The State Council approved the regulations on 10 June, but health ministry officials say the country's preoccupation with the disastrous flooding this summer has delayed a formal announcement.

"We will absolutely stop those projects that do not conform to the regulations."
—Yu Xiucheng

One of the few scientists who has been given a copy of the regulations, Jiang Feng of Shanghai Medical University, says their existence is "good news. … At least we know where we stand and what to do next." Jiang is working with Thomas London and others at the Fox Chase Cancer Center in Philadelphia on a study of the molecular epidemiology of liver cancer in men from the eastern Jiangsu city of Haimen. The study has been suspended for more than a year, and Jiang estimates that the delay has prevented early diagnosis of the disease in at least 150 patients. A colleague currently in the United States, Shen Fumin, is going over the new rules with his U.S. partners to make sure that the 5-year project, funded by the National Institutes of Health, is in compliance.

The regulations will be implemented by an office, jointly staffed by both ministries, that is being set up to oversee all international collaborations involving human genetic materials—blood, tissue, organs, and so on—and to approve exports of such material. Any materials lacking the required approval will be confiscated by Chinese customs. "We will absolutely stop those projects that do not conform to the regulations," says the health ministry's Yu Xiucheng, who helped draft the rules and is scheduled to head the new office. However, he said the office will be more lenient toward projects that will not take blood samples and other sensitive material out of China.

Yu says the office plans to review applications in batches, every 3 months, using an expert panel of scientists from around the country. Before seeking approval from his office, however, potential collaborations must first submit an application and draft contract to local departments where the Chinese partner is located and include written approval from donors of any genetic materials and their relatives. "This is to show respect to local authority with the immediate access to the sources," Yu says. Local authorities would collect an as-yet-unspecified fee, he adds.

But some scientists are worried about possible delays, and they question the imposition of a fee. "Once every 3 months is too slow. It should take 4 weeks at most," says Jiang. Harvard epidemiologist Xu Xiping also worries that the government will not provide enough staff to handle the workload and that some investigators will abandon their projects out of frustration. Other scientists say that the fee gives the impression that the government is trying to make money from research and selling the opportunity to do science to the highest bidder.

The regulations also address the issue of ownership, both of the material itself and any commercial value it may have. Patent rights and any profits will be shared in proportion to the contributions of each party. Yu says the requirement for informed consent reflects the government's concern for human rights and brings China in line with Western practices. He adds that there are also plans to review the rule in 3 to 5 years.

Yang Huanming, director of the newly established Human Genome Center within the Institute of Genetics of the Chinese Academy of Sciences, predicts that the new rules "will do more good than harm." He notes that "most of these projects have already sought permission from the relevant authorities" but that "the new regulations provide uniform principles." Wu Ming, a leading geneticist in Shanghai, praises the new provisions to protect patient rights. "After all, human beings are not animals, and they deserve due respect," he says. The new regulations, he adds, should send an important signal to the global research community about working in China: "Those who used to do whatever they liked will now have something in their way."

—LI HUI

Li Hui writes for *China Features* in Beijing.

ECOLOGY

Impact of Primate Losses Estimated

Like doctors battling a deadly disease, conservationists go about their work knowing that many species will die out despite their best efforts. A new analysis of looming primate extinctions now adds to the gloom: It suggests that the impact of extinctions in certain regions could be more damaging than one might expect from numbers alone, and that conservationists should pay more attention to the ecological value of species.

A team at the State University of New York, Stony Brook, combined data on the endangered status of primates with information on what those primates do in an ecosystem—disperse seeds, pollinate plants, or serve as prey for other animals, for example. In the current issue of the *Proceedings of the National Academy of Sciences*, they predict that in some parts of the world entire guilds of primates that perform specific and critical ecological roles will be lost, leading to deep impacts on ecosystems. "If we eliminate some of these species, there's going to be a whole hunk of ecosystem health that will be gone forever," says primatologist Patricia Wright, who did the work with her husband, evolutionary biologist Jukka Jernvall, at the University of Helsinki in Finland.

Ecologists have long noted that the loss of species that do a specific ecological job can have ripple effects across an ecosystem. Jernvall and Wright sought to quantify such impacts for primates, well-studied mammals that play key roles in many ecosystems.

The duo made their predictions using two potential waves of extinction, first removing all the endangered species, then all those now listed as threatened. Next, they examined 17 variables such as diet, habitat, tooth type, and body size and used them to characterize species' ecological roles—as predators or seed dispersers, for instance. Finally, they mapped out how the ecological diversity of the primates in a particular region would change as species die out.

The results varied dramatically by region. In South America, the set of doomed primates spans ecological niches, so the impact should be proportional to the number of species lost. But the ecological impacts will be worse in Asia, Africa, and especially Madagascar, where entire guilds of primates with similar specializations will be lost in a single clump. For example, in Madagascar the potential losses include a group of fruit-eating lemurs that disperse seeds, and in Africa they include the great apes, which also disperse seeds and eat massive amounts of foliage. "After that, no primate is doing that job in the forest," Jernvall says. Such losses might hasten the extinction of trees dependent on the seed-dispersers and so affect organisms dependent on the trees, says Wright.

D. HARDING/ANIMALS ANIMALS

Facing the future. Other species may suffer if seed eaters like this ruffed lemur die out.

But some primatologists say the results may not mean much for conservation. "It's an interesting exercise, but it doesn't get us that far in practical terms," says Ian Tattersall, a primatologist at the American Museum of Natural History in New York City, who notes that knowing the ecological effects of extinctions doesn't help much in staving them off.

Still, ecologist Stuart Pimm of the University of Tennessee, Knoxville, thinks this kind of study is quite valuable, because it helps "bridge the gap" between studies of extinction and of ecosystem productivity. "Most of what we do in terms of documenting species loss tends to look at the species as completely independent of each other," says Pimm. "In fact, the better analysis would be that you're tinkering with a complex piece of machinery."

–JOCELYN KAISER

QUANTUM COMPUTING

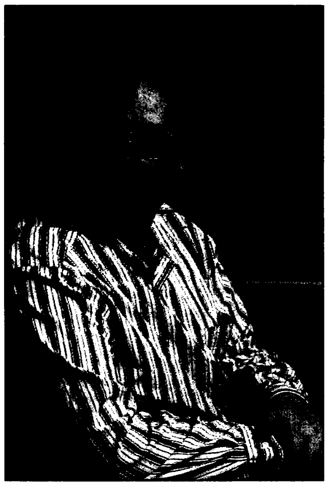
Fighting Corruption in The Quantum World

If there is one sure thing in the computer industry, it is that sooner or later, engineers will not be able to squeeze any more circuits onto chips. But an enthusiastic group of researchers is speculating about a whole new realm of miniaturization: devices so small that they operate according to the unfamiliar quantum laws of the atomic world. Quantum computers could remain a dream unless physicists can find a way around the vexing tendency of quantum information to leak away and degrade. But now a team of Los Alamos theorists and East Coast experimenters has shown that quantum computers could identify errors and fix them.

"What we have done is demonstrated in an experiment for the first time that we can make quantum information more robust, that we can protect it against corruption," says Raymond Laflamme, a member of the team at Los Alamos National Laboratory in New Mexico. According to David Deutsch of the Centre for Quantum Computation at the University of Oxford in England, "it's an important step toward the goal of building a useful quantum computer."

Current "classical" computers process information, or bits, as digital 0's and 1's. In quantum computers the element of information, the qubit, is a blend of both a 0 and a 1, their relationship expressed by the qubit's "phase." This mingling allows an array of qubits to carry a whole swath of numbers simultaneously, even though actually reading the array will yield just one value as the quantum states "collapse." By working on entire sets of numbers all at once, a quantum computer can in principle solve certain types of problems incredibly efficiently. Factoring big numbers, for example—a taxing task for today's computers—would be a cinch for quantum computers and would render obsolete today's most secure encryption systems, which are based on the difficulty of this task.

Unfortunately, a passing atom can interact with a qubit, causing some of its information to leak away and introducing errors. Skeptics say that the fragility of quantum information threatens the whole idea of a practical quantum computer. Because there is no way to avoid the errors, the next best thing is to correct them. This is not easy for quantum information, because reading it out to check for errors or correct them instantly collapses the qubit array, spoiling its number-juggling capacity. "The whole trick of the quantum error correcting code was to find a way to know what the error was without knowing what the message is," says Laflamme.



AT&T LABS

Error buster. Peter Shor's quantum error correction code has been shown to work.

In 1996 Peter Shor of AT&T Bell Labs and, independently, Andrew Steane at Oxford devised a theoretical scheme for doing so. The basic idea is to spread the information of one qubit into a family of linked qubits so that, should any be corrupted, the information can still be recovered from its partners. Now Laflamme and his Los Alamos colleagues have teamed up with a group of Massachusetts-based specialists in nuclear magnetic resonance (NMR) to demonstrate the scheme with atomic nuclei that encode qubits in their magnetic orientations.

A nucleus can behave like a small magnet and point either up or down relative to a strong magnetic field. Thus a molecule could be used as an array of qubits, with the nuclear orientations encoding 0's (up) and 1's (down). To control such an array, the researchers used NMR to manipulate the orientation of nuclear magnets by tweaking the nuclei with radio-frequency waves.

In the 7 September *Physical Review Letters*, the team describes tests on two molecules: alanine, an amino acid, and trichloroethylene. Both provide a suitable set of three neighboring nuclear magnets: a single information qubit plus two control qubits to provide error correction. The researchers first used a radio-frequency pulse to twist the linked nuclear magnets into a particular position, then left them to the mercy of their surroundings. Errors caused the three magnets to drift out of alignment before a further radio-frequency pulse reversed the initial twisting. Because the three magnets are linked magnetically, enough information was contained in the misalignment of the two control qubits to allow the team to figure out the error on the information qubit without having to measure it directly. The experimenters then showed that they could correct the error with another pulse. "We've demonstrated in the smallest and simplest code that we had enough control to do the right operation and preserve the quantum information," says Laflamme.

Although enthusiastic about this demonstration of principle, other researchers emphasize that this is just the first step toward full quantum error correction. "It's a long way from three qubits to a quantum computer powerful enough to solve significant problems," says Shor. A future "significant step" would be to demonstrate error correction in a five-qubit system, enough to guard both the phase information and correct another type of error that flips the 0's and 1's, explains Shor. "We hope to do this in the next few months," says Laflamme.

–ANDREW WATSON

Andrew Watson is a writer in Norwich, U.K.

CANADIAN FUNDING

NRC Seeks Boost for Base, Special Projects

OTTAWA—Canada's oldest and most revered scientific institution, reeling from 3 years of budget cuts, is pleading with the government for more money to shore up its scientific base and to launch projects in five areas. The National Research Council (NRC) makes its case in a still-secret report, which has been obtained by *Science*, that has been presented to government officials in a series of briefings. Insiders say that the NRC stands a good chance of regaining much of its core funding and winning approval for at least some of the special initiatives.

Established in 1916, the NRC holds a premier place in Canada's science establishment as a supporter of basic and applied research in industrial sectors or technologies seen as critical to the nation's economic development. But a $58 million cut in its budget, now at $242 million, has forced NRC's own labs to seek out contract services and