

China Plans Sweeping Reforms in Science

The government embraces competition in science as a key to bolster its economy

In its push to modernize and improve its economy, China has announced plans for sweeping reforms in the conduct of research in science and technology. The changes will introduce competition into its scientific system and, if successful, have a profound effect on the nation's 30,000 scientists and 5½ million technicians. To rouse its scientific community, the Chinese government now intends to loosen its control over the direction of scientific research, decentralize funding, and emphasize a greater need for applied rather than basic research.

The changes have the backing of the highest levels of Chinese government. Addressing a national scientific conference in China in March, Premier Zhao Ziyang declared the need for overhaul in a major policy speech. A week later, the Central Committee announced the details. China's highest ranking science official Song Jian reiterated the goals during a visit to the United States in mid-April. Song said in a speech in Washington that China "is like a large ocean vessel changing its course."

The impetus behind the changes is the government's ambition to quadruple the gross national product by the end of the century. The revamping is aimed at rapidly turning scientific and technological achievements into practical applications that will bolster the economy.

The scientific reforms represent a fundamental break from the past. Mary Bullock, staff director of the Committee on Scholarly Communications with the People's Republic of China, which is affiliated with the U.S. National Academy of Sciences, said, "It's a top-to-bottom change. It's an extraordinary change." For decades, the Chinese government and the Chinese Academy of Sciences, which comprises 9000 research institutes, have exercised close control over day-to-day operations of the country's scientists and mandated the type of research to be carried out. The government, however, now acknowledges that this system has been ineffective in translating technological advances into applications that would shore up the economy. Premier Zhao said, "Our old system . . . has virtually clogged all the direct channels between research and production."

Song's remarks, reflecting articles in the Chinese press, note that the reforms have been tested successfully already at several hundred of the academy's institutes, and, as a result, the central government is ready to implement the changes on a national basis. Under the plan, management responsibilities for research will shift from the state's central bureaucracy to local administrators of research institutes. According to the Central Committee announcement, local directors will assume full responsibility for research, and "will make their own decisions . . . on such matters as planning, outlays, personnel management and internal structure." In another fundamental change, local administrators will have authority to allocate money as they see fit.

A China specialist at the U.S. State Department remarks that the significance of these management changes is twofold. These reforms, he said, represent not only decentralization, but, much more important, signify that "the party is pulling itself out of the process" to a large extent. Second, the state leadership has relinquished direct authority over use of research funds by the local institutes.

The government plans to revamp almost the entire process in which research is funded. In the past the Chinese Academy of Sciences has allocated research funds from what is known as the "common pot," without regard to the scientific caliber of individual institutes. As a consequence, a recent article in *Beijing Review* said, "Technicians in most institutes don't care much about how they spend funds. They don't give much thought to efficiency when purchasing equipment and materials. . . . Waste and overstocking are rampant and overstaffing is common. But the institutes don't worry because the state pays the money." Under the old system, the state apparently was involved even in hiring of staff.

Under the new plan, government scientific and economic competition will drive the new "responsibility system." The state will hire institute directors, but the directors will now have the power to hire their own research personnel. Although peer review is common among Western scientific institutions, the Chi-

nese government is just now taking steps to set up such a process. Each research institute will have to vie with others for money from the academy or one of the various national "science foundations" that the government proposes to establish gradually. The foundations will also peer review proposals and award grants.

The state plans to wean most of the institutes from government subsidy of their operating costs, according to the Central Committee. Over the next 3 to 5 years, the government aims to phase down and eliminate altogether funding of operating budgets for most institutes. The money saved will be used to support other projects in science and technology. To compensate for the cuts in operating budgets and to encourage the transfer of technology to industry, the institutes will be able on their own initiative to contract services to other enterprises such as industry. Institutes can bid against each other for contracts. Whatever profit is made by the institute will not be taxed. The government hopes that out of some of these agreements, some institutes will merge with the companies and become self-supporting.

Basic research and major scientific projects will still be largely supported by the government. Institutes engaged in this type of research will have to compete for money from national foundations. The government says that it will continue to be the primary source of funding for research in public health, medicine, environmental science, and family planning.

Song told *Science* that total government research funding for basic and applied research will increase. He explained, however, that the rate of increase for basic research funding will be slower, while increases in money for applied research will rise dramatically.

In all of these changes, the government wants to bring in younger scientists to invigorate research. "We should unhesitatingly assign to key academic and technological posts a great number of accomplished and vigorous young and middle-aged people and should be bold in helping young talents to come to the fore," a *Beijing Review* article said. There is already evidence of this at high levels of authority in the Chinese science

community. Song during his visit led an 11-member delegation of other Chinese scientists, who are in top positions in their fields, and all of them appeared to be younger than participants in previous delegations, Bullock of the China committee noted.

Zhou Guangzhao, who is vice-president of the Chinese Academy of Sciences and one of China's leading physicists, says that for the first time in a long while a postdoctoral system will be put in place. This should help inject new blood into the system, said Zhou, who was a delegation member. Professors commonly have hired their own graduate students to stay on after they complete their degrees. Zhou has openly criticized this "inbreeding," as he calls it, and says the government is now trying "to weed out old scientists" by offering them early pensions.

profits to the institute. Institute directors will also have the authority to give bonuses to individual scientists.

Just how the party plans to implement these massive reforms is not altogether clear. But the Central Committee says that the changes will be made gradually and with flexibility. "This is to reassure scientists that they won't wake up without a job," Chase said. The Committee declared in March, "Any reform must be gradually popularized according to different situations and after it has been tried out. Neither should we expect to achieve quick results, nor should the reform be carried out by force."

The Chinese say that the primary factor that will hamper the achievement of these ambitious goals is that the country lacks a large enough pool of educated managers, scientists, and support staff. Premier Zhao said, "Competent people

expand the relationship even more. During his visit, he met with presidential science adviser George Keyworth, signed two new agreements that committed the two countries to cooperate in research concerning fossil fuels and mapping and surveying. The two countries cooperate in 23 other fields of research as well, including the study of earthquakes and cancer and other areas of medicine.

Not everything is equal though. American scholars who have studied in China have complained that they must work under difficult conditions and that the Chinese greatly restrict their access. Song conceded that the Chinese must provide better working conditions. "We are trying to improve them. We are doing our best to create better conditions," he noted.

In any case, Chase said it "is in our long-term interests to allow Chinese students to come here." The personal ties that the Chinese establish here will serve U.S. interests 25 to 30 years from now when these students attain high-ranking positions. "That's our largest gain," Chase said.

In his opinion, China's most difficult task ahead to achieve its reforms will be how to allocate its newly educated scientists. China will have to make a decision whether to encourage them to work as teachers to train more scientists or to conduct research that may lead to commercial results. The other key to the reforms, Chase notes, is whether China's patent system will truly protect new inventions and assure the payment of royalties. "That's really the income sweetener," he remarked.

There is some concern that basic research will be sacrificed at the expense of applied research. "I hope not," said Zhou. Chase notes that since the plans were officially announced in March, Song has "backed off" a little and reaffirmed the importance of basic research, but at the same time emphasized the state's push for applied research.

Perhaps a sign of the times in China is that Song has attained such a high-ranking government position as a scientist. His predecessor was older and regarded as a politico rather than a scientist. Song is 53 years old and Soviet-trained in mechanical engineering and cybernetics. He is fluent in Russian and English and has been a visiting professor at Harvard and the Massachusetts Institute of Technology. He is vivacious, and he is eager to implement the reforms. He says, "Our most pressing task is to raise the ability of our country to create social wealth."—MARJORIE SUN

Reaffirming U.S.—China ties

Presidential science adviser Keyworth and Chinese science minister Song Jian at a ceremony during Song's visit in April.



For the individual scientist, the reforms may mean greater freedom to choose what field they want to work in and where they want to work. In the past, the government has dictated a scientist his or her job, regardless of whether it matched the person's credentials, and imposed strict controls on job transfers. Now scientists "have a chance at mobility," said Peter Chase, a China expert at the State Department. The main issue here, he says, is whether the institute itself at the local level will let a staff scientist transfer.

Like the economic reforms implemented in the countryside, the government plan gives Chinese scientists an opportunity to earn more money. Zhou notes that the pay of scientists in China is low. Scientists will be able to work in their spare time as consultants to companies or other enterprises as long as they finish their regular work, and they can keep their profits. If their consulting draws on the institute's achievements or equipment, the scientists must obtain its consent for use and pay part of any

are in short supply; and second, those we have are not used to the full." In the wake of the Cultural Revolution when intellectuals were scorned, scientists are still apparently not fully accepted by many in Chinese society. When asked about the current status of scientists in China, Zhou, the physicist, paused for a moment and then carefully said, "It has improved, but it has a long way to go."

To enlarge the number of scientists, China wants to broaden its exchanges with the United States and increase scientific cooperation, which was the purpose of Song's visit. The China-U.S. bilateral program in science and technology is already the largest maintained by either country, according to the U.S. State Department. Roughly 12,000 Chinese students and scholars study in the United States annually, Song said. An equivalent number of Americans study in China but for much shorter time periods, a few months rather than 1 to 2 years.

Song, who holds almost the equivalent of a U.S. cabinet-level job, is hoping to