key collaborating facilities in the FSU). The working group recommends that such activities begin immediately. They should not await determination of the overall future scope of the program, and indeed they are a necessary prerequisite to such a program.

The working group did not attempt to estimate the dollar volume of useful projects that would likely develop in such a program but believes the program should not be confined to the \$25 million under discussion in connection with the Center (see below).

The Moscow Center

The United States, Russia, and Germany (through the EC) have agreed to establish an International Center for Science and Technology in the Moscow area to serve as a "clearinghouse" for research projects involving entities in the FSU that have special weapons expertise. Discussion of the ground rules and modus operandi of the Center is just beginning. The working group was generally impressed with the preliminary US plans for the Center and urges prompt commitment of at least \$25 million of Nunn-Lugar funds to the Center and prompt establishment of the Center. The working group makes the following additional observations.

The Center seems to be an appropriate vehicle for the "catalyzing effort" described above, and could become an institutional mechanism for the program of sustained assistance and cooperation with FSU weapons entities in future years. The Center's location in the FSU is important, given the need to gain on-the-ground acquaintance with the weapons enterprises and scientific communities of the FSU. The working group urges attention to republics in addition to Russia, which also have considerable military industries. The Center also can serve as "matchmaker" between scientists and appropriate projects and funders. Finally, the Center promises to engage the resources of European and possibly Japanese participants, which the working group regards as highly desirable. However, the working group believes that the Center should not be the sole or exclusive vehicle for such cooperation.

Present plans call for the Center to act on proposals in two steps. In the initial step, projects will be vetted for appropriateness and merit by the Center staff and board. In the second step, funders (governments and private parties) will choose projects for support on a case-by-case basis. The Center itself will have no power to make funding commitments apart from the national representatives on its board. The working group is

concerned that unless some funds are committed to the Center from the beginning, the Center will be seen as a needless and powerless middleman between proposers and funders rather than as a clearinghouse. More importantly, the establishment of the Center will not reflect the commitment and seriousness of purpose of its founding governments. The working group therefore recommends creation of a Director's Fund of committed funds, comprising perhaps one quarter of Center funding, to be obligated by the Center itself.

Finally, the working group noted that in order for projects to fulfill the objectives outlined above, involved scientists will need to make multi-year commitments to them. This commitment in turn calls for Center funding that extends beyond this year's Nunn-Lugar appropriation. The United States therefore needs to ensure continuing funding commitments to the Center. Additionally, the Center should be capable of making multi-year commitments.

Potential Role of Existing Bilateral Agreements

Several of the nine existing science and technology agreements also provide a mechanism for engaging FSU weapons S&Es in collaborative activities. For example, the agreements administered by DOE/NRC, NSF, and EPA could involve participation of FSU specialists who previously were not given the opportunity to collaborate in areas of obvious importance to these agencies.

Additional Steps in the United States

The working group believes that collaborative projects involving FSU weapons activities and western partners (public or private) will emerge spontaneously if veils of secrecy are lifted in the FSU. Projects of mutual advantage might even be supported through barter agreements between the collaborating parties. But substantial bureaucratic and legal barriers exist to such spontaneous collaboration in the United States, and the working group recommends that a complete review of such barriers be undertaken urgently to remove all those that derive from the cold war period and no longer serve US interests.

The working group also notes that legal counsel in different agencies is interpreting the Nunn-Lugar legislation in different ways and in a manner that seems excessively cautious and strict, especially regarding the so-called certifications. Government-wide consensus on these interpretations should be reached soon, so that they do not remain a barrier to action.

Additional Steps in the FSU

The working group believes that for the proposed types of programs to succeed, the Russian government (and, where applicable, other governments of the FSU) must take the following steps, which

are preconditions to success:

1. Participating weapons facilities need to open up to outside visitors and collaborators, limiting restricted security areas to the maximum extent possible ("higher fences around smaller areas").

2. Weapons laboratories must relax controls over individual scientists and engineers so they can communicate directly with western collaborators.

3. Participating FSU weapons facilities need to allow establishment of electronic communications with the outside.

4. Participating weapons facilities need to make laboratories, instrumentation, and other infrastructure available for non-weapons work. Access to that infrastructure will often be the principal attraction for western collaborators.

5. FSU governments need to establish appropriate tax treatment for foreign currency funds provided to institutions as part of this program.

Working Group on Basic Research

The working group on Basic Research proceeded from the position that it is in the economic and national security interests of the United States to preserve the strong scientific and technical capability of the Former Soviet Union (FSU) in order to sustain the transition to an open society and a market-oriented economy.

The FSU is in crisis. Dramatic changes in the region, although undoubtedly positive in a political sense, leave scientists in a precarious niche since there is very limited money for science. Salaries for scientists within and outside the academy structure are pitifully low, and FSU scientists are becoming increasingly isolated from their international colleagues owing to the virtual absence of hard currency necessary for western journals and for travel to meetings outside the FSU. Outstanding research groups are disintegrating, and some of the best scientists of all ages are leaving for temporary, and in some cases permanent, positions abroad. If the exodus of FSU scientists continues, and if FSU science and technology wither and flounder, it is difficult to see how the FSU nations can prosper. Science and technology, together with capital and free social institutions, propel a modern economy.

This situation is clearly a security issue for the United States. The United States has already invested huge resources in the "containment" of communism, and a comparatively small investment now could be very effective in stabilizing the FSU scientific establishment. This investment may also encourage scientists who have left for temporary positions to return to assist in the stabilization process. In our view, international disaster could ensue if the present political and economic restructuring of the FSU were to fail and new totalitarian regimes were to reemerge. An enlightened program that would help to stabilize FSU science and technology would make an important, perhaps decisive, contribution to the future of these burgeoning democracies.

Even though many prominent scientists have left the FSU, large numbers remain. The major scientific resources are to a large extent still intact and now free from bureaucratic strangleholds. They are free from undesirable interference, free to enter into collaborative agreements, and free to accept financial support open to accounting supervision. The cost of operation in the FSU (salary, maintenance, etc., but excluding equipment) is much less than the cost of comparable activities in the West. Moreover, the FSU possesses unique assets such as research ships, astronomy installations, botanical collections, and historic libraries, as well as world-class research groups.

The working group recommends that the United States undertake a number of initiatives that will help to stabilize science and technology in the FSU. We have based these recommendations on the concept of mutually advantageous binational collaboration. There are many competent and well known FSU scientists and high-quality research groups with whom American scientists could form collaborative research and technical projects. Such projects should not be viewed primarily as assistance programs; the working group is not proposing a welfare system for FSU scientists. We are proposing an expansion of international collaborative efforts, the results of which could be of substantial value to the American people and the American economy. There are, in fact, critically important projects to which both partners can make significant, complementary contributions.

The working group recommends identification of high-quality individuals and groups with whom to collaborate directly. Although many such are known to the American scientific community, the working group recommends that small teams of American scientists visit the FSU to assess first hand the current situation in institutes and university departments. Decisions regarding feasibility of productive collaborations should be based upon the judgment of such teams. These visits would also help to identify emerging younger researchers who could participate in collaborative activities, but may not yet be well known to American scientists.

The working group recommends that US contributions to collaborative research be principally in the form of supplies, such as equipment, journal subscriptions, travel funds, and communication systems (for example, e-mail), rather than direct transfer of currency or salary support (except during brief fellowships outside the FSU). Furthermore, the working group recommends that any form of assistance be provided directly to the individual scientists and groups, rather than to institute administrators or academy officials for distribution. Whenever possible, cooperation between scientific institutes and educational institutions in the FSU should be encouraged.

Decisions regarding potentially advantageous collaborations should be based upon principles of merit review now thoroughly familiar to US scientists. However, in recognition of the newness of such concepts to FSU scientists, merit review should give predominant weight to track records rather than to "grantsmanship." In addition, the application process should be kept relatively simple (short applications) and the review process should be expedited.

The discussion focused on an emergency, short-term approach to stabilizing science in the FSU and establishing collaborative projects between FSU and American scientists. The situation is urgent, and we believe that measures should be taken during this fiscal year. American support of selected FSU individual

scientists and research groups that qualify for extensions of peer-reviewed US research projects could be highly beneficial to both countries and would send a message of hope to FSU scientists far beyond the quantitative scope of initial efforts.

Clearly, American efforts to preserve science should not focus exclusively upon redirection of scientists who have participated in the creation and production of weapons of mass destruction. It is equally important that the United States pay close attention to scientists in the basic physical, chemical, geological, biological and mathematical sciences.

Recommendations for the US Government

Within the next six months

1. Immediately allocate between \$5,000,000 and \$10,000,000 of additional funds for supplements to existing American grantees of agencies such as, but not limited to, NIH, NSF, DOE, and ONR. Such supplements might come from the \$400,000,000 authorized by the Nunn-Lugar Act through interagency transfer to the research agencies or from other sources if more appropriate. These supplements will allow the grantees to initiate or expand collaborative activities with FSU scientists and rapidly provide some assistance. By using the best features of the NIH and NSF mechanisms to support the collaboration of American scientists with FSU scientists, immediate amplification of funds may allow these models to be expanded many-fold in the current fiscal year. Such an effort would represent a significant response to the present emergency and send much needed encouragement to beleaguered FSU scientists who are a main resource in rebuilding the societies and economies of the FSU. In addition, such efforts would substantially expand research projects of benefit to the American people.

2. Immediately develop an administrative mechanism for transfer to FSU scientists of equipment from US laboratories that has been displaced by more recent acquisitions and that remains capable of producing valuable research results. Such equipment should only be transferred to FSU scientists who qualify for collaborative projects with US scientists and who can effectively use the equipment in the approved collaborative research, thus ensuring that the US investment will further benefit domestic research objectives.

3. Facilitate the issuance of multiple-entry US visas for non-weapons scientists and engineers, such as are now offered to members of the business community, unless there are overriding concerns over potential violations of export controls. The Department of State should give special consideration to FSU scientists returning home for short

visits to assist in the improvement of working conditions in the FSU.

The near term

1. Support Congressman George Brown's proposal for a binational foundation, with the modification that the foundation be in the form of a withering endowment of 10 years. At the end of this period, both sides should evaluate the state of FSU science to determine if the continuation of this type of support for research cooperation is necessary and mutually beneficial. In order for a binational science foundation to have significant impact, it should be capitalized at a minimum of \$200,000,000, with both interest and approximately 10 per cent of principal available for support of peer reviewed research projects each year. Many of the experiences and lessons of the US-Israel Binational Science Foundation (as well as experiences of the Binational Agricultural Research and Development Foundation and Binational Industrial Research and Development Foundation) can serve as general guidelines for the establishment and management of the proposed US-FSU foundation.

2. Initial assistance should be offered in the form of laboratory equipment, development of improved means of communication, and travel, but not in the form of salary assistance. When a banking system with appropriate accountability is in place, the United States should not rule out efforts to transfer foreign currency directly to FSU scientists for support of research programs.

3. Encourage efforts of non-governmental organizations that are seeking ways to assist FSU scientists by supporting their research.

The long term

1. Cooperate and coordinate with activities initiated by other governments, scientific societies, the European Community, the World Bank, and international organizations involved in science and technology.

2. Sponsor programs on the management of science for FSU research administrators and scientists. Such programs should include an introduction to peer review procedures and grant management for many colleagues throughout the FSU.

Recommendations for FSU Governments

Within the next six months

1. Encourage FSU scientists now working in the West to return

to the FSU to work with other scientists, and assure freedom to travel back to their jobs outside the FSU. The offer of a leave of absence is in the best interest of the home institution, and job security should be assured even beyond the one-year period of absence currently recognized by the Russian Academy of Sciences, at least for a portion of established FSU scientists.

2. Guarantee continued salary support to FSU scientists involved in collaboration with American scientists throughout the period of the collaboration.

3. Provide internal travel support to FSU scientists.

4. Provide tax exemptions for hard-currency grants.

5. Facilitate the issuance of multiple-exit documentation for FSU citizens working in the West who wish to return for frequent visits to assist their home institutions and/or scientific colleagues.

The near term

1. Assist in identifying promising young researchers who are not yet known to American scientists (i.e. in basic sciences such as genetics that are essential for advances in agriculture and medicine).

2. Establish a clearing house or secretariat that can assist FSU scientists to make contact with organizations, programs, and scientists in the United States and other countries.

The long term

1. Implement promised reforms as quickly as possible, including the reform of tax laws, intellectual property rights, and education.

2. Encourage academies, universities, and industries to establish cooperative linkages and to bridge the non-interactive traditions of the previous regime.

Recommendations for Non-Governmental Organizations

The near term

1. Scientific societies (national and international) should be encouraged to ask members to assist FSU scientists by sending journals, expanding electronic mail networks (especially outside Moscow), and providing funds for travel to meetings.

2. NGOs can help to identify individual scientists and research groups that are leaders in their fields with whom collaborative research could be established.

3. Private foundations and professional societies can help to publicize opportunities for collaboration of FSU scientists with American scientists.

4. Private organizations should establish mechanisms for the transfer of hard currency to the FSU, when accountable banking systems have been established.

The long term

1. NGOs and scientific societies are encouraged to identify and support similar organizations in the FSU and to promote their growth.

Recommendations for NAS/NAE/IOM

The NAS had more than 30 years of experience in cooperating with the Academy of Sciences of the USSR. The Academy complex should build upon this experience of cooperation with FSU institutes and scientists in the following ways:

The near term

1. Make recommendations to the US and FSU governments on new approaches to technical assistance based on experiences with the Support for East European Democracy Act.

2. Send small exploratory groups to the FSU in as many different fields as possible to assess the quality and viability of small research groups and the opportunities for productive collaboration.

3. Take an increasingly active role in counseling prospective American collaborators on available opportunities and programs.

The long term:

1. Establish a bilateral advisory committee to assist the FSU and US Governments to implement new programs of cooperation. The committee would include FSU scientists who know western science well. The FSU members of the committee should extend beyond the established academies of sciences in the FSU and should be supported by the FSU governments. Among its activities, it could assist in defining a framework for intellectual property rights.

2. Serve as a catalyst for assembling national and international experts to participate in peer/merit review of proposals of FSU scientists. Provide guidelines similar to those established and tested over time by NSF, NIH, and other US funding agencies.

Working Group on Commercialization of Technology

The working group included senior executives from companies with strong business interests in the FSU, specialists with experience in transferring FSU technologies to American firms, economists specializing in FSU developments, representatives of US federal agencies with strong engineering interests, and representatives of engineering societies.

There should be considerable opportunities for establishing commercially viable enterprises in the FSU. The FSU has developed many good technologies, particularly in military enterprises (e.g. opportunities for application of BW capabilities to vaccine production and for new applications of aerospace technologies). Many young FSU scientists and engineers have exhibited considerable grass roots entrepreneurship, although on occasion some of their enthusiasm may be misdirected. Also, there is widespread interest in the FSU in working with American businesses and learning western approaches to a market economy.

However, the paradox is that relatively few commercial arrangements have been made between American and FSU organizations. Companies of other countries seem to be more successful, particularly firms from Germany and recently Korea and Japan. This limited American involvement is particularly significant since the window of opportunity for joint ventures and other types of business alliances may be closing either because firms of other countries simply usurp the most attractive joint venture opportunities or existing FSU capabilities erode to the point that they are no longer interesting.

There are few generalized conclusions and recommendations that apply to all industrial sectors and all types of organizations. For example, large firms have specialized staffs for identifying business opportunities in the FSU whereas small companies cannot afford such specialization. Firms involved in development of hardware have different concerns than software firms. Also, service companies use different criteria than manufacturing companies when considering investment commitments. Nonetheless, a few desirable actions that are applicable on a broad basis and would be beneficial to both American and FSU interests can be identified.

Much of the discussion centered on foreign investment, but the importance of FSU efforts to commercialize their own technologies for the internal market was also highlighted. While many technologies developed with or without foreign partners can potentially serve both the internal and global markets, there are special considerations for FSU firms attempting internal commercialization without access to the expertise of foreign partners.

Throughout the discussions, the complexities of understanding

the many factors that affect business decisions or should affect decisions within the FSU were very apparent, and the need for more extended consideration of the likely impacts of any individual measure that is proposed was recognized. Adding to the complications are the uncertainties within the FSU military industrial complex associated with the process of conversion. Conversion affects not only individual firms and local areas but in some cases can have dramatic effects on large geographic regions where the defense industry has become the only source of possible employment for hundreds of thousands of workers.

Four suggestions for immediate consideration emerged from the discussions:

-- The FSU must clarify real property ownership rights as a first step toward any type of meaningful market economy.

-- If US firms are to become more seriously engaged in commercialization of FSU technologies, and especially technologies that have been developed within the military sector, the US government must clarify its policy, and particularly the policy of DOD, toward acquisition by US firms of high technology from the FSU.

-- A portion of the \$400 already earmarked for dismantling of the FSU weapons complex (e.g. \$25 million in addition to the \$25 million allocated for reorienting the activities of the nuclear weapons scientists) should be made available to facilitate conversion of FSU non-nuclear military technologies to civilian applications through such mechanisms as providing venture capital for US-FSU projects, supporting feasibility studies by US firms interested in investing in conversion projects, and providing technical assistance to FSU firms that are assessing marketing and technical opportunities for reorienting military technology to civilian applications.

-- The US government should review its policies for sharing risks and financial burdens with American firms interested in investing in the FSU in the near term, including the policies, programs, and financial capabilities of ExIm Bank, OPIC, and the Trade and Development Program.

These and other suggestions for near-term actions by FSU and American institutions are set forth below.

Suggestions to Governmental Organizations of the FSU

The Legal/Regulatory Framework

1. Real property ownership rights need to be clarified as soon as possible.

2. The efforts that have been underway for many years to establish, implement, and enforce an appropriate legal framework for intellectual property rights should be revitalized.

3. Special steps are needed to ensure that regulatory agencies (e.g. organizations with responsibilities similar to those of FAA and FDA) do not become bottlenecks during the transition from Soviet to other institutions.

The Economic/Financial Framework

4. Establishment of a banking system that can serve as a reliable source of investment capital, including venture capital for innovation, and at the same time can help ensure the integrity of financial arrangements among FSU institutions and between FSU and foreign organizations deserves high priority.

5. Current efforts toward convertibility of the ruble should continue to receive strong emphasis.

6. Systems that encourage and reward economic competitiveness among firms should be strongly supported.

7. The current policy of heavy taxation on flows of foreign currency into the FSU should be modified.

Physical and Technical Infrastructure

8. Greater attention is needed at the national and local levels to providing access to electricity, heat, water, transportation, communication, waste disposal, and other services required for enterprises to operate on a competitive basis.

9. With the devolution of centralized responsibilities from the FSU to the independent states, special efforts are needed to ensure that there is no backsliding on the development and implementation of appropriate industrial standards which are consistent with international standards.

Attitudes and Approaches toward Science and Engineering

10. Scientific and engineering entrepreneurs, including key specialists spinning off from leading FSU research institutes, should be encouraged and not considered as an internal brain drain.

11. The size of many FSU research, development, and production organizations should be reduced to improve their economic competitiveness.

12. New systems of rewards are needed throughout the research establishment to foster projects that result in outputs which have clear relevance to economic needs of the FSU in addition to

resulting in publishable papers.

13. Greater attention to economics and management is needed in higher technical education institutions.

Suggestions for Agencies of the US Government

For NSC/OSTP/State/DOD/Commerce

1. US policy toward acquisition by American firms of high technologies from the former Soviet defense industry should be clarified, and American defense firms should be given a clear signal regarding those activities which are acceptable to DOD. This policy should be formulated on the basis of a careful evaluation of the many US interests that are involved, including the importance of high technology to a successful FSU transition to an open market economy, and the possibility that the current window of opportunity to acquire FSU technology may close as other countries increase their interest in FSU technologies.

2. A continuing relaxation of US export controls should be considered, particularly with regard to computer and telecommunication technologies.

For ExIm Bank, Overseas Private Investment Corporation, Trade and Development Program, AID

3. Consideration should be given to providing financial incentives through risk sharing and other approaches that will encourage American investment in the FSU. Among the approaches are support (through feasibility studies and guarantees) of local production of drugs and food processing equipment, possibly within the context of humanitarian assistance, export guarantees for investments in manufacturing equipment installed in the FSU, and encouragement of subcontracting of American firms with FSU institutions.

For Commerce/NSF

4. Cooperative research projects involving American industrial scientists spending time in the FSU and FSU scientists in the US should be encouraged.

5. Benchmark evaluations of selected subfields of FSU science and technology with potential for early commercialization should be carried out jointly between American and FSU specialists and institutions as a basis for targeting FSU internal financial support and American cooperative projects.

For State/Commerce

6. With the disappearance of services provided to foreign business by many agencies of the FSU, the US Government should strengthen

its supporting administrative infrastructure in the FSU to facilitate American business interests.

For State/NASA

7. A review of the opportunities for major collaborative space programs, including programs with commercial significance, should be undertaken before the FSU capability to participate disappears.

For AID/Commerce

8. Assistance in identifying opportunities for redirecting the enormous engineering capabilities of the military industrial complexes to commercially viable services and products, and particularly identification of marketability of services and products at home and abroad, is needed.

9. Assistance in the field of research management at the institute, laboratory, and enterprise levels is needed. This is in addition to the well recognized need for assistance in basic economics and cost accounting procedures in managing privatized enterprises. A major US initiative in this area could build on related US experiences in strengthening management capabilities in Central Europe, China, and other parts of the world.

Suggestions for US Industry

Becoming better informed of opportunities and impediments

1. Participation in trade fairs and exhibitions and in other activities organized by the FSU can open many doors in the FSU.

2. Special meetings devoted to developments in the FSU organized by trade and professional associations and other interested business organizations can help identify opportunities and problems.

3. Participation in consortia of business firms that establish offices in the FSU may be helpful to some companies.

4. Firms should take advantage of trade offices established in the US at the federal and state levels which follow developments in the FSU.

5. Business opportunities should be explored beyond Moscow -- throughout the Russian Federation and in other newly independent states as well.

Considerations for technology-based companies

6. Manufacturing and engineering staffs should explore possibilities for subcontracting in the FSU.

7. The experiences of companies which have established direct linkages among engineers and which have successfully defined subcontract tasks for component development should be reviewed by other companies with related interests.

Steps to improve the investment environment

8. Companies should bring problems and relevant experiences to the attention of the US Government with specific suggestions as to how to reduce legal, regulatory, financial, and other barriers to doing business in the FSU.

Suggestions for the NAS/NAE/IOM

1. The Academy Industry Program should consider organizing a meeting in Washington on commercialization of technology in the FSU.

2. The Academies should consider undertaking an evaluation together with FSU counterparts of FSU capabilities in one or two selected subfields of technology of potential commercial importance to the FSU (e.g. materials science).

3. The Academies should work with counterpart organizations in Europe to improve coordination of western initiatives related to commercialization of technology in the FSU.

Working Group on Interdisciplinary Problem-Oriented Research

The former Soviet Union (FSU) is undergoing a wrenching transition from a centrally planned to a market economy. In this process, it is imperative that the FSU successor states retain an ability to function in a complex technical world with the tools of a modern state. The FSU had a large and complex science enterprise that served its interests adequately. In the process of transition to a new economic structure, this enterprise is under serious threat of being dismantled in such a way that it may not recover. Without a suitable science and technology (S&T) base, the transition to a properly functioning, market economy will be difficult if not impossible. It is in the interests of the United States and of the entire international community that the S&T enterprise of the FSU be preserved and, as appropriate, reoriented, in such a way as to support the transition to a peaceful, modern, technology-based economy.

Part of the S&T enterprise of the FSU involves many areas of applied and interdisciplinary science and technology. These include management of biological diversity, preservation of the world's ocean resources, assessment of risks of earthquakes, stewardship of the Arctic regions, safe utilization of nuclear power, and the possible development of fusion power.

Collaboration between the United States and the FSU in many of these areas has a long history. For nearly twenty years, US mission agencies have collaborated with Soviet counterparts under a number of executive agreements. Known collectively as "S&T agreements," these instruments have facilitated bilateral collaboration in a number of areas including public health, environmental protection, space exploration, transportation, and energy. Activity under all such agreements was grounded in three principles, equality, reciprocity, and mutual benefit, and funded by each agency from its existing budget. An interagency working group on Soviet science and technology, known most recently as GOSSAT and chaired by the State Department, has sought to ensure coordination among the various programs and their conformity to US policy.

In general, the steps outlined below under the heading "Prompt Action" should be initiated by US Government entities. "Evaluations" and related activities, while they should include government specialists, should be organized by the non-governmental scientific community with financial support from agency supplements. "Events" such as workshops and colloquia could be undertaken by either governmental or non-governmental sponsors. "Longer Term Programs" will require greater involvement by the private sector, academic, corporate, and philanthropic, and will depend largely on the success of activities which have gone before.

Statement of Principles

1. It is in the interests of the United States to have a scientifically and technically strong FSU, so that when the former republics complete the transition to new political and economic structures, they have the capability to participate effectively in international scientific programs and also to establish modern science and technology-based commercial enterprises.
2. An important outcome of assistance should be maximization of mutually beneficial collaboration on important international problems of energy, the environment, public health, agriculture, and natural hazard mitigation.
3. The FSU is home to priceless scientific resources: collections, facilities, archives, data sets, and unique geographical sites.
4. Indigenous capacity to understand and manage environmental and energy processes and resources in the FSU is of interest to the international community.
5. Financial assistance should involve a mix of grants/contracts to individual researchers/small groups and core support for unique research facilities.

Steps FSU Authorities Should Take

1. Waive taxation on hard currency provided through contracts and grants and duty on all equipment and supplies provided in connection with collaborative research.
2. Facilitate open and unfettered access to research sites and data.
3. Inventory and make available appropriate former government/party facilities as FSU contributions to bilateral/multilateral centers for interdisciplinary research, education, and training.
4. Seek PL-480-type arrangements for support for research collaboration if and when suitable resources become available.

Steps US Side Should Take

Prompt Action

1. To the extent possible, modify procurement regulations or other administrative guidelines inhibiting research contracts from US Government agencies to research units in the FSU. On the condition that FSU authorities act to ensure the integrity of USG research contract fund transfers, a US mission agency should be able to contract directly with FSU laboratories when the agency finds it cost-effective to do so from current accounts.

2. Existing cooperative S&T programs with the FSU should be augmented through supplements to participating US agencies via the NSC Working Group on FSU Soviet Science and Technology (GOSSAT).

3. Defray portions of FSU hard-currency costs associated with their participation in major international or bilateral research programs (e.g., ocean drilling, IIASA) in the current year.

4. Dispatch small team(s) to assess conditions affecting the most valuable FSU scientific collections, archives, facilities, data sets, and real-time networks. The most endangered of these would be targeted for priority attention via augmentation of existing agency programs (see above).

Evaluations

1. The US scientific community should both respond to requests from FSU authorities for evaluations of specific research sectors and initiate proposals to evaluate sectors, including those which best available information suggests are deficient (e.g., resource economics, epidemiology, multi-media ecological processes).

2. In advising on or carrying out research evaluations in the FSU, US participants should strive to enhance or create indigenous evaluation capabilities and more open, representative science policy processes.

3. In prioritizing among potential foci of research evaluation, an important consideration should be the goals and priorities of the larger US assistance effort.

4. In consultation with relevant technical agencies and the US scientific community, the Assistant Administrator for Research and Development within the Agency for International Development should undertake an assessment of the S&T needs and opportunities associated with the current US assistance effort vis-a-vis the FSU in the fields of health, food, and energy (e.g., technical infrastructure for maintaining standards of food and drug purity).

Events

1. Workshops on research management and grantsmanship to be held at various locations in the FSU.

2. Colloquia on ethical aspects of human/experimental subjects.

3. Specific problem-oriented symposia and conferences (e.g., Arctic methane emissions, die-back of marine mammal populations in Bering Sea) to be held in the United States or FSU.

4. Individual support for FSU researchers invited to participate

in activities outside the FSU concerning international scientific programs of major interest.

Longer-Term Programs

1. Young investigator exchanges on multidisciplinary problems (biodiversity, energy efficiency, coastal zone management, etc.).
2. Pilot-scale demonstrations of innovative low/non-waste or energy-saving technologies.
3. Establishment of interdisciplinary research and study centers within existing FSU facilities.
4. "Mentoring" or "sister laboratory" relationships between critical FSU research facilities undergoing restructuring or reorientation and US counterparts.

PARTICIPANTS IN WORKSHOP AND WORKING GROUPS

Perry L. Adkisson, Texas A&M University
Victor Alessi, Department of Energy
Lew Allen, Jet Propulsion Laboratory
Michael Artin, American Mathematical Society
Ivo Babuska, University of Maryland
Harley Balzer, Georgetown University
Marcel Bardou, National Science Foundation
Jordan J. Baruch, Jordan Baruch Associates
DeAndra Beck, Agency for International Development
R. Stephen Berry, University of Chicago
Frederick M. Bernthal, National Science Foundation
Richard E. Bissell, Agency for International Development
Spud Bradley, American Mathematical Society
Jerry Brown, National Science Foundation (retired)
Bradford Biegon, American Institute of Aeronautics and Astronautics
John P. Boright, Department of State
Jack Brouger, Department of Commerce
Felix Browder, Rutgers University
Bernard F. Burke, Massachusetts Institute of Technology
Sandra Burns, American Association for the Advancement of Science
Bruce Cameron, International Disarmament Corporation
Ashton Carter, Harvard University
Richard F. Celeste, NRC Government-University-Industry Research Roundtable
F. Albert Cotton, Texas A&M University
Paul Cocks, Central Intelligence Agency
John Daly, Agency for International Development
Carl Dahlman, World Bank
Raymond F. Decker, University Science Partners
James Devine, U.S. Geological Survey
Gerald Dinneen, National Academy of Engineering
Craig Dorman, Woods Hole Oceanographic Institution
Paul Doty, Harvard University
Edward Dowdy, Department of State
R. Gordon Douglas, Merck and Co., Inc.
Eduardo Duek, Superconducting Super Collider Laboratory
Robert Earl, General Dynamics
Dennis Erickson, Los Alamos National Laboratory
Robert Etkins, National Oceanic and Atmospheric Administration
Nina Fedoroff, Carnegie Institution of Washington
James Fento, Environmental Protection Agency
Herman Feshbach, Massachusetts Institute of Technology
Murray Feshbach, Georgetown University
John Filson, U.S. Geological Survey
Joseph Fletcher, National Oceanic and Atmospheric Administration
Gordon Fowler, Nuclear Regulatory Commission
Hans Frauenfelder, University of Illinois - Urbana
Doyle G. Frederick, U.S. Geological Survey

Herbert Friedman, Hulbert Center for Space Research
 Theodore Frison, Randle, Inc.
 William Fulkerson, Oak Ridge National Laboratory
 Clifford Gaddy, Brookings Institution
 Robert Galucci, Department of State
 William W. Geimer, Jamestown Foundation
 Larry Grossman, National Public Radio (retired)
 David Hafemeister, Senate Foreign Relations Committee
 F. Gray Handley, Fogarty International Center
 Peter Henry, Department of Health and Human Services
 Gilbert Herrera, Office of Science and Technology Policy
 Allan Hirsch, Midwest Research Institute
 Roland Hirsch, American Chemical Society
 John Holmfeld, Council of Scientific Society Presidents
 John Hopcroft, Cornell University
 Michelle Hugel, Office of Science and Technology Policy
 John Hurley, John D. and Catherine T. MacArthur Foundation
 Barry W. Ickes, Pennsylvania State University
 Robert E.W. Jansson, Monsanto Company
 D. Gale Johnson, University of Chicago
 Lionel S. Johns, Office of Technology Assessment
 Norris Keeler, Kaman Aerospace Corporation
 Catherine Kelleher, Brookings Institution
 Samuel Keller, National Aeronautics and Space Administration
 K.I. Kellermann, National Radio Astronomy Observatory
 Arthur Kelman, Department of Agriculture
 David Kincaid, Department of Agriculture
 Masauki Kondo, World Bank
 Leigh Lamora, Jamestown Foundation
 Hiram Larew, Agency for International Development
 Arvid Larson, Institute of Electrical and Electronics Engineers
 Charles Larson, Industrial Research Institute
 William Layson, Science Applications International Corporation
 Woodrow W. Leake, American Society for Engineering Education
 Irving Lerch, American Physical Society
 William Lewis, Merck and Co., Inc.
 Gloria Lubkin, American Physical Society
 Frode Maaseidvaag, Ford Motor Company
 John Malin, American Chemical Society
 Vasant Malshet, Environmental Protection Agency
 Nancy Maynard, Office of Science and Technology Policy
 Helen McCammon, Office of Science and Technology Policy
 Bernard McDonald, National Science Foundation
 Edward McGaffigan, Office of Senator Bingaman
 William McHenry, Georgetown University
 Jane Metcalf, Environmental Protection Agency
 James Miller, House Armed Services Committee
 William C. Miller, Office of Naval Research
 John H. Moore, George Mason University
 Frederic Mosher, Carnegie Corporation of New York
 L. Manning Muntzing, American Nuclear Society
 Daniel Nathans, Johns Hopkins University School of Medicine

Michael Nelson, Senate Subcommittee on Science, Technology, and Space
 Richard Nichols, American Association for the Advancement of Science
 Rodney Nichols, Carnegie Corporation of New York
 John O'Neil, Office of Science and Technology Policy
 Harold O'Conner, U.S. Fish and Wildlife Service
 Ned Ostenso, National Oceanic and Atmospheric Administration
 Wolfgang Panofsky, Stanford Linear Accelerator Center
 Robert L. Park, American Physical Society
 David Pethick, International Disarmament Corporation
 David Pines, University of Illinois
 Leslie E. Pitts, EG&G, Inc.
 Captain Edward Pope, Office of Naval Research
 James L. Powell, Franklin Institute
 Frank Press, National Academy of Sciences
 Michael Quear, House Committee on Science, Space, and Technology
 J. Thomas Ratchford, Office of Science and Technology Policy
 Peter Raven, Missouri Botanical Garden
 Miloslav Rechcigl, Agency for International Development
 Andrew Reynolds, Department of State
 Walter A. Rosenblith, Massachusetts Institute of Technology
 Daniel Sarowitz, House Committee on Science, Space, and Technology
 Roald Z. Sagdeev, University of Maryland
 Philip E. Schambra, Fogarty International Center
 William Schneider, BDM International, Inc.
 Majorie L. Senechal, Smith College
 Benjamin S. Shen, University of Pennsylvania
 Richard B. Sheppard, Agency for International Development
 Gerson Sher, National Science Foundation
 Edward Shomaker, Nuclear Regulatory Commission
 Patricia Sholl, Department of Energy
 George Sinnott, National Institute of Standards and Technology
 Valery Soyfer, George Mason University
 John Steinbrunner, Brookings Institution
 Alexandra Stepanian, Fogarty International Center
 H. Guyford Stever, Carnegie Commission on Science, Technology, and Government
 Judy Sunley, National Science Foundation
 Michael S. Teitelbaum, Alfred P. Sloan Foundation
 John Thomas, Department of Defense
 Alvin W. Trivelpiece, Oak Ridge National Laboratory
 Michelle Van Cleave, Office of Science and Technology Policy
 Pace VanDevender, Sandia National Laboratory
 Peter Walsh, Kiser Research, Inc.
 Robert White, National Academy of Engineering
 Daniel Wikler, University of Wisconsin
 James Wyngaarden, National Academy of Sciences
 Rick Yannuzzi, Office of Science and Technology Policy
 Michael Yarymovych, Rockwell International

NAS/NAE/IOM/NRC Staff

Sherburne Abbot, Polar Research Board
Inta Brikovskis, Office for Central Europe and Eurasia
Elisa Chait, Office for Central Europe and Eurasia
William Colglazier, Office of International Affairs
Stephen Deets, Office for Central Europe and Eurasia
Polly Harrison, Institute of Medicine
Jo Husbands, Committee on International Security and Arms Control
John Lavery, Commission on Physical Sciences, Mathematics, and Applications
Peter MacDonald, Office for Central Europe and Eurasia
Norman Metzger, Commission on Physical Sciences, Mathematics, and Applications
Hans Oser, Commission on Physical Sciences, Mathematics, and Applications
Stephen Rattien, Commission on Geosciences, Environment, and Resources
Robert L. Riemer, Commission on Physical Sciences, Mathematics, and Applications
Glenn Schweitzer, Office for Central Europe and Eurasia
Inga Sedlovsky, Office for Central Europe and Eurasia
Philip Smith, Executive Office
Kathleen Trivers, Office for Central Europe and Eurasia
Cassandra Turczak, Office for Central Europe and Eurasia
Mitchel Wallerstein, Executive Office
Andre Varchaver, Division of Natural Hazard Mitigation
Gary Waxmonsky, Office for Central Europe and Eurasia

NATIONAL ACADEMY PRESS

The National Academy Press was created by the National Academy of Sciences to publish the reports issued by the Academy and by the National Academy of Engineering, the Institute of Medicine, and the National Research Council, all operating under the charter granted to the National Academy of Sciences by the Congress of the United States.

Sustaining Excellence in Science and Engineering in the Former Soviet Union

Report of a Conference

SUSTAINING EXCELLENCE IN SCIENCE AND ENGINEERING IN THE FORMER SOVIET UNION

Report of a Conference on February 9, 1993

Co-Conveners of the Conference

**Frank Press, National Academy of Sciences
Richard Getzinger, American Association for the Advancement of Science
John Moore, George Mason University
George Soros, International Science Foundation for the Former Soviet Union**

Working Group Chairs

**Direct Aid - Irving Lerch, American Physical Society
Infrastructural Issues - Gerson Sher, National Science Foundation
Global Scientific Heritage - Robert Hoffmann, The Smithsonian Institution**

**National Academy of Sciences
National Academy of Engineering
Institute of Medicine**

**National Academy Press
Washington, D.C. 1993**

The National Academy of Sciences is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Frank Press is president of the National Academy of Sciences.

The National Academy of Engineering was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Robert M. White is president of the National Academy of Engineering.

The Institute of Medicine was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Kenneth I. Shine is president of the Institute of Medicine.

The National Research Council was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Frank Press and Dr. Robert M. White are chairman and vice chairman, respectively, of the National Research Council.

Support for this project was provided by the International Science Foundation for the Former Soviet Union.

Copies of this report are available from:

Office for Central Europe and Eurasia
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Copyright 1993 by the National Academy of Sciences. All rights reserved.

Printed in the United States of America

Preface

Science and engineering in the former Soviet Union represent an asset of great value to the world. Renowned for its prowess in many fields, the scientific enterprise has much to contribute to our knowledge. In addition, science is a force for democracy, and can be expected to reinforce the transition to a democratic, market-oriented society in the former Soviet Union.

The political turmoil and economic tribulations of the last few years pose a grave threat to the survival of the best in natural science, social science, and engineering in the former Soviet Union. Scientists and engineers are being forced to leave their professions in order to survive. Old relationships have been sundered, and new ones are emerging only with great difficulty. The physical infrastructure is crumbling or tragically obsolete. Great research collections and unique data sets, some dating back centuries, are at risk. In short, the enterprise is in a state of intense crisis.¹

The conference that produced the documents included in this report was motivated by the recognition of this crisis and of the fact that sustaining what is best in science and engineering in the former Soviet Union requires the efforts of many organizations. Accordingly, representatives from private foundations, learned societies, government agencies, corporations, universities, and associations were brought together at the U.S. National Academy of Sciences on February 9, 1993, to share their knowledge of the problem and to discuss actions that should be taken. Also participating were colleagues from public and private organizations in Western Europe and Japan and diplomatic representatives from many of the Newly Independent States.

To provide background for the discussions, three individually-authored papers were prepared. Necessarily limited in coverage, the papers nevertheless addressed the three principal aspects of the situation: the need for direct support of individual scientists in this difficult period, the extensive problems in the infrastructure supporting scientists and engineers, and the grim prospect of the possible loss of irreplaceable collections.

Based on these papers, a draft Action Plan was drafted by the conference steering committee.² The purposes of the Action Plan are to identify principles of support, to point to needed actions, and to provide guidance about coordination and management of programs and activities. It deliberately does not attempt to match actions with potential actors. Rather, the

¹See, for example, "Reorientation of the Research Capability of the Former Soviet Union: A Report to the Assistant to the President for Science and Technology," (Results of a Workshop on March 3, 1992), National Academies Press, 1992.

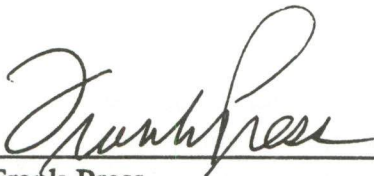
²Committee members included William Blanpied, American Physical Society and National Science Foundation; Sandra Burns, American Association for the Advancement of Science; Gilbert Fayl, European Community; Richard W. Getzinger, American Association for the Advancement of Science; Timothy Goggins, American Mathematical Society; Ernest Henley, American Physical Society; Robert MacPherson, American Mathematical Society; Gerson Sher, National Science Foundation; and Gary Waxmonsky, National Research Council. The committee was chaired by John H. Moore, George Mason University.

intent is to provide a menu of desirable actions, enabling interested organizations, public and private, to choose those that are best suited to their capabilities and interests.

The conference was focused on revising the draft Action Plan. Three Working Groups, one on each of the three major topics, spent most of the day in discussions of those topics. Many of their recommendations for modification and amendment of the Action Plan were then incorporated and the results presented in plenary session. The final document as revised by the conference steering committee is displayed here as the Action Plan.

Programs of assistance to science and engineering in the former Soviet Union are beginning to emerge. Notable among them is the International Science Foundation for the Former Soviet Union (ISFFSU), whose formation was announced by George Soros in December 1992. The ISFFSU will provide support of \$100 million over the next two years. Additional efforts by several learned societies and foundations are also underway, but much more is needed. Readers of this report are strongly urged to work with colleagues to develop programs attacking those problems identified in the Action Plan that are most compatible with their capabilities.

Thanks are due to the staffs of the National Research Council's Office for Central Europe and Eurasia and of the International Institute of George Mason University for their excellent work in support of the conference. The financial support of the ISFFSU is gratefully acknowledged.



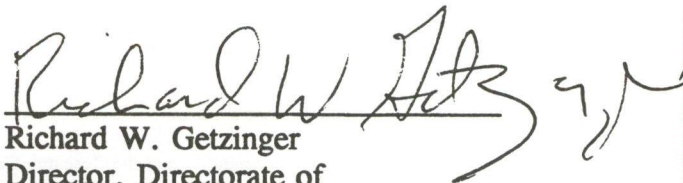
Frank Press
President
National Academy of Sciences



George Soros
Founder
International Science Foundation
for the Former Soviet Union



John H. Moore
Director
International Institute
George Mason University



Richard W. Getzinger
Director, Directorate of
International Programs
American Association for the
Advancement of Science

CONTENTS

ACTION PLAN	1
WORKING GROUP PAPERS	
Direct Aid to Scientists in the Successor States of the Former Soviet Union: A Case Study of the Physics Communities	9
Infrastructural Issues	25
The Global Scientific Heritage of the Former Soviet Union	43
LIST OF PARTICIPANTS	57

SUSTAINING EXCELLENCE

IN SCIENCE AND ENGINEERING IN THE FORMER SOVIET UNION

A Conference¹

Washington, D.C.
February 9, 1993

ACTION PLAN

The problems of science in the former Soviet Union are extensive and complex. Their resolution is important for the well-being of international science and to the further development of democratic, market-oriented societies in the former Soviet Union. Many organizations in the West -- governments, foundations, learned and professional societies, universities, and corporations -- are interested in these problems and their possible solutions. A growing number of these organizations are undertaking efforts to aid science in Russia and the former republics. Notable among them is the International Science Foundation for the Former Soviet Union (ISFFSU), which will provide \$100 million over the next two years to support basic research and related infrastructure.

A central issue in the provision of support to excellent science and engineering in the FSU is that of matching support programs to needs. The need is enormous. No single external organization can meet it alone, and there are significant needs that will not be addressed by the ISFFSU, including support for the social sciences, for large-scale research projects, and for training the next generation of scientists and engineers. At the same time, it must be realized that the principal investment in science and engineering in the successor states of the Soviet Union must be made by the peoples of those states. External support can only help to sustain excellence in science and engineering through the transition phase while helping to lay the foundation for the eventual self-sustaining enterprise.

However, high leverage opportunities can be identified. The purpose of this Action Plan is to provide information to organizations to help them plan their programs and to minimize, as far as desirable and useful, unnecessary duplication of effort. It does not presume to direct efforts, but aspires to contribute to a balanced, effective, and comprehensive set of support activities.

This Action Plan reflects the knowledge, expertise, and imagination of the participants in the conference, "Sustaining Excellence in Science and Engineering in the Former Soviet Union." It is hoped that the publication of the Plan will stimulate further dialogue among and concrete action by all those who are concerned about the present and future state of science and engineering in the FSU.

¹The conference was co-sponsored by the National Academy of Sciences, the American Association for the Advancement of Science, the International Science Foundation for the Former Soviet Union, and the International Institute of George Mason University. This Action Plan was developed at the conference.

Steps should be taken at every level to insure that the spirit of international understanding and cooperation which is so necessary to sustain high quality science and engineering in the FSU will continue to be an important element in the development of science and technology in the future. The availability of data and the possibility of developing cooperative projects, where appropriate, should characterize scientific relationships between the FSU and other countries.

The Action Plan's primary focus is on emergency aid to sustain the best in science and engineering during the difficult time of transition. However, it should be taken as a step in the direction of the ultimate goal: to help the FSU to develop a self-sustaining, self-managing system for its science and engineering enterprise.

Participants in the February 9 conference recognized that high level coordination and dialogue among the governments of North America, Europe, Japan, and the states of the FSU has great potential value. The focus of the conference, however, was on the non-governmental sector.

The conference produced a large number of suggestions for action. Among the most important are these:

- Short-term actions to provide emergency aid should be based on scientific merit and should be made directly to individual scientists and small groups. Support should seek to promote open access by FSU scientists to research opportunities and infrastructure, as well as to promote diversification of research among sectors in the FSU -- institutes, universities, industry, and emerging institutions.
- Support for the scientific infrastructure, including telecommunications, books and journals, research management capabilities, and the human infrastructure, should be undertaken as a matter of high priority.
- The irreplaceable collections of physical data and specimens in the FSU, as well as its unique pedagogical techniques in certain fields, represent a heritage of enormous value to the world and should be rescued from impending loss. Steps should be taken to publicize newly available collections throughout the world scientific community.
- New programs of support for science and engineering should be widely publicized within the FSU.
- An international network of information and operations centers should be established to insure better coherence of programs, to avoid duplication, and to catalyze follow-up activities. The network should include nodes within the FSU.
- Periodic consultations should be undertaken among relevant organizations in all concerned countries to exchange information and monitor progress of scientific efforts.

SUSTAINING EXCELLENCE

IN SCIENCE AND ENGINEERING IN THE FORMER SOVIET UNION

ACTION PLAN

1. General Principles

- 1.1 In all support programs, bear in mind the twin objectives of strengthening international science and engineering and developing democratic, market-oriented institutions in the FSU.
- 1.2 Design emergency support programs and enlist FSU cooperation keeping in mind the ultimate objective of creating a self-sustaining, self-managing system for the scientific and engineering enterprise of the FSU.
- 1.3 Make all awards on the basis of competitive merit review, as determined by independent evaluators.
- 1.4 Make awards directly to individuals rather than institutions, and support groups in cases of awards larger than the minimum. Consider including support for institutions in which the individual or group works.
- 1.5 Seek to insure open access by FSU scientists and engineers to research opportunities and infrastructure.
- 1.6 Make special opportunities available for newly established investigators and graduate students, both individually and through their mentors.
- 1.7 Seek broad distribution of awards, geographically and by discipline.
- 1.8 Encourage diversification of research and collaboration among sectors in the FSU -- Academy institutes, universities, industry, and emerging institutions.
- 1.9 Motivate partners in the FSU to share concrete responsibility in all external assistance programs.

2. Direct Grants to Individual Researchers and Small Groups

- 2.1 Place highest priority on emergency aid in the form of small grants and stipends to selected scientists and engineers as a first step towards developing a self-sustaining, self-managing system.
- 2.2 Make grants sufficiently flexible to allow for support of modest research needs, such as supplies and minimal equipment, in addition to salaries.

2.3 Develop and strengthen the basis for long term collaborative research involving FSU scientists and engineers with scientists and engineers from other countries.

2.4 Provide support for special activities.

- Support special educational programs that have contributed to excellence (special seminars for secondary school teachers, student Olympiads, etc.).
- Provide support for exceptional secondary school mathematics and science programs.
- Support workshops in the FSU, especially those involving foreign scientists and engineers.
- Support special summer and winter schools in the FSU.
- Give special consideration to activities designed for younger investigators.

2.5 Provide support for international travel on a limited basis.

- Develop mechanisms to coordinate requests for travel from FSU scientists and engineers invited to present papers at professional meetings.
- Encourage professional societies to help support travel by FSU scientists and engineers to society meetings.
- Conduct professional meetings in the FSU.
- Include funds for travel to international professional meetings in direct aid grants to FSU scientists and engineers.
- Provide support for short-term research visits by FSU scientists and engineers to Western research institutions.

3. Infrastructure Support

3.1 Telecommunications

- Provide low-cost packages of basic computer equipment needed for e-mail; develop and share lists of e-mail addresses.
- Facilitate network access and expedite equipment exports.
- Seek to influence FSU policy-makers to make telecommunications widely accessible to their scientific communities at reasonable cost.

- Help persuade them to give high priority to establishing efficient, low-cost telecommunications systems, for example by financing high-visibility demonstrations of practical systems.
- Provide them with information about the value of networking.
- Facilitate remote access to scientific databases at reduced cost.

3.2 Books, journals, and libraries

- Make grants to professional societies to support journal subscriptions, electronic transmission, and CD-ROM databases.
- Support procurement and installation of CD-ROM equipment in selected FSU S&T facilities.
- Seek to replace missing back issues of selected journals in several central institutional libraries.
- Coordinate and support shipment and distribution of journals and equipment to the FSU.
- Negotiate with publishers to secure appropriate fees for provision of journals, including electronic access.

3.3 Human and Institutional Infrastructure

- Give special priority to programs that create new linkages among FSU researchers and with user communities. Support should be emphasized, for example, for high quality university researchers; young investigators, graduate students, and undergraduates; activities that involve cooperation between academy, university, and/or industrial laboratories; and high quality applied research with potential industrial applications.
- Utilize expertise of national and international organizations with experience in supporting and conducting industrially oriented research to help with developing linkages between research and industry
- Assist the implementation of training opportunities in research management, science and technology policy, competitive merit review, accreditation, university administration and commercial application, technology transfer, S&T marketing, and intellectual property rights (IPR) and legal protection.
- Solicit donation and/or sale of surplus computers and equipment from Western manufacturers and government laboratories.

- Include non-FSU researchers as active research partners, especially in the applied research area, to help show how to bridge the gap between research and application.
- Develop general directories of research institutions and discipline-specific directories of individuals in the FSU. Make directories of Western research institutions available in the FSU.
- Support the formation of broadly based, representative science and engineering societies and support viable existing societies.

4. Scientific Heritage (Collections and Data Sets)

4.1 General observations

- Ensure mutual accessibility to collections and archives for both local and international experts, and promote the open availability of scientific data.
- Develop complementary roles for private sector and governmental organizations with respect to identification and preservation of collections and data sets.

4.2 Collections of objects

- Utilize existing inventories of collections and archives (including rare books), and develop action plans based upon them.
- Develop annotated directories of presently uninventoried collections and archives in each field.
- Develop strategies for long-term protection, preservation, and growth of collections and archives.
- Organize joint teams with access to discretionary resources to assess requirements for insuring the preservation of high priority collections and archives, to make on-the-spot disbursements where necessary.

4.3 Data sets

- Develop or endorse established protocols and promote data sharing.
- Develop annotated directories of presently uninventoried data sets in each field.
- Develop strategies for long-term protection and preservation of data sets.

- Provide support for joint efforts in digitizing, computerization, management, maintenance, and growth of existing data sets.

5. Procedural considerations

5.1 Management and coordination

- Encourage on-going donor consultation; share facilities for the transfer of financial and material resources to the FSU among donors.
- Provide support for an open, accessible information system for managing and tracking financial support, including all significant sources.
- Support the creation of information and operations centers for the logistics of providing financial and equipment support to the scientific and engineering communities of the FSU. Such centers ideally should have broadly based support from government, private foundations, and industry.
- Through professional and learned societies and foundations, organize advisory and coordinating committees to develop plans, procedures, and principles for development of assistance programs.
- Use Western scientific and engineering institutions as organizing bodies for coordinating direct aid efforts and forming advisory committees.
- Handle IPR issues arising from cooperative programs on a case-by-case basis, but encourage the FSU governments to adopt IPR laws that are consistent with Western practice.
- Use existing centers in the FSU wherever possible to coordinate the distribution of journals and equipment.

5.2 Publicity

- Publicize opportunities for support throughout the FSU scientific communities, using widely distributed national media and through joint newsletters involving both FSU and Western organizations.
- Use non-FSU organizations -- foundations, societies, corporations, government agencies -- active in the FSU to help with the publicity effort.
- Publicize the availability of newly accessible databases, collections, and research facilities among scientists outside the FSU.

**DIRECT AID TO SCIENTISTS IN THE SUCCESSOR
STATES OF THE FORMER SOVIET UNION: A CASE STUDY
OF THE PHYSICS COMMUNITIES**

Background Paper

by

Irving A. Lerch
American Physical Society

and

William A. Blanpied
National Science Foundation

prepared for

**SUSTAINING EXCELLENCE IN SCIENCE AND ENGINEERING
IN THE FORMER SOVIET UNION**

A Conference

February 9, 1993
National Academy of Sciences

Preamble

It is difficult to generalize from the experiences of one scientific community in the former Soviet Union (FSU) to characterize the problems, find potential solutions, develop operations, and formulate the rules applicable to conditions in other disciplines. This paper is, therefore, a case study based on experiences of the U.S. physics community in dealing with its counterparts in several nations of the FSU since 1992. Although the paper makes no claim to applicability beyond physics, the authors are grateful to colleagues in the American Astronomical Society (AAS) and American Mathematical Society (AMS) who have also established significant programs with their FSU counterparts and have generously shared their experiences with us. Our colleagues in the European Physical Society are also undertaking extensive efforts to support colleagues in both the FSU and East-Central Europe and have surveyed the status and needs of both research and academic institutions there. Several of the recommendations in Section 3 are based on their experiences and expectations.

The reasons for the difficulties faced in attempting to generalize beyond one community are inherent in the nature and history of Soviet science. Whereas the biological, behavioral, and social sciences were subject to direct political intervention, the mathematical and physical sciences were largely insulated from such control because atomic and nuclear physics especially were seen as instruments of state policy and a source of state power. Thus the elite physicists occupied a position of privilege in the Soviet State. Despite the emergence of seeds of dissidence in the market of freely circulated ideas which flourished in many of the most important physics institutes, the Academy and institutional structure maintained the strictest controls over the scientific establishment which was distinguished by a large measure of passivity and acquiescence to central authority.

Diminished productivity was often compensated by bloated and inefficient organizational structures. Upon the collapse of the Soviet State, these centers of excellence were deprived of essential resources and services and, unfortunately, self-management did not immediately emerge owing to the legacy of central control. In addition, the separation of the research institutes from the universities has left the latter in a depleted state, incapable of supporting major research initiatives.

The problem now is to assist FSU science to preserve its best endowed communities and traditions so that it will be granted the time and resources needed for restructuring. This paper focuses on provision of direct aid to investigators in the quantitative sciences as a case-study of one approach for solving the broader problem of sustaining the best of science -- and engineering -- in the former Soviet Union. The types of direct aid that will be accomplish that objective will necessarily be somewhat discipline specific. In much of experimental physics, chemistry, and the biological sciences, FSU scientists require modest supplies and instruments, in addition to salaries and stipends, in order to pursue their research. Since these items can often be obtained only in the West, funds for short-term visits which include a moderate purchase allowance can be critical in sustaining scientific excellence during the emergency period.

The social and behavioral sciences face a considerably different challenge. Whereas the principal, immediate problem in the mathematical, physical, and biological sciences is to sustain a tradition of excellence, the social and behavioral sciences in the FSU have been debilitated by decades of subjugation to ideological imperatives. Western colleagues therefore face the problem of **developing** a respected, self-sustaining community in those disciplines, rather than **sustaining** already acknowledged excellence. Thus, for the social and behavioral sciences, the most effective form of direct aid could be medium- to long-term visits to Western institutions for both junior and senior scientists that would permit them to grasp the "culture" of independent scholarly research in those disciplines.

Despite the precise form it takes, the overriding principle of direct aid programs is to bypass inefficient existing bureaucratic structures and provide aid to working scientists themselves based on some type of competitive, peer-review process.

This paper will explore the background of the current emergency for science in the FSU and existing and potential approaches for solving problems. It will recommend a specific actions that, with some fine tuning, could be applicable to disciplines beyond the mathematical and physical sciences. The paper will also seek to examine the immediate and longer term needs of the scientific community in the FSU in the context of the ultimate objective of achieving self-management with an investigator-initiated peer-review system.

The reader is alerted to the fact that this paper concentrates on the Russian Federation since the majority of FSU scientists are located in that country. However, large and important scientific groups are found throughout the FSU, particularly in the Western states, and it will be important to develop an awareness of the special needs and circumstances of each of them. The scope of this paper is unfortunately far too limited to take into account the many important details which differentiate the successor states from one another.

1. Background:

The overriding principle of direct aid programs cannot be stated too often: *to bypass the inefficient bureaucratic structures of the Academy, the institutes, and those few universities that conduct viable research, and provide aid directly to working scientists themselves, based on some type of competitive, peer-review process.* An important corollary principle is *reliance on personal and professional relationships rather than institutional ties to develop the mechanisms for soliciting, evaluating and administering aid.* If, on the contrary, assistance is funneled through the directorates of the Academy, the institutes, or the universities, most funds will be dissipated in preserving the existing bureaucracies.

It is important to note, however, that in physics, not all of the research institutes in the Russian Federation are managed and controlled by the Academy. The Institute for Theoretical and Experimental Physics in Moscow, for example, is a branch of the Ministry of Atomic Energy. Despite some exceptions, the institutes have traditionally functioned as isolated units, often in competition with one another.

While many of the successor states of the Soviet Union have been slow to reform the apparatus of centralized science management by the Academy and ministries, Ukraine put into effect an investigator-initiated peer-review program modeled on those in the West.

Personal trust is the currency for all direct aid transactions. Nonetheless, the APS and our colleagues in the FSU find institutional affiliations both viable and desirable since the most productive work is centered there. However, the extent to which such affiliations can be relied on differs according to discipline. In the case of mathematics, academic failure and social corruption--usually manifest in exclusionary ethnic and anti-semitic policies--have made the institutional and university departments unsuitable as vehicles for transformation and renewal. Thus, the American Mathematical Society (AMS) seeks to couple its aid programs to promoting the development of new mathematical institutions.

There is the further problem of infrastructure integrity. For if there is no heat or light and if the walls and roofing fall into disrepair, science is still endangered. Even more important, such essential central services as libraries and telecommunications are rapidly failing. These problems are addressed at greater length in the accompanying paper on Infrastructural Issues by Gerson Sher.

1.1 Dimensions of the Problem (Programmatic and Contextual)--

1.1.1 Libraries--Adequate technical libraries with current copies of world scientific literature are obviously essential to the work of scientists in the FSU. The accompanying paper by Gerson Sher includes a description of the special needs of physicists in the FSU, and on American Physical Society (APS) programs to help meet those needs on an emergency basis. A possible strategy for longer-term maintenance of scientific libraries appears in Section 3.1.2.

1.1.2 Computer-moderated telecommunications--Next to libraries, a high priority need for scientists in the FSU is for adequate telecommunications capabilities. Recommendations for short-term solutions is considered in Section 3.1.5. The accompanying paper by Sher explores the broader problem of telecommunications in the FSU, including experiences of the APS in dealing with individual scientists. It also proposes several possible short- and long-term solutions to the telecommunications problem.

1.1.3 Salaries, Research Funds, and the Brain Drain--Salaries are low and paid intermittently. Monthly wages range from 2,500 to 10,000 rubles (\$6 to \$25 based on exchange rates prevailing in February 1993). Physicists working at some institutions in Moscow have voluntarily foresworn monthly payments in order to make funds available to colleagues in regions of Russia distant from the capital. The collapse of the ruble, low and intermittent salaries, and a crumbling scientific infrastructure, have driven scientists at all levels to leave their posts, sometimes temporarily, often permanently. Up to 10 percent of the elite scientists from the major physics institutes have emigrated to Western Europe and the United States, and many of those remaining are forced to travel constantly to continue their work and to obtain sufficient hard currency to meet their domestic needs.

Some institutes, such as the renowned Landau Institute in Chernogolovka, almost ceased to be viable owing to the emigration of many senior scientists. Fortunately, that particular institute has been reinvigorated by a newly appointed director, Vladimir Zakharov, who also holds an appointment in the Department of Mathematics at the University of Arizona.

Funds for equipment, journals, and consumables are non-existent, doing great injury to experimental physics. Those younger scientists who cannot easily emigrate are often forced to seek employment in other sectors of the fledgling market economies. This "internal" brain-drain is of great concern to many senior scientists since they see the loss of their best junior associates as threatening the future of FSU science. There is no appreciation within the scientific

community for the role that these "displaced" physicists play in the transformation of FSU society.

A growing problem is the loss of technicians and artisans. FSU institutes have always had to rely on manpower to make up for deficiencies in commercial equipment availability and services. This has accelerated the decline in institutional infrastructure as technical support staff has been lost. At the Institute for Theoretical and Experimental Physics in Moscow, for example, there is only one plumber left to service the needs of a staff of 2,500.

The decline in experimental particle physics has been underway for the past 20 years and has accelerated precipitously over the past decade. Major projects have failed or been abandoned and such facilities as the Serpukhov accelerator are all but forsaken.

In Ukraine, where the situation has developed somewhat differently, 1.5 billion "coupons" (approximately 2.5 million dollars) have been allocated thus far to investigator-initiated peer-reviewed proposals; a sum equivalent to the resources provided by the Ukrainian Academy for the support of research institutes and universities. A ministerial officer, Serhey Ryabchenko (Chairman of the State Committee for Science and Technology in Ukraine), is administering this program and has agreed to provide matching funds to the laboratories of APS grant recipients, similar to an agreement reached with Deputy Premier Boris Saltykov in Russia.

1.1.4 Heterogeneity and Isolation within the Scientific Community--The physics community has two major components: the Academy and Ministry Institutes (which are the homes of the elite physicists) and the universities. Most of the significant research is done in the institutes, and both the Academy and government ministries have traditionally provided the resources needed for these scientists to establish and maintain communications among themselves. The universities have been responsible for training large numbers of students and have, in effect, become teaching "factories." The faculties have focussed on teaching and have traditionally done a credible job at the undergraduate level. But, lacking a high-quality research environment, the best graduate students must be recruited into the institutes. Thus, the universities are weak and reside well outside the mainstream of elite physics research.

Industrial research is also weak, and in some critical specialties, nonexistent. The exception is military research which had been isolated and pampered by the *ancien regime*. Many institutes were so self-contained that there was little interaction between them and, in some cases, open competition prevented scientific collaboration.

The second tier physics communities (those primarily associated with the universities and smaller, less well endowed institutes) have turned to a multiplicity of competing, would-be professional societies to satisfy their needs and ambitions. In Russia alone there is the Russian Physical Society, the Moscow Physical Society, the St. Petersburg Physical Society, the Nizhny Novgorod (Gorky) Physical Society, and numerous others. Some of these organizations view their role as finding commercial partners for technology transfer schemes. And while the

Russian Physical Society is attempting to unify the regional and urban societies, there is both resistance and suspicion.

In some of the other republics, however, the organization of such societies has met with some success. In Ukraine, for example, a significant portion of the physics community has rallied to the Ukrainian Physical Society, in large part because science in Ukraine became specialized under the Soviet Government with most of the resources and basic research institutes located in Russia. Thus, there is closer association among university and institute physicists, with much good science done in the universities. Nonetheless, there are centrifugal forces at work in some countries where ethnic and other rivalries disrupt unity among scientists. Particular concern has been expressed at conditions in the Baltics where government policies appear aimed at excluding ethnic Russians and other minorities. There have been examples of brutal repression in some of the Central Asian republics.

1.1.5 The Academy, The Ministries and The Government Circus--Russian government actions may be promulgated by parliament or decreed by the President. But they remain moot unless "enacted," a process as mysterious as it is rare. It is clear that the apparatus of government, the bureaucracies, are elephantine labyrinths which swallow resources while mandating programs.

Thus, for example, the telecommunications ministry has established corporate bodies that extort resources from commercial and academic ventures alike--often turning a blind eye to regulations prescribing cost limits--without regard to the consequences for Russian science.

In mid-1992, the Ministry of Science, Technology and Higher Education requested that external assistance to Russian science be exempt from taxes. But it was not until well after Presidential and Parliamentary action that the Finance Ministry agreed to support this policy, and only with some reluctance and then somewhat ambiguously.

Nor is this characteristic only of Russia. Similar problems plague programs in each of the republics. Negotiations with ministers and even deputy premiers are usually inconclusive, and in the current political climate, somewhat dubious since changes of regime (which must be regarded as inevitable) will almost certainly be followed by the abrogation of old policies. In Russia, where much of the discredited Soviet bureaucratic apparatus remains intact, even ministerial policies can languish in the netherworld of administrative indifference or outright opposition.

Nonetheless, some of the new leadership recognizes the need for structural change and have pursued policies which directly attack the power and prerogatives of the Academy and the ministries. In Ukraine as in Russia, government policy has been enunciated in support of science and technology with senior cabinet officials assigned to coordinating programs: Saltykov in Moscow and Ryabchenko in Kiev.

1.1.6 Inflation, Shortages, and The Less-Than-Perfect Banking Industry--

The collapse of the ruble has been alluded to earlier and the lack of funds has led to shortages of consumables. The scarcity of paper and other resources has resulted in an almost complete breakdown of scientific publishing with the subsequent disappearance of new textbooks, journals and bulletins. Many scientific communities have turned to commercial publishers in the West and have obtained little support or encouragement. Publishers often ask for total distribution and copyrights in exchange for a few hundred printed volumes. In addition, the decline of the scientific enterprise has threatened those important FSU publications whose English translations have an international audience. Attempts to transfer funds in support of these and other activities have been frustrated by antiquated or nonexistent banking facilities and ambiguous tax laws, a problem which hampers the wider effort to support scientists. Many groups in the West have taken the expedient route of bringing cash into the FSU and physically distributing it to the recipients. More extensive distribution schemes are hampered by confiscatory fees, cumbersome procedures and regulations and uncertainty about the status of intellectual property rights. Some individuals and institutions have attempted to circumvent these problems by acquiring Western bank accounts.

1.1.7 The Collapse of Shipping and Mailing--In many parts of the FSU, mail and parcel shipment are unreliable. While this is not true for a number of the smaller republics, the problem is particularly acute in Russia. Some foundations have established facilities for occasional bulk shipments, but needed mail and journal shipments often disappear into the postal machinery.

1.2 Existing Short-Term APS Programs--

Programs devised by the American Physical Society (APS), American Astronomical Society (AAS), and the American Mathematical Society (AMS), fall into two categories: short- and intermediate-term, both of which are geared to an ultimate goal of creating a self-sufficient, investigator-initiated, peer-review system of science self-management. This objective is obviously dependent upon the economic and political recovery of each nation. For the most part, the programs of these learned societies are constructed around short-term needs since they do not have the resources (nor the ambition) to tackle longer term goals except in an abstract, preparatory way; for example, by studying the objectives, structures, organization and operations of longer-term programs with a view to advising other institutions on how to develop and administer such programs.

The APS short-term emergency program consists of the distribution of back-issues of journals directly to institutions and libraries, the provision of limited resources for the repair or replacement of small pieces of equipment, the awarding of scholarships and small grants to exceptional researchers, the sponsorship of colleagues in the FSU as Matching Members by APS members and other organizations so that they may receive literature subscriptions, support for regional summer and winter schools for both researchers and graduate students, travel support to FSU enable colleagues to participate in major meetings and the organization of advisory

committees in the republics to serve as conduits for information, and program management. Several of these components of the program are discussed in more detail in Sections 2.3 and 2.4

The program is financed from APS funds, donations from our members (who have thus far provided more than \$100,000), and from funds and services provided by foundations. In particular, the Alfred P. Sloan Foundation awarded a matching grant of \$100,000 in support of the appeal for donations from APS members. The Soros Foundations have provided an additional \$525,000 to supplement the APS small grants and fellowship programs. The Meyer Foundation has made an award of \$100,000 to be disbursed as emergency grants. The National Science Foundation (NSF) has awarded the APS a two-year \$100,000 grant in support of summer schools and workshops, journal distribution, and administrative travel. Some urgent literature shipments have been supported by a joint American Academy of Arts and Sciences -- United Parcel Service program.

We are currently negotiating with other foundations for additional funds and we are preparing to collaborate (or have entered into collaboration informally) with the American Mathematical Society, the American Astronomical Society, the American Association for the Advancement of Science, the American Academy of Arts and Sciences, the European Physical Society and other institutions such as the University of California, which is providing funds for collaborative research with Russian institutional laboratories.

Information essential to the APS program has been provided by knowledgeable colleagues who have extensive experience and wide contacts in the FSU, and from expatriate colleagues currently resident in the United States, especially through the instrumentality of a major forum of expatriate colleagues, distinguished senior scientists, government officers and foundation representatives, held on April 22, 1992, in conjunction with the annual Washington, DC, meeting of the APS.

We also met with our European Physical Society (EPS) colleagues in Budapest May 25-27, 1992, and in Amsterdam October 1-2, for EPS-APS workshops on the Crisis in Basic Science in East-Central Europe and the Republics of the Former Soviet Union. We have agreed to participate in a series of coordinated actions in communications, regional self-help, support of libraries, peer review, centers of excellence, data bases, equipment distribution, and summer schools and workshops. We have also tentatively agreed to join with the European physics community in supporting a UNESCO-UNDP initiative aimed at strengthening the universities in East Central Europe and which will rely on grants from various development banks.

We conservatively estimate that of the approximately 2,000 grant and fellowship applications (representing more than 5,000 scientists) which the APS's Moscow committee has received, 80 percent merit support on the basis of scientific excellence and competence. This would require resources in excess of \$2 million per year (for Russia alone -- \$3 million per year taking into account all of the republics), excluding all expenditures for journals, equipment, consumables and travel (assuming average disbursements of \$500 for the year for each recipient). Our present resources of \$800,000 can accommodate no more than 640 group applications--from all

republics (on average there are 2½ physicists per application)--of the estimated 1,600 which merit awards.

The advent of such *ad hoc* programs has had an immediate, enormous impact on both the morale of our colleagues in the FSU and on their governments. Thus, with these funds and with Russian commitments to support basic science, we may be able to hold the core of the mathematical and physical sciences together during the current emergency period.

2. The APS in Action:

2.1 Early Actions--In the beginning of March, 1992, in response to growing concern about the crisis in basic science in the Republics of the former Soviet Union, APS President Ernest M. Henley asked William Blanpied (National Science Foundation), then Chair of the APS Committee on International Scientific Affairs, to chair an *ad hoc* Task Force on the crisis. The Task Force consists of Kurt Gottfried (Cornell), Herman Feshbach (past APS President, MIT), George Gamota (MITRE Corporation), Anthony Fainberg (Office of Technology Assessment), Pierre Hohenberg (AT&T Bell Labs), Herbert Berk (University of Texas), Yuri Orlov (originally a Task Force member and now advisor, Cornell) and Lev Okun (advisor, Institute for Theoretical and Experimental Physics, Moscow) with Henley serving *ex-officio* and Irving Lerch (APS Director of International Scientific Affairs, New York University) as APS Liaison Officer. Staff liaison and administrative support is provided by Amy Halsted of APS. Many of the Task Force members have extensive personal and professional associations in the FSU or have broad experience in international scientific affairs.

At the same time, Henley sent letters to D. Allan Bromley, Assistant to the President for Science and Technology, and Walter Massey, Director of the National Science Foundation, recommending immediate action to supplement NSF grants to support collaboration with colleagues in the FSU and to find additional funds for new programs.

By the end of March, the Task Force had recommended two immediate steps: the distribution of surplus issues of complete annual sets of *Physical Review*, *Reviews of Modern Physics* and other journals to responsible physicists in the USSR who will assure their access by colleagues throughout the Republics, and a Presidential appeal distributed by e-mail, limited bulk mailing (to APS Fellows and Department Chairmen of Ph.D. granting institutions), and as news announcements in *Physics Today* and *APS News*.

2.2 Journals--Our programs to provide APS journals to physics libraries in the FSU are discussed in the accompanying paper by Gerson Sher on Infrastructural Issues.

2.3 Development of International Schools and Workshops in the Republics of the former Soviet Union--Many of the elite institutions of the former Soviet Academy developed an extraordinary educational system that discovered and nurtured scientific talent and promoted a unique intellectual culture of physics. This is particularly true of the Lebedev, Ioffe and Landau institutes, for example. The opportunity of the moment is to open these unique schools

to the world by providing for the exchange of faculty, the recruitment of students from the region and the United States and the development of regional and international summer schools and workshops. The program was begun in 1991 with the St. Petersburg High-Energy Summer School (supported, in part, from the 1992 NSF award to APS). The St. Petersburg Nuclear Physics Institute has organized an international winter school in theoretical physics which took place at the end of January, 1993 and which was attended by 10 carefully selected US graduate students. It consisted of intensive lectures and seminars. In addition, several other republics, notably Ukraine, are seeking to establish their own regional summer schools and workshops. The APS program is supporting the establishment of one summer school in Ukraine and one in Russia and one winter school at the St. Petersburg Nuclear Physics Institute. The Ukraine program will develop a series of workshops which would eventually lead to the organization of "Gordon-like" annual conferences.

Faculty exchanges are made by agreement between the local institutes and cooperating US institutions. Similarly, in all these schools FSU and US counterpart institutions coordinate among themselves the selection of participants, both students and lecturers.

2.4 Small grants and fellowships--Policy and oversight for the APS small grants and fellowships program is provided by the Task Force appointed by President Henley in March 1992 (see Section 2.1) and is administered by the Society's Office of International Scientific Affairs. Initial policy guidelines were developed in Washington, DC on April 22, 1992, as described in Section 2.1. Subsequently, a US-FSU advisory committee was established to support the deliberations of the Task Force, and national advisory committees were organized in Moscow, Tallinn, Kiev, Tbilisi, Yerevan and Vilnius. Efforts continue to organize committees in the other republics.

2.4.1 The function of the FSU national advisory committees is to solicit emergency grant proposals from small groups, to organize disciplinary and, if necessary, regional subcommittees to assist in the evaluation of proposals, and to perform a preliminary evaluation of the submissions to assure accuracy and determine relative merit. Appropriate proposals are then forwarded to the Task Force, which forwards them for ranking to review panels in the appropriate APS disciplinary Divisions. The Task Force then determines how which proposals should be funded on the basis of these rankings. No proposal recommended by a national committee has yet to be declined. Rather, those not immediately funded are being held for further review pending a determination of available resources. This procedure has been adopted on the grounds that provision of funds based on a competitive, peer-reviewed process is very new -- and very unsettling -- to most FSU scientists.

Funds are provided on the basis of \$500 per group member per year, with groups not exceeding six physicists; it is anticipated that many awards will be extended beyond the first year. Where group leaders have access to hard currency and significant travel support, they are excluded from receiving emergency funds but are encouraged to apply for assistance on behalf of the group itself. By encouraging distinguished senior physicists to apply for support on behalf of their lesser known co-workers, the APS seeks to assure that the best physics is represented in the

application process. Funds may be used by the recipients as they see fit so long as they continue their scientific work. They are asked to prepare an article for submission to an appropriate peer-reviewed journal -- within one year for theorists and two years for experimentalists.

2.4.2 The disciplinary Divisions and Topical Groups of APS are encouraged to develop their own system of advisory committees and panels to promote their own scientific interests. For example, the Laser Science Topical Group (LSTG) has organized laser science advisory subcommittees to work inside the FSU with their respective national advisory committees to solicit and review proposals. In addition, the LSTG uses its own review panels to critically appraise proposals forwarded by the national advisory committees to the Task Force. The LSTG also raises funds in support of the general APS program.

2.4.3 Oversight is provided by 1) the Task Force which is responsible to the APS President, 2) the APS Executive Board which reviews expenditures and 3) the APS Council which approves program parameters and funding levels recommended by the Task Force.

2.4.4 As of December 31, 1992, 179 group awards totalling \$223,500 have been transferred for disbursement to Russia and Ukraine. Fifty group awards totalling \$42,000 are awaiting transfer to Armenia, Belarus, Estonia and Ukraine pending verification of the setting up of personal dollar accounts for the recipients in these countries. In addition, \$9,600 was provided as travel grants to 8 physicists to enable them to attend the International Atomic Energy Agency (IAEA) Fusion Physics Conference in Würzburg in September. These account for a total commitment of \$275,100 and we are currently processing an equal number of grants. In addition, \$15,000 has been set aside to finance travel to the FSU to facilitate organizational and administrative functions.

2.4.5 In June, 1992, Herman Feshbach, a former APS President and member of the Task Force, and Irving Lerch met with Deputy Premier Boris Saltykov to negotiate tax exemption for grants of funds, equipment and journals. In addition, and with the assistance of the Moscow Advisory Committee, Saltykov was encouraged to provide matching funds to the small laboratories of the grant recipients. The purpose was to insure Russian government participation in the program and to assure that those technicians and scientists associated with award winners (but who were not members of the research group) benefitted. Thus, the program provides funds to those who do the research and payments completely bypass bureaucratic structures. Tax exemption was presumably formalized by the Finance Ministry in October, although documents attesting to this have not yet been received. However, all disbursements are made under the presumption of tax exemption and statements to this effect are issued to each recipient. In December, Task Force advisor Yuri Orlov went to Russia to review the status and operations of the program, to advise the Moscow Committee on their activities, and to give guidance and counsel to the Task Force concerning needed changes. In Ukraine, a member of the APS Task Force, George Gamota (Mitre Corporation), met with Serhey Ryabchenko (see 1.1.3), Pavel Kislyi (Head of the Supreme Rada of Ukraine) and I. Yukhnovskii (First Deputy Prime Minister) to explore different aspects of the APS program. In

general, there was agreement on tax exemption for stipends and on matching funds to the laboratories of grant recipients.

2.4.6 Disbursements are currently arranged through the Soros Foundation offices in each country. Funds are transferred by APS to a holding bank in Finland and are subsequently transferred into dollar accounts in the names of individual recipients in local banks by Soros Foundation officers. The national advisory committees and Soros Foundation officers are notified of the names of the award winners and letters of disbursement are sent to the national advisory committees for distribution. The committees, foundation officers, and recipients coordinate with each other to arrange for the pickup of funds. No funds are given to the national advisory committees for disbursement. Recipients sign bank receipts which are returned to the APS Office of International Scientific Affairs.

2.4.7 Program review is the shared responsibility of the national advisory committees and the Task Force. The national advisory committee will request work reports from experimentalists after the first year and pre-prints of manuscripts from theorists after their first year and from experimentalists after their second year.

2.4.8 Lists of awards and program evaluations are made public and given to funding agencies and other societies (in order to detect multiple awards, program bias and other problems).

3. Action Plan (recommended actions listed in order of priority): While most recommendations will be sufficiently general to apply to any number of programs, a few should be addressed to the International Science Foundation for the Former Soviet Union (ISFFSU) Board, or to a consortium of funding agencies, where appropriate. While a few recommendations overlap those contained in the accompanying papers on Infrastructural Issues by Gerson Sher and on The Global Scientific Heritage of the FSU by Robert Hoffman, Douglas Siegel-Causey, and John Moore, we can discover no serious inconsistencies among those recommendations.

3.1 Emergency Short-Term Programs--

3.1.1 Organization--Each scientific community, presumably through its learned societies, academies and, perhaps, with foundation and government funding, should seek to organize coordinating and advisory committees nationally, internationally and within each of the successor states of the FSU. The purpose of these committees should be to develop plans, mechanisms, procedures and principles for the development of assistance programs. **It should be a clearly stated objective of all efforts that the purpose of such aid is not to pursue an imperial program to acquire cheap talent for the benefit of the West, but to make it possible for each scientific community to survive the current crisis so that each will contribute to the recovery of their nation. This policy is in the best tradition of free and open inquiry and exchange and benefits all mankind.**

3.1.2 Library support²--The APS program provides only limited numbers of APS publications. While these journals are important to the FSU physics community, there is urgent need for other US, European and Japanese research and archival publications. The need is far too great to be addressed by any single, existing funding agency, since it is estimated that this would cost from \$12-\$13 million/year for Russia alone.

A possible strategy is as follows: 1) select several central institutional libraries in each nation capable of assuring the circulation of all journals, 2) survey all journals available in these libraries in 1990, 1991 and 1992 to determine which back-issues are needed, 3) determine the minimum number of issues needed to promote wide availability (to include photocopying of relevant issues where necessary). The selected institutional libraries will be charged with distributing copies to outlying institutional and university regional libraries to assure wide accessibility to all communities. Such a program is estimated to require an expenditure of approximately \$4 million over 2 years for the physical and life sciences.

3.1.2.1 A title survey for all physics journals, total numbers of copies, by discipline, for each academy library in each republic was made for 1991 and 1992. A similar survey is currently underway in the Russian Academy Library for the Natural Sciences in Moscow (and in institutional and university libraries in some of the sciences). The numbers of multiple copies needed is part of this survey.

3.1.2.2 Representatives of the European Physical Society have initiated negotiations with European publishers to secure discount subscriptions³. The APS position is that back issues of physics journals (both U.S. and foreign) should be provided free and that all current and future subscriptions should be provided at the "runoff" or "last copy" price, approximately 10% of the library subscription price. The final cost will obviously determine the total numbers of journals to be purchased. Our European colleagues have negotiated a price of approximately 800,000 ECU for all physics journals which represents 50% of the institutional library subscription price. This is most certainly too high and will be negotiated further.

3.1.2.3 We recommend that a consortium of foundations provide support of not more than \$4 million over a two-year period to replace as many journal issues as possible in select institutional and university libraries for the natural sciences in the FSU. (If additional funds are needed, a multidisciplinary panel would return with a fully substantiated request.) We further recommend that a multidisciplinary commission be established to negotiate with European and US commercial publishers an appropriate fee for the provision of all scientific journals. These negotiations should include access to electronic databases.

²See also recommendations in the accompanying paper on Infrastructural Issues by Gerson Sher.

³Unlike the situation in the United States where the principal physics journals are published by the APS and American Institute of Physics (AIP), the most important European physics journals are published commercially and are considerably more expensive than their U.S. equivalents.

3.1.3 Emergency Grants and Fellowships--Several learned societies in the United States have demonstrated their capability to organize committees of distinguished in the FSU for the purpose of developing and managing programs in support of scientific activities. A central objective is to introduce self-management as an efficient means to allocate resources based on investigator-initiated peer-review mechanisms. This process should be expanded and supported by major government and non-government funding programs. There may be cases where some communities in some countries are not sufficiently well organized to insure rapid notification, solicitation and processing of proposals. In such a case, an automated system of soliciting and grading incoming applications may be undertaken, with emphasis placed upon publication records and research associations. **We propose that the learned societies be provided with sufficient funds to continue existing emergency grants program, and that learned societies that seek to establish new programs based on local self-management and peer review be provided adequate support for that purpose. Such actions will conserve total available resources and assure the survival of the nascent "bottom-up" approach in the FSU. It will also facilitate the organization and development of intermediate and longer-range programs. As expert panels and site teams are organized to implement reviews for longer-term programs, the learned societies should be relied upon to provide lists of qualified nominees for panels and committees.**

3.1.4 Emergency travel to attend international meetings--The distinguished Russian physicist Lev Okun, who chairs the APS Moscow Committee, has emphasized that funding agencies should take note of the need to provide travel funds for FSU scientists to attend meetings in the West at which they have been invited to make presentations. **In view of the fact that the learned societies organize a significant proportion of scientific meetings and actively participate in others, it is proposed that the societies coordinate their requests for such travel support in order to insure against multiple awards. It is recommended that participating societies consider the question of the appropriate size of these awards. (The APS's supplementary FSU travel grants have varied from \$750 to \$1,200 depending on the support provided by the conference organizers and sponsors).**

3.1.5 Computer Moderated Telecommunications⁴--Numerous proposals have been made and several programs implemented to provide needed computer telecommunications support to the scientific community in the FSU. Thus far, the APS has concentrated on Russia and Ukraine. Among scientific disciplines, the communications capabilities of the physics community are generally most advanced, with the highest capacity enjoyed by the particle physics community. But these capabilities are wholly inadequate and are threatened by numerous problems. It is urgent that approximately \$3 million be made available over a two year period to arrest the decline in computer moderated telecommunications and to extend these capabilities to the whole of the scientific community. The immediate need is to provide secure and reliable connections with the Moscow scientific community and to develop the network to include all other regions within the Russian Federation. Support for telecommunications facilities within the other republics should be coordinated with other providers within the international community. **We recommend that a consortium of donors be asked to set aside**

⁴See also the accompanying paper on Infrastructural Issues by Gerson Sher.

no more than \$3 million over a two-year period as emergency funds to purchase needed equipment and provide operating costs to expand telecommunications within Russia. Working out details for the use of those funds should be a high priority for the first six months of 1993. An immediate allocation of approximately \$170,000 will be needed to provide satellite capacity through the ground link at either the Institute for Space Research in Moscow or the new station installed at the Russian Academy Presidium. With respect to the other successor states, funding should be set aside to provide computers, servers, modems, optical disk readers, and other suitable equipment to help scientists exploit existing facilities.

3.1.6 Alerting the Scientific Communities--To alert all of the scientific communities in the FSU to the existence, criteria, and form for requesting support under emergency and longer duration programs, it is recommended that the journal *Argumentii i Facti* should be used (along with other suitable publications). Forms for emergency grant applications to include information for grant proposals may be published and widely distributed (circulation is 26 million). The various FSU scientific communities, their advisory boards and review panels will subsequently be provided with the forms and information needed to guide applicants through the process of applying for funds. The use of journals or other communications means will not be adequate as the physics community learned at the inception of its program. It is recommended that the editors of *Argumentii i Facti* and/or other suitable broad-distribution media be requested to make their journals available as preliminary fora for alerting the Russian community to the existence and requirements for all aid programs. It will be important to find equivalent organs for contacting scientists in the other republics.

3.1.7 Information Clearing House--It is urgent that the February 9 conference discuss mechanism and means to publicize grants, to insure that resources are not dissipated in multiple awards. We recommend that an open, accessible mechanism be established for tracking and managing awards and that this mechanism include disbursements made by other foundations, learned societies, governmental and international programs.

3.1.8 Promoting Collegial and Institutional Collaboration--It is important to consider promoting international collaboration through the exchange of faculty and junior research staff. Funds should be allocated to provide sufficient resources to support joint Western-FSU institutional and university appointments, the routine, short-duration exchange of key scientists and to continue the development and support of regional schools and workshops in the nations of the FSU.

3.2 Intermediate and Longer-Term Programs--Intermediate and longer range programs should shift their focus away from the stipend and subsistence support that characterizes most emergency programs to the actual support of research and related professional activity. This will make possible provision of increased support for experimental research than has been available through most emergency programs, since the small funds available have been of disproportionate value to theorists. Grants to individual scientists must also address the issue of "overhead" or infrastructure support. But to avoid the obvious complication of contributing to a corrupt or

ineffectual bureaucracy, it will be necessary to impose strict fiduciary restraints on all such aid and to monitor grants with appropriate tracking mechanisms and performance requirements.

3.2.1 Endowed Professorships--Scholars of international stature and outstanding achievement usually reside in the Academy institutes, although many have university associations. It would strengthen university programs to name distinguished scholars to endowed chairs with a view toward bridging the gap between the great research institutions and the universities.

3.2.2 Postdoctoral Fellowships--It will be important to establish postdoctoral fellowships to be awarded for a two-year period, with the possibility of an extension for a third year if funds are available. Each two-year fellowship should consist of a stipend and a conference travel allowance.

3.2.3 Independent Investigator Awards--Such investigator awards will provide salary support for independent junior and middle-level investigators, equivalent to assistant and associate professorships in the United States.

3.2.4 Research Grants--Research grants should be awarded, on the basis of competitive peer review, to investigators heading leading research programs. Each grant should be funded for a period of two years, with the possibility of an extension for a third year contingent on satisfactory progress and if adequate funds are available. The levels of support will vary with discipline, institution, group size, and needs. However, grants should be sufficiently large to support the work of independent groups and laboratories. Allowable costs should include salaries, supplies, essential small equipment, travel, communication and other allowable needs. Support of the principal investigator's graduate students should be an important element of the budget. An institutional allowance or overhead should be provided from the grant based on demonstrated costs. The overhead rates may not exceed 15 percent and should be negotiated with each institution after careful review of the efficiency of administration and management.

INFRASTRUCTURAL ISSUES

Background Paper

by

Gerson S. Sher⁵

prepared for

SUSTAINING EXCELLENCE IN SCIENCE AND ENGINEERING IN THE FORMER SOVIET UNION

A Conference

February 9, 1993
National Academy of Sciences

1. Introduction

Individual scientific and engineering researchers are of course the single most important asset of any nation's research enterprise. But these researchers work within a system of supporting relationships and facilities - the infrastructure - that defines in many ways the limits of their productive capabilities. In a broad sense, the scientific infrastructure consists of the buildings in which scientists work, the means by which they acquire and share information, the systems that produce new scientists, and the means by which the research community coordinates its efforts with other sectors of society. The extent to which these factors are important may vary from field to field; experimental equipment, for example, is generally less important for mathematicians than for engineers. But there are many needs that are common to the health of all fields, such as the need for free and efficient scientific communication. When these support systems fail, not only does science suffer but the most able and enterprising researchers find it increasingly compelling to move their work to other, more supportive environments.

⁵The author is indebted to Dr. Steven Goldstein, Ms. Sandra Burns, and Dr. Kenneth Gordon for their important contributions to this paper. Several sections of a draft paper on Direct Aid to Scientists by Irving Lerch and William Blanpied have also been incorporated. The views expressed in this paper are those of the author and do not necessarily represent those of the National Science Foundation or the U.S. Government.

The infrastructural crisis of science in the former Soviet Union (FSU) is of vast proportions, the catastrophic product of a combination of seventy years of enforced isolation, a legacy of centralized management and political control, and more recently political upheaval and economic chaos. Buildings are falling into disrepair, laboratory equipment is not just obsolescent but archaic, basic supplies and materials are virtually nonexistent, computing is for the most part primitive and spotty, telephone lines are unreliable. Access to any research resource requiring hard currency - supplies, publications, international telecommunications, journals - is beyond reach to all but the most privileged or those fortunate enough to have good contacts in the West. It is true that these commodities had for decades been severely restricted in the Soviet scientific community and rationed according to a system of privilege and political influence, rather than scientific merit. However at present the shortage of these goods is particularly acute because foreign currency, which was held by at least some elite institutions under the old system such as the military and the Academy of Sciences, has all but vanished. In no other area of scientific life is the evidence of the ravages of the new "golden curtain" more evident than here.

The dimensions of the problem in the FSU are indeed so enormous that no assistance effort can possibly "solve" it. It may legitimately be questioned whether it is the proper role of foreign assistance efforts to make major resource allocation decisions in lieu of the domestic capability to do so in the host country, including support for large-scale facilities and projects. The financial scope of the problem alone is overwhelming and beyond the capabilities of any potential donor. But even if available funding were unlimited, the collapse of the old structures for managing resource allocation, and the urgent need to develop more effective frameworks and systems in their place in the midst of a crisis situation, will limit the long-term effectiveness of any assistance effort unless it simultaneously attempts to address the financial needs *as well as* the system in which they exist.

At the same time, many of the infrastructural needs mentioned above are so basic and inexpensive, by Western standards, that even very small amounts of money strategically placed can provide tremendous leverage. Some needs are so critical to the functioning of a modern scientific community that making even a small dent in them may have a disproportionately large impact. Additionally, while some needs can easily be met at the level of support to individual investigators, others shared resources - such as telecommunication networks, journals, etc. - must be dealt with at a more general level if their use is to be reasonably efficient. Not all the problems are financial - in some cases, for example, policy issues such as export controls are involved.

Finally, it should be stressed that addressing this category of needs is not of importance only to the FSU scientific community. The world scientific community will also be a major beneficiary because the abilities of FSU scientists and engineers to communicate their findings, to be informed about developments abroad, to travel, and to identify new talent, are essential to ending the isolation of the FSU from the rest of the world, and that of the world from the extraordinary richness of FSU science and engineering.

This discussion paper focuses on four major issue areas: electronic communications, scientific literature, travel to international scientific meetings, and linkages between the research

community and other sectors of society (education and industry). Each of these issues relates to the broad theme of *scientific communication*, which is an essential element of the scientific environment that has a profound impact on the very ability to function as part of a larger scientific community. It was indeed the extremely stifling quality of scientific communication that characterized the Soviet scientific establishment in the past.

Today, the scientists of the FSU are in danger of falling into even further isolation from world science than in the past because of the legacy of control, economic disruption, the collapse of internal library and other information systems, and rapid technological advances in international communications. Yet these same advances may now make it possible for many FSU scientists who might otherwise seriously contemplate emigration to consider, instead, a situation in which living in the FSU and working as a member of the world scientific community are not mutually incompatible concepts. It is in the interest not only of FSU science but also the world scientific community to ensure as vigorous a flow of information as possible in both directions and that the isolation suffered by Soviet science in the past cannot be reimposed.

2. Electronic Communications

2.1 Background

Computer networking with access to the Global Internet, with over 1.1 million attached computers in about 50 countries, is no longer a frill but an essential need for research and higher education. Interactive computer networking permits the user to do the same things on a computer located half way around the world as could be done on a computer in the next room, providing that there is enough transmission capacity in the connecting networks. This includes exchanges of electronic mail, retrieval of information on demand from data bases, exchanges of documents and other files, remote execution of programs, multimedia conferencing among colleagues in several locations, etc. It also permits remote use of specialized computing and experimental resources, such as computers, telescopes and particle accelerators. Computer networking is thus a basic enabler of research, education, development and business activities. It is a "force multiplier" because it can enhance the effectiveness of users many-fold.

The gap between networking "haves" and "have-nots" is growing as the Internet continues to grow exponentially. Those who have access are enabled to do more and more with the networks, leaving those who do not have access further behind. This phenomenon can be observed world-wide. The FSU is especially vulnerable because it is starting from such a rudimentary position in terms of availability and quality of telecommunications systems, hardware, etc.

Access to computer networks is particularly important for domestic use when other means of communication are of questionable reliability or availability. Electronic mail often gets through when voice phone does not, for example, and it is less sensitive to time-of-day constraints because the addressee need not be present when the mail is delivered to the target machine.

Also, special error correction helps the electronic mail and transferred files get through circuits full of noise that would render speech unintelligible.

Computer networking can provide substitutes for scarce or non-existent local materials, equipment or bibliographic reference materials by permitting participation in work groups in other places of the world. Remote participation in the field of high energy physics is already well known to the FSU and their collaborations with western laboratories. But collaborations in other fields, from oceanography to medicine can also provide meaningful participation for otherwise isolated and resource-poor investigators.

Computer networks also contribute to political stability. They also help maintain communities of interest in the face of shortages and other adversities, including political upheaval. By making it possible for people with common interests to share experiences and information, global communities of interest are spawned and supported by literally thousands of special mail lists, bulletin boards and "news groups." The growth of such communities helps ensure that the recent political and other changes in the FSU will be irreversible.

2.2 Current Situation of FSU Computer Networking

Several joint ventures with western companies provide international electronic mail and file transfer service. But, there is little or no interactive service beyond major cities or internationally because the infrastructure is scarce or non-existent, and what does exist is very expensive. The commercial services are priced far beyond the reach of state-sponsored institutes and schools, and tend to be affordable by profitable domestic businesses or local affiliates of western enterprises.

The scientific community in the FSU is served--for the most part--by two organizations: Soviet Union European Academic and Research Network/For Research, Engineering and Education NETwork (SUEARN/FREENET) and RELCOM. SUEARN/FREENET is the FSU partner of EARN and BITNET, respectively, with FREENET running under the TCP/IP protocol used by Internet. It is based on aging mainframe computers (produced in the USSR and related to old IBM designs) and is unreliable. In addition, the expansion of the user base has been slow. Most of the Moscow-St. Petersburg-Novosibirsk physics community is served by the commercial network, RELCOM, which is based on networked small machines employing the UUCP connection to Internet in Finland. The unreliability of the telephone net slows message delivery considerably, delaying transmission from 2 to 4 days. But most important, RELCOM costs are rapidly rising, making it impossible for institutions to maintain their connections.

Real-time access to the academic computing networks in both Europe and the United States is almost nonexistent thus locking FSU users out of the more important abstract and textual databases (and there has been little, if any, distribution of CD ROM subscription disks to compensate this deficiency). For the Russian physics community, there is some relief in the existence of two dedicated lines, one from DESY (Hamburg) and one from CERN. However, these are low-capacity lines (unsuited to real-time database access or high-speed data transfers)

which are routed through Moscow switching stations and, as a result, connections are not reliable. Communications with some of the other republics, notably Ukraine, Georgia, the Baltic States and Armenia are usually good because the communities are small and concentrated. In particular, two direct lines are being laid which will connect Ukraine with Western Europe. The Scandinavian countries have nurtured a special relationship with the Baltic States and have subsidized direct and satellite connections.

Commercial services, including RELCOM, SPRINT and others have not been compelled to provide special fee schedules to the scientific community in Russia because the total volume of traffic is insignificant compared to commercial users. However, a new user group, RELCOM Academic and Research Network (RELARN) has been established in an effort to develop the non-commercial use of existing facilities and to seek resources to implement a networking plan to serve their members. There has been some movement towards coordination between RELARN and SUERN/FREENET users but a coherent set of proposals has yet to be developed.

The lack of reliable connections between Moscow and Western Europe, Japan and North America, and a reliable distribution network within the republics, remain major problems. It is clear that telecommunications needs and requirements differ from country to country and that any approach should be based on a decentralized system tailored to regional needs.

Research and academic networking in state-supported institutions was at best spotty up to a few months ago, and may be much worse off now as a result of large increases in telecommunications tariffs by the Russian state telephone monopoly. So far, the research and academic community have been unable to convince the telecommunications monopoly to provide special discounted rates for their not-for-profit sector.

Both telecommunications infrastructure and modern equipment to attach to what does exist are said to be sorely lacking. There are at least two levels of phone system services available for sale to the general public: the ordinary service which is said to be of very poor technical quality, and the ISKRA 2 phone system of former special government bureaus which can be purchased at much higher rates. Many western telecommunications companies are said to be queuing to invest and build infrastructure in the FSU, but progress is slow. Only the very lowest speed circuits can be leased for international connections, thus limiting what FSU researchers could do to the most basic of computer networking capabilities (e-mail, modest file transfer, submission of batch computing jobs). But even these limited capabilities can help to bind them to the global community and lessen the debilitating effects of isolation and deprivation.

Western government research organizations, including the U.S. Department of Energy and NASA, are working on a number of possibilities for limited networking connections to specific laboratories in the FSU, principally Russia. NSF is funding the purchase of e-mail terminals as part of its cooperative research grants and it is examining possibilities for connectivity in support of the general research and academic communities. However, U.S. government restrictions on access by FSU countries to U.S. federally-supported networks remains an important constraint. In addition, the Carnegie Corporation of New York has funded a study

of the current status of telecommunications and requirements for international connectivity in the former Soviet Union and that study is nearing completion.

2.3 Opportunities for High-Leverage Intervention

2.3.1 General:

- provide technology, promote speedy export licensing, and obtain permission to route FSU interactive traffic in U.S. Federal networks;
- influence Russian telecommunications policy-makers to provide affordable services for research and academic communities;
- install an interoperable, standard telecommunications plant to increase both domestic and international connectivity options.

2.3.2 High-Leverage Steps for Donors:

- find incentives for FSU institutions to prioritize affordable telecommunications services for research and academic communities;
- finance high-visibility demonstrations of practical solutions. These might require large startup investments (~\$1 million) and high sustaining contributions for limited period (several hundred \$K annually). Such projects might also entail matching or in-kind contributions from the FSU States - maybe a way to accomplish the preceding task!
- bring FSU telecommunication decision-makers to western countries to educate them as to the need for, and benefits from, computer networking;
- energize and support competing service providers that might help to drive down prices;

2.2.3 Steps for Professional Societies, Universities, and Other Institutions:

- provide low-cost packages of basic computer equipment suitable to function as e-mail terminals - PC's, modems - to as broad a range of FSU partners as possible, with special attention to institutions in FSU cities outside Moscow and St. Petersburg and to universities;
- develop and share lists of e-mail addresses of the U.S. science and engineering communities with FSU colleagues. Develop electronic bulletin boards to facilitate long-distance discussion, both internationally and within the FSU;
- offer remote access to scientific databases at reduced cost.

3. Scientific Literature

The attached paper by Sandra Burns of the AAAS entitled, "The Distribution of Scientific Journals in the Former Soviet Union," is a report on a feasibility study conducted by AAAS for the MacArthur Foundation concerning the distribution of Western scientific journals to the FSU. The original purpose of the study was to examine the feasibility of instituting a program to reinstate lapsed journal subscriptions. However, it was found that this approach was impractical for a variety of reasons to carry out through a single, central effort; as a result, AAAS has resorted to focusing on several central scientific libraries in Russia, Ukraine, and Belarus. The paper also describes other efforts of professional societies, including the American Astronomical Society (with partial support from the Sloan Foundation), the American Institute of Physics and the American Physical Society, the Sabre Foundation, the American Chemical Society, the American Psychological Association, and the AAAS in this area.

Prior to the collapse of the USSR, state operations such as *Mezh Kniga* negotiated directly with scientific publishers to provide archival and research journals to Academy, university and institute libraries. Thus, most scientific publishers had no knowledge of who received their publications. This was true for both learned society publishers such as the American Physical Society and the commercial science publishers. For APS, over a two-year period, institutional journal subscriptions dropped from 428 in 1990 to essentially 0 in 1992. In cataloguing all research and archival journal subscription needs in physics for the academy libraries of the natural sciences in Belarus, Armenia, Kyrgyzstan, Kazakhstan, Estonia, Azerbaijan, Latvia, Lithuania, Tajikistan, Uzbekistan, Ukraine, Georgia and Russia, we find almost all West European journal subscriptions lapsed, with 365 titles missing from the Russian Academy library alone. Institutional and university libraries are equally bereft, although the problem is mitigated by subsidized personal subscriptions.

In response to the decline in institutional library subscriptions, the APS has responded with a continuously increasing number of Matching Memberships. The APS Matching Membership program provides memberships for physicists in currency-poor countries, with costs being shared between APS and a U.S. sponsor. Such members (and/or their sponsors) can subscribe to APS journals at member rates. Twenty of these Matching Memberships for the FSU are sponsored by the American Institute of Physics and consist of the Russian editors of AIP publications. Numerous APS members and NSF funds sponsor more than 200 in the western republics.

The American Academy of Arts and Sciences has received a grant from the United Parcel Service (UPS) for air shipment of journals to the FSU. The program was targeted at Russia and will probably not continue. By means of this program, the APS has shipped complete yearly sets of *Physical Review* and *Reviews of Modern Physics* to key institutions in Moscow, St. Petersburg, Novosibirsk, Tallinn, Vilnius, Kiev, Yerevan, Tbilisi. These will be made broadly available throughout the FSU. This distribution program supplements the Matching Membership subscriptions which target individual colleagues for receipt of specific journals.

The Soros Foundation has--and the MacArthur Foundation is expected to have soon--offices in the Republics. The APS has an agreement with the Soros Foundation to use their offices as

shipping destinations for equipment and journals and is using their banking facilities for the disbursement of funds. In some areas, this will enable the APS to avoid some of the current tax and import duties levied on incoming funds and equipment. The problem has been raised with UN, UNESCO and IAEA officials in an effort to determine whether the UN system can provide a solution as well. UN and UNDP offices are being set up in Moscow, Kiev and Minsk, and we may use these facilities for the disbursement of hard currency, if needed.

An inexpensive method for shipping journals and equipment into the Baltic States, the republics and East-Central Europe is managed by the Sabre and Brother's Brother Foundations. They send bulk shipments by surface transport 4 times each year at a cost of 35 cents per pound from warehouses on the eastern seaboard.

The above referenced study of this issue by Burns, as well as the experiences of the APS, suggest the following generalizations which may be used to guide the thinking of donors and professional societies in devising responses:

3.1 General Issues

- Mail and other distribution systems have broken down in the FSU, both internally and externally. The unreliability of delivery systems for hard-copy publications increases the importance of other communications technologies, especially electronic.
- The disarray in the postal system even further isolates researchers in remote regions (i.e., outside Moscow and St. Petersburg) and in the non-Russian republics. Special attention should be given to ensuring that these locations are included in programs to address these issues.
- The holdings of university libraries are significantly weaker than those of Academy of Sciences organizations. Linkages need to be established between these facilities and special attention should be devoted to university libraries.
- Technologies such as CD-ROM for making available large amounts of information would be very effective; however, the appropriate hardware must also be purchased and put in place.
- The collapse of communications with the FSU, and of journal subscription lists within the FSU has generated a need for directories of FSU scientific institutions and individuals. In this respect the assistance of FSU partners and support recipients would be extremely valuable.

3.2 Steps for Donors

- Make grants to professional societies to fund journal subscriptions and CD-ROM databases to libraries, institutes, and universities and to subsidize remote access to scientific databases such as MEDLINE;
- Support procurement and installation of CD-ROM equipment in selected FSU S&T facilities.

3.3 Steps for Others

- Create programs by professional societies to solicit membership contributions for journal subsidies;
- Subsidize subscriptions by individual U.S. scientists participating in cooperative activities.

4. Travel to Scientific Meetings

Closely related to the issue of access to scientific literature is that of participation in scientific meetings; both are central to the flow of information in the scientific professions. Yet participation of Soviet scientists in meetings held abroad, a rare enough phenomenon before the fall of the Soviet Union as a result of political controls, has now become even more problematic because of the drastic devaluation of the ruble and the total financial inaccessibility of international travel to all but a very few. The inability to participate in such meetings compounds the isolation of FSU scientists and denies them a means of keeping current in their field that most scientists elsewhere in the world take for granted. The presence of scientists from the FSU at such meetings is of value not only to them but also to the discipline as a whole which is otherwise deprived of timely information about important developments in the field taking place in FSU laboratories.

Little systematic information is available on the extent to which special support has been available to FSU scientists and engineers wishing to travel to scientific meetings in the United States. Some meeting sponsors have been able to reduce or eliminate registration fees for FSU guests, but defraying their travel and subsistence costs is usually beyond the capacity of societies or organizers. FSU visitors participating in independently sponsored cooperative activities sponsored by NSF, NAS, or other programs, have often been able to take advantage of their stay to attend major scientific meetings, but cooperative programs do not generally fund participation in such meetings as a sole objective.

4.1 Possible Steps:

- A portion of membership contributions collected by professional societies in support of FSU scientists might be set aside in a special fund for support of FSU

scientists attending professional meetings sponsored by the society or in its discipline.

- Foundations and other organizations might consider requests from professional societies for support of special assistance for FSU scientists seeking to attend scientific meetings.

(In both of the above cases, mechanisms would have to be devised to disseminate information about such opportunities to FSU scientists and to filter and select requests for assistance.)

- Consideration might be given to siting certain smaller meetings in the FSU, either as bilateral workshops or special sections of society activities.
- Grants programs for support to individual FSU scientists should include support for travel to international scientific meetings as a key component. The creation of a well-provided-for but still isolated scientific community would only repeat past problems.

5. Linkages with Other Sectors

Just as the linkages between the scientific research enterprise of any country with that of the world scientific community are important to the health of both, the linkages of that country's effort within its own society are of critical importance to its ability to sustain itself and to attract internal and external resources for its long-term development. While FSU emergency S&T relief efforts may properly devote the greater part of their attention to support of individual researchers and their immediate needs (including the infrastructural needs described above), they must also do so with the knowledge that these efforts are of only limited duration. Unless emergency relief programs also devote some effort to addressing the underlying problems of the FSU R&D establishment, their medium- and long-term impact may be only superficial or worse once the outside supporters leave the scene and the policy-makers and researchers of the FSU are left to work out where to go from there.

Of special concern are the linkages with education and industrial development. These are central to the health of any nation's scientific enterprise. One of the hallmarks of the Soviet Union's S&T organization and policy for sixty years were the gaps between the research sector - particularly its elite establishment in the Academy of Sciences system - and education, on the one hand, and industry on the other. The roots of this arrangement are complex with their origins deep in the history of the Stalin Revolution of the 1930's, but their result was an artificial - and deliberate - separation of these sectors, a separation so profound and even enforced that in any other society it would be seen as an extreme handicap to the health of science and technology. Indeed the history of Soviet S&T policy consisted largely of a series of largely unsuccessful efforts to redress the inefficiency and waste imposed by this basic structural arrangement, brought about more by political exigency than by scientific or economic rationality.

The preferential access to resources of researchers and institutions in the Academy system, as compared with university and industrial research laboratories, has been remarked upon widely by visitors.⁶ There is a temptation to draw from this comparison the overly simplistic conclusion that assistance efforts should go primarily to leading institutions and researchers in the Academy system and that the universities can be dealt with later. And of course support should go only the best people and facilities. But support for university science must not be neglected by assistance programs, because it is essential to the long-term health of the research enterprise to have a healthy pipeline of young scientists and engineers. While it perhaps cannot be the goal of such programs to create new educational institutions (although some foundations have done just that elsewhere in Eastern Europe), it is appropriate and important for them to make special efforts to seek out and support deserving research groups in universities and to give priority to activities that are characterized by partnerships among researchers from the Academy and university sectors.

Much the same can be said of the industrial R&D sphere. Here, the profound disjunction between the relatively high-quality basic research carried out in Academy institutes and the poor in-house capability of industrial ministries to innovate is widely perceived as a key source of Soviet technological backwardness. There is also no doubt that there are researchers and laboratories of very high quality in the industrial sector, in many cases the beneficiaries of military R&D funding that has now all but disappeared. But these researchers typically have limited understanding of the cycle of turning ideas into technologies and products in a competitive market environment, and a key element in learning these skills is to build close ties with the academic research sector, on the one hand, and with the consumers of the technology on the other. Again, while assistance efforts cannot create these structures outright, they can judiciously promote their growth by offering special incentives to potential grantees to build these linkages into their activities from the beginning.

To address these concerns, special priority should be given to programs that support:

- High-quality researchers at university institutions, with special allowances for instrumentation.
- Activities that involve young investigators, graduate students, and undergraduates.
- Activities that involve cooperation between academy, university, and/or industrial laboratories.
- High-quality applied research with potential industrial or commercial application, with linkage where possible to implementing organizations such as commercial enterprises.

⁶To be sure, there are important exceptions. One educational institution often cited as being of exceptional quality in terms of research and linkages to other sectors is the Moscow Physico-Technical Institute (MFTI). Another exception is the entire area of defense-related production, which had been well endowed. The fact, however, that these examples are exceptional (and arguably irrelevant, in terms of the military-industrial complex now that defense R&D funding is virtually nonexistent) and not typical simply illustrates the problem.

- Assistance in implementing training opportunities (e.g., workshops, internships) in university administration and commercial application, S&T marketing, intellectual property rights, and technology transfer.

In addition, the following steps should be taken:

- Ensure that information about all funding opportunities is broadly disseminated among and within the FSU university community.
- In any information dissemination program, make use of U.S. corporations and foundations currently active in the FSU.
- Make effective use of the expertise of U.S. government agencies involved in supporting and conducting industrially oriented research and technology development in the U.S.
- Assist FSU successor states in the development of technology policy, including topics such as the government role in technology development, methods of transferring technology from research laboratories into commercial products, and strategies for obtaining technology from other countries and arranging joint ventures with other FSU successor states.
- Especially in applied and industrial research, include U.S. researchers - universities, government laboratories, or corporations - as active partners for improved leverage and research performance.

INFRASTRUCTURAL ISSUES

Appendix

**THE DISTRIBUTION OF SCIENTIFIC JOURNALS IN THE
FORMER SOVIET UNION**

Feasibility Study Seminar Report

Sandra M. Burns

November 1992

INTRODUCTION

The economic situation in what was formerly a 15-republic Soviet Union is dismal, making it extremely difficult for scientists to conduct research and to keep abreast of the latest developments in their respective fields. One vital link with the world scientific community involves foreign scientific journals, yet the formerly Soviet scientific community has not been able to renew subscriptions in recent years due to the shortage of hard currency. This could have dire consequences for scientists in the FSU, just emerging from decades of isolation, and already facing problems ranging from unemployment, to scarcity of research material, to food shortages. The journals problem is particularly acute for younger FSU researchers attempting to publish results of their work in prestigious international journals in their respective fields. Their lack of access to western journals means that they have no examples of articles selected for publication nor a complete picture of what journals exist to which they could submit manuscripts. More importantly, it is crucial that researchers keep abreast of research results elsewhere in the world. If the serious lack of journals continues, the survival of the FSU scientific community is in jeopardy, and it could take years for FSU science to recover.

The US scientific community is well aware of the threat to FSU science, and has convened several meetings in an effort to identify problem areas and compare notes about specific steps being taken to assist colleagues in the FSU. Examples of such sessions include the March 3, 1992 meeting at the National Academy of Sciences on "The Future of Basic Research in the FSU"; the August 13, 1992 session at the White House Office of Science and Technology Policy, part of planning for an Autumn 1992 meeting between Presidential Science Adviser D. Allan Bromley and Russian Deputy Premier Boris Saltykov; and an October 28, 1992 meeting convened by the American Academy of Arts and Sciences, "Saving Soviet Science." Time and again, the need for journals and for financial support of researchers are at the top of the lists of priorities emanating from these meetings.

In light of this, and with the support of the MacArthur Foundation, AAAS recently completed a feasibility study to determine how best to address the situation. The original plan was to identify journals subscriptions, going to the FSU from AAAS affiliates, which had lapsed due to the shortage of hard currency in the FSU, and then determine the cost of reinstating the lapsed subscriptions. This turned out to be problematic, however, for a number of reasons, as reflected in the results of the initial feasibility study funded by MacArthur.

FEASIBILITY STUDY

Launched by AAAS in early 1992, the feasibility study had two major components: a survey of publishing societies; and a study of library and research facilities in the FSU. Many requests to AAAS for journals were generated by the contacts made through the feasibility study and by a short article appearing in the newspaper *TRUD* via Voice of America reporting on our efforts to secure journals for FSU researchers.

The Survey

To conduct the survey, AAAS sent questionnaires to 16 affiliated societies, requesting information on the journals they publish and trends in subscriptions going to the FSU in recent years. Through this survey, AAAS aimed to accomplish several tasks:

- identify societies most likely to have subscriptions going to FSU;
- determine the number of subscriptions going annually to the FSU;
- ascertain the cost involved given the number of subscriptions;
- get a break down of institutions and individuals to whom the journals are addressed;
- determine the publishing societies' willingness to continue the subscriptions at cost for two years;
- examine other journals projects underway, to avoid the duplication of efforts.

The results of the survey indicated that it would be both very difficult and quite costly for any one funding organization to attempt to reinstate current and recently lapsed journal subscriptions for several different societies and associations. In fact, in the course of conducting this study it became apparent that several factors complicate a journals project of this magnitude, three of which deserve special attention.

- First, precise information on journal recipients in the FSU republics was kept at a Soviet institution, *Myezhniga*, a central governmental organization in Moscow through which all foreign book and journal orders were processed in the former Union. The US scientific societies had no access information as they often used subscription services to fulfill journal subscriptions foreign recipients. With the breakup of the USSR, *Myezhniga (MK)* underwent a major transition, losing its hard currency accounts in the process, and reports are that remaining staff members at *MK* are attempting to enter the business world, offering to sell various types of information on the FSU. Accurately identifying former recipients of the US journal subscriptions would therefore amount to an immense, if not impossible, task.
- Second, given the breakup of the USSR, distribution channels used previously, including surface mail and air mail, are no longer viable and new reliable ones must be found. The situation is particularly bad for distributing materials through Moscow to non-Russian republics.
- Third, since the majority of those subscribers we have been able to identify were individuals, not libraries or institutes, reinstating these subscriptions ultimately would have a minimal effect on FSU science since the journals would only be targeted to a small segment of the FSU research community.

For these and other reasons, rather than attempting to reinstate the journal subscriptions, we have devised an alternative approach to make select journals available at major scientific libraries which are accessible to the majority of researchers in Russia, Ukraine, and Belarus.

Library and Research Facilities

During the feasibility study, the AAAS project director made site visits to Russia, Ukraine, and Belarus where she met with researchers, librarians, administrators, government officials, and university representatives. As is well known, the situation for scientists is extremely difficult, especially since individual research institutes are in flux, as supplies and salary support dwindle. Discussions revealed that the scientific community as a whole is well-acquainted with the several science and technology (S&T) libraries for different sectors of the research community located in major cities. These generally include a library affiliated with the Academy of Sciences, a public S&T library, and a university library. The main Academy of Sciences library also maintains smaller branches throughout the city, primarily at research institutes. There is also a library affiliated with the Academy of Medical Sciences in each of the former USSR republics.

All major libraries have a foreign acquisitions section headed by a director whose English language skills tend to be quite good. Library affiliates or branches also have a foreign acquisitions or journals librarian who works closely with the foreign acquisitions director at the main branch. This network of foreign acquisitions librarians will be an important component of the AAAS plan, as library personnel are very capable, would be cooperative in conducting the journals project, and are in an advantageous position to encourage equitable usage of journals.

AAAS has chosen to target four centers of scientific research: Moscow, St. Petersburg, Kiev, and Minsk. A sample of libraries to be involved in the AAAS project includes the following:

Library of Natural Sciences of the Russian Academy of Sciences/Moscow. The 300 institutes of the Russian Academy (RAN) look to the Library of Natural Sciences as the central source of fundamental scientific information. At one time, the library had 3,000 foreign journal subscriptions, but this has decreased to about 10% of that. The most recent journals on the shelves date from December 1991. The institution is only for Academy-related researchers, however, which is one reason AAAS believes it is important to work with university and other libraries as well.

Jakub Kolas Library for Science and Technology/Minsk. Most of the scientific material in Belarus is located at this library, affiliated with the Academy of Sciences in Belarus. University, Academy, and industry researchers utilize the library which formally subscribed to \$1.5 million of foreign journals, and also received 1,200 titles via international exchanges; this has decreased substantially. The library has devised a system of intra-library loans with its branches elsewhere in Minsk to facilitate the sharing of journals.

Moscow State University Library. Formally, the library had 1,500 titles of journals, and only about half as much hard currency for foreign subscriptions as other libraries. The library system at Moscow State consists of some 20 individual department libraries. University libraries in Minsk and Kiev face a similar lack of resources. The university system is clearly in poorer shape than the Academy system, and the university infrastructure would profit greatly from S&T assistance.

Each library is struggling to obtain journals in any way possible. One interesting alternative to foreign subscriptions does seem to have arisen -- some libraries are considering engaging the services of the Moscow-based enterprise "AS Plus." An advertisement for "AS Plus" obtained in Minsk indicates that the group offers to send photocopies of entire journals to libraries in former republics. Payment is made for three months only. Most of the library personnel with whom AAAS has been in contact expressed skepticism as to whether such a system would work, finding it potentially very costly and unreliable. They also had serious doubts as to the idea's viability given the severe shortage of paper in the FSU.

Related Journals Projects

The survey also revealed other US efforts underway to provide journals to FSU researchers, several of which complement the proposed AAAS effort. These include the following.

American Astronomical Society (AAS): The membership of AAS set up a program to provide journal subscriptions and support for small grants program. Funding came from personal donations in response to solicitation by electronic mail and the Society's Newsletter. By October 1992, contributions had reached \$54,000, which has been augmented by matching funds of \$70,000 from the Sloan Foundation. A shipment of journals has reached the FSU through a grant from the United Parcel Service to the American Academy of Arts and Sciences.

American Institute of Physics (AIP) and American Physical Society (APS): AIP has established two separate journal donation programs to the FSU. The first supplies US journals to the editors of the 20 Russian language physics journals with which AIP works. Each editor receives *Computers in Physics*, and two journals of the editor's choice from among all physics journals published by AIP and its Member Societies. In addition, AIP cosponsors with the American Physical Society (APS) memberships in the APS for all of the editors, which provide them with the monthly *Physics Today* as one of the benefits. Under the second program, 100 free subscriptions to AIP journals and magazines are sent to other scientists in the FSU.

Sabre Foundation: Under the Sabre Foundation's "Scientific Assistance Project," books and journals solicited from scholarly publishers in the US and abroad are distributed to targeted libraries in Eastern Europe and in the former Soviet republics. Within the FSU,

Sabre has had most extensive contacts in Ukraine, and in the Baltics; a Russia project is slated to begin by 1993.

American Chemical Society (ACS): ACS has earmarked \$30,000 to support journals for the FSU over three years. Recipients will arrange for overseas shipment. ACS has provided 800 kg. of back issues, shipped to Moscow, for distribution to research institutes via a special Aeroflight, in cooperation with the Science Office of the Russian Embassy in Washington, D.C.

American Psychological Association (APA): APA provides 57 institutional subscriptions to the FSU on a complimentary basis. APA also sends back issues of psychological journals and books to Estonia and Novosibirsk, and plans to earmark some journals for the FSU under its program to provide journals to developing countries.

American Association for the Advancement of Science (AAAS): The AAAS Board of Directors voted unanimously to send 20 subscriptions to *Science* to several FSU republics, at the Association's expense. At the same time, recipients are being contacted to verify the subscription information, to confirm receipt of the magazine, and to inquire as to its use and how it is made accessible to researchers.

The major obstacles cited in all of these endeavors include the need to find a reliable delivery system as well as to avoid the perception of the journals as "charity" by both the recipients and by the membership of participating US societies.

THE GLOBAL SCIENTIFIC HERITAGE OF THE FSU

Background Paper

by

Robert Hoffmann
The Smithsonian Institution

Douglas Siegel-Causey
University of Kansas

John H. Moore
George Mason University

David F. Murray
University of Alaska

Eric P. Hoberg
U.S. Dept. of Agriculture

prepared for

PRESERVING SCIENCE IN THE FORMER SOVIET UNION

A Conference

February 8 - 9, 1993
National Academy of Sciences

Foreword

The global scientific heritage of the former Soviet Union is both historical and contemporary. It includes the great scientific traditions outlined in the first part of this paper as well as unique and irreplaceable collections of specimens, data, and documents. The paper does not pretend to be a systematic or comprehensive report on this heritage. Rather, its purpose is to suggest by illustration the importance of this heritage and to stimulate discussion and extension of the subject. It contains a number of concrete recommendations for action, but these mostly pertain to the specific examples given. The intent is to generate discussion that will produce more general recommendations and actions. One of these might be to develop a more comprehensive survey of the collections extant in the FSU so that a rational plan of action could be developed.

Historical Background

The scientific heritage of those republics formerly comprising the Soviet Union is inextricably bound to the history of imperial Russia. For three centuries, Russia has in various times and to various degrees dominated its neighbors militarily, politically, and culturally. This historical period seems now to be drawing to a close, but it forms the background of the development of modern science in the region. And since modern science grows out of, and in a broad sense is a part of a people's culture, we must consider the development of the scientific heritage as a part of the cultural heritage.

One must first note that early Russian culture developed within the context of Eastern orthodoxy -- theological dogma maintained a strong hold over Russian intellectual life, and western scientific thought was condemned; "the discoveries of Copernicus, for example, were labelled.. 'satanical craft'..." (Vucinich 1956).

The emperor Peter I provided the catalyst to initiate change in the rigidly conservative culture of Russia. Having personally experienced western attitudes and accomplishments during his youthful years of travel in western Europe, Peter the Great planted western traditions and institutions in Russian ground. In 1724 he called for the establishment of a scientific forum in the western style, and the next year the Imperial Academy of Sciences was founded. Although his personal interest in western science was initially mainly utilitarian, he came to value basic scientific research. However, the new academy was established not simply as a scientific research institute but was also to organize Russia's system of secondary and higher education. Peter died that same year, and since Russia did not have her own scholars, its first members were recruited from western Europe by his successors, in particular by Elizabeth and the two Catherines (I and II). Among the most notable of these were the mathematicians Hermann Euler, the natural scientists Bernoulli and Bayer, and the philosopher Büllfinger.

For the first quarter century of its life, the Imperial Academy lacked a governing statute and was run directly from the imperial court. In 1747 it received from the empress Elizabeth a statute dividing it into the Academy proper and the university, and began to achieve a degree of stability.

The second half of the eighteenth century saw the members, although still predominantly western European in training, open their ranks to more native Russian scholars (Mikhail Lomonosov was named in 1841), including such eminent natural historians as Peter Pallas, who organized the first expeditions to study the geography, geology, biology, and ethnography of Siberia, which was now under Russian control.

In the early years of the nineteenth century the Academy began to show some changes. It gradually began to relinquish its educational responsibilities to the growing universities, and its monopoly on scientific research was broken by the establishment of independent learned societies such as the Moscow Society for the Study of Nature, founded in 1805. At the same time, the Academy established, under the statute of 1803, departments of history, economic and political science, and Oriental studies. This was followed by a third statute (1836) which explicitly

relieved the Academy of any educational duties and proclaimed it to be the "primary scientific body of the Russian empire." Shortly thereafter, it absorbed the Imperial Russian Academy founded by Catherine the Great in 1783, thus absorbing language and literature into its domain. For nearly a century thereafter, the academy had three principal divisions: physical-mathematical sciences; Russian language and literature; and historical and political sciences and philology.

Throughout the remainder of the nineteenth century and into the twentieth, the Russian Academy of Sciences functioned much as did similar academies in western countries. Ties with those institutions were strengthened, foreign scholars elected to membership, and Russian scientists regularly studied in western laboratories. Nevertheless, in contrast to the increasing democratization seen in the west, the Russian Academy worked within a strong autocracy.

During this period as well there were striking parallels between scientific developments in the United States and Russia that were driven by similar historical events. The nineteenth century colonization and conquest of the American West was a partial reflection of the earlier, but continuing colonization and conquest of Siberia, Middle Asia, and finally the Caucasus region. In the vanguard of both of these efforts was scientific exploration directed by the Russian Academy, and in the United States by a combination of military expeditions and the newly founded Smithsonian Institution. This was of obviously great importance in shaping the study of the natural sciences in both countries, both of which developed strong traditions in these areas of science.

An essential element of those traditions was the collection and preservation of object of the natural world--specimens of individual animals and plants; samples of rocks, soils, and water--that could later be examined, described and analyzed in museums, herbaria or botanical gardens, or laboratories of research institutes. These objects constituted the concrete foundation of those biological and geological sciences that are as much historical as experimental in their natures, and as such the specimens are both essential and irreplaceable. Museums and associated institutions in Russia were founded early (Peter the Great's Kunstkamera, for example), and developed steadily under both imperial and Soviet patronage.

These collections include scientific specimens, rare publications, unpublished or nontraditional scientific resources (e.g., maps, notebooks and diaries, photographs) collected from times and regions now recognized as critical to understanding present-day problems such as global change, biodiversity, and environmental perturbation. They now constitute an important part of the world's scientific patrimony, but the holdings generally have been unknown to the international community.

The first World War and its aftermath created a watershed in Russian science that was not initially apparent. For the first decade after the October 1917 revolution, the new authorities, while asking the academy to undertake a variety of practical investigations and creating a series of new commissions, did not directly interfere in most cases with the internal functioning of the academy, which continued to be administered under the terms of the statute of 1836. All that

changed in 1927, when a series of organizational changes effectively Sovietized, and Bolshevikized, the academy by 1929. In that year occurred the first mass purge of the academy, to be followed by many others. This story has been told well and in great detail by a series of authors. It should be noted, however, that the traditions of Russian science that had been growing and maturing in the two centuries since the Imperial Academy of Sciences was established provided a resilient framework which could in many cases absorb the distorting stresses placed upon it by the Communists. That these stresses did sometime produce a breakdown in important areas of science is widely recognized -- politicization of genetics under Stalin, through the influence of Prezent and Lysenko is a well known tale -- but similar fates were accorded to applied mathematics and statistics, ecology and conservation (Weiner, 1988), and virtually all of the social sciences. Although driven underground, these sciences survived in the form of private seminars and in samizdat, only gradually emerging after Stalin's death.

The scientific communities that we see today in the republics of the former Soviet Union exhibit a range of health. The basic physical sciences are intellectually strong, as are what may be called the "field sciences," those natural sciences that depend upon direct observations of nature, such as the many branches of biology, geology, and geography, as well as the museums and similar institutions preserving the voucher specimens that validate these sciences. Genetics, and with it molecular biology, have made a remarkable recovery from Lysenkoism. The social sciences as a group remain more problematic. However, the infrastructure of most of these sciences is seriously deficient. At present, lack of adequate equipment, including computers, imposes great limitations, but simple items such as high quality microscope slides, alcohol to preserve specimens, and even such common supplies as paper are in short supply or absent. Coupled with this is the problem that the organization and direction of scientific research in most academy institutes and universities remains essentially unchanged since the collapse of the Soviet Union and the dismantling of the Communist Party. The vast majority of scientists are constrained by the existing bureaucracy and organization to continue almost as though the party still controlled the academy. In addition, and in some respects most important, FSU scientists are among those segments of society that have suffered most from the economic breakdown that is occurring in Russia and its sister republics. Rapid inflation has eaten away most of the buying power of scientific salaries, to the point that the average scientist must spend much of his time searching for life's necessities, or else earning money outside of his scientific profession.

Given this scientific heritage and those factors, both historical and economic, that now control the behavior of scientist in the FSU, what does this suggest concerning possible approaches to alleviating the afflictions of science? The following broad generalities might be considered:

1. Support those sciences that have been traditionally strong.
2. Encourage greater democratization of the academy system.
3. Encourage greater diversification in active research by those institutions that have traditionally conceded that role to the academy, such as universities and other public or private organizations.
4. Encourage collaborative research between FSU and western scientists, in order to foster democratization and diversification.

Evolutionary and Environmental Biology

More specific actions must be tailored by specialists to meet the needs of their particular disciplines. We speak here only for evolutionary and environmental biology, and particularly those fields that depend upon scientific collections of specimens and associated data from nature.

The number of such specimens in museum, herbarium, and institute collections in Russia and other republics of the former Soviet Union numbers in the millions. Unfortunately, estimates of collection size are available for only a few of the major institutions (Table 1). The largest is the collections of the Zoological Museum of the Academy of Sciences, which houses some tens of millions of animals; the largest plant collection is at the Komarov Institute of Botany--both are in St. Petersburg. In Moscow, the Zoological Museum of Moscow State University, and the Main Botanical Garden of the Academy are much smaller, but nonetheless of great significance. Other collections of major regional significance are located in Siberia, in the Far East, and in the several republics.

Some of the scientific collections were initiated for specific regional issues, such as documenting the history or biota of a particular autonomous region. In most case, however, the scientific tradition represented by the various Academies of Sciences controlling these collections has meant that scientific collections in the FSU, regardless of age, size, or locality, are of high scientific value and comparable to modern collections elsewhere. Such a claim cannot be made, for example, for many regional collections in the U.S., where data standards are minimal or lacking, or specimen preparation, maintenance, and storage are inadequate. Some of the regional scientific collections in the FSU comprise holdings of specimens and early publications unduplicated anywhere else, including the larger collections in Moscow and St. Petersburg.

Until recently, these collections have been carefully conserved by dedicated curators and scientists. Dedication is the watchword here -- during World War II, some scientists in the Zoological Museum in Leningrad refused to be evacuated from the besieged city and remained to protect the collections from destruction, and the devotion of the staff of the Vavilov Institute to their unique seed collections is legendary. By Western standards, some curatorial practices appear suboptimal; cardboard boxes are used to house bird and mammal specimens, rather than dust- and insect-proof metal cases, for example. These reflect economic realities, however, rather than lack of expertise. Similarly, most collections are housed in old buildings (in Moscow and St. Petersburg, some are 18th century in age), where temperature and humidity controls cannot be brought up to Western standards.

Nevertheless, those who have worked with the collections know that they remain generally in good shape, with properly recorded associated data. The new problem facing the scientists is that the basic level of support formerly available for building maintenance, heating, and for

Table 1. Biological Collections in the Former Soviet Union

INSTITUTION	SPECIMEN TYPE	GEOGRAPHIC COVERAGE	TOTAL NO. SPECIMENS	RISK ASSESSMENT
Moscow				
Main Botanical Garden	Plants	FSU	350,000	High
Moscow State University Museums	All	FSU	3,000,000	High
Central Helminthological Museum	Parasites	World	145,000	Moderate
St. Petersburg				
Komarov Botanical Institute	Plants	FSU	5,700,000	High
Vavilov Institute of Cultivars	Plants	World	236,000	High
Zoological Institute	Animals	World	20,000,000	High
Other Major Collections				
Acad. Sci. Collections, Alma-Ata	All	Kazakhstan	550,000	High
Acad. Sci. Collections, Baku	All	Asia	1,500,000	Moderate
Acad. Sci. Collections, Dushanbe	All	Asia	400,000	?
Acad. Sci. Collections, Frunze	All	Asia	600,000	Moderate
Acad. Sci. Collections, Kiev	All	Ukraine	2,500,000	?
Acad. Sci. Collections, Tashkent	All	Central Asia	1,900,000	?
Acad. Sci. Collections, Tbilisi	All	Georgia	2,700,000	High
Acad. Sci. Collections, Yerevan	All	Armenia	800,000	High
Centr. Sib. Acad.Sci., Novosibirsk	All	Siberia	950,000	Moderate
Inst. Biol. Prob. North, Magadan	All	Far East	650,000	High
Rostov-On-Don State Univ.	All	Volga	1,300,000	High
Tomsk Univ., Tomsk	All	Siberia	1,800,000	High
Other Collections				
Various localities	All	FSU	3,500,000	Mod - High
Total	All	World	45,000,000	Mod - High

essential preservatives such as alcohol, is no longer there. Temperature in buildings sometimes falls to 10° C or below, and some fluid-preserved specimens are slowly drying up, due to lack of sufficient funds. Important field research sites and scientific preserves (zapovednik) no longer can maintain staffs to patrol their territories, and poaching has become a very serious problem in many.

To address the most serious problems in this discipline; the following steps might be considered:

1. Identify those scientific collections of objects and data (including libraries) that are of international importance.
2. Establish small (2-4) teams of disciplinary specialists to visit those collections, to assess their current condition and urgent needs.
3. Prioritize, by importance and need, those institutions which should receive emergency assistance (funding, expertise).
4. Determine the safest and most efficient means of delivering the assistance, and ensuring that needed repairs, supplies, etc. are obtained.
5. Prepare for international publication descriptions and summaries of the prioritized institution collections, listing the scope and extent of the holdings, and the basis for status as international resources.
6. Support computerization of holdings and creation of accessible databases.

Parasitology

This discipline holds a unique and central position among the zoological sciences of the FSU. Contrary to what is regarded as a minor role in North America, parasitology in Russia has represented a far-reaching scientific discipline that has been the focus of intensive research, particularly over the past 70 years. The founder of contemporary Russian parasitology was K.I. Skrjabin, who was responsible for the emergence and diversification of helminthology and was the driving force that influenced the direction and stability of this science in the Soviet Union (Petrov et al. 1953; Ryzhikov et al. 1978). The contributions by Skrjabin were significant, resulting in the training of a substantial number of Soviet helminthologists (in excess of 500 scientists by Skrjabin alone), the organization of research centers, and the publication of an array of seminal monographs in helminth systematics. These latter have proven to be requisite for modern parasitological research, having no published counterparts in the western literature.

Initiated in the period 1920-1922, the Helminthological Department of the All Union Institute of Experimental Veterinary Science was to become in 1932 the All Union K.I. Skrjabin Institute of Helminthology (VGIS) in Moscow, the current site of the Central Helminthological Museum. Later in 1942, the Helminthological Laboratory of the USSR Academy of Sciences was founded. These institutions along with laboratories in Vladivostok, Kiev, St. Petersburg and elsewhere serve as repositories for some of the most diverse and irreplaceable helminth collections in the world, along with important research libraries and archives.

The formation of these institutes marked the beginning of full integration of parasitology and helminthology as a primary direction for research among many sections of the USSR Academy of Sciences and their affiliates scattered throughout the Soviet Republics. Coincidental with the earliest organization of these institutes, a series of All Union Helminthological Expeditions (now in excess of 350) were initiated in 1921. These resulted in the rapid and comprehensive elucidation of the helminthofauna of terrestrial, aquatic and marine vertebrates (and invertebrates) of the FSU by specifically trained teams, often under the guidance of Skrjabin. The All Union Expeditions fostered field collections across representative habitats and landforms of the FSU and were instrumental in the training of almost every major contemporary Russian helminthologist. The legacy of these synoptic explorations resides in an extensive and irreplaceable data base on the morphology, taxonomy, evolution and distribution of helminths not only within the borders of the FSU but of worldwide scope (Table 1). As a consequence, the helminth faunas among vertebrate hosts in the FSU are better understood than in any other comparable region of the world. Collections represent a source of unrivaled biogeographic, systematic and ecological information for hosts and parasites, and requisite components of any biodiversity research program.

Oceanography⁷

In the field of oceanography, according to NOAA, large quantities of irreplaceable data that are of great potential value to the world's scientists are in danger of being lost forever. For example, NOAA estimates that the volumes of bathythermographs and hydrocasts held by the Russian National Oceanographic Data Center are 30% and 50%, respectively, of the corresponding holdings in the U.S. These data frequently supplement U.S. holdings, since they are from areas where the U.S. has not collected data (e.g., water column data from FSU peripheral seas, the Arctic Ocean, the Indian Ocean, and the Southern Hemisphere. The data are considered to be of good quality, and to form the basis for fruitful collaborations between U.S. and Russian scientists. Table 2 reproduces a summary of oceanographic holdings in the FSU that was prepared by NOAA.

NOAA has developed a plan for a collaborative program with institutions of the FSU. The plan would:

1. Digitize large quantities of manuscript and atlas data into common formats;
2. Perform data continuity analyses;
3. Merge U.S. and FSU data to create a global database available without restriction to the international scientific community;
4. Reanalyze the merged database and recompute ocean climatologies.

The program would be carried out through one-to-one pairings of U.S. government organizations and FSU counterparts; the FSU organizations selected are the Russian National Oceanographic Data Center at Oboresk (physical oceanographic data), the Geological Institute of the Academy of Sciences in Moscow (bathymetric data), and the Arctic/Antarctic Research Institute in St.

⁷Based on material provided by NOAA.

Table 2. Estimated Oceanographic Data Holdings in the Former Soviet Union

INSTITUTE	DATA TYPE/ TIME COVERAGE	AREA OF COVERAGE	DATA VOLUME	ESTIMATED RISK LEVEL
Physical Oceanographic Data				
Russian NODC Obninsk	Hydrocasts (1900-1990)	Global	220,000 digitized	High to very high
	MBTs (1946-1991)	Global	260,000 undigitized 180,000 digitized 160,000 undigitized	
Murmansk Marine Biological Institute	Hydrocasts	Baltic, North Atlantic north of England	100,000 undigitized	High
Navy Ministry, St. Petersburg	MBTs (1940-1991)	Global	150,000 digitized 200,000 undigitized	Unknown
Arctic and Antarctic Research Institute, Vladivostok and Murmansk	Hydrocasts	Polar Regions, Sea of Okhotsk, Bering Sea	5,000 undigitized	Moderate
Fisheries Ministry, Vladivostok	Hydrocasts	North Pacific, Sea of Japan, Yellow Sea	100,000 undigitized	High
	MBTs (1946-1991)		50,000 undigitized	
Riga Institute National Academy of Science, Latvia	Hydrocasts	Global	140,000 undigitized	Moderate
Bathymetric Data				
VNII Okeanologiya, St. Petersburg	Single Beam Echosounder (1946-1989)	High Arctic	100,000 analog records 15,000 analog stations	High
	Multibeam echosounder (1986-1991)	North Atlantic	Unknown	High
Geologic Institute, Academy of Science, Moscow	Single beam echosounder (1946-1989)	Global, except high arctic	2 million miles analog tracklines	High
	Multibeam echosounder (1986-1991)	Global, except high arctic	20 million digital records Unknown analog records	Very high
Sea Ice Data				
Arctic and Antarctic Research Institute, Vladivostok and Murmansk	Sea ice analysis charts (1990-1991)	Polar regions	Unknown	Unknown

Petersburg (sea ice data). This program does not directly involve U.S. university researchers and may leave out Russian scientists who are not affiliated with the selected Russian organizations. Thus there may remain a significant role for private sector activity in the field of oceanographic data and research.

Seismology⁸

The FSU's collections of seismic data are also at risk. According to IRIS, seismic stations that have recorded data for decades are being shut down and archives of data will soon be destroyed. Not only would this mean the loss of data important for developing scientific for understanding earthquake propagation, it would result in inability of the former Soviet republics to monitor seismicity and to carry out coherent programs of earthquake hazard assessment. Furthermore, the station shutdowns threaten loss of coverage over a significant portion of the earth's surface, a development that would be disastrous for global seismology should it occur.

The problem in seismology has a particular geographic twist, since two of the most important threatened observing stations are in Kazakhstan and Tajikistan. In most other sciences, the key people and facilities are in Russia.

IRIS identifies three action items:

1. Maintain the infrastructure for seismological observations and research; rescue the data from threatened observing stations and ensure the survival of the "national" seismic network.
2. Coordinate and provide facilities for joint research projects (IRIS could provide the necessary facilities base for such a program).
3. Support key CIS scientists and key research programs, particularly those involving younger scientists who have not yet achieved international recognition.

The assessment of the problem with seismological data, the diagnosis of the problem, and the specific actions that would be appropriate may be a subject for further elaboration.

⁸Based on information provided by IRIS.

Glaciology⁹

The World Data Center A for Glaciology (WDC-A)¹⁰ has identified a number of targets for the rescue of environmental data. Snow cover data from 38 regions of the FSU are available in Obrinsk in rare hard copy reports from the 1930s to 1965 and in monthly publications since then. Besides snow cover data, the tabulations include data on depth, thickness of crust, snow water equivalent, snow topography, and snow type, as well as other atmospheric and surface data. These hardcopy records are rare and would provide validation of passive microwave observations. Digitization is needed.

A second data set consists of 69 published volumes inventorying 14 percent of the world's glaciers. These data are needed to complement and interpret available FSU data on glacier fluctuations, a key variable in the IPCC 90 and 92 reports. WDC-A also proposes to provide support for digitization of data from the Soviet North Pole manned stations on ice floes. A final effort involves the digitization of records from the Institute of Arctic and Antarctic Research in St. Petersburg, which includes sea ice data for the Eurasian Arctic and tables of surface and air reconnaissance of ice and snow conditions in the Arctic and Antarctic. These data are important to understanding the flows of polar sea ice.

In the non-Russian states, the Central Asian Regional Research Hydrometeorological Institute (SANIGMI) in Tashkent has extensive holdings on snow cover, avalanches, glaciers, and runoff in the mountains of Central Asia. They have maintained a glacier research station at 4000m on the Abramov Glacier in the Pamir-Altai Mountains since 1969. Extensive data sets exist at SANIGMI as a result of these activities. In addition, the other Asiatic republics (Kazakhstan, Kyrgyzstan, Tajikistan) have archived data at SANIGMI. There is concern now, however, that these states may discontinue archiving their data at SANIGMI and may even recall those which are there now.

Other Data Sets

The oceanographic, seismographic, and glaciological data sets briefly described here are merely examples, albeit important ones, of a wealth of data that is at risk in the former Soviet Union. These data are of great potential importance to scientific investigations throughout the world. Some previously unavailable data are now becoming open to scientists. Cataloguing the

⁹Based on information provided by the World Data Center A for Glaciology [Snow and Ice].

¹⁰The twelve World Data Centers (WDC's) of the International Council of Scientific Unions are a valuable source of scientific contacts between the United States and Russia. These centers have extensive experience, both in the past and in the present, in the exchange of geophysical and environmental data and scientific personnel between the United States and Russia, where companion World Data Centers are located. In some cases the contacts and exchanges date back to 1957 when the WDC system was founded to support data management activities of the International Geophysical Year. The scientific disciplines represented by the centers include oceanography, meteorology, glaciology, paleoclimatology, solar-terrestrial physics, marine geology and geophysics, rotation of the earth, rockets and satellites, solid earth geophysics, seismology, atmospheric trace gases, and remotely sensed land data. The U.S. National Academy of Sciences provides oversight of the WDC-A data centers through the Committee on Geophysical and Environmental Data. The Executive Secretary of the committee is Dr. Lorraine Wolfe (202-334-3368).

information and taking steps to rescue imperiled data sets are activities surely in the interests of the world's scientific communities and, ultimately, its peoples.

Mathematics¹¹

Mathematics presents a unique situation. Russian mathematicians, despite occasional opposition by the political authorities and central scientific organizations, have developed one of the world's most successful systems of mathematics education. The system is an orally transmitted cultural tradition, and its survival depends on the survival and continued activity of those who understand and practice it. According to the American Mathematical Society, the system includes the following components:

1. A pyramid of mathematical Olympiads for high school students, formerly culminating in the all-Union Olympiad.
2. "Mathematical Circles," held outside school hours under the guidance of research mathematicians, where high school students learn to solve problems.
3. Special high schools for mathematics and physics staffed by research mathematicians and university students as well as high school teachers.
4. A series of books, and the journal Quant, for high school students, written by research mathematicians.
5. A particular style of mathematical seminars at universities which mixes undergraduate teaching with research exposition in a unique way.

The organizations that developed this approach did so under adverse circumstances, without official support. They survived and even prospered in these circumstances, perhaps because the adverse conditions afforded them the aura and spirit akin to that of samizdat. In the process, they developed an independent, intellectually pure style.

Now, however, they are in danger, because their authors and practitioners are suffering the same deprivations as are other Russian scientists. Their disappearance would be a serious blow to world science. It would mean the loss of future top mathematicians, since the Russian system has produced a large number of such people. We would lose a source of important ideas for our own educational system. Finally, the Russian system produces an approach to mathematics whose practitioners are a source of mathematical ideas for the entire world.

Some aid programs have been launched in this area. The German Volkswagen Stiftung has started a program to help save the university seminars. The Mathematical Association of America is working to provide back issues of Quant for high school students. The AMS is providing support to individual research mathematicians through grants. But these programs are directed at individual segments of the Russian mathematics education system; a more systematic, holistic approach is thought to be needed.

¹¹Based on information provided by the American Mathematical Society.

The AMS makes the following recommendations for action in this matter:

1. Provide direct support for the mathematics Olympiads.
2. Provide modest pay for high school teachers who teach the "mathematical circles" and for university students who volunteer to teach in mathematical high schools.
3. Provide support for existing seminars for teachers.
4. Provide funds to support publication of mathematical books and journals.
5. Give direct support to mathematical researchers and University seminars.

In providing aid to Russian mathematics, the AMS makes several procedural recommendations,

1. Avoid using institutions that previously hindered the development of the instruction system to administer the funds.
2. Take steps to insure that aid provided to mathematics teachers does not cause resentment among teachers not so favored. Payment on an "overtime" basis for special work will alleviate this problem.
3. Do not attempt to interject American educational ideas into the program.

Conclusion

As used in this paper, the scientific heritage of the FSU refers to the collections of physical specimens -- plant and animal -- and of data from many fields of science, as well as to certain unique pedagogical techniques that have been developed over decades of experience. The paper does not cover the most important part of the heritage -- the talented and skilled scientists and engineers who live and work in the FSU. However, the collections and the techniques that are the focus of attention here represent a heritage of incalculable value to the world scientific community. Rescuing them from what seems to be almost certain serious damage or even total loss should be a matter of the highest priority.

Citations:

Vucinich, A. 1956. The Soviet Academy of Sciences. Hoover Institution Studies, Ser. E: Institutions, No. 3. Stanford University Press, Stanford, California, vi+157 pp.

Weiner, D. R.. 1988. Models of Nature. Ecology, conservation and cultural revolution in Soviet Russia. Indiana University Press, Bloomington, Indiana, xiv+312 pp.

SUSTAINING EXCELLENCE IN SCIENCE AND ENGINEERING IN THE FORMER SOVIET UNION

February 8-9, 1993

List of Participants

William G. Aldridge, National Science Teachers Association
Jens Ulrik Andersen, Danish Natural Science Research Council
Michael Artin, Massachusetts Institute of Technology
William Bader, The Eurasia Foundation
Harley Balzer, Georgetown University
Alison Barkley, U.S. Department of State
Robert Beckman, Agency for International Development
Alexandra Belyaeva, Russian Academy of Sciences
William A. Blanpied, National Science Foundation
John Boright, U.S. Department of State
Felix E. Browder, Rutgers University
John T. Bruer, James S. McDonnell Foundation
Joan Buchanan, American Psychological Association
Sandra Burns, American Association for the Advancement of Science
Cathleen Campbell, U.S. Department of State
Norval Carey, General Atomics
Peter Carter, British Cabinet Office
Jane Cave, American Association for the Advancement of Science
Charles Chambers, American Institute of Biological Sciences
Purnell W. Choppin, Howard Hughes Medical Institute
E. William Colglazier, National Research Council
Khadisha Dairova, Embassy of Kazakhstan
John A. Daly, Agency for International Development
Gerald P. Dinneen, National Academy of Engineering
Paul Doty, Harvard University
William Duax, American Crystallographic Society
Irving Engelson, Institute of Electrical and Electronics Engineers, Inc.
Robert Etkins, National Oceanic and Atmospheric Administration
Gilbert Fayl, Delegation of the Commission of European Communities
Nina Fedoroff, Carnegie Institution of Washington
Herman Feshbach, Massachusetts Institute of Technology
Martin Frank, American Physiological Society
John Gage, Sun Microsystems
George Gamota, The MITRE Corporation
Terry Garrett, The Royal Society
Paul Gassman, University of Minnesota
Richard W. Getzinger, American Association for the Advancement of Science
Timothy Goggins, American Mathematical Society
Alexander Goldfarb, International Science Foundation for the Former Soviet Union

Steven Goldstein, National Science Foundation
 Jay Goodman, National Aeronautics and Space Administration
 Kenneth F. Gordon, National Institute of Standards and Technology
 Richard Grant, Boeing Defense & Space Group
 Norman Hackerman, The Robert A. Welch Foundation
 Robert Hall, Sun Microsystems
 Amy Halsted, American Physical Society
 Reno Harnish, U.S. Department of State
 Brenda Heaster, U.S. Department of State
 L. Louis Hegedus, W.R. Grace & Co.
 Ernest Henley, University of Washington
 Peter Henry, U.S. Department of Health and Human Services
 James Henson, Washington State University
 Andrzej Herczynski, American Institute of Physics
 Maurice Hilleman, Merck Institute for Therapeutic Research
 Robert Hoffman, Smithsonian Institution
 Marjorie Holland, Ecological Society of America
 Allen Holt, National Institutes of Health
 Jo Husbands, National Research Council
 Natalya Ivanova, Russian Academy of Sciences
 Harold Jaffe, U.S. Department of Energy
 Stanley R. Johnson, Iowa State University
 Mary Ann Kibarian, Embassy of Armenia
 Galina Kitova, Russian Academy of Sciences
 Steven Kohl, U.S. Fish and Wildlife Service
 Masayuki Kondo, The World Bank
 Nicholas Kyriakopoulos, George Washington University
 Martin Lacis, Embassy of Latvia
 Donald N. Langenberg, University of Maryland System
 Hiram Larew, Agency for International Development
 Charles F. Larson, Industrial Research Institute
 John Lavery, National Research Council
 Joshua Lederberg, Rockefeller University
 Elisabeth Legrand, Ministere de Recherche et de la Technologie
 Irving Lerch, American Physical Society
 Sydney Levitus, National Oceanic and Atmospheric Administration
 Alan MacDonald, American Academy of Arts and Sciences
 Robert MacPherson, Massachusetts Institute of Technology
 John Malin, American Chemical Society
 Leonid Margolis, Moscow State University
 Lisa Martin, U.S. Geological Survey
 Luigi Massimo, Commission of the European Communities
 Daniel Matuszewski, International Research and Exchange Board
 George Metakides, Commission of the European Communities
 Don Miller, National Aeronautics and Space Administration

John H. Moore, George Mason University
 Lev Mukhin, Embassy of the Russian Federation
 Terry Myers, Agency for International Development
 John O'Neil, Office of Science and Technology Policy
 Roza Otunbayeva, Embassy of Kyrgyzstan
 Joseph G. Perpich, Howard Hughes Medical Institute
 Edmond Pope, Office of Naval Research
 Frank Press, National Academy of Sciences
 Michael Quear, U.S. House Committee on Science, Space and Technology
 J. Thomas Ratchford, Office of Science and Technology Policy
 Peter Raven, Missouri Botanical Garden
 Andrew Reynolds, U.S. Department of State
 Robert A. Schadler, U.S. Department of State
 Doris Schenk, Deutsche Forschungsgemeinschaft
 John F. Schumacher, National Aeronautics and Space Administration
 Jeff Schweitzer, Office of Science and Technology Policy
 Gerson Sher, National Science Foundation
 Atsuo Shibota, Embassy of Japan
 Anatoly Shurygin, Embassy of Russia
 Douglas Siegel-Causey, University of Kansas
 Brian Silver, Michigan State University
 David W. Simpson, The IRIS Consortium
 Benjamin B. Snively, American Institute of Physics
 George Soros, International Science Foundation for the Former Soviet Union
 Valery N. Soyfer, George Mason University
 Alexander Spirin, Russian Academy of Sciences
 Alexandra Stepanian, National Institutes of Health
 Paul Stern, National Research Council
 Guyford Stever, Carnegie Commission on Science, Technology and Government
 Michael Teitelbaum, Alfred P. Sloan Foundation
 John Thomas, Defense Technology Security Administration
 Bonnie Thompson, National Science Foundation
 Harry Tollerton, American Association of Engineering Societies
 Cassandra Turczak, National Science Foundation
 Tania Vitvitsky, Sabre Foundation
 Yaroslav Voitko, Embassy of Ukraine
 Michael Voloshin, University of Minnesota
 Nikolai Vorontsov, Russian Academy of Natural Sciences
 Peter Walsh, Kiser Research Inc.
 Gary Waxmonsky, National Research Council
 Albert R.C. Westwood, Martin Marietta Corporation
 William Wing, Agency for International Development
 Suzanne Woolsey, National Research Council
 Stan Woosley, University of California, Santa Cruz
 Salvatore Zecchini, OECD - Center for Cooperation with European Economies in Transition

Staff

NAS/NRC

Inta Brikovskis, Office for Central Europe and Eurasia
Elisa Chait, Office for Central Europe and Eurasia
Stephen Deets, Office for Central Europe and Eurasia
John Modzelewski, Office for Central Europe and Eurasia
Kelly Robbins, Office for Central Europe and Eurasia
Inga Sedlovsky, Office for Central Europe and Eurasia

George Mason University

Marissa Meskunas, International Institute

NATIONAL ACADEMY PRESS

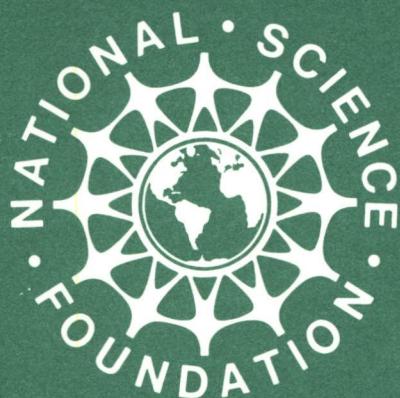
The National Academy Press was created by the National Academy of Sciences to publish the reports issued by the Academy and by the National Academy of Engineering, the Institute of Medicine, and the National Research Council, all operating under the charter granted to the National Academy of Sciences by the Congress of the United States.

U.S.-U.S.S.R. COOPERATION IN THE FIELD OF BASIC SCIENTIFIC RESEARCH

Program Announcement

DIRECTORATE FOR SCIENTIFIC, TECHNOLOGICAL,
AND INTERNATIONAL AFFAIRS

DIVISION OF INTERNATIONAL PROGRAMS



NATIONAL SCIENCE FOUNDATION
Washington, D.C. 20550

The National Science Foundation (NSF) provides awards for research in the sciences and engineering. The awardee is wholly responsible for the conduct of such research and preparation of the results for publication. The Foundation, therefore, does not assume responsibility for such findings or their interpretation.

Facilitation Awards for Handicapped Scientists and Engineers (FAH) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on an NSF project. See the FAH program announcement, or contact the FAH Coordinator in the Directorate for Scientific, Technological, and International Affairs, phone (202) 357-7456 (NSF Publication 84-62, rev. 5/87).

In accordance with Federal statutes and regulations and NSF policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, denied the benefits, or be subject to discrimination under any program or activity receiving financial assistance from the National Science Foundation.

The National Science Foundation has TDD (Telephonic Device for the Deaf) capability, which enables individuals with hearing impairment to communicate with the Division of Personnel and Management about NSF programs, employment, or general information. This number is (202) 357-7492.

This program is described in the Catalog of Federal Domestic Assistance category 47.053, Scientific, Technological, and International Affairs.

TABLE OF CONTENTS

Background	1
Objectives	1
Scope and Eligibility	1
Scientific Scope	1
Types of Activity	2
Key Features of the Program	2
Proposal Review and Selection	2
Proposal Preparation and Guidelines	2
Joint Research Projects	2
Joint Seminars and Workshops	3
Individual Scientific Visits	3
Proposal Submission and Processing	4
Grant Administration	4
Reporting	4
Publications and Intellectual Property	4
Other Considerations	4
Additional Information	5
Appendix I: Lodging and Subsistence Allowances for U.S. and Soviet Participants	7
Appendix II: Proposal Information Page	9
Appendix III: Illustrative Target/Deadline Dates	11
Other Programs of Interest	12

BACKGROUND

The National Science Foundation encourages and supports U.S. participation in international science and engineering programs and activities that promise to benefit the U.S. research effort. Its program for U.S.-U.S.S.R. Cooperation in the Field of Basic Scientific Research (hereafter "the Program") was established by the Memorandum of Understanding between the National Science Foundation and the Academy of Sciences of the U.S.S.R. on Cooperation in the Field of Basic Scientific Research, signed May 6, 1989. The Memorandum of Understanding is subject, in turn, to the general provisions of the Agreement Between the Government of the United States of America and the Government of the Union of Soviet Socialist Republics on Cooperation in the Field of Basic Scientific Research signed January 8, 1989.

OBJECTIVES

Through the program the NSF seeks to contribute to the advancement of scientific knowledge by combining the complementary efforts and capabilities of leading researchers of the United States and the Soviet Union in the area of basic scientific research on the basis of equality, reciprocity, and mutuality of benefit. It promotes this objective through support of long-term cooperative research projects between scientists and scientific institutions of the two countries. The program complements other opportunities for cooperation between American and Soviet scientists.

SCOPE AND ELIGIBILITY

1. **Scientific Scope.** *Only proposals which are in areas and topics of basic scientific research mutually agreed to by the NSF and the Soviet Academy of Sciences are eligible for support. The current list of approved areas and topics, extracted from Annex II of the May 6, 1989 Memorandum of Understanding, is included below:*

Mathematics

- Complex analysis
- Geometry (differential, algebraic, and topology)
- String theory
- Differential equations
- Algebraic structures
- Representation theory
- Control theory
- Dynamical systems
- Algebra
- Mathematical physics

Theoretical Physics

- Theoretical nuclear physics
- Relativistic astrophysics

- Mathematical physics
- Theoretical atomic, molecular, optical, and plasma physics
- Cosmic ray physics
- Condensed matter theory
- Cosmology

Scientific Problems of the Arctic and the North

- Global biogeochemical cycles
- Permafrost studies related to world climate change
- Studies of the magnetospheric cusp

Geosciences

- Global change
- Global biogeochemical cycles
- Regional geology, stratigraphy, and tectonics
- Paleontology and geochronology
- Magmatic and metamorphic processes
- Volcanoes and volcanic processes
- Paleoclimate and climate change
- Surficial processes and geomorphology
- Continental lithospheric seismology, geophysics, and geochemistry
- Seismic risk and earthquake prediction
- Continental scientific drilling
- Physical and chemical properties of the earth's interior
- Upper mantle studies

Chemistry

- Molecular environmental catalysis
- Bioelectrochemistry of membranes

Life Sciences

- Plant biology (flowering research)
- Cell biology
- General and cellular physiology
- Biodiversity
- Ecology
- Protein polymorphisms and other molecular-genetic markers in domesticated plants and animals
- Developmental biology
- Neurochemistry

Engineering Sciences

- Thermal engineering (heat and mass transfer)

2. Types of Activity

Three types of activities are supported:

- **Joint Research Projects** of up to three years' duration. This is the primary mode of program activity.
- **Joint Seminars and Workshops** involving 5-10 researchers from each country, for the purpose of identifying joint scientific priorities in areas of special interest and developing concrete proposals for joint research projects for subsequent competitive review.
- **Individual Scientific Visits** for the purpose of developing concrete proposals for joint research projects for subsequent competitive review in areas of special interest. (Note: As a rule the Foundation supports such visits only under exceptional circumstances.)

Proposals for support of travel to, or participation in, international scientific meetings are not eligible for consideration through this program. Individuals requiring such travel support may wish to contact the relevant disciplinary programs of NSF to inquire about the availability of funding.

Eligibility of applicants follows normal NSF policy, described in *Grants for Research and Education in Science and Engineering* (GRESE), NSF 83-57 rev. March 1989 (or subsequent editions).

The Foundation welcomes proposals from all qualified scientists and engineers and strongly encourages women, minorities, and persons with disabilities to compete fully in any of the research and research-related programs described in this document.

KEY FEATURES OF THE PROGRAM

All proposals must be based on direct cooperation between U.S. and Soviet scientists who wish to work together in a project of common scientific interest. Plans for all joint activities are developed *directly* between the U.S. and Soviet principal investigators, who submit their proposals in parallel to the NSF and the U.S.S.R. Academy of Sciences. Proposals are evaluated independently by the U.S. and Soviet sides and require joint approval to be included under the program.

The program requires that each side share in the cost and effort of each project. Although a precise matching of funds, personnel, facilities, or time spent in each country by scientists of the other is not required in each project, each project should result in the achievement of substantial mutual benefit.

The program is intended to cover those incremental costs that are incurred directly as a result of the international collaboration, primarily for the transportation and subsistence of participants in each country, expendable materials and supplies, publication charges, etc. Proposals may be linked to ongoing or proposed sources of funding for domestic "core research" support.

The financial arrangements for support of visiting scientists under this program are based on the "receiving-side pays" principle. This means that each country assumes responsibility for the necessary expenses of scientists from the other country when visiting its territory under the program. The levels of support agreed to by the NSF and the U.S.S.R. Academy of Sciences are provided in Appendix I.

International cooperation supported under this program is bilateral in nature, i.e., involving primarily U.S. and Soviet scientists. However, with adequate justification individual scientists or scientific institutions from third countries or international organizations may be invited to take part in a program activity. Normally the cost of such participation is borne entirely by the third party.

PROPOSAL REVIEW AND SELECTION

Proposals will be reviewed on the U.S. side in accordance with established Foundation procedures and the general merit review criteria described in GRESE.

In addition, all proposals will be evaluated on the U.S. side with reference to the prospective scientific benefit from the proposed international cooperation.

In accordance with U.S. Government policy, proposals submitted to the NSF will also be subject to internal U.S. Government review for potential national security concerns, in particular to ensure that supported U.S.-Soviet cooperative activities are consistent with U.S. laws and regulations concerning export of controlled technology or technical data.

Evaluation procedures and criteria of counterpart proposals on the Soviet side may be different from those of the NSF.

Joint approval of the NSF and the U.S.S.R. Academy of Sciences is required for any proposal to be funded.

PROPOSAL PREPARATION GUIDELINES

Proposals should be prepared and submitted in accordance with the guidelines provided in GRESE.

Each proposal must also contain a Proposal Information Page (Appendix II) to be inserted directly behind the NSF Cover Sheet. (For further information about this form, see "Proposal Submission and Processing," below.) In addition, it must follow the specific guidelines described below:

I. Joint Research Projects

Proposals for joint research projects must be submitted in parallel by the U.S. and Soviet principal investigators to the NSF and the U.S.S.R. Academy of Sciences. In addition to the requirements described in GRESE, each proposal must contain a section entitled "International Considerations" that explicitly addresses the following issues:

- *Objectives and benefits of the international cooperation.* Why is the research being carried out in a cooperative mode, and what scientific benefits can each side expect to derive from the cooperation?
- *Methodology and work plan.* How is the international cooperation to be carried out? This section should include a description of the division of labor and a schedule of planned travel in each direction (approximate date and duration).
- *Qualifications of U.S. and Soviet investigators.* What is the unique "fit" of their training, experience, or ap-

proaches that makes the cooperation scientifically attractive? Vitae of the Soviet principal investigator and other major Soviet participants must be included.

- *Facilities.* What are the scientific advantages of combining these resources? All items of major equipment that will be utilized in the course of the research must be identified. If an instrument is to be used only by scientists of one country, please so indicate.

The proposed starting date for a joint research project should be not earlier than nine months from the date of submission.

Allowable Costs

The following expenses are typical of joint research projects and may be included in the cost estimate. Eligibility of other project-related costs should be discussed with the appropriate NSF disciplinary program.

1. International transportation of U.S. participants.
2. Expenses in the United States for Soviet participants, as follows:
 - Lodging, subsistence, and health insurance according to the provisions of Appendix I.
 - Direct, round-trip transportation of the Soviet scientist from point of entry into the U.S. (New York or Washington) to the principal research site, as necessary.*
 - Transportation within the United States for Soviet participants for travel directly related to the project.

The Foundation considers the above expenses to be Participant Support Costs and thus not subject to indirect cost.

3. Cost of communication, materials, supplies, and publication.

II. Joint Seminars and Workshops

Small bilateral joint seminars or workshops consisting of 5-10 scientists from each country may be supported in order to identify joint scientific priorities in areas of special interest. These activities, normally three to five days in duration, should be research-oriented and normally focused on a single main topic. Format may vary on subject and location, but prepared papers should typically serve as the basis for discussion. The main objective of this activity is to allow scientists from both countries to identify potential research partnerships and, ideally, to begin preparation of proposals for long-term joint research projects; the agenda should be designed accordingly. Normally the program will support only one workshop on a given topic; reciprocal workshops are discouraged. U.S. participants should represent a range of U.S. research institutions; participation by younger investigators is strongly encouraged.

*NSF prefers that the sending side cover the full cost of transportation to the principal site of research, including connecting flights between port of entry and final destination. Where necessary and with justification, NSF will consider covering the cost of internal connecting flights.

Seminars or workshops must be jointly organized with a Soviet co-organizer. Proposals must contain information on the importance of the meeting topic for its research field and the justification for holding the seminar in a bilateral U.S.-Soviet framework. The proposal must contain a detailed agenda, including complete information about the proposed site and date of the meeting as well as other organizational arrangements (such as related site visits), and a full list of anticipated participants (both U.S. and Soviet as well as third-country, if any), listing areas of individual expertise and biographic information. The proposal should also include a plan for disseminating the information resulting from the meeting. Seminars should be scheduled to take place no earlier than nine months from the time of proposal submission.

Allowable Costs

1. For seminars held in the United States:

- Lodging, subsistence, and health insurance for up to 10 Soviet participants according to the provisions of Appendix I.
- Internal transportation in the United States for up to 10 Soviet participants, including round-trip transportation from point of entry to meeting site, as necessary.
-
- Transportation and per diem (at standard U.S. Government rates) for up to 10 U.S. participants.
- Cost of publishing seminar proceedings of up to \$2,000.
- Organizational expenses for the U.S. coordinator of up to \$1,000.
- An administrative allowance to the institution of \$250 in lieu of indirect costs.

2. For seminars held in the Soviet Union:

- International transportation (APEX) for up to 10 U.S. participants.
- Cost of publishing seminar proceedings of up to \$2,000.
- Organizational expenses for the U.S. coordinator of up to \$250.
- An administrative allowance of \$250 to the institution in lieu of indirect costs.

III. Individual Scientific Visits

Individual visits by scientists of one country to the other, normally for a period of two weeks, for the purpose of developing concrete proposals for long-term joint research projects can be sponsored by the program. However, the Foundation will consider requests for support of such visits through the program only in exceptional cases. Normally the Foundation will consider such requests only where there is strong evidence that (1) the research promises to be of high mutual interest and benefit and the investigators' qualifications are very strong, (2) a proposal for long-term joint research cannot be prepared without

first-hand contact, and (3) other opportunities for such contact have been exhausted.

Applications for individual scientific visits under the program are made by U.S. scientists directly to the NSF, rather than through their institutions, in the form of a letter-proposal. Awards for such visits are made in the form of individual travel grants. Three copies of the application should be submitted. The application should: describe the objectives of the proposed visit and of the envisioned long-term collaboration; identify the Soviet counterpart scientist and institution and the length and date of the proposed visit; describe the benefits to be obtained from the collaboration and the pressing circumstances requiring this mode of support; present evidence of concurrence on the Soviet side (prior correspondence) and of attempts to obtain support for the visit from other sources; and include biographic and bibliographic information about the applicant. Such letter-proposals should be submitted to NSF no less than six months in advance of the proposed visit.

PROPOSAL SUBMISSION AND PROCESSING

Twenty-five copies of each proposal for joint research or a seminar or workshop submitted under this program, including one copy bearing original signatures, should be mailed to:

Proposal Processing Unit - Room 223
Attention: U.S.-U.S.S.R. Cooperative
Science Program
National Science Foundation
Washington, D.C. 20550

Only one (1) copy of NSF Form 1225, Information about Principal Investigator/Project Director, should be sent, attached to the original signed proposal.

Proposals for developmental activities (workshops and individual visits) may be submitted at any time of the year. Because proposals for joint research projects will be evaluated through the merit review process of the individual NSF discipline-oriented programs, investigators are advised to consult the appropriate discipline-oriented programs concerning applicable deadlines or target dates.

Proposals for cooperative research should identify, on the "Proposal Information Page" (Appendix II), the NSF discipline-oriented division that covers the field of the proposed research. In the event of any uncertainty as to which division to list on this form, consultation with the U.S.-U.S.S.R. program staff or the staff of the discipline-oriented program(s) is strongly encouraged.

As a convenience the names and proposal deadlines of several relevant NSF discipline-oriented divisions are listed in Appendix III; these, however, are subject to change and may not represent all NSF discipline-oriented divisions whose fields are covered in this cooperative program.

GRANT ADMINISTRATION

Grants awarded as a result of this announcement are administered in accordance with the terms and conditions of NSF GC-1, "Grant General Conditions," or FDP-II, "Federal Demonstration Project General Terms and Conditions," depending on the grantee organization. Copies of these documents may be requested from the NSF Forms and Publications Unit, Room 232, phone (202) 357-7861. More comprehensive information is contained in the NSF *Grants Policy Manual* (revised), available through the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

Reporting

Upon completion of the project a Final Project Report (NSF Form 98A) will be required. Applicants should review this form prior to proposal submission and insure that appropriate tracking mechanisms are included in the proposal plan so complete information is available at the end of the project. The Final Project Report should include an assessment of mutuality of scientific benefit from the project to the U.S. and Soviet participants.

U.S. principal investigators in joint research projects must additionally submit to NSF a progress report at the end of each intervening year of the project. Interim reports should include concise but scientifically informative descriptions of visits in either country carried out under the project.

U.S. seminar or workshop organizers must submit a report to NSF within two months of completion of the workshop. The report should include a complete set of papers delivered on both sides as well as a summary of the resulting plans for further cooperation.

U.S. scientists undertaking Individual Scientific Visits under the program must submit a trip report to NSF within thirty days of the completion of the visit.

Publications and Intellectual Property

It is expected that the scientific results completed under this program will be published in professional journals.

The Memorandum of Understanding between the National Science Foundation and the Academy of Sciences of the U.S.S.R., as well as its parent intergovernmental Agreement on Cooperation in the Field of Basic Scientific Research, contain provisions concerning allocation of Intellectual Property Rights based on work carried out under those agreements. Grantee rights in inventions, writings, and data may be affected.

Other Considerations

Communications dealing with the implementation of activities approved under this program are to be carried out directly between the U.S. and Soviet principal investigators.

The U.S. principal investigator is responsible for obtaining visas for travel to the U.S.S.R. and, through the U.S. host research institution, for providing supporting documentation (Form IAP-66) for U.S. visas for Soviet participants. When applying for visas, participants are to specifically indicate that

the visit will be in support of cooperative research under the agreement between the NSF and the Academy of Sciences of the U.S.S.R.

The principal investigator is responsible for ensuring that exports of technical data or equipment in connection with projects supported under this agreement are consistent with applicable U.S. law and regulation. The principal investigator is also responsible for ensuring that all activities undertaken outside the United States are carried out in accordance with the laws and regulations of the country in which the work is to be conducted.

ADDITIONAL INFORMATION

General inquiries should be made to the U.S.-U.S.S.R. Cooperative Research Program, Room 1212, Division of International Programs, National Science Foundation, Washington, D.C. 20550, telephone (202) 357-7494 (telefax 357-5839). Telephone numbers of several relevant NSF discipline-oriented divisions are included in Appendix III.

Telephone consultation and/or submission of informal preliminary proposals to NSF prior to formal proposal submission is strongly encouraged.

APPENDIX I

LODGING AND SUBSISTENCE ALLOWANCES FOR U.S. AND SOVIET PARTICIPANTS

The following financial arrangements apply to visits carried out under the program in accordance with Annex III of the Memorandum of Understanding between the NSF and the Soviet Academy of Sciences signed May 6, 1989. Expenses for Soviet participants visiting the United States are to be covered by the U.S. side and must be included in the budget request submitted to the NSF (or otherwise met by the host U.S. institution). *The lodging and subsistence expenses for U.S. participants' visits to the Soviet Union are shown below for information only and are not to be included as part of the U.S. budget.*

The **host institution** covers the cost of lodging "appropriate to the professional level of the visiting scientist and, as far as possible, to the needs of accompanying family members," **plus subsistence** at the following rates:

	In U.S.S.R.	In U.S.A.
Visits of one month or less, per day:	18 rubles	\$ 30
Visits longer than one month, per month:		
For the visiting scientist:	420 rubles	\$ 700
For accompanying spouse*	60 rubles	\$ 100
For each accompanying dependent child:*	50 rubles	\$ 80

The above allowances are to be paid to visiting scientists beginning with their first day in the receiving country.

Health insurance expenses for visiting scientists must also be covered by the host institution and should be budgeted accordingly.

*Dependent support is available only for visits of three months or longer.

APPENDIX II

U.S.-U.S.S.R. COOPERATIVE RESEARCH PROGRAM

PROPOSAL INFORMATION PAGE

U.S. Principal Investigator	
Soviet Principal Investigator	
Lead Soviet Research Institution	
Area/Topic of Research from pages 1-2 (e.g., "Mathematics/Complex Analysis") Area:	Topic:
NSF Discipline-Oriented Division (for cooperative research proposals only)	

For NSF internal use:

Program Reference Code 5939

APPENDIX III

ILLUSTRATIVE TARGET/DEADLINE DATES FOR SUBMISSION OF PROPOSALS FOR JOINT RESEARCH PROJECTS

The following listing provides key dates on which grant proposals are due in NSF discipline-oriented divisions that fund research in areas covered by this program. The dates listed are subject to change. The following listing is provided as a convenience only and may not represent all relevant NSF discipline-oriented programs. A deadline means that proposals received after the cutoff date generally will be returned to the proposer. A target date indicates that proposals received after the cutoff date will be reviewed, although they may miss a particular panel meeting.

	TARGET DATE	DEADLINE
Division of Mathematical Sciences (357-3453):	N/A	N/A
Division of Physics (357-7412):	N/A	N/A
Division of Materials Research (357-9787):	N/A	N/A
Division of Astronomical Sciences (357-7643):	N/A	N/A
Division of Polar Programs (357-7817):	N/A	September 1
Division of Earth Sciences (357-7958): December 1	N/A	June 1 and
Division of Atmospheric Sciences (357-9874):	N/A	N/A
Division of Chemistry (357-7947):	N/A	N/A
Division of Biotic Systems and Resources (357-7332):	N/A	N/A
Division of Behavioral and Neural Sciences (357-7564):	January 15 and July 15	N/A
Division of Cellular Biosciences (357-7905):	June 1 and December 1	N/A
Division of Molecular Biosciences (357-7777):	June 1 and December 1	N/A
Division of Chemical and Thermal Systems (357-9606):	N/A	N/A
Division of Biological and Critical Systems (357-9545):	N/A	N/A

OTHER PROGRAMS OF INTEREST

NSF Guide to Programs briefly describes all Foundation activities. Proposers may consult the GRESE for additional guidance.

The following brochures, available from the NSF publications unit, describe Foundation-wide programs:

Research in Undergraduate Institutions (RUI) provides support for faculty research at predominantly undergraduate institutions. Contact RUI Coordinator, Room 1225, NSF, phone (202) 357-7456).

Research Opportunity Awards (ROA) allows science and engineering faculty in predominantly undergraduate institutions to participate in NSF-supported research at research institutions. Contact relevant NSF disciplinary program office or the ROA Coordinator, Room 1225, NSF, phone (202) 357-7456. (duplicated instructions)

Visiting Professorships for Women (VPW) provides support for experienced women scientists or engineers to undertake advanced research and teaching at a host institution. Contact VPW Program Director, Room 1225, NSF, phone (202) 357-7734). (NSF Publication 88-32)

Research Improvement in Minority Institutions (RIMI) provides grants to predominantly minority institutions and those with substantial minority enrollments that have graduate programs in science or programs in engineering. Contact RIMI Program Director, Room 1225, NSF, phone (202) 357-7350. (NSF Publication 89-7)

Minority Research Centers of Excellence (MRCE) provides funding to upgrade research capabilities of the most productive minority institutions. Contact MRCE Program Director, Room 1225, NSF, phone (202) 357-7350.

Research Assistantships for Minority High School Students encourages principal investigators supported by NSF to provide opportunities for minority high school studies to participate in their research projects. Contact the relevant NSF disciplinary program office. (NSF Publication 87-2)

Minority Research Initiation (MRI) provides one-time grants for minority scientists and engineers to become actively engaged in research as independent investigators. Contact the relevant NSF disciplinary program office or the MIR Coordinator, Room 1225, NSF, phone (202) 357-7350. (NSF Publication 87-3)

Minority Research Initiation Planning Grants provide limited support to investigators who are eligible for MRI awards to plan and prepare a research proposal for submission to the MRI program. Contact relevant NSF disciplinary program office or the MRI Coordinator, Room 1225, NSF, phone (202) 357-7350. (NSF Publication 87-3)

Research Careers for Minority Scholars (RCMS) permits all institutions to encourage undergraduate or graduate minority science or engineering students to participate in research. Contact RCMS Program Director, Room 1225, NSF, phone (202) 357-7552. (NSF Publication 88-126)

Research Experiences for Undergraduates provides opportunities for undergraduate students to participate in research or related activities. Contact the relevant NSF disciplinary program office. (NSF Publication 88-28)

Instrumentation and Laboratory Improvement Program provides matching grants for the purchase of undergraduate instructional apparatus. Contact ILI Program Director, Room 639, NSF, phone (202) 357-7051. (NSF Publication 88-90)

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE \$300

RETURN THIS COVER SHEET TO ROOM 233. IF YOU DO
NOT WISH TO RECEIVE THIS MATERIAL ☐ , OR IF
CHANGE OF ADDRESS IS NEEDED ☐ , INDICATE
CHANGE. INCLUDING ZIP CODE ON THE LABEL. (DO
NOT REMOVE LABEL).



POSTAGE AND FEES PAID
NATIONAL SCIENCE FOUNDATION
NSF-640

OMB 3145-0058
P.T. 34, 42, 48
K.W. 0113007, 0111001, 1010000, 1013029,
1002016, 0606009

NSF 89-100