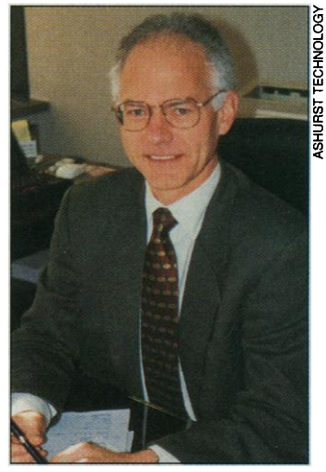
The Perils of Partnership

As the best scientists in the former Soviet Union move from being aid recipients to partners in international collaborations, they risk having the carpet pulled out from under them as the region's infrastructure crumbles

KIEV, UKRAINE—In a freshly painted white room that looks as sterile as an operating theater, a team of specialists here at the Institute for Problems of Materials Science (IPMS) fuss over a machine, unique to all Ukraine, that they hope to keep purring well into the next century. This exotic specimen—a $1 million British-made glow discharge mass spectrometer—may just be the most expensive piece of research equipment in the country. IPMS director Victor Trefilov himself glows with pride as he shows off the machine. It is the first fruit of a joint venture IPMS forged in 1991 with a Western company, in which select institute staff test theories about how metals such as scandium added to aluminum can make lighter and less brittle alloys—the stuff of the next generation of bicycles, for instance. The joint venture already holds several patents in this and other areas. "Within 2 years, we'll earn a living on our own and not be so poor," says Trefilov.

His prediction typifies the positive outlook of many in the top echelon of researchers in the former Soviet Union (FSU) who are pinning their hopes on a shift in their scientific dealings with the West. Gone are the days when Western agencies simply threw a lifeline to colleagues in the east—in the form of one-off grants—to stop them from going under. Now, the name of the game is collaborative research: teaming up with Western groups with pump-priming grants from a new wave of agencies, such as the U.S.-backed Civilian R&D Foundation (CRDF) and the International Science and Technology Center (ISTC). Even R&D contracts with Western companies are moving away from exploitation to more equitable agreements. "Developing R&D relationships with the West is the wave of the future," says Anne Harrington, coordinator of science cooperation programs at the U.S. State Department. IPMS deputy director Alexander Tchetchel agrees: Joint ventures and collaborations "are not a one-way street. They are how science in the FSU will survive."

But while the region's best scientists are buoyed up by these new links to the West, the infrastructure that supports them is sinking fast. Visits by *Science* to dozens of FSU institutes over the past 18 months found that instruments and buildings are becoming decrepit with age; credit-weary utilities are threatening to pull the plug on dozens of institutes of the Russian Academy of Sciences (RAS) now in arrears for electricity, gas, and water payments; and institute directors are reluctant to fire redundant staff. If labs are shuttered, a handful of top scientists would undoubtedly be able to jump ship to the West. But the hard fight to keep science alive in the FSU will have been lost. "Institutes are on life support now," says Leo Borkin, vice president of the Association of Scientific Societies of Russia. "But many of them are on the brink of slipping into a permanent coma."



ASHURST TECHNOLOGY

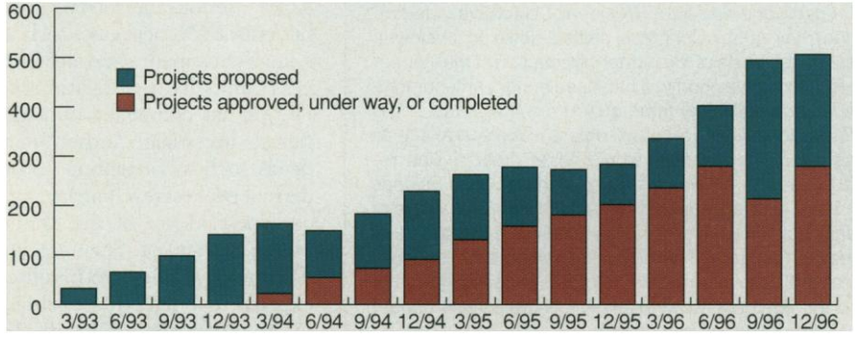
Stronger ties. "It took a couple of years to gain trust," says joint venture chief Benton Wilcoxon.

From aid to alliance

In the coming months, efforts to build bridges to FSU science are likely to intensify. Last September, the CRDF announced 257 grants for collaborative U.S.–FSU projects focused on applied research, and the long-delayed funds are now reaching scientists. The ISTC, a multilateral fund that has sustained more than 17,000 of the FSU's former defense scientists, plans to add about $15 million this year to support new collaborations. Other government and nonprofit programs (see table on p. 471) inflate the total to some $318 million currently invested in joint research. Companies, particularly ones based in the United States, Korea, and Germany, are estimated to have sunk an additional $200 million into joint R&D. All told, Western funds in ongoing collaborative projects will exceed $500 million in 1997—an amount that many experts predict will be the high-water mark for years to come.

But that flood of support has been a long time coming. When the Soviet Union dissolved in 1991, spawning 15 new countries, initial efforts focused on sustaining as many scientists as possible through small grants. For example, the International Science Foundation (ISF), launched by billionaire financier George Soros, gave $500 grants to some 15,000 basic researchers in 1993.

ISF soon followed up these "emergency grants" with more significant funding: 2-year grants, averaging $13,000 each, which were peer-reviewed in FSU countries and abroad. ISF also bankrolled an Internet backbone in the FSU, which many see as its most important contribution. "All our work is possible through e-mail," says Victor Yudovich, a mathematician at Russia's Rostov State University.



SOURCE: ISTC

Gaining momentum. The numbers of U.S.–FSU collaborations funded by the ISTC are surging.

Wooing wandering weaponeers

While the ISF focused on funding basic researchers, applied scientists foundered. Their lifeblood—money from industry and the military for specific research projects—was disappearing fast. Western governments quickly realized that out-of-work nuclear physicists and weapons scientists might soon find employment in countries that could pose a threat to the West. "I've been at institutes where I've followed on the heels of Libyans and Iraqis,"

Peer Review Lands Safely in Russia

MOSCOW—Ludmila Burakova, chief researcher at Moscow's Institute of Biomedical Problems, doesn't care for the stress of U.S.-style peer review. "It's like passing an exam for each researcher," she says. And she hates the uncertainty: "You work hard and don't know what you get in the end." Although competing for funding is new to them, she and other Russian scientists have learned the system well enough to impress a U.S. delegation that visited recently to monitor a new grants program run jointly by NASA and the Russian Space Agency (RSA).

"There is nothing really off the wall," says Ronald Merrell, chair of Yale University's surgery department and a member of the U.S. delegation. "Some of these experiments are superb, and I strongly expect to see some papers published in the West." Adds Arnauld Nicogossian, acting life and microgravity chief at NASA: "We demanded results, and we treated [the Russian researchers] in the same fashion we treat our own principal investigators."

IGOR ZOTIN

A closer look. From left, RSA's Anatoly Grigoryev reviews proposals with NASA's Arnauld Nicogossian, James Collier, and, standing, Yale's Ronald Merrell.

Since the collapse of Russia's massive scientific enterprise in 1991 as the government crumbled, numerous agencies, societies, and companies have thrown a lifeline to scientific colleagues in the former Soviet Union (FSU) (see main text). Initially little more than subsistence aid, the money is increasingly coming back with strings attached. Most of these programs now demand that FSU researchers collaborate with Western colleagues and follow Western-style peer review rather than the old, hierarchical Soviet approach in which money is passed from ministries through academies and institute heads to researchers. This approach, Western officials say, will improve their chances of carrying out successful collaborations with other nations and raise the quality of Russian science.

Take, for example, the joint NASA-RSA program: This grew out of a U.S. decision in 1995 to pay RSA $400 million for access to the Mir space station in preparation for working aboard the international station, which the United States, Russia, Europe, Japan, and Canada intend to start building later this year. Russian scientists were given $20 million of that pot, over 3 years, with the stipulation that they would have to compete for it through peer review. The competition attracted 274 proposals, and 166—91 in the life sciences and the rest scattered across many disciplines—received funding.

Merrell says the criteria for selection of the winners were the quality of science and whether the experiment was compatible with an upcoming flight opportunity. Once the selection panels made their choices, the panel chairs met to hash out a cross-disciplinary plan that determined the final winners. According to Nicogossian, it was not an easy process. "There was a food fight," he says. He adds that the largest grants—including some for technology development—were for between $500,000 and $600,000, while the minimum was less than $10,000.

Although the selection went quite smoothly, the Russians' unfamiliarity with the process led to some bumps and scrapes along the way. When U.S. scientists complained that some of the proposed salaries for principal investigators seemed excessive, for example, the Russians agreed to adjust those figures. And the Russians found efforts to limit conflicts of interest a peculiar idea. "I even had to walk out of the room when we discussed two similar applications, one of which was made by our institute researchers," recalls Anatoly Grigoryev, a member of the RSA committee and director of the Biomedical Institute.

But the Russian researchers did not find it all smooth sailing. The new approach to funding science is particularly difficult for older scientists, says Burakova, who led the biomedical subcommittee. She cites the long wait and the stiff competition as the major difficulties. "The change [to peer review] is easy for young researchers," she says. "But for the old scientists, it is a painful process to give up the old style."

U.S. officials warn, however, that the real lesson is that Russian scientists must fight hard to be competitive not only in Russia but globally. Once Russians embrace the system, "then they will be asked to participate in the review of other research—European, Asian, American, all of us together," says Kathryn Havens, a NASA life and microgravity sciences manager. And Merrell says the incentive to learn quickly should be high: "They have to accrue the skills to go elsewhere [for funding]."

However, it is not clear how much more time the Russian scientists will get. NASA officials say it is unlikely there will be more money forthcoming. Although Alexey Krasnov, RSA's deputy chief of international collaboration, says the agency hopes to pick up some of the slack by financing some basic research, the cash-strapped RSA is already struggling to find money to build key components of the space station.

In the meantime, U.S. and Russian researchers agree that NASA's money has been well spent. "I'm not sure it was perfect," says Roald Sagdeev, a University of Maryland space scientist who was instrumental in lobbying for the grant money. "But at least it was an honest attempt."

–Andrey Allakhverdov and Andrew Lawler

Andrey Allakhverdov is a writer in Moscow.

says John Hnatio, manager of the Department of Energy's (DOE's) Initiatives for Proliferation Prevention program. "The threat of these folks going elsewhere is a possibility with very scary consequences," he says.

But U.S. efforts to help applied scientists got off to a slow start. In 1992, Representative George Brown (D–CA) sponsored legislation to establish the CRDF with $25 million of Pentagon money for defense conversion in the FSU. For months, the Pentagon balked at the sum, but eventually it agreed to put up $10 million, so long as the National Science Foundation found matching money from another source. Last year, Soros agreed to donate $5 million after he was personally lobbied by Vice President Al Gore.

Since then, CRDF has been going like gangbusters. The foundation last September announced the winners of its 2-year grants: 257 research teams in 10 FSU countries and their collaborators in the United States. About 23% of grants involve former weapons researchers, but the majority went to scientists outside the military, such as a team at the Institute of Solid State and Semiconductor Physics in Minsk, Belarus, which will get help from Florida Agri-

Russians Tread Boards to Sell Their Wares

HEMPSTEAD, NEW YORK—A Russian institute director stands at the front of a spacious hall here at Hofstra University, motioning toward a blank screen used to display slides. A colleague snaps a photo of the proud presenter, but cropped from the shot—so the folks back home don't see—is a sea of empty chairs stretching from the podium to the back of the room. Although this symposium was meant to introduce a select group of Russian materials scientists to potential partners from U.S. companies, only a few Americans showed up. "The turnout was not as great as we expected," laments Oleg Jouravlev of Atomergic Chemicals Corp. in Farmingdale, New York.

Collaborating with colleagues in the West is now a necessity for Russian scientists (see main text). But the empty seats at the 3-day symposium last October, called "New Materials From Russia," suggests that it could be a tough sell. The State Committee for Science and Technologies (GKNT), formerly Russia's science ministry, helped foot the expense, flying in representatives of 10 top materials science institutes to put on a show and interest American firms in the idea of joint ventures to bring new materials to the Western market. But the 50-odd materials and technologies on display—everything from high-strength yarn and basalt fibers to ozone sensors—far outnumbered potential buyers. And the Americans who did show up were mainly there for a quick peep. For instance, Gang He, a research engineer at Allied Signal in Morristown, New Jersey, says he ventured to Long Island simply "to take a look at what the Russians were doing in gas sensors."

While their expectations were deflated, the Russian attendees did not appear bitter. "We didn't need to strike a deal here," says Vladimir Vikulin, deputy general director of Technologiya, a 3500-strong state research center in Obninsk that develops military hardware. Like many others at the symposium from Russia's top research centers, Vikulin is managing to stay productive by shifting the institute's focus. Technologiya recently launched its first moneymaking product for the civilian sector—insulated spark plugs for cars. About 75% of the institute's budget, Vikulin says, comes from selling products. "I think the hardest times are behind us," he says.

For others, however, the symposium was a lost opportunity. "It's very difficult for me to organize contact with foreign scientists," says Victor Panin, director of the Institute of Physics, Strength, and Materials Science in Tomsk, Siberia, a remote city near a cluster of weapons labs, which was closed to foreigners until 1990.

Jouravlev, who helped GKNT organize the symposium, at first blamed the poor turnout on the media. "Many [Western companies] say they can't cooperate because of bad press, that Russia can't live up to its promises," he says. But later he acknowledged that the organization itself was partly at fault. "We did huge mailings, but people throw those in the garbage," Jouravlev says. Indeed, even GKNT adviser Kirill Diumajev, who attended the symposium, admits his government has much to learn before it becomes a force in initiating East-West collaborations. However, he says, "I sincerely believe that our foreign partners will have patience with us." –R.S.

cultural & Mechanical University in developing Belarus's nascent production of industrial diamonds. Only the top 8% of the 3100 proposals were funded. "There's going to be a lot of disappointed people," says CRDF executive director Gerson Sher.

These grants account for $8.2 million of CRDF's funds, which will be augmented by $2.2 million in matching funds from FSU countries. Another $4 million is planned to go to special activities to promote research cooperation in specific industries such as materials science and computing. One such initiative will spend $1.5 million on six regional experimental support centers outfitted with pricey equipment that can be shared by academic and industrial users. And the latest CRDF program, announced last month, will spend $400,000 to send about 100 ISTC-funded U.S. scientists to visit labs at Russia's premier nuclear research facilities—the former supersecret "closed cities" Arzamas-16 and Chelyabinsk-70 (*Science*, 20 December, p. 2002).

The measure of CRDF's success, Sher says, will be "the number of long-term, self-sustaining collaborations that result from these projects." Solid state physicist Tasoltan Basiev, a grantee at Moscow's General Physics Institute, is already convinced. Collaborations with the West "will keep our institute running for the next 5 years," he predicts.

Another organization spearheading this new brand of collaborative aid is the ISTC. Coordinated by the U.S. State Department, the ISTC serves as a matchmaker between Western companies, agencies, national laboratories, and universities and FSU institutions. Since it began operating in March 1994, the program, which is funded jointly by the United States, the European Union (EU), Japan, Russia, and Sweden, has committed $121 million to 327 projects that aim to reduce the risk of the spread of Soviet weapons. A second center for Ukraine, established in Kiev in 1995, has so far awarded $10.4 million to 87 projects. "Some people have the impression this is just busy work to keep people off the streets—it's not," says ISTC's Harrington. The program, she adds, is intended to get collaborations off the ground—collaborations that the State Department hopes will become self-sustaining. "We still have a window of opportunity to influence their future," Harrington says.

Fueling self-sufficiency

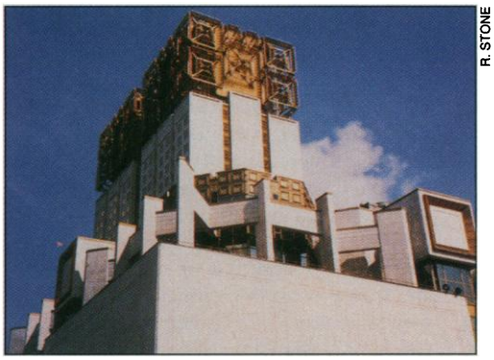
Although it's still too early to assess just how well these programs are working, Harrington and others point to one budding success story: a joint effort to develop fuel cells, essentially giant batteries that rely on controlled oxidation to generate power. The United States and the Soviet Union had pioneered fuel cells for space vehicles, and both are now interested in developing them for down-to-earth markets such as providing power in remote areas or in developing countries. "It's an incredible technology for developing countries with an enormous potential market," says DOE foreign affairs officer Barry Gale.

Two years ago, Lawrence Livermore National Laboratory hosted an entrepreneurial workshop at which Russian scientists working on fuel cells at Chelyabinsk-70 and Arzamas-16 had a chance to mix with their American counterparts. The meeting led to months of delicate negotiations between DOE and Russia's Ministry of Atomic Energy, culminating last September in the formation of the Russian-American Fuel Cell Consortium (RAFCO) to develop technologies for molten carbonate, solid oxide, phosphoric acid, and polymer electrolyte membrane fuel cells.

A tricky issue for RAFCO has been crafting adequate protection for intellectual property. "One of our deepest concerns has been to guard against loss of American technology," says Gale. The agreement gives RAFCO participants the right to sell jointly developed technologies in their home countries, while the parties' rights in other countries are subject to negotiation. Similar concerns pervade ISTC, says Harrington. "Unless we can assure reasonable protection of work done under ISTC, an American company is not going to be interested," she says.

Russians are equally wary about losing out. "Very often we have a good agreement with Western colleagues—on paper it looks fine," says Valery Trufakin, director of the Institute of Physiology in Novosibirsk. But after the contract is signed, he says, Russians sometimes feel they have been duped. "We are becoming tougher in negotiations now," Trufakin says.

Success stories such as RAFCO fulfill the Western governments' original aims. "The focus should be on developing R&D relationships that, through licensing, will put money back into the institutes," Harrington says. "This is the beginning of what we call a 'partners' program," she says, one that she hopes will grow well beyond ISTC. Adds DOE's Hnatio, "One of our principal objectives is to work ourselves out of business."



R. STONE

Ivory tower. Russian Academy leaders from their Moscow headquarters have opposed efforts to focus resources on their best scientists.

Many FSU scientists say they are committed to riding out the storm at home. Emigrants "have to pay back the people who invite them to come," says Alexander Andropov of the Institute of Physics of Microstructures in Nizhni Novgorod, Russia. "Here, we use money from contracts to move in our own directions of research. I know many people who are not so free abroad."

Industry's mixed message

Governments are not the only Western organizations interested in employing FSU scientists: Companies were quick to make forays into the region when the Iron Curtain came down. And FSU scientists were hungry and anxious to deal. "We were ready to interrupt our work, at any price," says Rostov State's Yudovich. But many FSU scientists complain that some Western firms took advantage of their plight, invading the FSU like sharks drawn to blood. "We were deceived many times," says Vladimir Minkin, director of the Institute of Organic Chemistry in Rostov-on-Don, who recalls several instances in 1991 when he would produce unique chemicals for Western firms but failed to receive a promised payment. "The majority of companies have just come to buy results cheaper, scientists cheaper," says Oleg Nefyodov, a vice president of the RAS.

But the situation seems to be improving. Minkin, for instance, found a good partner in Specs & Biospecs, a 25-strong Dutch firm in The Hague that acts as a clearinghouse for Western chemical and drug companies looking to hire FSU chemists to synthesize organic compounds on contract. "We try to conduct business in a style that's based on mutual trust and respect," says Jan Schultz, Specs's coordinator for Eastern Europe. Minkin's deal with Specs also left him in a position to negotiate a strong contract with Servier, a French firm that has licensed his institute's patents on about 20 compounds that could potentially treat diabetes. Future royalties could end up being "100 times or more than my institute's entire budget," Minkin says.

Western firms are just now beginning to rehabilitate their reputations in the minds of many FSU scientists. According to Benton Wilcoxon, head of the Baltimore-based Ashurst Technology Center, which leads the joint venture with IPMS in Kiev, "It took a couple of years to gain trust. We're not sucking the lifeblood out of these scientists to make a killing."

Shaky foundations

While the growth of East-West collaborations is giving cause for optimism, their success could hinge on one critical factor: that FSU researchers will continue to have somewhere to work. And that can no longer be taken for granted, for the region's science infrastructure is becoming decidedly shaky. Take Kiev's IPMS. Funds from the joint venture with Ashurst can support only 25% of the institute's 1700 scientists. The majority must scrape by on meager and often-interrupted paychecks from the Ukrainian Academy of Sciences and income from other pursuits such as translating documents, selling cigarettes on the streets, or chauffeuring visitors around Kiev. Research materials are scarce, and temperatures in IPMS's halls and labs hover just a few degrees above that outdoors.

A similar dichotomy between haves and have-nots has developed at nearly every one of the estimated 6500 scientific institutions, big and small, scattered throughout the FSU. The poor conditions have in less than a decade driven nearly half of Russia's 1 million researchers abroad or out of science, says chemist Fritz Stoeckli of the University of Neuchatel in Switzerland, an adviser to EU efforts to aid FSU science.

To outsiders, the solution is obvious: Retain only the best science and dispose of the rest. "What will cause stabilization is a downsizing of major proportions," says Sher. But most FSU countries have been loath to put mediocre scientists on the streets. In Russia, for example, the academy has eschewed consolidating good labs into a smaller, viable number of institutes. "You have very large institutes that have only small good groups remaining," says Kenneth Dawson of Dublin University, another EU adviser. And although Russia set up its own granting agency—the Russian Foundation for Basic Research—in 1992 to fund peer-reviewed projects, it still gets a tiny slice of the R&D budget: This year, it will distribute $162 million, or just 5.85% of the Russian government's $2.7 billion in research funds. The rest is spent mostly in block grants that are not peer-reviewed.

Apart from not wanting to exacerbate the unemployment situation, those in power also do not want to see their power diluted. For instance, Evgeny Chazov, director of the Cardiology Research Center (CRC) in Moscow, has been lobbying to merge the top 10 of the Russian Academy of Medical Sciences' 60 institutes into a Russian version of the U.S. National Institutes of Health. "I understand that the state will not be able to support so many institutes," Chazov says. But he says the medical academy's leadership, unwilling to loosen its grip on its institutes, has blocked the plan.

Without some form of consolidation, many observers warn that increasingly dire conditions—such as shortages of new equipment and materials—could strangle budding East-West collaborations. "There is abundant evidence that the science community ... is becoming technically obsolete," said a report on ISTC released last month by the U.S. National Academy of Sciences. Biochemist Vladimir Shirinsky, a rising star at the CRC who collaborates with American and British scientists, puts it this way: "Subjectively, I'd like to be an optimist. Objectively, it is time to quit." If FSU countries lose too many Shirinskys, they may soon face the task of rebuilding their science from scratch.

–Richard Stone

With reporting by Alexander Hellemans in Paris.

EAST-WEST R&D COLLABORATIONS

Program	Funds for Projects ($ millions)	Active Projects	FSU Scientists Supported
ISTC	121	327	15,400
IPP	109	150	2,200
INTAS	69	1204	15,000
ISTC-Ukraine	10.4	87	1,650
CRDF	8.2	257	1,400

ISTC: International Science and Technology Center (E.U., Japan, Russia, Sweden, U.S.)
IPP: Initiatives for Proliferation Prevention (U.S.)
INTAS: International Association for the Promotion of Cooperation with Scientists from the New Independent States of the FSU (E.U.)
ISTC-Ukraine (Canada, Sweden, Ukraine, U.S.)
CRDF: Civilian R&D Foundation for the Independent States of the FSU (U.S.)