data. The downside of open access was brought home by a recent intrusion that briefly crippled the machine on which the director of the computing division reads his e-mail.

But none of the alternatives to open access looks very attractive, says Greg Woods, an NCAR software engineer. A single gateway, he says, "would be a real bottleneck. ... We will have to have more than one [gateway] machine directly accessible to Internet users." Woods and his colleagues are also considering one-time passwords. But many scientists send in their data in automatic scripts that run in the middle of the night. One-time passwords could make that more difficult because someone might have to be present to respond to the computer's challenge. "We have to be careful not to make it too hard for our users," says Woods. "If it's too hard, people will try to get around it. They'll try—unintentionally—to subvert the security."

Laissez-faire at the universities

These dilemmas are felt even more keenly at universities, long used to keeping their computers open to the easy flow of information. One university's experience with a fire wall has been positive (see box), but many others insist that their students and faculty won't put up with even minor restrictions on their Internet access. System administrators at Columbia University, for example, say the idea of a fire wall has been tossed around, but their users simply wouldn't stand for it.

Yet security problems at universities can be even more acute than at government institutes because their computer systems are managed so loosely. Thanks to cheap desktop computing power, nearly every departmental research group has its own workstations, ordered directly from the manufacturer and installed and maintained by a graduate student who would rather be doing something else. Most universities have taken a rather laissez-faire attitude toward these security vulnerabilities, but as evidence of the dangers mount, they are taking some first steps. Many are adopting network programs that conceal informative files such as lists of user names and force users to choose passwords that are hard to crack. The Massachusetts Institute of Technology is trying to reduce its system's vulnerability through its use of Kerberos, a program that encrypts information passing through the huge campus network.

For the long term, universities are hoping that the burgeoning research on computer security will soon deliver some better way to balance security with user needs. One line of work is aiming at building a better fire wall, such as the experimental one erected by the distributed systems group of Stanford University's computer science department last year to protect the group's computers. Thanks to some fancy programming, the fire wall appears virtually transparent to authorized users both inside and outside it.

Another avenue of research starts with the assumption that computers and networks cannot be designed without security holes and aims instead to detect break-ins early. For example, researchers at the University of California, Davis, are working on artificial intelligence programs that can recognize anomalies in network use. Ultimately, such programs might be able to respond to suspicious activity by cutting off the suspect user or notifying the system administrator.

In the meantime, universities and other institutions are moving cautiously. As TIS's Ranum puts it: "If you're so scared of the hackers that you destroy the network to protect it, they've won."

–Ellen Germain

Ellen Germain is a science writer in New York City.

RUSSIA

Chechnya War Threatens Science

MOSCOW—Another year of financial chaos is in store for Russian scientists in 1995. Last week, deputies in the Duma, the lower house of Russia's parliament, put themselves on a collision course with Boris Yeltsin's government over this year's science budget. Members of the Duma's subcommittee on science more than doubled the requested amount for science for the year, an increase that would still fall short of the country's 200% inflation rate. But it will be virtually impossible for the government to pay even this amount and still meet other commitments, such as the war in Chechnya, that are draining the public purse.

The government's proposed budget for 1995 was debated in mid-December in the first of three sessions that analyze the proposals in increasing detail. This first revision pegged science to receive 5.4 trillion rubles (about $1.36 billion), which is 2.5% of total government expenditure. Although this is 500 billion rubles more than last years' science spending, it would have been a substantial cut in spending power because inflation totaled 204% in 1994.

Last week, however, in the second Duma budget session, deputies from the science subcommittee proposed hiking science spending to 13 trillion rubles ($3.25 billion). From this pot, the Russian Academy of Sciences, which runs most of the country's fundamental research institutes, would receive $401 million, and the Foundation for Basic Research, a new body that dispenses Western-style peer-reviewed grants, would receive $110 million. The committee also earmarked $70 million to continue work on several key nuclear physics facilities—at Protvino and Dubna near Moscow, Gatchina near St. Pe-

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A prolonged military operation could undo proposed increases in the science budget.
— Alexander Pochinok

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tersburg, and Novosibirsk in Siberia—that have been unfinished since the collapse of central funding several years ago.

The third and final session, in which deputies vote on all the proposed changes, is due to take place in mid-February, after which the budget will become law. But deputies are already pessimistic about the government's ability to stick to the budget. Estimates for the cost of the campaign in Chechnya and for reconstruction run into trillions of rubles. Alexander Pochinok,

deputy chair of the Duma budget committee, says that if military operations last much longer, it may sink the whole budget and lead to a "wartime budget" with severely restricted expenditure on science, culture, and education. Anatoly Shabad, the Duma deputy who leads the work on Russia's new science law, has visited Chechnya several times during the conflict and is even more pessimistic: He says it is already practically impossible to pay for the conflict and maintain this budget.

Another drain on the goverment's coffers will be the Duma's populist stance on a minimum wage. A new law that raises minimum salaries to 54,100 rubles ($13.50) per month will double the budget deficit, which currently stands at $18.5 billion. Duma deputies worry that with more budget commitments than it is able to pay for, the finance ministry will withhold money for some programs, as it has done in previous years.

So Russian scientists have another year of belt-tightening to look forward to. Pochinok says the government may have to face the unpleasant task of reducing the number of research institutes it supports. He believes the country should concentrate its resources in key institutes—"the pride of Russia," he calls them, without naming names—as well as awarding grants to specified research programs.

–Andrey Allakhverdov

Andrey Allakhverdov is a science writer in Moscow.