SCIENCE IN RUSSIA

Post-Cold War Science Thrives in the Heart of Siberia

NOVOSIBIRSK—Despite its remote location in southern Siberia, thousands of miles from Russia's main centers of science, the Institute of Nuclear Physics (INP) here has equipment and research projects that would be the envy of most Russian research centers. The INP boasts two accelerators in the gigaelectron-volt range and several smaller accelerators for industrial applications, as well as facilities for plasma research and controlled fusion experiments. But the biggest surprise is that all this apparatus works. The INP buzzes with activity as 450 scientists and 2800 technicians go about their business, and the institute is able to cough up more than $250,000 every month to pay for electricity, gas, and water.

Such vitality is practically unheard of in today's Russia. The virtual collapse of state research funding following the breakup of the Soviet Union crippled Russia's huge scientific community. Large, power-hungry facilities remain unused because of unpaid electricity bills, and those researchers who have not emigrated often sit idle in unheated labs unable to pay for experimental materials (*Science*, 27 May 1994, p. 1262). In Moscow, these trends have been exacerbated by the growth of the commercial sector, which has lured some of the brightest young scientists out of science. And Muscovites in particular must cope with a skyrocketing cost of living and rising crime. The INP, however, has managed to fend off some of these corrosive forces. And it is not the only success story in Academgorodok, the hub of the Russian Academy of Sciences' (RAS's) Siberian division a few kilometers south of Novosibirsk, Siberia's largest city. Several other institutes here also have active work programs and ample funding to pay for them.

Academgorodok's residents say the secret of their relative success is a mixture of a unique scientific culture, aggressive pursuit of international funding, and most importantly, R&D contracts with overseas industry. Says University of Oregon chemist Bruce Hudson, who visited Academgorodok a few years ago and has stayed in touch with colleagues at the Boreskov Institute of Catalysis, "I was very favorably impressed [with the scientists], especially their independence, enthusiasm, and relative freedom from obvious corruption."

According to Renad Sagdeev, director of the International Tomography Center in Novosibirsk, "We're past the worst times and have kept our scientific infrastructure in Academgorodok. I'm very optimistic about the future here." Indeed, many scientists here argue that Novosibirsk's ability to attract Western funds and retain many of its best scientists and science graduates suggest that it could be the cradle of a Russian scientific renaissance.

NOVOSIBIRSK INSTITUTES RECEIVING THE MOST ISF MONEY*

	# of grants	Amount ($)
Institute of Nuclear Physics	18	287,000
Institute of Cytology and Genetics	12	225,000
Institute of Bio-Organic Chemistry	7	179,000
Boreskov Institute of Catalysis	12	166,000
Institute of Mathematics	18	154,000
Institute of Inorganic Chemistry	7	115,000
Institute of Automation and Electrometry	6	115,000
Lavrentyev Institute of Hydrodynamics	8	102,000
Institute of Geology and Geophysics	7	99,000
Institute of Theoretical and Applied Mechanics	7	98,000

*Data from ISF Rounds 1 and 2 long-term grant competition

SOURCE: ISF

The golden valley

The story of Academgorodok began in 1957, when former Soviet leader Nikita Krushchev dispatched a team led by renowned physicist Mikhail Lavrentyev to scout out a location at which to nurture a new Siberian Division of the Soviet Academy of Sciences. Lavrentyev chose "the Golden Valley," an area south of Novosibirsk where the birch trees, the locals claim, keep their yellow leaves longer into autumn than do trees on the nearby plains.

Several months later, the first wave of immigrants arrived in Academgorodok to staff the new Institute of Hydrodynamics, headed by Lavrentyev. By 1962, 20 institutes had put down roots. Lavrentyev and academy officials lured scientists to Novosibirsk with the promise of more lab space, ample funding, and special shops to buy meat and luxury items otherwise in short supply in Siberia—and hundreds of researchers took the bait.

Much of the rationale for building up Academgorodok was to create a research stronghold for the Soviet military-industrial complex. "All the institutes were doing research for the military," says physicist Semen Musher of the Institute of Automation and Electrometry. Although the proportion of military research varied from institute to institute, nearly half the funding to Academgorodok came from the military-industrial complex.

Science center. Novosibirsk's geographic isolation may be an asset in retaining researchers.

Academgorodok quickly earned a reputation for high-quality science. By the end of the 1960s, for instance, Siberian scientists were pioneers in nonlinear optics and plasma shock waves, and they built the world's first electron-beam collider. During this time, scientists in Novosibirsk enjoyed a rare privilege in the Soviet era: freedom to express nonmainstream views in public. Their forum was a club called "Under the Integral," which held dances, shows, and discussions "for people who would like to speak out about the future of the country," recalls chemist Marianna Voevodskaya, now an official at the RAS presidium in Moscow.

This golden age was short-lived, however. Shortly after the Soviet invasion of Czechoslovakia in 1968, Communist Party officials in Novosibirsk closed down "Under the Integral." This seemed to sap the unique spirit of Academgorodok, says Voevodskaya. Although funding to the institutes was maintained, the flow of scientists to Novosibirsk ebbed, and in the 1970s the ennui of the Soviet system began to take hold.

In the late 1980s and early 1990s, the dying spasms of the Soviet state brought more change. When the Cold War ended, the military-industrial complex canceled between 80% and 90% of its R&D contracts in Novosibirsk, estimates Musher—a blow that devastated some institutes. And, in common with institutes all over Russia, funding from the RAS soon began to dwindle, allowing only small salaries for scientists and precious little for equipment or materials.

Survival of the fittest

Yet despite the hardships of the 1990s, many institutes in Novosibirsk have managed to retain an impressive scientific vitality. For some, the lifeline has been Western grant money, from organizations such as the International Science Foundation (ISF)—the

Weapons Researchers Come In From the Cold

In the Soviet era, scientists who came to work at NPO Vector—a biological weapons facility on the outskirts of Novosibirsk—enjoyed certain privileges. They received apartments without having to wait the usual months or years, drew much higher salaries than their scientific colleagues did, and commanded a splendid view of the southern Siberian steppe from Koltsovo, the hilltop town built to service the institute. Nowadays, the only perk is the view.

Five years after the Ministry of Defense all but cut off funding for Vector, most secret research on deadly viruses and bacteria has ceased, and the staff has dwindled from 4500 to 2500. Vector, like other institutes in Novosibirsk (see main text), is trying to get off the canvas by pitching itself to potential foreign collaborators as a premier research facility for peaceful research on some of nature's more frightening pathogens, such as the Ebola virus. "They have a top group of molecular biologists as well as some experience with several viruses that [we're] interested in," says virologist C. J. Peters, whose research team at the U.S. Centers for Disease Control and Prevention plans to collaborate with the institute to study hantavirus strains found in Russia.

R. STONE

Bioweapons to biotech. Vector Director Lev Sandakhchiev.

The skeleton crew at Vector, now known as the State Research Center of Virology and Biotechnology VECTOR, does not pine for the past. "We have less money but more freedom," says institute director Lev Sandakhchiev. "The atmosphere here feels like an academic institution" rather than a military installation, he says. "I feel more comfortable now." But the legacy of the Soviet biological weapons program continues to haunt the center and has made its transition into the world scientific community harder than it has been for other institutes.

Sandakhchiev had good reason to be uncomfortable a few years ago, when Vector was a hard-core military lab. Opened in 1980, the complex in Koltsovo features negative air-pressure rooms for work on pathogens such as the Marburg virus, which causes blood vessels to hemorrhage and kills more than half of those infected, including a Vector staffer in 1988. According to a directive from President Yeltsin to all Russian weapons labs, Sandakhchiev is still barred from discussing details of the biological weapons work, but he says a "few percent" of Vector's research is still funded by the Defense Ministry and is still very secret.

With military funding now so scarce, Vector has been forced to rely on funds from the Ministry of Science, which last year named the institute one of 60 state research centers, entitling it to extra money. Nevertheless, says Sandakhchiev, Vector expects to receive only $2.5 million from the ministry—30% of its planned 1995 budget. As a result, Vector is struggling to preserve an adequate research staff. Most of the 2000 staff members who have left in the past few years were technicians, but some 30 scientists have gone too. "We did lose many of our best scientists," says Sandakhchiev. This is reflected in Vector's poor showing in winning peer-reviewed Western grants—only four Vector scientists won long-term grants from the International Science Foundation (ISF).

So scientific survival at Vector means embracing capitalism. Sandakhchiev, himself a prominent biologist, is now finalizing an R&D contract with Boryung Pharmaceutical Co., which represents a group of South Korean drug firms. But contract R&D alone will not solve all the institute's problems, so Vector itself has stepped up production. About 25% of Vector's staff now work for two companies, Vector-Pharm and Vector-Best, which produce a variety of items, such as drugs, diagnostic kits for HIV, hepatitis virus strains, and enzymes and immunoglobulins for other tests.

Yet even these efforts have not been enough: Scores of Vector staff members supplement their incomes by selling homegrown vegetables or imported Western goods. These pursuits have slowed the pace of research, admits molecular virologist Sergey Netesov, an ISF grantee. However, he says, without the extra income, the staff "would have money only for bread and potatoes" and not enough for relative luxuries such as milk, butter, and meat.

–R.S.

$130 million fund set up 3 years ago by financier George Soros—and the European Union's fund for scientists in ex-communist states, INTAS. In many institutes, "it's nearly impossible to do research if you don't have a Soros grant," says Musher.

For many researchers here, it was a wrenching experience to suddenly be thrust into the world of competitive funding. In 1992, when the ISF handed out $500 emergency grants to scientists, the foundation stipulated that the grants were for basic research only, and many scientists who had carried out applied research for the military were forced to leave science or are still floundering, says Ilya Ginzburg, a particle physicist at the Institute of Mathematics.

Institutes that did less military research have adapted more easily. One surprising success is the Institute of Cytology and Genetics (ICG). Until the early 1980s genetic research struggled in Russia under the Lysenkoist dogma that reigned in the Soviet Academy of Sciences. During the 1980s the state invested "huge sums of money for the development of molecular biology" in an attempt to catch up to Western standards, says Igor Zhimulev, head of ICG's molecular cytogenetics lab. Despite this late start, ICG has won more ISF money than any other Novosibirsk institute apart from INP.

The institutes that have fared best are the ones which have struck deals with foreign companies. One of the most successful dealmakers is Valentin Parmon, whose Boreskov Institute of Catalysis (BIC) brings in about half its budget—millions of dollars a year, Parmon says—from 60 licensing agreements with foreign firms. One contract is with the U.S.-based chemical company Monsanto, for which BIC is developing technology for use in car exhaust systems to bind volatile organic pollutants that create smog.

BIC's success can be traced to the mid-1980s, when Mikhail Gorbachev's government gave extra funding to the institute and 60 others nationwide to spur transfer of new technologies from labs to industry. "When the Soviet state collapsed, we were prepared" to switch to foreign clients, says Parmon. And BIC learned how to play hardball: The institute rejects two thirds of the contracts it is offered, Parmon says.

BIC's prosperity has enriched its staff. In September, the institute's 1000 scientists and technicians received an average salary and incentives of 770,000 rubles ($170)—about twice as high as the average monthly salary for a scientist in Moscow, where the cost of living is higher than in Novosibirsk. Some BIC scientists supplement their pay by as much as $400 a month with grant money or bonuses from licensing agreements.

Equally successful at selling itself is the INP, which like BIC was negotiating with Western firms and research groups before the

Soviet collapse. "Our institute was an island of capitalism in a sea of socialism," says Simon Eidelman, a senior research physicist at INP. However, the institute has not totally abandoned its socialist roots: All the money flowing into INP—be it from the government, Western foundations, or industrial contracts—is divided more or less equally among the staff.

In the mid-1980s, at least one top scientist in Novosibirsk was canny enough to foresee the rapid dissipation of state funds for science. At the beginning of *perestroika* in 1986, physical chemist Renad Sagdeev set out to create the International Tomography Center (ITC), an institution for medical research using techniques such as nuclear magnetic resonance and magnetic resonance imaging (MRI). "Our idea was to organize a scientific institution without a state budget," says Sagdeev—the first of its kind in the Soviet Union.

Sagdeev persuaded Bruker Analytische, a German company that produces medical imaging machines, to donate 1 million marks toward the building, which was finished in late 1992. Since then, ITC's work has won funding from the Russian government's Foundation for Basic Research, ISF, INTAS, and France's Ministry of Foreign Affairs. However, the bulk of ITC's budget comes from selling MRI machines, mass spectrometers, and other equipment in Russia and abroad.

Some foreign companies, meanwhile, have opted to bankroll specific labs rather than whole institutes. A matchmaker for these collaborations is Science Applications International Corporation (SAIC), a U.S. company that has sealed $25 million in deals in Russia since it launched an initiative here 3 years ago. SAIC helps U.S. companies find Russian collaborators and carry out the paperwork and legal details. The companies then manage the collaborations themselves and own the results. According to SAIC program manager Linda McCabe, U.S. firms have a chance to employ, "at very little expense, some of these very talented scientists."

With the help of SAIC, a team of scientists at the Institute of Thermal Physics in Novosibirsk is now working for Hewlett Packard to develop technology for ink jet printers. And a consortium of South Korean companies led by Samsung and Daewoo has invested in two computer labs at the Institute of Automation and Electrometry.

The next generation

Novosibirsk's remoteness, a bane during the harsh Siberian winter, has one advantage: As a place, it is harder for scientists to get away from. And that may help the city to eventually rival Moscow's scientific dominance. Novosibirsk's institutes have lost proportionally fewer top scientists than many Moscow-area institutes, and the city claims to have retained more young scientists. Despite the interest in business during *perestroika*, says ICG geneticist Nikolay Kolchanov, starting about 3 years ago, "I was surprised to find that we had regained a high level" of competence in the student body at Novosibirsk State University (NSU). Compared to Moscow, says Parmon, "we have a lot more students who have stayed with science." Perhaps the biggest wild card for Novosibirsk's future is whether those talented students will stay.

Despite the uncertainty, many Novosibirsk scientists share an optimism about the future. "I've told my son, 'You can go wherever you like after you graduate,' " says ISF official Natalia Baranova, whose son is an economics major at NSU. "But he doesn't want to leave Academgorodok," she says. Adds BIC chemist Yuri Aristov, "I prefer the manner of life here. ... I've spent a lot of time abroad, and all I can say is that there's a special spirit for doing research here that I haven't found anywhere else."

–Richard Stone

ENERGY RESEARCH

Fusion Advocates Scramble for Scraps

Managers of the fusion program at the Department of Energy (DOE) say they are just looking for a practical way to salvage a program whose budget fell 32% this year, to $244 million, and could well drop further next year. But to U.S. fusion advocates, the department is running up a white flag. So last week, when DOE asked members of its Fusion Energy Advisory Committee to help design a program acceptable to Congress that would cost between $200 million and $275 million a year, several panelists argued that the department instead should be fighting for a bigger slice of the federal pie.

"We're getting killed in this game between the department and Congress," said Marshall Rosenbluth, a physicist at the University of California, San Diego. And Joseph Gavin, a retired aerospace executive, called DOE's approach "a fundamental error," saying it would only encourage Congress to make further cuts. A $200 million program would do "deep damage" to the field, noted Stewart Prager, a University of Wisconsin physicist who served on a presidential panel that has recommended annual funding of at least $320 million (*Science*, 23 June, p. 1691). "It's too high a price to pay for the budgetary savings involved," Prager said in a briefing to the panel.

But DOE officials insist that the only way to keep the fusion program intact is to come up with a plan that Congress will accept. They note that last summer Representative John Myers (R–IN), who chairs the House Appropriations Committee panel that oversees the department, said he envisions a 1997 fusion budget of $204 million. "There has to be change [in the program], and it has to be dramatic," says Martha Krebs, DOE assistant secretary for energy research. Adds her deputy, James Decker: "It's an issue of what is credible. Greater than $275 million is probably not going to be credible."

The change that Krebs has in mind would scale back the U.S. program from a concerted attempt to develop fusion technology to a modest research effort. DOE officials say the cuts planned by Congress would kill a planned $742 million Tokamak Physics Experiment at Princeton Plasma Physics Laboratory designed to demonstrate continuous use of a tokamak. And Krebs warned that it would be difficult to go beyond early designs for the $10 billion International Thermonuclear Experimental Reactor, a project with Europe, Japan, and Russia to show the feasibility of fusion as a commercial power source.

Nevertheless, DOE does not want to pick a fight with a Congress committed to trimming federal spending. DOE officials want the results of the advisory committee's review by mid-January, before the president's 1997 budget plan goes to Capitol Hill, and their charge to the panel is a clear sign that the Administration's request will not exceed $275 million. Proposing a bigger budget could cede control of the program to Congress, Krebs told reporters. At the urging of the panel's chair, University of California, San Diego, engineer Robert Conn, the members reluctantly agreed to take on the task of describing the features of a smaller program.

The greater challenge for fusion advocates is to bolster their political standing. This year's budget debate revealed that the program has few politically powerful friends in Washington. A last-minute attempt by DOE Deputy Secretary Charles Curtis to restore $50 million wound up with $15 million, but several program advocates complain privately that DOE officials had failed to back earlier lobbying efforts.

DOE managers counter that they can't carry fusion's water alone. "The community has to ask itself what base of support it has," Krebs told the advisers. "If it broadened [its appeal] in the scientific community, then I think it might have a chance." Rush Holt, assistant director of the Princeton lab, ruefully agrees that the community's attention to research has left little time to meet with politicians who foot the bill. Now the goal is to save as much science as possible.

–Andrew Lawler