RUSSIA

Bringing Research And Teaching Back Together

ROSTOV-ON-DON—For 30 years, biology professors in this southwest Russian city have run an effective recruitment program for promising students. They have spent their Sundays lecturing and teaching labs at a local high school to about 50 eager students, one third of whom go on to attend Rostov State University (RSU). But these days, it is getting harder to entice youngsters into taking science courses, and even more difficult to keep them interested in scientific careers when they get to RSU.

One problem is that when new students arrive on campus, they learn the hard lessons of what it means to be a Russian biologist. Because of declining government funds for education and research, Rostov's biology department is finding it increasingly hard to function. Teaching labs are short on glassware and chemicals, and graduate students lack access to state-of-the-art equipment. "We have problems everywhere," says RSU biology dean Vitaly Dumbai, who cannot even afford to fix the broken chairs around the conference table in his office. With these drawbacks, it is tough to compete with the glitter of Russia's fast-growing commercial sector for bright young students. Says Cornell University chemist Roald Hoffmann, an expert on Russian science, "Russian universities all of a sudden are facing the same problems we [in the United States] have, of attracting students to science."

Rostov's plight is typical of the widespread deterioration of the Russian education system. "There is a crisis in higher education resulting from the political and economic problems of our country," says Oleg Nefedov, vice president for chemistry at the Russian Academy of Sciences (RAS). State spending on education rose from 26 billion rubles in 1990 to 26 trillion rubles in the first half of 1994, but when converted into U.S. dollars, spending has actually fallen more than 50% over this period. The squeeze has left most university departments with barely enough funds to pay small salaries to staff.

But lack of money is not the only problem: Most now agree that the long-standing separation of research and teaching in Russia is a major obstacle to recovery. In a vestige of the Soviet era, many of RAS's 325 research institutes remain scientific monasteries, isolated from students and teaching. With rare exceptions, universities employ only a handful of scientists with sufficient expertise to lecture on current trends in their fields. "The degree of separation of education and research that existed in the Soviet system was excessive and damaging," says Loren Graham, a specialist on Russian science at the Massachusetts Institute of Technology.

A few institutions are struggling to overcome this legacy. For example, Moscow's Higher Chemical College is training top chemistry master's-degree students at several RAS institutes (see box on this page), while Pushchino State University is the centerpiece of an effort to remodel a biology research center after the U.S. land-grant university system (see box on next page). In addition, billionaire financier George Soros, founder of the International Science Foundation (ISF)—a popular grant program for scientists of the former Soviet Union—last year launched a $50 million effort to improve science education in Russia and several other former Soviet countries.

These are, however, only the high points in what is mostly a desolate landscape. "A thorough reform of Russian science and education has not occurred and does not seem very likely," says Graham. Like other relics of the Soviet era, the Russian educational system is struggling to define itself in Russia's rapidly evolving society.

Academy Produces the Right Chemistry

MOSCOW—When the six members of the first graduating class of Moscow's Higher Chemical College (HCC) receive diplomas next month, the ceremony will represent more than a rite of passage for the college: It will mark a milestone for the Russian Academy of Sciences (RAS). That's because the college is the academy's boldest scheme to get involved in education and mold the first post-Soviet generation of scientists. And it seems to be working. The HCC "attracts the very best young people ... [who] can compete with the best American graduate students," says Cornell University chemist Roald Hoffmann.

HCC's appeal is simple: University teaching is deteriorating partly because of the separation of Russia's universities and research institutes (see main text). If such a system persists, says HCC Vice Chair Igor Svitanko, "it would be very difficult to replace the scientists lost to the brain drain." So in 1990, to help bridge the gap between research and teaching, Oleg Nefedov, vice president for chemistry at the RAS, Svitanko, and colleagues at Moscow's Zelinsky Institute of Organic Chemistry organized the HCC and the Chemical Lyceum, a chemistry high school. From the pool of students at the Lyceum and from participants in the Mendeleev Olympiad, an annual chemistry competition among high schools in Russia and other former Soviet republics, HCC lures budding chemists with the promises of stipends, graduate training overseas, and instruction from some of the country's top researchers. "Our students are a little crazy about chemistry since childhood," says Svitanko.

Perhaps the most novel aspect of HCC is the unprecedented access it offers its 120 students to RAS scientists and laboratories. Even in their first year, students work in the Institute of General and Inorganic Chemistry. By the third year of the 5½ -year master's program, students are performing original research in an academy institute of their choice.

HCC students are richly rewarded for their work. Of 130 chemistry students who won $80-a-month stipends from the International Soros Science Education Program, 46 attend HCC. The stipend is about the same as the monthly salary of a veteran RAS scientist. By the second year, says Svitanko, "all of the students have contracts" to synthesize compounds or engage in other forms of grunt work for Western chemical and pharmaceutical companies such as DuPont and Rhône-Poulenc Rorer.

The prospects get even brighter after graduation. Three students who graduated early are now working on doctorates in Hoffmann's lab at Cornell, for example, and HCC has received 80 invitations from foreign labs for its graduates to pursue Ph.D.s—far more invitations than HCC has graduating students.

Despite its success, critics say HCC may simply be grooming young scientists for foreign labs. "We don't worry about brain drain," asserts Svitanko. For those students who go abroad for graduate or postgrad work, he says, "they will have scientific jobs when they come back." Svitanko and his colleagues are hoping that Western scientists will encourage HCC's progeny to return to their native land.

–R.S.

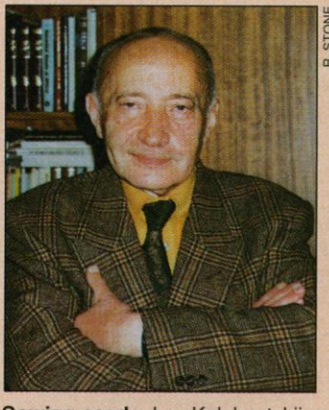
A once-proud system. The tragedy is that Russian science education had so far to fall. The Soviet university system was a massive enterprise, providing free higher education to all high school leavers who passed university qualifying exams. Students usually worked 5½ years to get a master's—skipping the bachelor's degree—and institutions had modern facilities and textbooks, and rivaled or eclipsed most Western universities in terms of teaching quality, says Valery Soyfer, a molecular geneticist at George Mason University in Fairfax, Virginia. In its prime, the education system was one of the "great achievements" of the Soviet Union, says Vladimir Shirinsky, a biologist at the Cardiology Research Center in Moscow.

Most students did not, however, gain from direct contact with active researchers, who were isolated in the academy's research institutes. The intention was twofold: to boost the scientists' productivity and to

New University Takes Science to the People

PUSHCHINO—When Soviet planners established the Pushchino Biological Research Center (BRC) here in 1963, they had bold plans for this little village on the Oka River 120 kilometers south of Moscow. The intent was to create an enclave for fundamental biological research. Over the next 3 decades, the number of biological institutes in the BRC expanded to eight, and Pushchino earned an international reputation which it still retains today—six of 80 grants that the Howard Hughes Medical Institute awarded last July to outstanding biologists in Eastern Europe went to Pushchino scientists. Now the town is spearheading another bold move: a unique endeavor to integrate a segment of Russia's isolated research community back into wider society.

The centerpiece of this effort is Pushchino State University (PSU), founded in October 1992 to ensure a steady supply of skilled scientists for the town's institutes. The university aims to break down the wall that Soviet leaders erected between research and teaching by having active researchers from BRC institutes teach and train students. "One of the most important reasons we dove into the area of education was to help repair the split between higher education and laboratory science," says PSU vice chancellor for research Lev Kalakoutskii, head of the All-Russian Collection of Micro-Organisms.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Sowing seeds. Lev Kalakoutskii and colleagues modeled Puschino State University on U.S. land grant colleges.

But transforming scientists into teachers is just one step toward a grander goal: integrating science and education with the economic development of the surrounding agricultural region, stretching from Pushchino to Voronezh, a city 350 kilometers to the south. To accomplish this, a group of institutions here and in the United States formed the U.S.–Russian Science, Education, and Economic Development Consortium,* which is shaping PSU in the image of U.S. land-grant colleges, such as those founded by Cornell University with a mandate from the State of New York to provide educational opportunities to the entire community. "We are trying to develop a new model system which can be copied throughout Russia," says Milton Schroth, chair of the plant pathology department at the University of California (UC), Berkeley.

These plans were hatched largely for self-preservation. In the late 1980s, Alexander Boronin, director of the Institute of Physiology and Biochemistry of Micro-Organisms, was concerned that Pushchino might lose everything it had gained. The Soviet Union's dying spasms not only squeezed the BRC's budget, but economic turmoil at universities in Kazan, Nizhni Novgorod, and other nearby cities threatened to reduce the flow of skilled young scientists to Pushchino. After the Soviet Union dissolved in 1991, these fears began to be realized. "Until recently we have had almost no young people in our laboratories," says Vasiliy Zagranichny of the Pushchino branch of the Shemyakin Institute of Bio-Organic Chemistry. Faced with the prospect of a graying research staff, Boronin, Kalakoutskii, and others established PSU in 1992.

The young university immediately ran into trouble. Pushchino "was simply not prepared for housing hundreds, let alone thousands, of students," recalls Kalakoutskii. PSU got some relief, however, when the BRC gave the university a newly built dormitory originally intended to house guest scientists and Moscow State University agreed to lease to PSU dorms it had used to house summer students.

But this still only provided space to house 150 students. Partly because of this, PSU's planning board decided not to establish a traditional 5½-year combined bachelor's-master's program but instead to offer a 2-year master's that capitalizes on a trend at Russian universities to separate bachelor's and master's degrees. In the 1995–96 academic year, PSU, with about 85 million rubles ($19,000) in funding each month from Russia's State Committee on Higher Education, was running at full capacity with 142 master's students in its dorms and 80 Ph.D. students who have apartments in Pushchino.

Now Boronin and his consortium colleagues are reaching out to other segments of the community. In 1994, the consortium won a $2.2-million grant from the U.S. Agency for International Development to launch programs to involve BRC scientists in training and educating workers in Russian agriculture, long known for its Promethean waste and questionable science. To help local scientists and businesses, the consortium has established an office to help them obtain patents and negotiate licensing agreements. And it has opened the Higher Agrobiotechnological College, which teaches about 35 undergraduates techniques for cattle breeding and raising crops. "This is the beginning of an extension system similar to what made agriculture so effective in the United States," says Schroth.

So far, Pushchino's visionaries seem to be achieving their goals. Last spring, about half of the 60 students in PSU's first graduating class opted to stay on as Ph.D. students. Most of the rest, says Kalakoutskii, found positions with biotech firms, in agriculture, or in environmental monitoring and remediation. Sure, Kalakoutskii says, PSU for now "isn't changing the fate of the country." But, he says, the university has introduced—to at least a small swathe of Russia—a popular guiding principle in the West: "We're thinking globally and acting locally."

–R.S.

* Consortium members include: the BRC, PSU, the Higher Agrobiotechnological College, UC's Division of Agricultural and Natural Resources, and Washington State University, Pullman.

reduce their political influence. Freedom of thought, although crucial to innovative research, was "potentially dangerous for education," Soyfer says. "Educators were supposed to just accept orders, fulfill requirements, and deliver knowledge."

The problem persists today, but the barrier is now more economic than ideological. Because university salaries depend on the number of hours logged in the classroom, says biologist Vladimir Bashkirov of Moscow's Institute of Gene Biology, the last thing teachers want to do is donate part of their class load—and pay—to RAS researchers.

Most contact between students and academy scientists comes at the students' own initiative. By the third or fourth year of college, says Shirinsky, "students begin to show up [at institutes] and try themselves at the bench." Moving to an RAS institute is more common after obtaining a master's, but the institutes are then able to pick the best of a crop of young researchers by taking on more grad students than they need, then separating the wheat from the chaff by hiring only the best new Ph.D. graduates. This luxury, however, is slipping away for two reasons: The academy's budget has shrunk to a fraction of its value in Soviet days, so fewer grad students can be taken on, and there is a smaller pool of potential grad students. According to Russia's Center of Science Research and Statistics (CSRS), the number of Ph.D. students at Russian state universities and colleges fell 25% between 1985 and 1993.

The force pulling students away from research is the pursuit of the ruble. In 1992, Shirinsky's Cardiology Research Center was nurturing two "very promising and bright" Ph.D. students. Both quit. "One of them showed up later well-dressed, in a fancy car," says Shirinsky. "Graduate students now have a different mentality," adds Pavel Balaban of the Institute of Higher Nervous Activity and Neurophysiology in Moscow. "They understand that science cannot support them now, so most have some sort of side work for money."

For grad students, a stipend of about $30 a month does not go far in Moscow, where the cost of living is approaching Western levels. "Only grants, especially Western ones, give us the possibility to support students when they are preparing their theses," says Ivan Shatsky of the Belozersky Institute of Physico-Chemical Biology at Moscow State University (MSU). In Moscow the situation is complicated by the fact that students who come from outside the city must get temporary permits to live there. For some students, a Ph.D. program is simply a means to get a Moscow living permit allowing them to pursue business opportunities.

Similar problems permeate undergraduate education—although they are less visible. According to the CSRS, the number of undergraduate students in Russia declined only 14% between 1985 and 1994. But statistics do not tell the whole story, says Pavel Sarkisov, chancellor of the prestigious Mendeleev University in Moscow. Even as Mendeleev's 10,000 students are preparing for careers in applied chemistry labs, scores of them hawk Western goods or moonlight in the burgeoning business community. "It's a pity, but we're losing many talented students to business," says Sarkisov, who adds he is not surprised by this: "Many students are making more money than their own [chancellor]."

Points of light. As Russian educators strive to hold onto their wayward students, their ability to teach them with the rapidly diminishing funds from the state is becoming increasingly difficult. Even the likes of MSU, Russia's largest and most renowned college, are facing hard times. MSU's chemistry department won more ISF grants than did any other institution in the former Soviet Union and managed to publish 15 new textbooks last year, says department dean Valery Lunin, but "for some time now we haven't received 1 ruble for renovation of our teaching labs."

The pinch at MSU has spurred Lunin to seek other sources of funds. A few years ago, the department began recruiting foreign students, and it now has 26, each of whom pays $4000 a year—"three times cheaper than an American university," says Lunin, who sees income from foreign students as a potential savior for his department and for others at MSU. "The world market in education is a big opportunity for us," he says.

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Bridging the gap. Moscow's Institute of Theoretical and Experimental Physics is one of the few research centers to play an active role in education.

Another source of Western help is the International Soros Science Education Program (ISSEP). Launched by Soros in February 1994, ISSEP is a 2-year, $50 million operation to reward quality high-school and college teaching and to support top university students, which Soros has offered to extend for three more years if the Russian government foots half of ISSEP's annual $25 million bill. Over the past year, most ISSEP funding has been spent on monthly stipends to nearly 800 Russian professors and associate professors, 4000 high-school science teachers, and 5000 undergraduate and Ph.D. students. The program has also organized a series of conferences throughout Russia in which ISSEP-funded professors present their work to ISSEP-funded high school teachers. The goal, says George Mason's Soyfer, chair of the ISSEP board, is to transform a system in which "university professors and high school teachers were separated from each other as if by the Great Wall of China."

Despite these signs of progress, most experts foresee a long struggle ahead for Russian higher education. Even for institutions that have retained high-quality education programs, the country's crumbling scientific infrastructure may yet drag them down. Take the case of the Institute of Theoretical and Experimental Physics (ITEP) in Moscow. ITEP is an atypical state research center: In addition to doing science, its staff runs an elite educational program that takes in 10 to 15 of Russia's top high-school physics graduates. "We have more good students now than we had 5 or 6 years ago," says ITEP physicist Leonid Kondratyuk.

But the institute may soon have little to train them on. Many of ITEP's experimental physics projects have ground to a halt since last March, when the institute, short on cash for electricity, was forced to shut down its 10-gigaelectron-volt accelerator. ITEP's diminished scientific potential could scare off prospective students, says Kondratyuk. "It's a situation that many of us are worried about," he says. Indeed, it's a situation of concern to all of Russia.

–Richard Stone