

Regeneration of plantlets in our study was from well-dedifferentiated cells of hypocotyl origin, cultured for a long time, unlike in previous reports, where regeneration was either directly from explants<sup>1-4,6</sup> or from intervening callus<sup>7</sup>. This indicates the persistence of somatic embryogenic capacity in long term callus cultures of groundnut and the possibility of developing a programme to obtain plants from long term hypocotyl callus cultures in the cv TMV-2 in order to develop improved crop lines, through somaclonal selections

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## COMMENTARY

### China: Also a power in science and technology?

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The past decade has witnessed China rapidly changing in many aspects, including science and technology. Some Indian scholars have even used the title 'The sleeping dragon wakes up' to describe the progress in China's science and technology<sup>1</sup>. I think it is indeed an appropriate metaphor. China is waking up, yes, but she has not stood up yet

#### Not strong enough in science and technology

There were 17 million scientists and engineers in China in 1991 (ref. 2). By absolute terms it is quite impressive, but in terms of the number of scientists and engineers per million population, China's rank would be lower than that of South Korea and Brazil<sup>3</sup>.

As far as the output of scientific and technological activity is concerned, China produced 6630 papers in 1991 according to *Science Citation Index*, which put China at the fifteenth place in the world. In comparison, India yielded 10,468 papers, ranking eleventh. Furthermore, China's papers have so far had only a slight impact on world science. A study by the Institute of Scientific and Technical Information of China (ISTIC) based on *SCI* indicated that among China's 16,810 papers produced in 1988-1990, only 3608 papers got cited in 1991 (ref. 4). That is

to say, for every five papers published only one paper attracted any attention.

China's patent applications are increasing at a high speed year by year. In 1991 the Chinese Patent Office granted patent rights to 21,178 Chinese applicants and 3438 foreign applicants. Out of a total of 21,178 patents, however, only 1311 were for inventions, accounting for 6%, while 82% (2811) of the foreign patents were for inventions<sup>2</sup>. Most of China's patents are in the utility models or designs category. China is not very strong in technological inventions

As in business, competition in science is also tough. In this arena, not forging ahead means lagging behind. Mainland China's rank in terms of papers covered by *SCI* was 14th in the world in 1988, and 15th in 1989, 1990 and 1991.<sup>4</sup> In contrast, Taiwan failed to enter the list of 30 most productive nations (areas) in 1988, but it quickly raised its status to 27th place in 1991. Brazil's rank changed from 26th to 22nd over the same period

#### Chronic problem in reward systems

It goes without saying that basic physical needs must be satisfied before scientists can devote themselves to scientific research. However, for many

years, China's intellectuals, including scientists and engineers, have been paid too low a salary for their contribution. Currently, the monthly salary of a typical scientist would not surpass 300 yuan (roughly 80 US dollars at the official exchange rate). For some scientists the actual income may be double this figure through moonlighting, though 600 yuan a month is still not encouraging. In contrast, an ordinary secretary working in a joint-venture company could earn a monthly income of 600 to 800 yuan quite easily, plus good dividends and bonuses at the end of the year. It is estimated that the salary standard in enterprises is 20% higher than that in government institutions<sup>5</sup>. Most Chinese scientists work in government institutions. What is more, many upstarts who get rich at astronomical speed since the economical reform are poorly educated and thus the educated people find hard to accept psychologically. A pun (no longer a pun in English version) very popular today reflects their sentiments: 'Both using sharp instruments, a barber is better off than a surgeon, both producing things round in shape, a tea egg (egg boiled with tea leaves and other ingredients) peddler is better off than a missile designer.'

In the face of such irrational, big income gap, the motivation of many scientists does get damped. Although

government leaders of China have adopted the slogan that 'science and technology are the foremost productive forces', they have not yet introduced any effective measures to raise the income level of intellectuals in general, and scientists and engineers in particular. The bottleneck to further expansion of China's science and technology might lie just here.

### Brain drain, a headache

Unlike India, China has a very serious language barrier for its scientists to publish abroad. It is mentioned above that Taiwan has made great progress in science. One significant reason for Taiwan's improvement of its rank in *SCI* statistics is that many people who had gone abroad for study and stayed overseas after graduation have returned to Taiwan in recent years, as indicated by some Taiwanese. These people are proficient in English and writing papers in English is no problem for them. In 1989, for every two papers published in Taiwan, there was one paper by Taiwanese authors getting published in international journals. In the same year, for every eight papers published in mainland China, there was only one paper covered by *SCI*<sup>4</sup>. More importantly, people returning to Taiwan function as a bridge to the outside world and scientific communication is greatly enhanced as more and more people come back from abroad.

China's leaders have been aware of the value of overseas Chinese students and began to take steps to attract them

back to China. Unfortunately, unlike what is done in India, where the people trained domestically are regarded as valuable as the people trained in foreign universities, the Chinese government gives preferential treatment to returning students in such matters as living space, research budget and promotion speed.

As a result, many domestically trained professionals are angry and alienated. In many cases, they also decide to go abroad just to 'have a layer of gold plated' on them, meaning to obtain a foreign degree, which usually sounds more prestigious. Thus, the special measures designed to attract people back to China drive away more working scientists. A vicious circle sets in. In some departments of some universities, almost all the erstwhile young teachers have gone abroad or turned to more profitable jobs within China. Many scientists of the old generation cannot help sighing; 'To whose hands should we transfer the baton to continue the scientific relay race?'

On the other hand, the Chinese government has set a series of rules to restrict young people from going abroad. For instance, bachelor degree holders have to work for at least five years in an organization in China, which excludes joint-venture companies operating in China, before they are allowed to study abroad. Whoever likes to go abroad before the mandatory five years has to pay the so-called training fee to their current employers, or to the universities they just graduated from, if they plan to study abroad immediately after graduation. The amount of

'training fee' is beyond the economic capacity of most Chinese families. Masters and doctors pay more than bachelors. After these rules came into effect, there are fewer Chinese students going abroad than before. However, it is safe to predict that as soon as those anxious to study abroad endure the five long years and finally make their way to foreign universities, fewer of them would return even in the remote future.

In my opinion, China's science is at crossroads. Dealt with well, China's science and technology can have a bright future along with the momentum in economy. If the Chinese government adopts policies dominated by short-term viewpoints, it is not impossible to see China's science declining again after a hardwon growth period. China's science and technology have come a long way. They still have a long way to go.

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