CHINA

Scientists Pushed Into Deep End of Market Economics

BEIJING—For four decades a 3-meter-high brownstone wall has sealed off the square-kilometer campus of Beijing University from the hubbub of the city streets. Over the years it has grown shabby, with chain-link fencing shoring up gaps and shacks and shops concealing parts of it. But in March of this year the entire south wall disappeared altogether, brought down by the trumpet blast of economic reform. Going up in its place is a business park intended to house dozens of high-tech firms started by university researchers.

The breaching of Beijing University's wall dramatizes the changes sweeping China's research community as the nation evolves toward "socialist market economics." The pace has quickened since the winter of 1992, when Deng Xiaoping urged faster economic reform, breaking the deadlock between reformists and hardliners that had paralyzed the country since the prodemocracy movement was crushed in June 1989. "Everyone is trying to make money somehow," remarks a third-year biology major. "That's just the way China is these days. Why should Beida [as the university is called] be any different?" (Chairman Mao, meanwhile, has attained folk godhood: His image adorns taxi dashboards as a charm against traffic accidents.)

With science and technology seen as the twin engines of economic growth, Chinese scientists face an era of great opportunity—and great anxiety. In an attempt to force scientists into the marketplace, the government has slashed by 70% the operating budgets of the 117 institutes of the Chinese Academy of Science (CAS), China's foremost centers for basic research. This move is intended to shrink staffs bloated with party appointees. At the same time, the government is strengthening a competitive, investigator-initiated grant system run by the Natural Science Foundation of China (NSFC). When grants are not enough, the institutes must earn money by selling products and services. "Leaping into the sea" is what the Chinese call this plunge into the brave new world of market economics.

Science for sale. The changes are already obvious in the once-quiet neighborhood around Beida. Shop windows are splashed with red and blue lettering advertising brand-name computers and software. Splaying their tripod feet across sidewalks are bone-white satellite dishes, sold in the tens of thousands by some 150 companies operated by the Ministry of Machinery and Electronics Industry. The dishes allow people to tune into Star TV, the Hong Kong satellite broadcast company that brings "The Simpsons" and MTV to Asia. The Ministry of Radio, Film, and Television tried to ban them, to no avail: They were simply too profitable.

"A director's first responsibility is to make money," explains Wang Zhiqin, president of the Shanghai Branch of the CAS. "It's not easy. Scientists don't know how to run a business." But some are learning fast. The Shanghai Institute of Biochemistry, famed for synthesizing insulin in the 1960s, owns a scientific equipment maker and has converted its

FORREST ANDERSON/GAMMA LIAISON

Sign of the times. Business park being built where Beijing University's wall once stood.

Song Jian: Pushing Hard

PROFILE

"Everybody's grandfather." Song Jian.

As chairman of China's State Science and Technology Commission (SSTC), Song Jian wields ultimate power over the nation's scientific activity. The policies that are shaking up Chinese science today—including "socialist market economics" and "xia hai" (plunging into the sea, that is, to go into business for oneself)—can be found in statements he made during the mid-1980s.

As chairman of the SSTC since 1985, Song has urged scientific institutes to become more competitive and less dependent on the central government for funding and guidance. In 1987 he announced a plan to beef up China's research establishment by pushing scientists to think like entrepreneurs and by promoting the economic value of science.

Part of Song's success lies in his ability to avoid the fierce ideological bickering and political maneuvering that dominate the upper reaches of the Chinese government. "Song Jian is not the type to take off the gloves and publicly slug it out with other leaders, but he does play a key role behind the scenes," says one Western diplomat.

Most recently, Song won out over the State Education Commission (SEC) on the question of whether students and researchers should be free to travel abroad and return without hindrance. The SEC, one of the most ideologically hidebound organizations in the Chinese government, harbors deep suspicions about the political reliability of scholars who travel abroad. "The freedom to come and go is a policy we proposed, and we discussed it in detail with the SEC," said Song in an interview with *Science*. "We had to argue with them, actually, and everyone finally accepted it."

Song himself is intimately familiar with the benefits of a foreign education. In the 1950s, he trained for 8 years in Moscow in the fields of cybernetics and automation engineering, before returning to China to lead the team that developed China's first generation of land-to-air missiles. He rose steadily through the ranks of the Chinese Academy of Sciences and various government ministries before becoming a member of the 13-person China State Council, which sits at the pinnacle of power.

Despite that clout, Song comes across as cheerful, open-minded, and unpretentious. In the words of a scientist in frequent contact with the 62-year-old science czar, Song is "everybody's grandfather." And like any grandfather, he worries about his descendants. "When I see these scientists who 'plunge into the sea,' the first thing I ask them is, 'Can you earn enough money to feed and clothe yourselves?'" says Song.

Their answers make him proud, he says. "They all tell me that's no longer a problem, that they now want to enter the world market and compete with foreign companies," he says. "They brag quite a lot," he adds, "but they also make much more money than I do."

–Ted Plafker

Will Profits Override Political Protests?

When the Chinese army rolled through Tiananmen Square in Beijing on 4 June 1989, crushing the democracy movement, that bloody event and its aftermath cast a long shadow over U.S.-Chinese scientific relations. Exchanges between the two countries ground to a halt, and the flow of Chinese scientists returning from overseas studies, never great to begin with, was reduced to a trickle, depriving China of many skilled young researchers needed to develop the country's scientific base. There have been recent indications, however, that a U.S.-China agreement covering basic research may soon be renewed, and informal exchanges are again blossoming.

CHIP HIRES/GAMMA LIAISON

June 1989. Scientific links cut after Tiananmen Square massacre are being reestablished.

Human rights groups fear that the fate of jailed prodemocracy activists will be ignored in the rush toward improved relations and economic profiteering. Many scientists were among the thousands of students and activists arrested after the Tiananmen Square massacre. The most prominent were released 3 years ago, but hundreds of others were sentenced to jail terms ranging from 2 to 13 years in a series of trials in 1991. Today, according to the Committee on Human Rights (CHR) of the National Academy of Sciences, about 30 scientists and others in "science-related positions" are being held for the "nonviolent expression of their political beliefs."

In the meantime, U.S.-China scientific relations are on the mend. One major obstacle to restoring official exchanges was recently resolved when Chinese authorities agreed to release social and opinion survey data they had seized in 1990 from University of Michigan researchers. The National Science Foundation (NSF), the U.S. sponsor, had responded to the seizure of the data by allowing a memorandum of agreement on scientific exchanges to expire in December 1990 and turning a cold shoulder to official Chinese requests for scientific missions to the United States (*Science*, 6 August, p. 677). But now that China has relented, NSF officials hope that the U.S.-China scientific memorandum of understanding can be renewed.

As for informal exchanges, U.S. researchers say that links in some areas have returned almost to pre-Tiananmen days. But China watchers like astrophysicist Fang Lizhi do not foresee a return to the wide-open embrace between the two societies that occurred during the early 1980s. Fang, the most famous scientist-critic in the democracy movement, escaped arrest in 1989 and took asylum in the U.S. embassy. Now a professor of physics and astronomy at the University of Arizona in Tucson, Fang doubts China will reap the full benefits of its investment in science until it relaxes its censorship. He sees the Chinese government being tugged in two directions. To "help develop the economy," it wants to lure home the tens of thousands of young people who were educated in the United States in the 1980s. To that end, it has liberalized travel rules. But at the same time, China's leaders are frightened of the "ideas of democracy and freedom" they would bring back, Fang says. Many students cannot go back, according to Fang, without risking arrest.

To protect these exiles, President George Bush issued a special executive order in 1990 permitting Chinese in the United States before April 1990 to apply for and automatically receive a "green card" recognizing them as permanent U.S. residents. Many students began receiving their green cards this summer. Yu Maochun, a historian and director of the Berkeley China Forum, a political discussion group based at the University of California at Berkeley, estimates that as many as 80,000 exiles (counting spouses) may be entitled to U.S. residency.

Ironically, many Chinese exiles are using their green cards as a license to visit China. While some of these people are going to help scientists back home, many others are setting up import-export businesses. Yu is discouraged by the rampant commercialism. "Most people think politics is irrelevant today," he laments, and have been swept up by the "enormous craze" for moneymaking sanctioned by China's leaders. Meanwhile, Yu sees a decline in the status of intellectuals and basic researchers.

Fang doesn't believe shunning China will speed up political reform. Instead, he endorses the low-key tactics of many U.S. scholarly societies—including the National Academy of Sciences—that ask U.S. visitors to China to raise human rights issues whenever possible. Papers at scientific meetings are dedicated to individual prisoners, for example. The CHR encourages scientists who feel they cannot even visit China to make their reasons public. Yu favors the "case-by-case" approach by which Western organizations have supported prisoners of conscience. The drawback: Most prisoners are anonymous.

–Eliot Marshall

reagent factory into a joint venture with a Hong Kong firm. An institute in Chengdu developed a wildly popular antihypertensive drug, which it now produces. It is one of six CAS enterprises earning more $15 million a year. But there are 400 others that are not doing nearly as well. "I don't know if there's room for failure in this country," says Keith Clemenger, director of the Beijing office of the Committee on Scholarly Communication with China, sponsored by three U.S. scholarly societies. "Each research institute is going for broke."

One problem is knowing what price to set for their work. A Chinese shipping company, for example, paid a Fudan University computer science lab only $20,000 to build a sophisticated system that enables it to keep tabs on its worldwide fleet of 20,000 ships. "Companies don't realize the value of our work," remarks Zhang Shiyong, the professor who presided over the project. But the lab went along with the deal, he adds, "because we think we can sell it to other companies."

Boosting basics. Scientists who are sticking with basic research can only cross their fingers. Zhao Xinsheng, a young chemistry professor at Beida, describes his department's plans to create a company that will produce chemicals and machines. "It doesn't benefit us yet," he says, adding with a worried look on his boyish face that "also it may fail." Fifty out of the 250 department faculty are involved, Zhao guesses, but he's not one of them. "I'm hoping the country will value basic science, so I'm concentrating on my research," he says. So far he's made the right choice: He received $350,000 to build a molecular beam lab after returning from doctoral and postdoc stints with Nobel Prize–winning chemist Yuan Lee of the University of California, Berkeley.

Indeed, for capable scientists, funding has never been better, thanks to the emphasis the government is putting on competitive

Capitalism, Military Style

BEIJING—China's military researchers have joined their civilian counterparts in a campaign to spin profits out of scientific know-how. The government-controlled China Association for Peaceful Use of Military Industrial Technology (CAPUMIT) says that the shift is part of China's "wish to contribute to the welfare of the human race," but a defense attaché at a Western embassy says some of the profits are going to buy new weapons, especially from the Russians.

In addition to meeting their primary mission, China's military factories each year churn out thousands of automobiles, refrigerators, and washing machines—not because of superior technology, but because of the army's unrivalled access to supplies. That dual use is not new, but a new category of products incorporating advanced technology is now making its way to civilian customers. These include satellites, nuclear reactors, and computer-controlled telecommunications networks.

SIPA-PRESS

Dual use. Military factories make goods ranging from high-technology fighters to refrigerators.

Although the government declines to reveal the size of China's military establishment, officials do say that the percentage of its output deemed to be "civilian" has soared from less than 10% in 1979 to nearly 70% last year. Western intelligence sources say that arbitrary decisions on classification and sloppy accounting make all numbers questionable, but that the trend toward greater civilian production is clear. Estimates of the number of military enterprises now engaged in civilian production are equally unreliable, ranging from a few hundred to several thousand.

Although it is too soon to tell whether military marketers will reach the government's goal of making their facilities self-sufficient, if not profitable, the effort is expected to produce an unprecedented flow of once-classified military research into China's civilian research community. "They have not yet worked out a mechanism for declassifying military technology," notes one Western military analyst. "The only apparent rule is that they will open up classified information if they see a way to make a buck from it."

Wang Luye, a senior CAPUMIT official, says that many enterprises still show "poor market consciousness" and that many managers have failed to recognize the importance of efficiency and quality control. They must also learn to handle less docile employees. "In the past, workers in the defense industry had a spirit of selfless contribution," says Wang. "But now, with so many people in the big cities getting rich, our workers are not always content."

Not everyone is happy with the rampant commercialization of China's military. Generals have begun to warn publicly that "money fever" threatens the army's ideological purity and undermines its ability to defend China.

But such criticism is unlikely to slow the process. The hunt for profits has become so important, says one Chinese military official, that defense researchers of every stripe have learned to keep one eye on the civilian market as they go about their work.

–T.P.

awards. Grants from NSFC will reach $50 million this year, double the 1991 figure, and they are scheduled to climb to $75 million by 1995. Created 8 years ago, the NSFC's original mission was "to have wide coverage and small money," explains its director, Zhang Cunhao, a well-known chemist. Today, it funds roughly one-third of the 14,000 proposals it gets each year. "We give 60,000 yuan ($10,000) per grant over 3 years," says Zhang. "By 1995, we'd like to give 90,000." Larger 5-year grants of $100,000 are awarded for "key projects," and "major projects" get $400,000. There are also 3-year grants of $17,500 for scientists under the age of 35.

In addition to the NSFC, scientists can apply for "climbing-up grants" offered by the powerful State Science and Technology Commission (SSTC). There are 30 of these, at $160,000 apiece, aimed at helping China scale figurative peaks in the world of science. "We want to get to the top," explains Zhou Yuan, a policy analyst for the SSTC. "Priority is given to basic research with close ties to technology development," such as biotechnology, information technology, new materials, and new energy sources.

In keeping with this focused approach, the government has created about 130 national labs, usually within institutes and universities that already excel in a particular field, and 80 State Key Labs run by several ministries. These labs receive funds to buy up-to-date equipment and to pay visiting scientists from other institutes—a major departure from the previous policy of restricting facilities to institute employees. The national labs get reviewed every other year, and at least one in the northeast of China has been stripped of its status because of poor reviews, according to one insider. Officials, however, won't confirm that. "These laboratories represent China's highest standard of science," says one government spokesman, "so there is no question of closing them down."

Centers of excellence. Given adequate support, Chinese scientists can be very productive. The Beijing Electron Positron Collider (BEPC), a 5.8-GeV ring that is China's first high-energy particle accelerator, was built in just 4 years for $350 million. Not a cent was wasted on appearances. Parched weeds squeeze through cracks in the pavement on the site, and visitors enter through a peeling, fly-specked foyer guarded by an ancient woman in a Mao jacket. Despite its somewhat shabby look, the lab has produced the world's best measurement of the tau lepton mass, and physicists are now looking for glueballs, four-quark states, and other exotic events.

BEPC has enabled China to get a jump start in a slew of advanced technologies—superconducting magnets, klystrons, electronics. A $200 million upgrade will boost the rate of collisions by an order of magnitude, creating the world's first "factory" for tau leptons and charmed particles. Achieving this goal will require speedier electronics, materials that can withstand the intense radiation, and a faster detector. "That's very advanced technology," notes BEPC director Zheng Zhipeng. "But we have good engineers." Meanwhile, BEPC has spun off commercial products, such as superconducting magnets for medical magnetic-resonance imaging machines and high-vacuum technology for integrated circuit manufacturing.

It's not surprising that high-prestige, high-tech projects like BEPC have adequate support. But how are less practical fields faring? A visit to the Institute of Vertebrate Paleontology and Paleoanthropology suggests that, in keeping with the popularity of *Jurassic Park*, the only lucrative area of paleontology these days is digging for dinosaur bones.

The discovery of Peking Man in 1929

won fame but not glory for the institute, which is housed in a decrepit building near the Friendship Hotel. Piles of crates and brown packages crammed with fossils tower precariously in stairwells and halls. The office of professor Huang Wanpo overflows with specimens and papers. Huang is studying fossilized giant panda teeth to learn when the panda first began to eat bamboo, a clue for understanding ancient ecology. His funding is not adequate to mount an expedition in search of the skull of *gigantopithecus*, a large primate whose jaw was unearthed along the Yangtze River. "That's just a dream," he sighs.

Dinosaurs are different, however. Canadians gave the institute $100,000 for a dig in Inner Mongolia, Huang says. And *Asahi Shimbun*, Japan's largest newspaper, donated another $100,000 for the rights to announce any new dinosaur species dug up along the ancient Silk Road.

But not all is gloomy. Huang mentions that he will be moving to a new building, a seven-story edifice shimmering across the courtyard that is the result of 30 years of lobbying by three successive directors. "My new office is beautiful!" he exclaims happily. "I don't really know why it is finally getting done now. We'll need computers, equipment, and display cases. They will put the donor's names on a plaque. We hope to have room for foreign researchers, too."

Bottlenecks. New buildings and new funding sources have greatly improved working conditions for some, but much more needs to be done. Equipment in all but the elite institutes is outdated. International journals are so costly that hundreds or even thousands of scientists must share a single library copy. Electronic-mail is virtually unknown. The BEPC has a link through Stanford University, but everyone else must rely on faxes and telephones. "I feel cut off from my colleagues," complains Zhao, the young Beida chemist. When people send him faxes, he gets billed $1 a page—a charge that makes a sizable dent in his $60 monthly income.

One of the biggest problems is the lack of young researchers. China lost a generation to the Cultural Revolution (1966-1976), when universities were shut and intellectuals were sent to work in fields and factories, and it has taken another decade for higher education to recover. "The quality of Chinese students has improved very much in the last 5 years," says a Japanese science policy maker. But tens of thousands have gone overseas to study, and many, perhaps most, have not returned. "In our institute, 30 have gone abroad, and only one has come back," remarks Wu Chien-ping, director of the Shanghai Brain Research Institute. In addition, he says that most graduate students want to get their Ph.D.s in the West or in Japan.

Some argue such a system benefits China. "China can't afford basic research," says Cai Mingjie, a Shanghai-born Stanford Ph.D. who now works at the Institute of Molecular and Cell Biology in Singapore. "If they got 10,000 Ph.D.s coming back, there'd be no jobs for them. And it's not that China desperately needs these people back. China needs talent in management, economics, and business, but not in basic research. The government also knows that having those people abroad can eventually help China." To ease that interaction, the government now allows scientists living abroad to come and go freely, and staff at several CAS institutes can also work overseas for 3 months each year.

More worrisome is the growing gulf between salaries in the public and private sectors. "When I was a student," says Zhao, speaking of the early 1980s, "the brilliant ones looked for hard and interesting fields, even if not practical. Now the best look for something not so hard but very practical." To combat the lure of industrial salaries that may be 10 times those of academia and to

China Beckons to Drug Companies

BEIJING—With a population of 1.2 billion, 1.4 million registered physicians and 67,000 hospitals, China offers unrivalled opportunities for clinical research. Although annual sales of pharmaceuticals now stand at only $3.5 billion—compared with $50 billion for the United States—the value of foreign drugs sold in the country is doubling each year, and some Western industry executives predict that China may become the world's largest market by the end of the decade.

Foreign pharmaceutical companies are interested in more than just the size of the potential market, however: China is also an attractive testing ground for new drugs. Relatively low standards of health care, poor nutrition, and primitive hygiene prevail in much of the country, resulting in high occurrence rates for many diseases. Northern China, for example, has the world's highest rate (6 per 1000 births) of congenital neural tube disorders such as spinal bifida and anencephaly, while hepatitis, tuberculosis, and polio remain widespread in both rural and urban areas. In addition, there's little geographical mobility, making it easier to conduct long-term studies. And cost may be significantly lower in China.

But there is also a downside to conducting clinical trials in China. A lack of essential equipment and trained personnel in hospitals can make the experience difficult and dangerous for Western companies. "This is a highly erratic environment and you have much less control over any work done in China than at your own doorstep," says Ian Stones, director of the pharmaceutical division of Pfizer-China.

Indeed, hospital standards can be appallingly lax. At Beijing's Capital Hospital, one of the country's best, an American who was there for an HIV test (mandatory for foreign residents) recalls seeing technicians carrying racks of uncapped vials of blood from the clinic to a lab a block away, seemingly oblivious to the vigorous sloshing experienced by the samples on their journey. And basic equipment is often simply not available. While many hospitals boast of sophisticated diagnostic imaging systems, few have access to such basic equipment as electrolyte analyzers.

The U.S. Food and Drug Administration (FDA) requires tests conducted in China to meet the same standards as those carried out in the United States, and applicants must certify the worthiness of the researchers and facilities involved in the trial. An FDA spokesman admits, however, "there are limits to what we can do about evaluating the qualifications of Chinese clinics."

The greatest risk for foreign firms doing trials in China is that a participant may die for reasons entirely unrelated to the product. Such "serious adverse events," as the FDA calls them, must be reported promptly, and the company is left trying to figure out the cause. "Even if the drug itself was clearly not responsible, the event will be recorded in your dossier and could have disastrous consequences for the future of the product," says Pfizer's Stone.

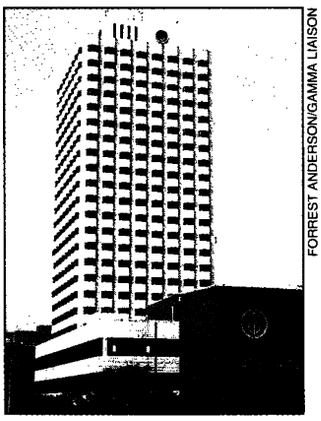
Despite such difficulties, foreign firms are sponsoring trials and beginning to have the results accepted by the FDA. In return for their participation, Chinese clinics gain the prestige of cooperating with foreign researchers and, at times, flat payments or donated equipment. Researchers involved in trials often get invited to international meetings. Trials using Chinese patients also can help boost sales of the drugs among a local population. "Many local doctors believe that ethnic factors affect a drug's performance," says one executive at a leading European company, "and they prefer to see data on local populations." Given the mutual benefits, clinical trials appear to be opening new frontiers for collaboration between scientists in China and the West.

–T.P.

Intellectual Property: A Tenuous Concept

BEIJING—The publishers of a comprehensive tome on China's copyright laws were recently found guilty of an embarrassing offense: copyright infringement. Their use of 60,000 Chinese characters from other published works in their publication suggests that the concept of ownership of intellectual property in China is indeed tenuous.

But the government has begun a big push to make patent and copyright protection more rigorous. The main driving force is international pressure: China wants to join the General Agreement on Tariffs and Trade, and intellectual property is one of many areas in which its policies must be made consistent with those in the West. There is also a strong domestic incentive: Better patent protection is essential for the success of thousands of small high-tech companies (see main article).



FORREST ANDERSON/GAMMA LIAISON

Trying to send a message. China's new patent office.

Last year, China took a major step when it joined two international copyright conventions. (Ironically for scientists, this move curtailed their supply of free copies of scientific journals, which used to be pirated within China.) It followed this up in August with the first appeals courts for hearing intellectual property cases. And on 1 January, a new system of patent laws goes into effect, based on the European model, that lengthens the terms of protection and includes inventions not previously protected, such as pharmaceutical, biological, and chemical products.

Chinese entrepreneurs are not convinced that these moves go far enough, however. For one thing, enforcement of existing patents has been erratic, ranging from the brutal—the recent execution of a man for producing fake "Maotai," China's most expensive liquor—to the virtually nonexistent. "Small companies don't know or care about the patent law," says Yang Yuliang, chairman of the macromolecular science department at Shanghai's Fudan University. He says China is just too big and the economic rewards too great to prevent widespread piracy.

Indeed, Yang and others say it is easy to buy confidential information from research assistants, especially at a time when researchers earn less than most taxi drivers. They even doubt that their patent applications are safe in the hands of patent examiners. "The patent application process takes 2 or 3 years," said Jin Riguang, professor of polymer science at the Beijing Institute of Chemical Technology and holder of three patents. "How do we know we can trust the Patent Bureau" to protect information in the application? he asks.

Yang says the patent application process is so full of leaks that the only way to make money on an invention is to market it first. "If it's a low-tech product that everyone can copy, it's best to make a large production first," he said. "Then you control the market. If you get a patent, then the market is gone."

To understand researchers' frustrations, consider what happened to Jin. In 1985, he discovered that a colleague had sold to a factory in southern China his patented idea for making use of atactic polypropylene, a chemical by-product. But his attempt to seek retribution was foiled by another common problem—a reluctance to sue. University officials told him only that the action should be "criticized." "They even implied that I should be flattered" by the rip-off, Jin said.

Enforcement of patents may be lax, but protection of software is even less rigorous. The Patent Bureau has thousands of agents throughout the country, while the Software Registration Center has fewer than 20 people, all in Beijing. A Western diplomat in Beijing who specializes in intellectual property rights says China's software industry has been crippled by the lack of protection. "People generally don't regard software as a valuable commodity in its own right," he says. "This has prevented China's software industry from really taking off."

In one celebrated example, a collective enterprise was sued after it refused to pay for a computer system and instead simply hired away seven of the company's top designers. Although the company, Five Star Communications Ltd. of Nanjing, was awarded $15,000 for damages, Wang Zhengwen, head of the company's legal department, feels the same thing could happen again. "Recently, the leaders of several high-tech companies in Nanjing got together and decided that we don't dare to continue investing in research and development if intellectual property protection is not improved," he says. "It's safer to go into foreign trade or something else."

–Julie Chao

Julie Chao is a journalist based in Beijing.

reward scientific excellence, the president of Fudan University has offered a 10,000-yuan bonus for an article published in *Science* or *Nature*. So far, it has not cost him a cent.

A more permanent solution—raising salaries—may be on the horizon. The CAS hopes to do so by sending two-thirds of its staff to spinoff companies, leaving more money for those who remain. "The academy is trying to keep only 15% of its staff for basic research," says Hao Bailin, a chaos theorist at the Institute of Theoretical Physics. He leans forward with an impish gleam in his eye. "I think the percentage doing basic research has never reached 15%," he exclaims.

The question now is whether change will come fast enough for scientists at centers of excellence like the Institute of Theoretical Physics. Founded 15 years ago as a "new type of institute for China," lean and efficient, it has a staff of only 55, of whom 30 are scientists. Hao proudly shows a visitor its excellent library, the students and postdocs crouched over banks of Sparc workstations, and the many papers published in international journals. What the institute doesn't have is a cash cow. The physicists who work there have little to fall back on, and one safety net in the old system—cheap housing—may soon vanish. Rumor has it that a Beijing flat, which now rents for 20 yuan a month, will soon cost 200 yuan. Few have enough money to exercise the option of buying their units. "I just don't have that kind of savings," says one theorist, anxiously.

In the end, China's scientists can only hope that their country's colossal, chaotic experiment in market economics will work. Yet their optimism does not seem forced. This is a nation in which people sit for hours without complaint on the two-lane country road that links Beijing to its airport, stuck in a bumper to bumper caravan of soot-belching trucks and mule carts piled high with cabbages, while, less than 100 feet away, a new six-lane expressway stands empty, awaiting its opening this fall. This image sums up China today: congested, polluted, inefficient and frustrating, but offering visions of a boundless future, almost within grasp.

–June Kinoshita

With additional reporting by Ted Plafker, a journalist based in Beijing.