

that Linux has a chance at the desktop market." A Microsoft spokesperson has confirmed publicly that these memos are legitimate, saying they describe "business models that would be valuable in order to stimulate additional internal dialog within Microsoft."

Linux is not the only success of the open software movement. Many add-on programs, so-called utilities such as the file compression program Zip, and file readers such as Ghostview were born of this movement. Apache, an Internet server program that runs under Linux and was developed by about 20 programmers from around the world, is now found on more than half the computers that host Web sites, according to the November 1998 Netcraft Web Server Survey (www.

netcraft.com/Survey). BIND, developed by hackers at the University of California, Berkeley, in the 1980s, is used by virtually every Internet router system to convert Web aliases into true numeric addresses, and the open-source program Sendmail routes about 80% of all e-mail sent today.

Netscape embraced the open-source software credo last March when it released the source code for the latest version of its Communicator software. Within hours after its release, a group of Australian hackers wrote a small piece of cryptographic code that greatly increased the security of Communicator, which can be downloaded free from Netscape's Web site. Netscape got the fix for free, every user of Commu-

nicator benefited, the Australians, who call themselves the Mozilla Crypto group, got kudos from the programming community for their great hack, and their consulting group, Cryptosoft in Brisbane, probably got some more business.

Is the open software movement likely to have further successes? Microsoft evidently thinks so. These programs have proven to be "at least as robust—if not more—than commercial alternatives," wrote Valloppillil. And for participants in the movement, the rewards remain strong. "It's a very positive ego thing, knowing that you've contributed to a great piece of software," says Lewis.

—JOSEPH ALPER

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RUSSIAN SCIENCE

New Minister Sets Lofty Goals

As Russia unravels, Science Minister Mikhail Kirpichnikov struggles to find a balance between supporting basic research and forcing science to pay for itself

MOSCOW—If you find running a lab and stumping up grant support an oppressive burden, spare a thought for Mikhail Kirpichnikov, Russia's new science minister. Kirpichnikov, a protein chemist who still manages to keep one foot in the lab, is trying to patch together enough resources to keep the entire country's once-proud research enterprise from crumbling away. It's a daunting challenge. Russian researchers, sick of not receiving salary for months, are staging strikes. Unable to pay utility bills, institutes are plunged into a cold twilight during working hours. The few labs able to sustain world-class research rely on foreign colleagues for access to instruments or reagents. And in the latest blow to Russia's scientific community,

the ruble has lost two-thirds of its value against the dollar in 3 months, vaporizing razor-thin budgets for Western research supplies.

Kirpichnikov, who moved into the research hot seat on 25 September, says his chief priority is to "do everything we can to protect basic research. It is our country's destiny." But just how to fend off further decay is a matter of vigorous debate among rank-and-file scientists—and is likely to dominate discussions at a meeting next week in Moscow, co-sponsored by the ministry and the Paris-based Organization for Economic Cooperation and Development, on the future of Russian science. Kirpichnikov "understands all the problems of science, I think," says Alexander Litvak, deputy director of the Institute of Applied Physics in Nizhny Novgorod. "But what depends on him? It all depends on money." Still, top officials place high hopes in him. "I am convinced that Kirpichnikov ... will do his best to preserve the best of Russian science," says Michael Alfimov, chair of the Russian Foundation for Basic Research, Russia's version of the U.S. National Science Foundation.

Kirpichnikov, who agreed to an interview with *Science* despite government restrictions on Cabi-

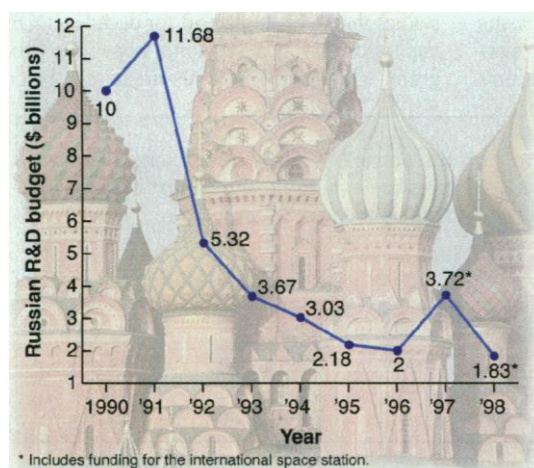
net members speaking with the press, says he is ready to try some new maneuvers to steer Russian science through its latest crises. These measures may include channeling money to some disciplines at the expense of others and "aggressively" claiming intellectu-

al property rights for scientists. To Kirpichnikov, saving Russian science means exploiting it: stepping up efforts to patent inventions, license products, and contract out research. "Science is one of our strategic resources, a reusable resource," he says. "For years, science has been underutilized."



In the hot seat. Kirpichnikov.

Kirpichnikov acknowledges, however, that his ministry's options are limited by Russia's dwindling finances: This year, the government will spend less than \$2 billion on science, the lowest sum in decades—and that's an official figure that, optimistically, includes payment of overdue salaries by month's end (see graph). August's financial crash made a bad situation far worse. The ruble lost half its value in a week, cutting pay for top scientists to \$100 a month, says Vladimir Strakhov, director of the All-Union Institute of Earth Physics in Moscow. The result was double jeopardy for research: "On the one side, the ruble fell, and on the other, we get less rubles," says Strakhov, who went on a hunger strike in 1996 to protest shrinking research budgets. "Today's situation is the worst it's ever been for Russian science. And the most difficult times are in the future." Sources say that next year's budget, which is expected to go to the Duma, the lower house of parliament, on 12 December, includes a paltry 8 billion rubles (\$444 million, at the present exchange rate) for science.



Sifting through the ruble. Science funding is in free fall.

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NEWS FOCUS

Kirpichnikov, 53, has experienced the rise and fall of Russia's scientific community firsthand. He graduated in 1969 from the prestigious Moscow Institute of Physics and Technology, specializing in molecular biophysics. From there he landed a research position at the Engelhardt Institute of Molecular Biology, where he pioneered techniques for making artificial proteins, racking up more than 200 publications. His research has been "highly appreciated and recognized by the scientific community," says Alfimov. Today, Kirpichnikov heads the institute's protein engineering group, where he still puts in regular appearances. "When I come to my laboratory, it's a kind of relaxation for me," he says.

Conducting research provides a respite from Russia's government offices, where Kirpichnikov has labored for the last 9 years. He spent 4 years as a division chief in the science ministry before becoming director in 1993 of the government's Department of Science, High Technologies, Education, and Culture—a position similar to that held by Neal Lane, President Clinton's science adviser. Known as an intelligent and soft-spoken administrator, Kirpichnikov forged a strong ally in former Science Minister Vladimir Bulgak, now a deputy to Prime Minister Evgeny Primakov. For 2 years Bulgak talked up plans for commercializing Russian research and closing some of the Russian Academy of Sciences' roughly 350 institutes, where much of the best research is done, but he failed to deliver on the promised reforms (*Science*, 14 November 1997, p. 1220).

Like Bulgak, Kirpichnikov says he hopes to "target funding for research priorities" and "increase the competitiveness of Russian scientists on the world market." He rattles off a list of areas that he says merit special attention: molecular biology, genetic engineering, physics, new materials, telecommunications, and information technology. "Not a single country in the world can carry out research in all disciplines," he says. Targeting research in this way, he acknowledges, would require restructuring the academy.

The question is whether Kirpichnikov can do any better than Bulgak in shaking up a research system deeply rooted in the Soviet era, when there was little competition for funding. Institutes still receive budgets determined primarily by the size of their staffs, and the science minister has no authority over how the academy spends its money. Kirpichnikov, for now, declines to reveal how his ministry might steer more money to labs in strategic areas. And when he does show his hand, he is sure to provoke a backlash from scientists clinging to tenuous careers. "The very mention of reforms irritates impoverished scientists," says Leo Borkin, founder of the St. Petersburg Association of Scientists and Scholars.

Kirpichnikov also faces a tough challenge in trying to stem the loss of Russian innovations overseas. The brain drain of the early 1990s may be over, but for "any scientist who remains here in Moscow, his intellectual property may drain to the West," Kirpichnikov says, referring to dozens of contracts inked between Russian researchers and firms such as Microsoft and Motorola, as well as inventions for which institutes lack funds to seek patents. "We don't have much experience with protection of intellectual property. This worries me a lot." The ministry is exploring ways to safeguard Russian inventions without harming the ability of scientists or institutes to cut deals with foreign firms, and they will seek ideas at next week's meeting in Moscow.

One recent thrust Kirpichnikov says he's planning to continue is a ministry program called Integration, which spent \$32 million this year priming collaboration between researchers at the academy institutes, where the best science often takes place, and professors and students at universities. Loosely coordinated with a similar initiative run by the Education Ministry and Western foundations

(*Science*, 29 May, p. 1336), Integration is expected to remain a priority next year, with an undetermined amount of new funds set aside for equipment for future joint academic-university labs, called Centers of Excellence. "This is a very acute issue," Kirpichnikov says. "Most equipment is out of date."

Reform-minded scientists welcome such moves, but they argue that the prospects for Russian science are now so dire that radical surgery is needed. "It's terrible," says Strakhov. "Instead of reading scientific literature and discussing problems, scientists must spend their time selling cigarettes or tending gardens. They're losing their professional level." The time has come, he says, to fire mediocre scientists and close lame institutes. "The government is avoiding confronting this inevitable question. They are afraid of the responsibility." With the gauntlet thrown down, Russian scientists are waiting to see if Kirpichnikov, unlike his predecessors, will pick it up. Over the next few months, those precious few hours Kirpichnikov spends in his lab are likely to seem more and more appealing. —RICHARD STONE

NUCLEAR POWER

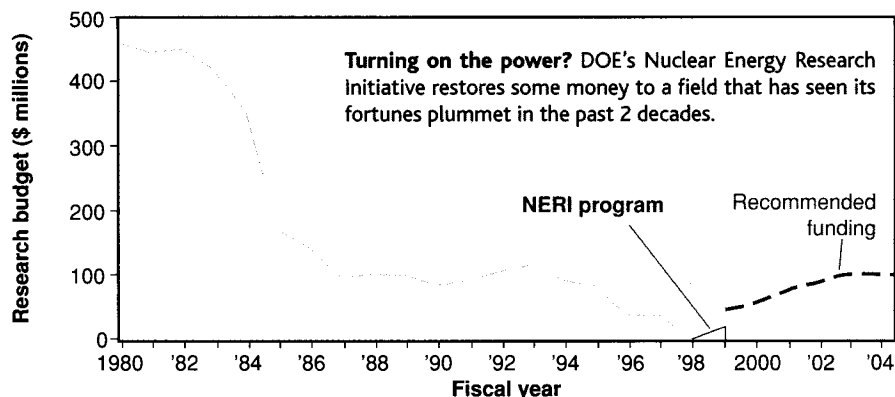
New DOE Research Program To Boost Sagging Industry

A \$19 million competitive grants program aims at developing new technologies and reinvigorating the nuclear science community

When nuclear engineers from academia and industry gathered last month in Washington, D.C., for an annual conclave, they heard an old refrain: The prospects for building a nuclear power plant in the United States anytime in the foreseeable future are bleak. Panelists noted that no new U.S. plants have been ordered since 1978, and many others have been shuttered because of cost and safety concerns. And there was consensus that an increasingly competitive power market may soon snuff out more of the nation's

109 aging plants. But, amid the gloomy predictions, researchers heard one note of optimism: Officials at the U.S. Department of Energy (DOE) had breathed fresh life into the government's moribund nuclear research program with the creation of a Nuclear Energy Research Initiative (NERI).

Supporters say the \$19 million initiative is a desperately needed first step toward funding studies that may not pay off for decades. DOE undersecretary Ernest Moniz hopes the program, which has six focus areas (see box),



SOURCE: DOE