ent languages. Other research topics at Media Lab Europe include chaos and complex systems and biofeedback—a two-way link between man and machine that researchers hope could lead, for instance, to waking people from comas.

Media Lab Europe hosts students from MIT and universities in Europe and may someday grant master's degrees and PhDs. The lab is also forming an incubator program called media lab ventures, intended, says Callinan, as a "halfway house between the research lab and the cruel world of start-ups."

A 10-year contract not only arranges for the Cambridge- and Dublin-based media labs to share inventions and knowledge, but also assures the Irish government that the parent MIT Media Lab won't create new satellites in Europe—for which, media lab members say, there is no shortage of interest.

Technology serving the masses

"We have had many projects using technology in the services of the masses—geodesic domes, minitractors, water prospecting instruments, and now computer-based lessons," says Shrinath Kalbag, who, after retiring as head of the engineering science division of Unilever in India, moved to a rural village near Pune to start the Vigyan Ashram. "Our main objective is to reform the educational system of India, which I believe is the root cause of all our problems," he says. "We also have many needs, where our lack of knowledge is the hurdle in developing or using technology. This is where Media Lab Asia comes in."

"We didn't wake up one day, and say, 'Let's go to India and give them gadgets,' " agrees Gershenfeld, who is coordinating technology for Media Lab Asia. "We were pulled in. Media Lab Asia is based on the belief that many of the hardest problems in development need not the lowest, but the highest, technology. We found an

NEIL GERSHENFELD

Neil Gershenfeld (right) visits officials in the new Indian state of Chattisgarh to discuss applying information technology for handling local land records.

amazing overlap between their problems and the capabilities we could help provide. It's demand driven."

Gershenfeld tells of a visit to a rural village in India: "They wanted roads that don't wash out, a hospital, and a network of computers to replace their written land records, which determine taxes and benefits and are a source of great corruption. They didn't use these words, but what they were asking for was a low-cost computer that could be powered by people, not batteries; that is multilingual and multimodal—the villagers are illiterate; that has secure encryption; and that could integrate data with geographical information so they could learn about disasters as they happen. If you start assembling that string, it goes far beyond what a laptop does today. These are hard problems that are emerging in computing technologies. And, to be deployable on the scale of India, they have to be made locally by micro-entrepreneurs—they can't feasibly be produced and customized at a distance."

Chikan embroidery is another example, says MIT's Michael Best, one of Media Lab Asia's directors. "There is some work on building a printing technology that would allow women to get the patterns off the Net and iron them onto fabric. They are entrepreneurial women who are interested in taking this process in directions that allow them to engage in the market economy."

Media Lab Asia is planned as a partnership of the Indian government, India's prestigious Institutes of Technology, corporations, and rural nongovernmental organizations. Unlike the US and European media labs, it is starting out as a network. Sites in Mumbai, New Delhi, Kanpur, and Chennai will focus on developing various aspects of computer operating and networking systems for local needs, such as multilingual computer systems, computers for kids and for people who don't read, wireless systems, and a non-desktop interface. Microsoft® Windows®, says Best, "makes use of a metaphor called the desktop. Why should a community that doesn't value the desk want to use a desktop? There will be learning and education, but local culture will be the background music to all of these projects."

Media Lab Asia starts out with $12 million from India's Ministry of Information Technology, of which about $1.7 million goes to the MIT Media Lab. After a year, the two will negotiate a 10-year plan, with a total budget of $500 million to $1 billion, most of which will have to be raised from industrial sponsors. "We anticipate that the lab will impact all 1 billion people in India in some meaningful way. It may have a pan-Asian, or even a global reach," says Best.

In the media lab expansions at MIT and abroad, says Gershenfeld, "the hopes and fears are the same—organizational scaling. One danger is that we could overextend. Another danger is becoming the establishment. But that's one more reason we are doing all these changes—to reset, to bring new energy."

Toni Feder

Math and Science Suffer in Education Bill

On 19 December, less than a week before Christmas, members of the House of Representatives were scrambling to wrap up several pieces of legislation so they could leave for the holidays. One item on the agenda was the final appropriations report for an education bill that would authorize $26.5 billion in federal spending in 2002—about $8 billion more than in 2001.

The bill, promoted by President Bush as the No Child Left Behind Act, had passed both the House and Senate with overwhelming majorities and the president was eager to sign it into law. But Representatives Vern Ehlers (R-Mich.) and Rush Holt (D-N.J.), the two physicists in Congress, were not happy. A complex interplay of political ideologies and inattention had caused the final bill to be stripped of millions of dollars intended primarily for training elementary-school teachers to better teach science and math. The two scientists-turned-politicians used a procedural device called a colloquy

> The hundreds of millions of federal dollars that in past years supported training of elementary school math and science teachers have been redirected into new math and science partnerships, and the result may be less money for the teachers.

to try to limit the damage.

Addressing appropriations subcommittee chairman Rep. Ralph Regula (R-Ohio), Holt said, “It is my understanding . . . that it is the intention of the committee that no less money than last year be spent on teacher training for math and science. Is this correct?”

“That is correct,” Regula replied. Ehlers then stepped forward. “It is my understanding that . . . no less than $375 million be expended on math and science professional development in fiscal year 2002. Is that correct?” Regula responded that Ehlers was “substantially correct.”

On those two exchanges, which establish congressional intent but do not have the force of law, hangs the bulk of the federal funding for training science and math teachers. Although Ehlers is hopeful that it will be enough to steer the money to science teacher-training programs, there are no guarantees.

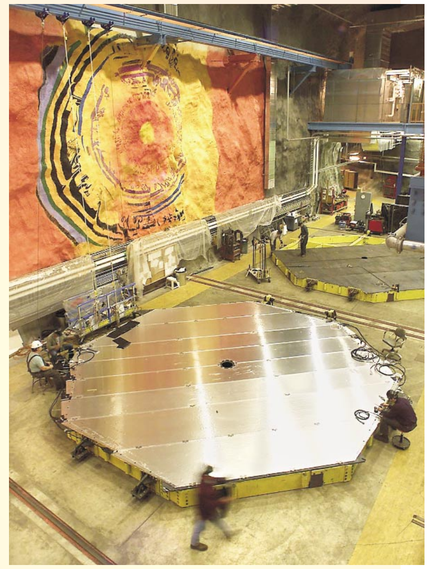
Why Ehlers and Holt had to resort to a colloquy to try to save the funding is a complex story. It begins with the decision by the administration and some House Republicans to end the decades-old Eisenhower Professional Development Program, which for many years has earmarked hundreds of millions of dollars for math and science teacher training. In 2001 alone, the money available to school districts for developing math and science teachers, especially at the elementary level, was the $375 million figure mentioned by Ehlers.

But the Eisenhower program had become more than a teacher-training fund in recent years. President Bill Clinton increased the money in the program, then used it to fund a host of other education-related activities. To prevent the math and science training money from being diluted, the Eisenhower program was restructured so that about 85% of the overall money was guaranteed for math and science teacher training each year.

As the scope of the program was expanding, Ehlers said, House members who disliked it because it directed school districts to use the money for a specific purpose, repeatedly tried to kill it. “I’ve saved Eisenhower four times,” Ehlers said.

Neutrino Detector Lab Looking Good

In an old hematite mine far below the ragged landscape of Minnesota’s Iron Range, workers have installed about one-quarter of the 486 octagonal steel “planes” that will make up the 5500-ton “far detector” for Fermilab’s Main Injector Neutrino Oscillation Search experiment. The $40 million detector, located in a newly excavated chamber in the Soudan Mine, will be the target for a neutrino beam line being constructed 730 kilometers away at Fermilab.



DULUTH NEWS TRIBUNE

The MINOS experiment is part of the Fermilab’s “neutrinos at the main injector” project. The $167 million project includes the construction of a “near detector” and the new Fermilab beam line, as well as the far detector at Soudan. By firing the neutrinos through the near detector to the far detector, physicists hope to measure neutrino oscillations that will provide evidence about the mass of the elusive particles. Physicists hope the far detector, made of alternating planes of steel and plastic scintillator strips, will detect about 9000 neutrino interactions out of the 5 trillion neutrinos that pass through it each year.

For about 15 years, the Soudan site has been the home of the Argonne–Minnesota–Oxford–Rutherford–Tufts Soudan proton-decay detector, housed in a room adjacent to the new neutrino detector. To install the neutrino detector, a chamber about 690 meters underground was excavated, creating a room 84 m long, 16 m wide, and 14 m high. The steel detector planes, each about 8 m in diameter, are constructed horizontally on the lab floor, as shown in the photo, then stood vertically and moved into position in the detector. The detector is expected to be completed in late spring of next year. The first firing of neutrinos is expected in about two and a half years.

In addition to being a science laboratory, the Soudan Mine attracts some 40 000 visitors each year to the labyrinth of ore mine tunnels. As part of a public outreach effort, the Minnesota legislature funded a visitors’ gallery in the neutrino lab, and the University of Minnesota physics department commissioned the 8-by-18-meter mural on the wall opposite the gallery, shown about 25% complete in the photo. The mural, by artist Joseph Giannetti, symbolizes the formation and expansion of the universe.

JIM DAWSON

Eisenhower replaced

The Bush education proposal also called for eliminating the Eisenhower program, and instead proposed a $200 million math and science partnership program at NSF. Instead of giving money directly to school districts, the program would fund partnerships in which colleges and universities would work with local school districts to improve math and science teaching. Funding for the NSF partnership settled at $160 million, with $120 million of that coming from other NSF programs.

Meanwhile, back in the House, the education bill was being shaped so that it took much of the federal money that had been going to school districts under the Eisenhower program and lumped it together with class size reduction and other programs in a general $2.85 billion block grant. The grant didn’t specify money for math and science teacher training until Ehlers interceded. “I got language in the bill that a certain percentage of all of the funds [in the block grant] would be exclusively for math and science teacher training,” Ehlers said. The Eisenhower program was dead, but the money lived on based on Ehlers’s language. By making the math and science training funds a percentage, a “set-aside” from the larger block grant, Ehlers avoided establishing a separate program, which House Republicans didn’t want. Ehlers’s percentage language would have dedicated $450 million for math and science teacher training in 2002.

The Democrat-controlled Senate, however, did want a separate program and established a math and science partnership program in the Department of Education. The authorization for the partnership, which was separate from the NSF program of the same name, was a whopping $900 million. The House and Senate bills, each with significant money for math and science teacher training but with very different funding approaches, then went to a conference committee for a single, final version. The committee went with the Senate’s approach by setting up the partnership as a separate program rather than a percentage of the large block grant. The conferees then authorized funding for the Department of Education partnership at $450 million.

Money vanishes

But when the education bill went before the joint appropriations committee, the $450 million all but went away. "As many people forget, an authorization isn't an appropriation," Holt said. "There was no one in the [appropriations] conference committee looking out for science education. I wouldn't call anyone an enemy of the partnership, but there was no one who felt responsibility for the partnership."

The appropriators, Holt said, looked at the partnership as a new program because the final education bill structured it that way. "When appropriators see a new program, they are reluctant to put too much money into it, and because nobody was there to explain what the history was, the partnership only got a small fraction of what was authorized." That fraction amounted to $12.5 million.

With the guaranteed money for the partnership reduced far below the level needed to run state-based programs, Holt and Ehlers had to use their colloquy on the House floor to try to fund math and science teacher training from the $2.85 billion education block grant. Whether that will happen is not clear.

"While the block grant is there for professional development, it is also available for 13 other uses, including class-size reduction, hiring, merit pay, and teacher testing," said Jodi Peterson, the legislative director of the National Science Teachers Association. "The teachers are already standing at the back of the line and if it comes down to a school district using the money for hiring a new body or training a teacher in math and science, we're afraid training won't be a priority."

Instead of trying to create new partnerships with its $12.5 million, the Department of Education has indicated it will co-fund some of the NSF math and science partnership programs. "The NSF program was supposed to be the developmental project, the laboratory, for the larger Department of Education program," an education specialist on Capitol Hill said. "It didn't turn out that way."

The funding situation doesn't change much under the administration's 2003 budget proposal, which calls for the NSF partnership to be funded at $200 million and the Department of Education partnership to receive $13 million. Ehlers and Holt indicated they will try to restore guaranteed math and science teacher training money that goes directly to school districts. In the meantime, they hope that their colloquy fills the void. **Jim Dawson**

Powerful NMR Machines Debut in US

OXFORD INSTRUMENTS

A 900-MHz nuclear magnetic resonance device.

US laboratories are installing the first batch of 900-megahertz (21-tesla) nuclear magnetic resonance (NMR) machines months ahead of their European and Japanese competitors. With a 12% increase in resolution over their 800-MHz (18-T) predecessors, the new machines can resolve previously inaccessible protein structures. "NMR is probably the most versatile if not unique tool to study such complex structures," says Andrey Geim, a leading expert in high magnetic fields from the University of Manchester in the UK, "and these new machines are incredibly technologically complex." Ten 900-MHz systems are either deployed or currently in production worldwide; and the only two wide-bore models, which accommodate larger-than-usual samples, will both be in the US.

At the heart of the new machines are superconducting coils, cooled with liquid helium, that create a 21-T magnetic field uniform to one part in a billion. Any slight instability in the magnetic field can create a millikelvin temperature change in the system, which in turn can destroy the superconducting state and crack the magnet. To combat these effects, engineers have developed new ways to contain the immense stresses on the magnets.

NMR machines work by sending a series of radio-frequency pulses through a magnetically polarized sample (see Physics Today, September 2000, page 19). When the frequency of the pulses matches the Larmor frequency of a particular type of nucleus in the sample, those nuclei absorb and emit energy. The resonant frequencies identify the isotope—for example, 900 MHz is the resonant frequency of hydrogen in a 21-T field. NMR can also indicate what chemical bonds are in the sample. "This chemical shift is usually small, which makes the resolution so important," says Geim.

"Even an incremental improvement in magnetic field strength can often lead to dramatic advantages for the spectroscopy or imaging of specific molecular systems," says Timothy Cross, NMR spectroscopy and imaging program director at the National High Magnetic Field Laboratory (NHMFL) at Florida State University in Tallahassee. Many peaks hidden in previous NMR spectra can now be detected with the increased resolution. And experiments that used to take a month can be done in days.

Building these multimillion dollar machines can take years and, because of the high cost, most of these new systems are being sold to national or international research centers. Last June, the nonprofit Scripps Research Institute in La Jolla, California, took delivery of the first narrow-bore (55-mm diameter) 900-MHz NMR system from Bruker Instruments in Germany. "It's fantastic," says Peter Wright, chairman of the department of molecular biology at Scripps. "The capabilities of this instrument take us to a new level."

Scientists are even more excited about trying out new wide-bore machines. "Mice are commonly used animal models for a variety of biological studies," says Cross, "and adult laboratory mice cannot be accommodated in a narrow-bore system." The extra room provided by a wider bore also allows research into solid-state materials, catalysts, and large membrane proteins. One of the wide-bore systems (65 mm), developed by UK-based Oxford Instruments, will be at the William R. Wiley Environmental Molecular Sciences Laboratory at the Department of Energy's Pacific Northwest National Laboratory. The