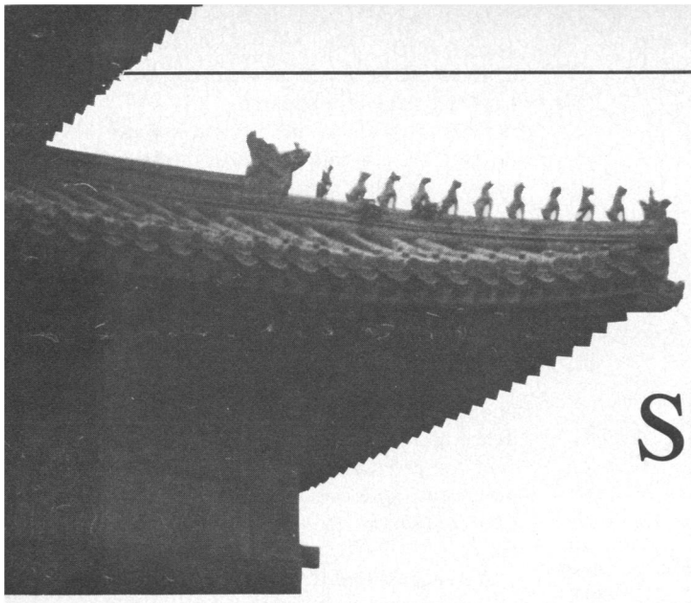

Science in China

Last month a delegation of American science journalists spent 16 days in China at the invitation of the Scientific and Technical Association of the People's Republic (STAPRC). The delegation, sponsored jointly by the AAAS and the National Association of Science Writers, was the first exchange under a cooperative agreement reached last year between STAPRC and the AAAS. The delegation met with political leaders, scientists, and workers in Beijing (Peking), Zhangzhou, Shanghai, Hangzhou, and Quangzhou (Canton).*

It is apparent what the Chinese mean when they speak of their own "backwardness" and why they are so singularly committed to achieving what they refer to as the "Four Modernizations"—of agriculture, industry, national defense, and science and technology—by the end of this century. These deficits are real, partly the legacy of the Cultural Revolution that began in 1966 and ended with the death of Chairman Mao Zedong in September 1976. It was a decade of intense anti-intellectualism dominated by a fanatic ideological renunciation of all things foreign, including thought, and it robbed China of an entire generation of scientists and scholars.

The Cultural Revolution was a political event so powerful and so pervasive that it reached to the most private aspects of daily life. Scientists and intellectuals were denounced for "bourgeois" thinking and reviled by the infamous Gang of Four as the "stinking ninth category" of reprehensible citizens. Militant youths by the millions joined the Red Guards and roamed throughout the country routing out the "four olds" (ideology, thought, habits, and customs) in the name of Mao Zedong Thought. We met scientists who told us about book burnings and the loss of papers and notes. Foreign language study was forbidden. Study of the thoughts of Chairman Mao was compulsory.

At the Institute of High Energy Physics in Beijing, where there is today an all-out effort to build a 50 billion electron volt proton synchrotron, we met physicists who had spent time during the Cultural Revolution feeding hogs.

Zhang Lungxian, vice president and professor of biochemistry at Beijing University, was sent to a provincial "cadre school" to be "reeducated" and then was ordered to a peasant commune to cultivate rice.

At Fu Wai Hospital and Cardiovascular Institute in Beijing, the ideology of the Cultural Revolution took its toll on patient care. Hospital director Wu Yingkai recalled that "One year we were allowed to perform only 24 open-heart operations. Prior to 1966 we were doing about 200 a year. Now we can handle about 600 open-heart operations a year and save a lot of people. The Gang of Four," Wu said, "thought that the revolution was more important than surgery."

Then, in October 1976, the Cultural Revolution ended when, as the Chinese rhetoric tells it, "The Party Central Committee headed by Chairman Hua [Mao's handpicked successor] smashed the Gang of Four at one stroke," which is to say they were arrested.†

The new order was in and Vice-Premier Deng Xiaoping and Vice Premier Fang Yi, head of the then newly restored State Scientific and Technological Commission, began the process of moving China away from blind idolatry of the peasant revolutionary and toward modernization. In fact, both Deng and Fang are veteran politicians who were interested in China becoming a more modern nation back in the 1950's.

The need for modernization is plainly visible in China (as it is in other poor nations). On the streets of Beijing, men and women trudge along with wooden carts loaded with vegetables. In good weather and bad, bicyclists pull carts heavy with bricks for the new housing China so urgently needs. Ubiquitous handtractors, propelled by 8-or-12 horsepower diesel engines, puff along with carts loaded

Fang Yi (followed by interpreter Chou Baochen): "No one who is against science can possibly be a revolutionary."

*Barbara J. Culliton, chairman; David Perlman, the San Francisco *Chronicle*, deputy chairman; George Alexander, the Los Angeles *Times*; Frederic Golden, *Time*; Ronald Kotulak, the Chicago *Tribune*; Joann Rodgers, the Hearst papers; Cristine Russell, the Washington *Star*; Walter Sullivan, the *New York Times*; Robert Trotter, *Science News*.

†Chairman Hua announced recently that the Gang of Four, led by Mao's estranged wife, may soon be brought to trial on charges yet to be made public.

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with commodities of every kind. The handtractor is to China what the Mack truck is to us.

With respect to scientific research, China is equally in desperate need of modern equipment for laboratories and hospitals. Although we saw some new equipment here and there and some reasonably high-quality instruments that were made in China (a fact that is always pointed out with pride), the Chinese know better than any of their short-term visitors from the West how far they have to go.

It is clear that China has begun a "new long march," and recognizes science and technology as its foundation. To achieve the Four Modernizations, whether by the year 2000 or a couple of decades later, China will have to train a large corps of scientific personnel, establish strong intellectual and financial ties with the West and with Japan, and skillfully adapt what she imports to her own special needs. Politically, this is what China is setting about to do now, although problems in the past year and a half have already forced a revision of the master plan that was first set forth in March 1978, when an unprecedented National Science Conference was held in Beijing.

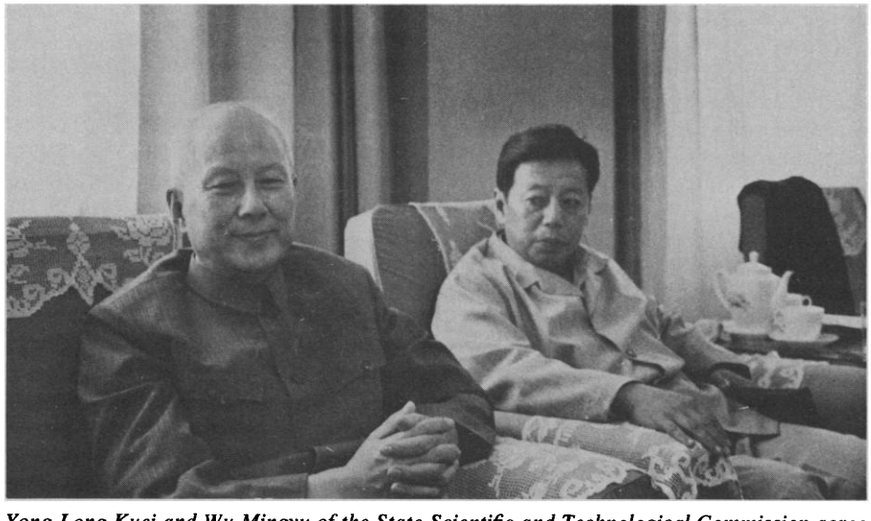
"No one who is against science can possibly be a revolutionary," Vice Premier Fang declared in a statement to 6000 scientists and technical workers. In a stunning reversal of the policy of the Gang of Four, Fang said that, with respect to scientists and other intellectuals, "we should . . . create favorable conditions for their work." In practical terms of great importance, that meant, Fang said, that scientists should be able to spend at least five-sixths of their time doing research, they should have adequate numbers of technicians to assist them, and they should be freed from needless administrative work. Scientists should be allowed to study science, rather than politics, in their spare time, and they should be rewarded for outstanding research.

Bicyclists jam Chang'an Avenue at rush hour in Beijing.

In a lengthy interview in the ornate and imposing Great Hall of the People, Fang said the state is already rewarding scientists in tangible ways, "Though I don't think this is going to create any riches." Nonetheless, scientists are being given preference for good housing, prizes with cash bonuses attached are being established, and high-ranking scientists are being well paid. The director of a major scientific research institution, for example, earns 360 yuan a month; his deputies get about 260 yuan, whereas an interpreter may get about 60 yuan and a factory worker as few as 20 to 40 yuan a month. Because rents are extraordinarily low (the highest that anyone we met paid was 7 yuan a month) and things like medical care are virtually free, it is clear that at 360 yuan a month one would have a lot of discretionary money to spend on food, clothing, and the like. One veteran scientist we met said he even has savings now—10,000 yuan (about $7500) in the bank. "It feels good," he laughed, "but what do I really need it for? I have a good suit (Mao style) that will last me 3 years, and when I travel abroad, the government pays my way. Still, it feels good."

Among China's more ambitious goals in the name of modernization is the creation of a force of "red and expert" workers in science and technology that would number 800,000 by 1985. (One should note that China's pragmatic turning toward the West for science does not imply a newfound fondness for democracy. Fang told us that he espouses the idea that one should "let a thousand flowers bloom and a thousand schools of thought contend," but that does not diminish the premium attached to loyalty to the party and the state.)

Fang is sure it can be done. The majority of the 300,000 students who can be recruited into universities annually are "students of science and engineering," he said, adding that research institutions and even factories are establishing training programs to increase scientific and technical personnel. "We are fully confident we can reach the goal of 800,000," he says, quite willing to acknowledge that the actual number by 1985 could be



Yong Long Kuei and Wu Mingyu of the State Scientific and Technological Commission agree that China needs "time, peace and foreign help" in order to modernize.

a little under, "but the difference will not be great."

Asked about the pace of progress during the past couple of years, Fang observed "Surely no long-range program can move forward without the slightest change, and any program will have to go through necessary alterations and changes in the light of actual conditions." In a separate interview, Yong Long Kuei, director of planning for the State Scientific and Technological Commission said, "The time will come when China will make important contributions to science, but we will be able to reach the world level in only a few areas by the year 2000. Generally we are still very backward. Perhaps if we have foreign help and peace, in 50 years we will be number one in the world."

Barges and sampans are a common form of transportation—and a place to live. [Photo by Carol Rogers, AAAS]

China's first estimates of what it would cost to achieve the Four Modernizations came in at $600 billion. That may well be the cost of buying the almost fully modern society contemplated in the long run, but for the short term China has scaled down her ambitions by focusing, for instance, on agriculture and light industry rather than on heavy industry. According to a recent article in the *Far Eastern Economic Review*, China is now talking about a program that might cost $280 to 360 billion in the next 20 years.

Much of that money is going to have to come from foreign loans, often guaranteed by foreign governments. For years, China wanted nothing to do with foreign loans; but now she seems eager for them, and lenders are eager to lend, though not without some sense of the risk involved. Nevertheless, China is poor, and money is a crucial problem. Her energy posture is an example. A year ago, the Chinese were negotiating with the French for the purchase of two nuclear power plants. But China has little foreign exchange and plenty of alternative resources, so the nuclear option was dropped. "We won't say that this effort with France is totally cancelled," said Fang, a skillful politician, "but it is not going on at the moment. We believe that nuclear power generation has bright prospects in the future, but China enjoys such an abundance of hydropower reserves, why should we spend an enormous amount of money to build nuclear power stations."

Indeed, it seemed clear that hydropower is at the top of China's energy list. "China enjoys a natural and unique advantage in that the peak of the world, the Himalayas, are situated in our country, which give rise to an abundance of water reserves . . . . We have only made use of 1 to 2 percent of our hydropower reserves, leaving the other 98 percent untouched. And I understand that to go into hydropower generation is much less expensive, and the built-in expenses would be much less as well." Fang estimates China has the potential for generating as many as 600 million kilowatts from hydropower if she can make full use of her resources. When Vice President Walter Mondale was in Beijing at the end of August, he and Fang talked "during a working luncheon" about the United States cooperation in this sphere. Mondale, in his address to the Chinese people, said "I will be signing an agreement on development of hydroelectric energy in the People's Republic of China. U.S. government agencies are now ready to help develop China's hydroelectric power on a compensatory basis." One of the first sites for a hydroelectric plant is likely to be in the Yangtze River gorges.

China also has substantial reserves of coal which, Fang says, will provide much of the country's energy in coming years. "Last year we succeeded in producing a total of over 600 million tons of coal, leaving only a tiny gap as compared with that of the United States." China may well begin exporting coal to Japan, with whom she has done some $3 billion worth of trade this year. Oil exportation is another possibility. Just how much oil China has is unknown. (Says Fang, "Senator Jackson gave an estimate of an annual output of 100 billion barrels of oil, but I don't know how he got this figure.") There is no doubt, however, that oil is there, in the South China Sea, the East China Sea, and on the continent. Already, China and American oil companies are engaged in joint exploration that Fang says is going "smoothly."

"In the event that you become an exporting nation, would you join OPEC?"

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China to Build Synchrotron Near the Ming Tombs

China, anxious to enter the mainstream of modern physics, is intent on building a 50-billion-electron-volt (50 Gev) proton accelerator by 1985. Work on the design of the accelerator is under way at the Institute of High Energy Physics in Beijing. The accelerator is to be built in the hills about an hour outside of the city, near the tombs of the emperors of the Ming dynasty.

Admittedly, at 50 Gev China's accelerator will be small by world standards. The Fermi National Laboratory in Chicago and the European Nuclear Research Center in Geneva have 500-Gev machines. But it represents China's determination to become "world class" in at least some areas of science. At a time when money is desperately short, the symbolic value of this commitment of $200 million is substantial.

Li Yi, deputy director of the institute, talked about that commitment. "If we want to make a major breakthrough in science, we have to do basic research. High energy physics, this synchrotron, is an important part of basic research. The project is a comprehensive research tool that will require technical skills and equipment in many different fields. It can greatly improve our level of achievement in science and technology, which is important to the Four Modernizations. And it can improve the training of our scientific and technical workers."

Obviously there is a lot riding on the Beijing Proton Synchrotron, which its designer, Xie Jalin, says is already affectionately called BPS by the world physics community. Xie, who graduated from Stanford in the late 1940's, says that American collaboration is essential to the success of the project. Indeed, this collaboration, which has been proceeding steadily since normalization of diplomatic relations between the United States and China last January, is one of the first concrete expressions of a desire for scientific exchange. Thus far, says Xie, who visited the United States last fall, "we have contacted physicists at Stanford, Fermi, Brookhaven, Argonne, and the Lawrence Berkeley labs. We feel our ties are strong and

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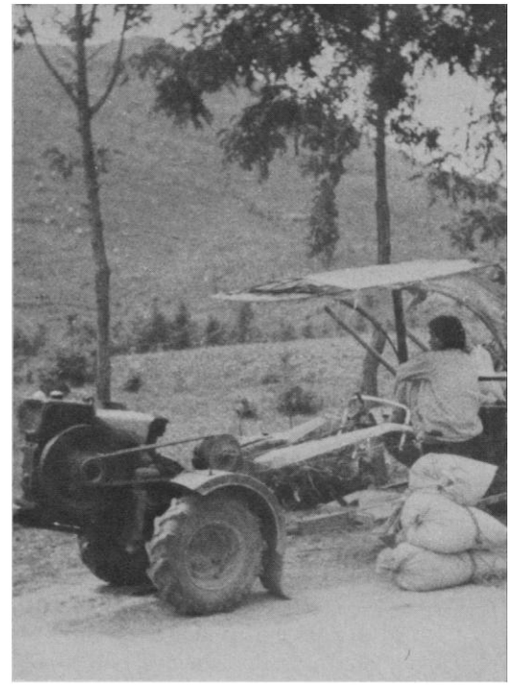

(Left) In the industrial city of Zhangzhou, every bit of ground is plowed and cultivated. (Right) The ubiquitous handtractor. [Photo at right by B.J.C.]

(Continued from page 428)

Fang was asked. He smiled broadly and replied, "A proper handling of this question will be considered in the future."

China is rich in other resources as well. Copper. Vanadium. Titanium. Rare earth metals. All of these are of considerable value for internal consumption and foreign exchange. Yong cited titanium in particular. "One of your Boeing 747's requires 30 tons of titanium," he said, with the obvious implication that doing business with China would be good for America. He added that most other deposits of vanadium and titanium are under Soviet control.

Fang declared China's "vast expanse and enormous abundance of natural reserves . . . open for joint study and research." There is no doubt that American scientists and industrial companies are eager, but conversations with Americans and other Westerners in China made it plain that doing business with the People's Republic is neither easy nor risk free. "Things happened very fast last year and through normalization in January," said one American, who added that using his name would be regarded as indiscreet, "but they've slowed down a lot now. That may be good for China but it's very frustrating too. China simply hasn't the bureaucratic mechanisms for implementing joint agreements. They want them and at the same time seem very wary." A computer specialist told us that his company was "not necessarily all that eager to get into the China market." And Japanese newspapers that we saw while abroad had a lot to say about taking a cautious stance when doing business with China. For example, an editorial in the Japan *Times* said, "With no small portion of the borrowed capital coming from Japan, there is serious concern here about the potential risks involved in lending too much money to a socialist country that has a history of violent political changes. One cannot rule out the possibility that some of the money might go down the drain should the country plunge into yet another period of political turmoil."

That is to say, another Cultural Revolution. How it could have happened seems for the present beyond explaining. Harvard sinologist John King Fairbank‡ calls it ". . . the era in China's modern history that we can least understand, not only because it is too soon for definitive studies but also because the events seem so bizarre and confusing to us outside observers. (They confused people in China too.)" In an interview with *Science* in Beijing, George Hatem, an American physician who has lived in China for 40 years, remarked that China has no strong corps of social scientists and historians to bring their intellectual energies to bear on the question but that, in any case, "Now is a time for healing and for looking forward. If China is going to achieve the Four Modernizations, there isn't time for dredging up the past." Could history repeat itself? Possibly, Hatem thought, but not likely. Yet he and others talked about currents of unrest that are evident now.

‡J. K. Fairbank, *The United States and China*, (Harvard University Press, Cambridge, Mass., ed. 4, 1979.

At Democracy Wall along Beijing's main thoroughfare, one sees hundreds of demonstrators gathering to demand some kind of justice from the government. Many of them want back jobs they lost during the Cultural Revolution. Lately, angry students have demanded that Red Guard soldiers move off university campuses to free precious dormitory space. Others among the disaffected are the young men and women, now in their thirties, who were denied an education when the universities were shut down or politically controlled. They are the lost generation of scientists and scholars for whom it is too late. And there are the unemployed, many of them recent middle school graduates who can neither get into the university nor find a job. The possibility for ferment is clear.

For the future, science, technology, modernization, and political stability in China are all entwined, each in its way dependent on the other. The posture of the present Chinese leadership seems clear, but China's leaders are elderly men and no one is certain who will take their place. Speaking of the United States' renewed friendship with China, Vice President Mondale said in Beijing, "An America deepening its relations with China does so not only out of genuine sentiment and not only out of natural curiosity; it does so out of the same combination of principle and self-interest that is the engine of mature relations among all modern states." Those observing China today are watching to see if one of the world's oldest cultures is able to sustain mature relations.

—BARBARA J. CULLITON