Issues & Studies© 38, no. 3 (September 2002): 122-149.

Strengthening China Through Science and Education: China's Development Strategy Toward the Twenty-First Century*

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The paper reviews the background against which the strategy of "revitalizing the nation through science, technology, and education" (kejiao xingguo) was put forward, related major national programs, and progress, problems, and prospects of China's science, technology, and education at the turn of the twenty-first century. With support from the Party leadership and the government, China during the past seven years has increased her funding for research and education, and implemented major programs that would elevate the country's standards in science and education. However, the nation is still facing challenges of insufficient funding, lack of high-quality researchers, weak industrial research and development (R&D) and high-tech capabilities, and lower research quality. Pur-

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*This paper updates Richard P. Suttmeier and Cong Cao, "China Faces the New Industrial Revolution: Achievement and Uncertainty in the Search for Research and Innovation Strategies," *Asian Perspective* 24, no. 3 (1999): 153-200. The author would like to thank Professor Richard P. Suttmeier, Professor John Wong, and three anonymous reviewers for their suggestions and comments on earlier drafts, and Mr. Aw Beng Teck for his editorial assistance.

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suing quick returns and short-term interests will only result in the stagnation of China as a second-tier science, technology, and education country for a long time to come.

KEYWORDS: China; science and technology (S&T); research and development (R&D); education; public policy.

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For China, the May 1995 National Conference on Science and Technology held in Beijing marked an important milestone in the development of science, technology, and education. Like its predecessors in 1956, 1962, and 1978, this conference set the tone for China's science and technology (S&T) for five to ten years. In preparing for the conference, the Chinese Communist Party (CCP) Central Committee and the State Council issued the "Decision on Accelerating the Progress of Science and Technology" (中共中央國務院關於加速科技進步的決定), along similar lines of their March 1985 "Decision on Reforming the Science and Technology Management System" (中共中央國務院關於科技體制改革的決定). The conference and the new decision signaled a new era by proposing for the first time a now well-known strategy—"revitalizing the nation through science, technology, and education" (科教興國, *kejiao xingguo*).[1]

The *kejiao xingguo* strategy sets up the principles of China's science and education development toward the twenty-first century. In particular, this strategy defines the role of S&T as "orientation, dependence, and climbing up to new heights" (面嚮,依靠,攀高峰, *mianxiang, yikao, pangaofeng*); that is, S&T must be oriented toward the economy, economic development must depend on S&T, and S&T must climb up to new heights. The policy stresses the importance of raising the nation's indigenous innovation capability and the importance of technological development at the enterprise level. High technology is given enormous attention in both the national economy and the nation's industrial policy, while basic re-

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[1] Song Jian (宋健), then China's state councilor and head of the State Science and Technology Commission, is credited with coining the term.

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search shoulders the responsibility of pushing forward future economic and social development. The new strategy also mandates increased investment in science and education by requiring that China's gross research and development (R&D) expenditure and education expenditure reach 1.5 and 4 percent of the gross domestic product (GDP), respectively, by the year 2000.[2] The paper will access the achievements of the objectives outlined by the *kejiao xingguo* strategy and the impact that the nation's development strategy has brought to science, technology, and education.

The paper is organized as follows. The first section reviews the support from the political leadership to the *kejiao xingguo* strategy. The second section describes major national programs initiated by different government agencies. The third section evaluates progress and problems with China's science, technology, and education. The fourth section examines the strategic shift of China's science and technology development from follower to indigenous innovator, as well as new initiatives in standards and patents. The paper concludes by stressing the importance of revitalizing science and education (國興科教, *guoxing kejiao*) for China's future development.

Leadership's Commitment

The *kejiao xingguo* strategy would not have progressed smoothly without the commitment and support of the Chinese leadership, a continuity that dates back to Deng Xiaoping (鄧小平). Jiang Zemin (江澤民), general secretary of the CCP Central Committee and PRC president, for example, was featured twice in June 2000 in *Science* weekly journal (Washington, D.C.). Jiang reiterated that "scientific research and education are both national priorities and are incorporated into all of China's development strategies." He further indicated that "information science,

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[2] Zhu Lilan et al., *Kejiao xingguo: Zhongguo maixiang ershiyi shiji de zhongda zhanlue juece* (*Kejiao xingguo*: China's important strategic decision toward the twenty-first century) (Beijing: Zhonggong zhongyang dangxiao chubanshe, 1996).

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life science, materials science, and resources and environmental studies will be crucial to China's sustained development in the future."[3] Jiang was also the first top leader to endorse the Knowledge Innovation Program (知識創新工程) at the Chinese Academy of Sciences (CAS, 中國科學院).

Upon becoming premier, Zhu Rongji (朱鎔基) announced immediately that *kejiao xingguo* would be the most important task of his government. He also revealed that the money saved from downsizing government ministries, redistributing staff, and restricting redundant construction would be invested in science and education. As stipulated by the *kejiao xingguo* strategy, a state leading group for science and technology was established at the State Council in March 1996, which became the State Leading Group for Science, Technology, and Education (國務院科技教育領導小組) under Zhu Rongji's leadership with education added to demonstrate the government's new emphasis.[4] In addition to Premier Zhu Rongji and Vice-Premier Li Lanqing (李嵐清), the Leading Group is composed of the chiefs of the leading science, education, and economic bureaucracies: the State Development Planning Commission (國家發展計劃委員會); the State Economic and Trade Commission (國家經濟貿易委員會); the ministries of Education (MOE, 教育部), Science and Technology (MOST, 科學技術部), Finance (財政部), and Agriculture (農業部); the Commission of Science, Technology, and Industry for National Defense (COSTIND, 國家科學技術工業委員會); the presidents of the CAS and the Chinese Academy of Engineering (CAE, 中國工程院); and a deputy secretary-general from the State Council.

The Leading Group is responsible for studying and reviewing both the nation's overall strategy and key policies for the development of science, technology, and education; for discussing and reviewing major tasks and programs related to science, technology, and education; and for co-

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[3] "*Science* Interview: China's Leader Commits to Basic Research, Global Science," *Science* 288 (June 16, 2000): 1950-53; Editorial, "Science in China," ibid. (June 30, 2000): 2317.

[4] The Leading Group for Science and Technology was first set up in 1983 when Zhao Ziyang (趙紫陽) was premier.

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Table 1
Meeting Agendas of the State Leading Group for Science, Technology, and Education (1998-2002)

	Date	Agenda
1	June 10, 1998	Knowledge Innovation Program by CAS
2	October 28, 1998	Education Revitalization Action Plan in the Twenty-first Century by MOE
3	December 31, 1998	Preparation for the National Technology Innovation Conference and the National Education Conference
4	June 30, 1999	S&T Development Plan in Agriculture
5	December 29, 1999	Reform in State Council-affiliated research institutes
6	June 8, 2000	10th Five-Year (2001-2005) S&T Plan, Educational Development Plan, and the S&T Development Plan in Agriculture
7	July 27, 2000	High energy physics, accelerators, and Shanghai synchrotron radiation facility
8	December 21, 2000	863 High-Tech R&D Program, CAS and CAE matters
9	April 28, 2001	Education
10	December 28, 2001	Impact of China's WTO entry on economy, society, and S&T
11	July 8, 2002	Vocational and distance education

Sources: *People's Daily*, various issues.

ordinating important issues of science and education involving agencies under the State Council and regions. The Leading Group seems to be considerably more active and important in setting the nation's science, technology, and education policy. This group meets two to three times a year, usually prior to major national policy announcements or conferences, to discuss critical issues the nation faces in science and education and to approve important initiatives and programs (see table 1 for the agendas of each meeting). The Leading Group has also invited leading scientists to update members of the State Council on such hot topics as nanotechnology, microelectronics, software technology and industry, information security, genetically modified foods, e-government, and global climate change.

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Prioritization and Resource Concentration on Major Programs

One of the characteristics of China's post-1995 science policy is to emphasize the importance of prioritizing and concentrating resources in order to both achieve quality and enhance performance. The principle of "anchoring one end, freeing up the other" (穩住一頭,放開一片, *wenzhu yitou, fangkai yipian*) attempts to redefine the role of the state in the support of research through resource allocation. This involves a radical reduction of the traditional role of supporting applied R&D in industry and a more concentrated focus on areas of science most susceptible to "market failures"—basic research, education, pre-competitive R&D, and research for public missions. The reform of State Council-affiliated research institutes starting from the late 1990s has corresponded to this principle. Moreover, President Jiang Zemin has put his weight behind the emphasis with his slogan of "doing what we need and attempting nothing where we do not" (有所爲,有所不爲, *you suo wei, you suo bu wei*).[5] This means that China must be selective in supporting various research endeavors and research personnel in order to best utilize scarce resources. With these themes, post-1995 China has initiated and continued implementing various science- and education-related programs via priority in resource allocation.

The Knowledge Innovation Program

With the endorsement of Jiang Zemin and the approval of the Leading Group, the Knowledge Innovation Program, launched in 1998, seeks to build the Chinese Academy of Sciences into China's national knowledge innovation center in the natural sciences and high technology, and into a base for world-class state-of-the-art scientific research fostering first-rate

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[5] These words are taken from Jiang Zemin's report to the CCP's 15th National Congress which reads, "We should formulate a long-term plan for the development of science from the needs of long-range development of the country, taking a panoramic view of the situation, emphasizing key points, *doing what we need and attempting nothing where we do not*, strengthening fundamental research, and accelerating the transformation of achievements from high-tech research into industrialization" (emphasis added). In the May 1995 "Decision," the wording was slightly different—"catching up what we need and attempting nothing where we do not" (有所趕,有所不趕, *you suo gan, you suo bu gan*).

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scientific talent and promoting the development of high-tech industries. In particular, the CAS is streamlining its 123 research institutes in 1998 into 80 new centers or bases, according to area of research. The aim is for 30 to gain worldwide recognition and renown, and for 3 to 5 to attain first-class standing internationally, whose achievements are not to be determined by the CAS itself, but benchmarked by international standards. For example, the Institute of Mathematics and Systems Science invited Fields medalists (菲爾茨獎得主) and other internationally renowned scientists to determine the direction of the institute's research, recruit promising young scientists, grant major awards, and appoint senior scientists.[6]

The Knowledge Innovation Program includes three phases and is scheduled to be completed by 2010. A total of 67 research institutes participated in the pilot restructuring and reorganizing phase (1998-2001). In 2001, CAS launched a five-year (2001-2005) action plan to implement projects in basic and strategic high-tech research. The last phase (2006-2010) will consolidate the reforms and realize the above-mentioned goals.

The reorganization has focused on changing old management practices and raising efficiency. By drastically decreasing the number of fixed positions from 68,000 in 1998 to no more than 20,000 by 2005, the CAS should be able to increase significantly the salaries and levels of research support for the remaining staff (most of them are under forty-five years old). Indeed, three years into the reform the CAS has reduced the average age of the current 36,000 professionals to around fifty. Of the 6,000-odd researchers who have been contracted under the pilot phase, 72 percent are forty-five years old or younger. In the meantime, with the fixed positions significantly decreased, the CAS has become more open and competitive, and its staff, more mobile. Over 100 young scientists have been recruited from across the country. A mobile force comprised of 8,000 graduate students (pursuing master's and doctoral degrees), post-doctoral fellows, and visiting scholars have participated in the pilot phase of the Program.

Aggressive recruitment of outstanding overseas Chinese scientists is

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[6] See <http://www.cas.ac.cn> (accessed on June 12, 2002).

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one of the key components of the Program. Supported by special government funding, the CAS spent RMB600 million (US$72.5 million) successfully attracting 300 young talented scholars from abroad, and will recruit another 500 young scientists in the next five years with further funding of RMB1 billion (US$145 million).[7]

The budget for the Program was set to be RMB5.4 billion (US$650 million) for the first three years. The CAS invests 40 percent of its R&D expenditure on basic research, among which one-fourth is devoted to exploratory, curiosity-driven projects, while the remainder supports mission-oriented basic research. Through encouraging its research personnel to compete for funding, the CAS has provided a substantial amount of grants to match extra government support.

Education Revitalization Action Plan Toward the Twenty-first Century

The main components of this MOE Plan include compulsory nine-year education, the increase of the gross enrollment rate for higher education, the 211 Program, and the Cheung Kong (Changjiang, or Yangtze River) Scholars Program (長江學者獎勵計劃).

The 211 Program was launched in 1995 to position some of China's universities as world-class distinguished academic institutions in the twenty-first century. In his speeches delivered on the 100th anniversary of the founding of Beijing University (北京大學) in 1998 and at the 90th anniversary of the founding of Qinghua University (清華大學) in 2001, President Jiang Zemin reaffirmed such a goal. To that end, about one hundred leading universities and some sixty hundred disciplines have been identified, with Beijing, Qinghua, Fudan (復旦大學), Zhejiang (浙江大學), Nanjing (南京大學), and Shanghai and Xi'an Jiaotong universities (上海

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[7] Funding of RMB2 million (US$240,000)—including money for research, a housing subsidy, and a moderate salary—is significant even by international comparison. For example, the Canadian government established research chairs for "rising stars" or young faculty members at universities, with funding of only US$70,000 a year. See "Massive Hiring Plan Aimed at Brain Gain," *Science* 286 (October 22, 1999): 652-53.

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交通大學和西安交通大學) being selected as "the most important of the important" (重點中的重點, *zhongdian zhong de zhongdian*).[8] For example, Beijing and Qinghua universities would receive RMB1.8 billion over a three-year period. The 211 Program has activated the enthusiasm of not only central but also provincial and municipal governments and various ministries. Government appropriation for the Program when combined with funds raised by universities and other sources has topped RMB18.4 billion (US$2.2 billion).[9]

As part of the 211 Program, the government has orchestrated a merger mania to form a number of education conglomerates, such as Zhejiang (浙江大學) and Zhongnan (中南大學) universities, and the Huazhong University of Science and Technology (華中理工大學).[10] Such trend seems to be healthy, having strengthened the comprehensiveness of some of China's key universities as well as the 211 Program.[11]

While the 211 Program is aimed at upgrading the infrastructure for China's leading universities, the Cheung Kong (Changjiang) Scholars Program is targeted at establishing Chinese scholars in the international research arena. Launched in August 1998 with an initial donation of HK$70 million (US$9.5 million) from Li Kai-shing's (李嘉誠) Cheung Kong Holdings and matching funds from MOE, the Program provides money to set up a series of endowed professorships for outstanding young and middle-aged scientists (usually under forty-five) residing either in China or abroad. Each scholarship carries an annual stipend of RMB100,000 (US$12,000), on top of the appointee's regular salary and benefits from a

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[8] The University of Science and Technology of China (in Hefei, Anhui, 安徽合肥,中國科技大學) and the Harbin University of Technology (哈爾濱工業大學) were added later.

[9] Available at <http://peopledaily.com.cn/GB/kejiao/39/2002916/823808.htnl> (accessed on September 17, 2002).

[10] Ironically, some of the mergers just recombined those schools split under the 1952 reorganization of universities and departments (院系調整, *yuanxi tiaozheng*). For a discussion on *yuanxi tiaozheng*, see Ruth Hayhoe, *China's Universities, 1895-1995: A Century of Cultural Conflict* (New York: Garland, 1996), 73-90.

[11] China is not alone in pursuing merger of universities. For example, there was a proposal to merge Imperial College and University College London to create British's largest research university. See "Looking After Number One," *Nature* 419 (October 24, 2002): 763.

university. To accommodate the interest of expatriate Chinese and their desire to contribute to their homeland, the Program has set up a special professorship whose holders need only to work less than full-time—just four months—in Chinese universities. Cheung Kong Scholars with distinguished achievements will be given the Cheung Kong Scholar Achievement Award (長江學者成就獎), with prize money going as high as RMB1 million (US$120,000).

MOE intends to establish 500-1,000 Cheung Kong Scholars positions in three to five years. Through vigorous review process including a final approval by a committee comprised of Chinese experts from both home and abroad, 689 positions have been identified from 114 institutions. Four rounds of recruitment have resulted in the endowment of 423 positions at 75 universities, including 27 special professors for overseas Chinese. Of these, half are concentrated in 11 institutions (see table 2). Six professors have been given the Cheung Kong Scholar Achievement Award. The Cheung Kong Scholars Program has also inspired the establishment of similar programs at provincial and municipal levels, such as the Qianjiang Scholars Program (錢江學者計劃) in Zhejiang and the Furong Scholars Program (芙蓉學者計劃) in Hunan (湖南).

The State Key Basic Research and Development Program (The 973 Program)

Members of the Chinese scientific community have argued that one of the consequences of the earlier S&T management system reform had been the orientation toward applications and the ignorance of basic research, and that the China of the late 1990s should make a greater commitment to basic research.[12] In the meantime, both the scientific and political leadership were also beginning to think that China should be playing in the big leagues of international science, that national prestige could be increased through significant scientific achievements, and that the time had come for Chinese scientists, working in China, to be considered for

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[12] Interviews (China: 1998 and 1999).

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Table 2
Distributions of Distinguished Cheung Kong Scholars (1998-2001)

Institution	Location	1998	1999	2000	2001	Total
Beijing University (北京大學)	Beijing	9	8	9	15	41
Qinghua University (清華大學)	Beijing	6	15	6	10	37
Shanghai Jiaotong University (上海交通大學)	Shanghai	4	5	7	7	23
Fudan University (復旦大學)	Shanghai	8	7	3	4	22
Nanjing University (南京大學)	Jiangsu (江蘇)	2	6	3	8	19
Zhejiang University (浙江大學)	Zhejiang	2	2	3	9	16
Dongnan University (東南大學)	Jiangsu	2	3	5	5	15
Wuhan University (武漢大學)	Hubei (湖北)	3	3	4	3	13
Jilin University (吉林大學)	Jilin	2	4	2	3	11
Huazhong University of Science and Technology (華中理工大學)	Hubei	1	4	3	2	10
Beijing Aeronautics and Astronautics University (北京航空航天大學)	Beijing	0	2	5	3	10
Total **(% of that year)**		39 (53.4)	59 (50.4)	50 (51.5)	69 (50.7)	217 (51.3)

Note: Beijing Medical University (北京醫科大學) is now part of Beijing University; Shanghai First Medical University (上海第一醫科大學) is now part of Fudan University; Wuhan Technical University of Surveying and Mapping (武漢測繪科技大學) is now part of Wuhan University; Huazhong University of Science and Technology includes Huazhong University of Technology (華中工業大學) and Tongji Medical University (同濟醫科大學).

Source: At <http://www.cksp.edu.cn> (accessed on March 20, 2002).

a Nobel Prize.[13] Furthermore, by the mid-1990s elite scientists were better represented, and were more active, in the National People's Congress (NPC, 全國人民代表大會) and the Chinese People's Political Consultative Conference (CPPCC, 中國人民政治協商會議). Their continuous lobby

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[13] See, for example, *Keji ribao* (Science and Technology Daily), August 4, 1998; *Zhongguo kexue bao* (China Science News) and *Dongfang baodao* (East China News), November 27, 1998, 1; *Qiao bao* (China Press) and *Zhongguo kexue zhoubao* (The China Science Weekly) (New York), August 20, 2000, C2; *Beijing chenbao* (Beijing Morning News), November 2, 1999; and *Zhongguo qingnian bao* (China Youth News), December 15, 2000.

for increases in the state's expenditure on R&D reached a critical mass in March 1997 when the NPC and CPPCC held their annual sessions. The Program is conventionally known as the 973 Program (referring to March 1997). The Program originally called for the channeling of some RMB2.5 billion (US$300 million) over five years (1998-2002), via the Ministry of Science and Technology (MOST), to support projects falling within six broad areas relevant to the nation's economic and social development—population and health, information, agriculture, resources and the environment, energy, and new materials—at an average level of RMB30 million (US$3.6 million) per project.

The research projects to be included in the 973 Program must meet one of three criteria. First, they can attempt to solve major problems associated with China's social, economic, and scientific and technological development. Second, they can be related to major basic research problems with interdisciplinary and comprehensive significance. Third, they can make full use of China's advantages and special characteristics—including natural, geographic, and human resources—and help China occupy "an important seat" (一席之地, *yixi zhidi*) at the table of international research.[14]

The project selection process for the Program involves proposal solicitation, peer review, and approval by an expert advisory panel comprising mainly academicians (院士, *yuanshi*) of CAS and CAE. For each project, MOST appoints one to two chief scientists (normally no older than sixty) who have the authority to decide the direction of the project and the addition of sub-projects, as well as the responsibility for administering budgets and personnel by working with a project expert committee. An approved project will receive stable funding for five years, with the addition of new researchers, ideas, and sub-projects being factored in. Continuous funding is sometimes offered to a sub-project for an additional three years, depending on the performance evaluation at the end of the second year

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[14] While inspecting the Beijing Electron-Positron Collider on October 24, 1988, Deng Xiaoping said that China must develop its own high technology and occupy an important seat in the world's high-tech area. See *Selected Works of Deng Xiaoping*, vol. 3 (Beijing: Foreign Languages Press, 1994), 273.

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(the so-called "2+3" project management). Between 1998 and 2001, 108 projects were selected, with a total funding of RMB1.8 billion (US$217 million). Of the 135 chief scientists, 40 were under forty-five years old.[15]

The National Science Fund for Distinguished Young Scholars

Launched in 1994, the National Science Fund for Distinguished Young Scholars (國家傑出青年科學基金)[16] comes under the jurisdiction of the National Natural Science Foundation of China (NSFC, 國家自然科學基金委員會), which, established in 1986 following the model of the U.S. National Science Foundation, serves as a major agency to fund peer-reviewed basic and mission-oriented (應用基礎, *yingyong jichu*) research projects. The Fund provides support for promising scientists under the age of forty-five from seven scientific fields—mathematics and physics, chemistry, life science, earth science, engineering and materials science, information science, and management science. Awardees are selected based on past performance, and allowed to pursue research of their own interest. Awards were initially made for a three-year period, with awardees in experimental and technological sciences getting RMB600,000 (US$72,000), and half that amount going to those engaged in theoretical research. On the occasion of the Fund's fifth anniversary in 1999, and in recognition of its achievements, Premier Zhu Rongji approved a significant increase in the Fund's budget from RMB70 million (US$8.4 million) in 1998 to RMB180 million (US$21.7 million) in 1999. The grant tenure has also been extended to four years, with funding for experimental and theoretical research increased to RMB800,000 (US$96,000) and RMB550,000 (US$66,000), respectively. The total number of awardees in each year has also since been increased. This demonstrates the importance and high expectation of the Fund under the *kejiao xingguo* strategy.

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[15] See <http://www.most.gov.cn> (accessed on March 20, 2002).

[16] For a more detailed introduction of the Fund and its implications for Chinese science, see Cong Cao and Richard P. Suttmeier, "China's New Scientific Elite: Professional Orientations Among Distinguished Young Scientists," *The China Quarterly*, no. 168 (December 2001): 959-83.

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The Fund has made awards to 858 young scientists from a total pool of about 4,000 applicants. About 95 percent of the Fund recipients have doctoral degrees, with more than 80 percent having foreign study and/or research experience. Among these, 19 have been elected as CAS or CAE members (*yuanshi*), quite a few have been selected as chief scientists of the 973 Program, and many have become Cheung Kong Scholars.

The State High-Tech Research and Development Program (The 863 Program)

In March 1986, as the worldwide new technology revolution gained a firm foothold in China, four senior scientists who had contributed to China's strategic weapons program suggested to Deng Xiaoping, then China's paramount leader, that China should follow the global high-tech trend and develop its own high-tech industry, thus initiating the State High-Tech Research and Development Program. Later becoming known as the 863 Program to honor the time the Program was approved (March 1986),[17] the Program is still growing strong under the *kejiao xingguo* strategy. Aimed at enhancing China's international competitiveness and improving China's overall R&D capability in high technology, the Program initially covered seven priority areas—biotechnology, space, information, laser, automation, energy, and advanced materials, with an additional category (marine) being added in 1996. The civilian-oriented technology proj-

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[17] There are at least two possible interpretations of the origins of the 863 Program. Given the status of the senior scientists who were the driving force behind China's nuclear and strategic weapons and space (兩彈一星, *liangdan yixing*) programs and their consciousness of the U.S. Strategic Defense Initiative (SDI), the Program gave consideration to the national defense application potential of the selected areas. Ma Junru (馬駿如), the first director of the 863 Program Office, pointed out that the 863 Program is "the *liangdan yixing* program in the new era." See Li Mingsheng, *Zhongguo baliusan* (China's 863 Program) (Taiyuan, Shanxi: Shanxi jiaoyu chubanshe, 1997) and *Zhongguo qingnian bao*, February 27, 2001. From another perspective, China was just as concerned with Japan's Fifth-Generation Computer Program and Europe's Eureka Program. From this angle, the 863 Program drew inspiration from *liangdan yixing*, but has been basically focused on the civilian economy. See Evan Feigenbaum, "The Military Transforms China: The Politics of Strategic Technology from the Nuclear to the Information Age" (Ph.D. dissertation, Department of Political Science, Stanford University, Stanford, California, 1997) and "Who's Behind China's High-Technology 'Evolution'? How Bomb Makers Remade Beijing's Priorities, Policies, and Institutions," *International Security* 24, no. 1 (1999): 95-126.

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ects of the 863 Program were managed by the State Science and Technology Commission and now by its successor, MOST, while those in the space and laser areas are under the jurisdiction of the Commission of Science, Technology, and Industry for National Defense (COSTIND).

With an investment of RMB5.9 billion (US$710 million)[18] in about 5,200 projects selected from more than 230 subject topics between the years 1986 and 2000, the 863 Program is said to have achieved significant results. Some projects reached global standards, others made breakthroughs, still others mastered critical technologies, and some gradually reached or made progress toward internationally advanced levels. During this period, scientists working on the Program published more than 47,000 papers, and received more than 2,000 patents from home and abroad.[19] The cumulative contributions from the more than 20,000 high-tech enterprises incubated by the Program reached added-value of more than RMB56 billion (US$6.8 billion), and provided indirect economic spillover of more than RMB200 billion (US$24 billion).[20]

The Program has also nurtured an army of visionary scientists with specialized expertise and knowledge of the trends in international high-tech competition. These individuals also help make recommendations to map China's technological response to the competition. Some 10,000 doctoral and master's candidates have participated in the Program. Interestingly, the Program has also targeted younger scientists—so far more than 30 percent of the members of the Program expert committees are under forty-five years old.

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[18] The state originally planned to invest RMB10 billion (US$1.2 billion) in fifteen years. See Li, *Zhongguo baliusan.*

[19] According to a World Bank report, however, the number of patents obtained by projects funded by the 863 Program is on the order of 700 over the period 1986-98, approximately half the number obtained by basic research projects supported through the National Natural Science Foundation of China—for which the government spent about one-third as much money over the same twelve years. See Carl Dahlman and Jean-Eric Aubery, *China and the Knowledge Economy: Seizing the 21st Century* (Washington, D.C.: World Bank Institute, 2001), 136 n. 6.

[20] *Keji ribao*, January 15, 2002, 1.

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How Successful Has the *Kejiao Xingguo* Strategy Been?

Funding

Although the proportion of gross expenditure on R&D in China's gross domestic product (GERD/GDP) had not reached 1.5 percent by the year 2000 as planned (in retrospect, the target was apparently set unrealistically high), recent years have witnessed a remarkable increase, and an outpaced GERD growth over the GDP growth (see table 3). This internationally-used indicator reached 1.0 percent in 2000 and 2001.[21] More encouraging is that in 2000, R&D spending from enterprises exceeded 60 percent for the first time, implying that enterprises have started to surpass the government as an important player in China's R&D activities.

Nevertheless, Chinese science is still seriously underfunded. In terms of the percentage of the R&D expenditure in the GDP, China has (1.0 percent, 2000) lagged far behind not only developed countries, but also South Korea (2.5 percent, 1999), Taiwan (2.1 percent, 1999), and Singapore (1.9 percent, 1999).[22] The proportion of basic research funding in the R&D expenditure decreased from 6.7 percent in 1993 to some 5 percent in the last five years (between 1995 and 2000); this despite the fact that many basic research-oriented programs were initiated, and the *kejiao xingguo* strategy requires an increasing basic research funding in the R&D expenditure year over year. Out of the basic research spending, only about 30 percent was allocated to NSFC between 1996 and 2000, and funding to NSFC's "curiosity-driven" general (面上, *mianshang*) projects was a mere RMB172,000 (US$21,000) for three years (in general the grant period is for three years). By examining the priority list of various programs discussed above, we see that too many bureaucratic fiefdoms are dispensing scarce resources based

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[21] However, the increase of GERD/GDP may have resulted from the adjustment of scope (口徑, *koujing*) in R&D expenditure statistics. See You Guangrong, *Zhongguo keji guoqing fenxi baogao* (An analytical report on China's national situation in science and technology) (Beijing: Zhongguo qingnian chubanshe, 2001), 125.

[22] International Institute for Management Development, *World Competitiveness Yearbook 2001* (Lausanne, Switzerland: International Institute for Management Development, 2001), Table 4.3.03: Total Expenditure on R&D, p. 494. The data except for that on China were for 1999.

Table 3
Major Indicators of China's Science, Technology, and Education (1995-2000)

	1995	1996	1997	1998	1999	2000
• Funding						
Gross Expenditure on R&D (RMB billion)	34.87	40.45	50.92	55.11	67.89	89.80
GERD Growth[1] (%)	–0.20	9.50	24.90	10.90	20.30[2]	16.30[2]
GDP Growth (%)	10.50	9.60	8.80	7.80	7.10	8.00
GERD/GDP (%)	0.60	0.60	0.64	0.69	0.83	1.00
Basic Research (%)	6.14	5.00	5.70	5.30	5.00	5.20
Applied Research (%)	39.77	24.54	27.20	22.60	22.30	27.00
Development (%)	54.09	70.46	67.10	72.10	72.70	77.80
• Manpower (10,000 persons)						
Total S&T Personnel	262.47	290.32	288.57	281.45	290.56	322.35
Total S&Es	155.39	168.78	166.78	149.01	159.46	204.59
Total R&D Personnel	75.17	80.40	83.12	75.52	82.17	92.21
Total S&Es Involved in R&D	52.20	54.80	58.87	48.55	53.11	69.51
Undergraduate Education Enrollment	92.59	96.58	100.04	108.36	154.86	220.61
Gross Enrollment Rate of Higher Education (18-22 years old) (%)	7.20	8.30	9.10	9.80	10.50	11.00
Graduate Education Enrollment	5.11	5.94	6.37	7.25	9.22	12.85
• Publications (piece)						
Major International Reference System	26,395	27,569	35,311	35,003	46,188	49,678
% of International Papers	1.2 (92-94)		1.5 (95-97)			3.6
Precedence according to the *Science Citation Index*	15	14	12	12	10	8
Papers in Domestic Journals	107,924	116,239	120,851	133,341	162,779	180,848
• Large and Medium-Sized Enterprises (10,000 persons)						
% with Tech-Development Units	39.80	34.00	30.40	30.60	32.00	28.50
Total Tech-Development Personnel	123.40	145.50	147.40	141.00	145.40	138.70
S&Es	71.00	79.60	80.20	63.70	66.80	76.90
S&Es Involved in R&D	26.00	42.80	44.30	38.30	42.80	54.30
S&Es Involved in R&D/S&Es (%)	36.62	53.77	55.24	60.13	64.07	70.61
GERD (RMB billion)	14.17	16.05	18.83	19.71	24.99	54.06
GERD Spent by Enterprises (%)	40.64	39.68	36.98	35.76	36.81	60.20
GERD/Sales Revenue (%)	0.46	0.48	0.52	0.53	0.60	0.71
• High-Tech Trade (RMB billion)						
Exports	10.09	12.66	16.31	20.25	24.70	37.04
Imports	21.83	22.47	23.89	29.20	37.60	52.51
Deficits	–11.74	–9.81	–7.58	–8.95	–12.89	–15.47

Notes:

[1] Calculated by GDP deflator.

[2] Calculated on a comparable basis and calculated by GDP deflator.

Sources: State Statistical Bureau and Ministry of Science and Technology, comps., *Zhongguo keji tongji nianjian 2001* (China statistical yearbook on science and technology 2001) (Beijing: Zhongguo tongji chubanshe, 2002); Department of Planning and Construction of the State Education Commission, comp., *Zhongguo jiaoyu tongji nianjian 1999* (Educational statistical yearbook of China 1999) (Beijing: Renmin chubanshe, 2000).

on self-interest.[23] Coupled with struggles over control of one's turf, the result may be ineffective R&D spending, which raises the question of "who spends how much, on what, and of what quality."

Similarly, China's government expenditure on education in 2000 accounted for 2.8 percent of its GDP, less than the 4 percent goal set by the *kejiao xingguo* strategy. Of the spending, only one-fifth went to higher education. To address the problem of resource scarcity, the government has taken a more commercial approach to expanding higher education, putting the pressure and burden on individual universities. As such, the emphasis on quantity may come at the expense of quality and may hurt the long-term development of China's higher education.

Manpower and Human Resources

China's pool of scientific talent ranks after only the United States, Japan, and Russia. In 2000, the total number of personnel engaged in S&T activities was 3.2 million, with 2 million scientists and engineers (S&Es); R&D personnel numbered 922,000, including 695,000 S&Es. However, the distribution is uneven, with the best being more likely concentrated in institutions of research and learning. Even though enterprises have increased their share in the nation's R&D expenditure, they do not have enough qualified researchers. Therefore, China's industrial R&D capability is still weak. In 2000, 71 percent of Chinese enterprises did not have independent R&D units.[24] Of the 12,683 invention patents granted in China in 2000, only 1,016 (8 percent) went to Chinese enterprises.[25]

Although about half of the Chinese professionals were under thirty-five years old according to the latest data, indicating a more youthful scientific community, a close look at the age structure across professional

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[23] For an excellent discussion on the competition for research money in the American scientific community, see Daniel S. Greenberg, *Science, Money, and Politics: Political Triumph and Ethical Erosion* (Chicago: University of Chicago Press, 2001).

[24] State Statistical Bureau and Ministry of Science and Technology, comps., *Zhongguo keji tongji nianjian 2001* (China statistical yearbook on science and technology 2001) (Beijing: Zhongguo tongji chubanshe, 2002), 68-69.

[25] Ibid., 197-98.

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Table 4
Age Structure of Chinese Professionals[a]

Age Group (years old)		**30 and under**	**31-35**	**36-40**	**41-45**	**46-50**	**51-55**	**56-60**	**61 and over**
Percent (1997)		32.2	18.3	11.9	13.5	10.6	7.2	5.6	0.5
Age Group (years old)		**under 30**	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**	**55-59**	**60 and over**
Percent (1994)	*Senior*	0.38	3.00	4.17	4.02	8.60	31.89	43.09	4.85
	Middle	12.55	21.98	15.01	14.36	13.33	14.72	7.79	0.26
	Junior	51.90	19.05	12.23	8.28	4.89	2.53	10.90	0.05

[a] The term "professionals" refers to those engaged in activities in the engineering, agriculture, medicine, and scientific research areas. The terms "senior," "middle," and "junior" refer to professional ranks.

Source: Ministry of Science and Technology, comp., *Zhongguo kexue jishu zhibiao 1998* (China science and technology indicators 1998) (Beijing: Zhongguo kexue jishu wenxian chubanshe, 1998), 33, 183.

ranks shows that senior positions have been dominated by older scientists, three-quarters of whom would be retiring in 2004 (see table 4). During the 9th Five-Year Plan period (1996-2000), 84 percent of the key (重點, *zhongdian*) projects and 74 percent of the major (重大, *zhongda*) projects supported by NSFC, China's research funding agency, were chaired by scientists over forty-five years old.[26] These figures indicate that younger-generation scientists are not entrusted with heavy responsibilities. At the same time, they may not be mature enough to take over from their seniors.

An additional problem is the "brain drain," both to foreign countries as well as to multinational corporations, joint ventures, and high-tech start-ups within China. Various programs aimed at attracting expatriate Chinese back to their homeland have not been effective. For example, among some three hundred China-born experts in the field of life science who are recognized as leaders (in terms of their appointments at high-quality institutions,

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[26] National Natural Science Foundation of China, comp., *Guojia ziran kexue jijin weiyuanhui nianbao 2000* (Annual Report of the National Natural Science Foundation of China 2000), available at <http://www.nsfc.gov.cn> (accessed on March 20, 2002).

leadership of laboratories, and substantial research grants), only five have returned to China, none of whom are among the top 20 percent.[27] Other areas are not doing any better. The recent "returnee fever" has been mainly in the applied research and high-tech fields, and therefore more oriented to moneymaking-centered businesses. While this has helped and will continue to help China economically and technologically, it will not lend much support to China's long-term sustainable development in science and education. To make up for the shortage of high-quality personnel, the general offices of the CCP Central Committee and the State Council recently pushed for a joint program for professional personnel building to be implemented between 2002 and 2005. One of the innovations of the program is to grant long-term and permanent residence to those overseas professionals working in such areas as information, biotech, materials, advanced manufacturing, and aerospace and aeronautics. The measure will not only attract more ethnic Chinese and other professionals, but also accelerate the process of internationalization in China.[28]

In order to nurture the next generation of scientists and other professionals, China's higher education institutions have been expanding their student enrollments. More than 2.85 million new students entered various types of undergraduate and graduate programs in 2001, more than double the intake in 1995.[29] Since 1998, the number of newly admitted graduate students has increased by about 20,000 annually; the more than 12,000 doctoral degrees granted in 2001 rank China among the highest doctorate-producing countries.[30] The education authorities have vowed to further expand university enrollment in the next five to ten years, and the total number of students attending Chinese universities and colleges is expected to reach 14 million, closer to the level of the United States.[31]

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[27] *Keji ribao*, May 13, 1999, 1.

[28] *China Daily*, June 13, 2002.

[29] State Statistical Bureau, *Zhongguo tongji nianjian 2002* (China statistical yearbook 2002) (Beijing: Zhongguo tongji chubanshe, 2002), 674-75.

[30] *Zhongguo jiaoyu bao* (China Educational News), October 11, 2002, 1.

[31] Ibid., October 1, 2002, 2.

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However, human resources development is an uphill battle since statistics for the year 2000 show that 8.7 percent of adult Chinese (or 85 million) were still illiterate.[32] In addition, the 2001 survey on scientific literacy of the Chinese population conducted by the Chinese Association for Science and Technology (CAST, 中國科學技術協會) indicated that the rate of scientific literacy for those aged between eighteen and sixty-nine was 1.4 percent, which suggests that only 14 of 1,000 Chinese in that age group have sufficient scientific knowledge, quite low by international comparison.[33] Even with a significant increase in undergraduates, the gross enrollment ratio for the 18-22-year-old Chinese was merely 13.3 percent, far lower than Hong Kong's 36 percent (1995) and South Korea's 52 percent (1995).[34]

High-Tech Growth Path

High-tech development has been viewed as an answer to China's economic growth. One of the spillover effects of the high-tech development is the establishment of high-tech parks in China. To date, fifty-three high-tech parks have been established across the country since the Beijing Experiment and Development Zone for High Technology and Industry (北京市新技術產業試驗開發區) was set up in 1988. In 2000, industrial products from these high-tech parks were equivalent to about one-quarter of the nation's industrial value-added output; in 2001, total income from trade, industry, and technological development (貿工技, *mao, gong, ji*) reached RMB1.2 trillion (US$145 billion), or approximately 13 percent of China's GDP.[35]

High-tech development has also made substantial contributions to trade. According to a recent United Nations report, China was the world's

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[32] *Beijing qingnian ribao* (Beijing Youth Daily), February 21, 2002, 6.

[33] Available a <http://www.cast.org.cn> (accessed on March 20, 2002). This was the fourth nationwide survey of this kind, the previous ones being held in 1992, 1994, and 1996.

[34] The Task Force on Higher Education and Society, *Higher Education in Developing Countries: Peril and Promise* (Washington, D.C.: The International Bank on Reconstruction and Development/The World Bank, 2000), 104-7.

[35] *Keji ribao*, January 15, 2002, 1.

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10th largest high-tech exporting country in 1998-99.[36] In 2001, China's high-tech exports hit US$46.5 billion, a more than fifteen-fold increase over that of 1991, and their share in China's foreign trade reached 17.5 percent.[37] Nevertheless, China's high-tech exports have been mainly from multinational corporations which invest in China. For example, in the first nine months of 2002, foreign-invested enterprises (三資企業, *sanzi qiye*) accounted for 82.6 percent of China's high- and new-tech product exports.[38] In addition, high-tech trade has shown an increasing deficit, from US$6.6 billion in 1991 to US$17.5 billion in 2001.[39] Moreover, many of the items exported cannot be counted as "high-tech," if an internationally acknowledged definition is used.[40]

In fact, China's high technology has not really advanced internationally. Most of China's high-tech products do not possess independent intellectual property rights (IPRs), especially in critical technologies, given that their profit margins are slim. Located at the bottom of the high-tech "value-chain," these products are invariably impacted by any change upstream in terms of standards, specifications, designs, and so on. In a word, high-tech development is unsustainable without competitive advantages in technology.

Quality Research

In the year 2000 China became the world's eighth largest contributor

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[36] United Nations Development Programme, *Human Development Reports 2001: Making New Technologies Work for Human Development* (New York: Oxford University Press, 2001), 42.

[37] *Keji ribao*, February 22, 2002, 1.

[38] Available at <http://jks.moftec.gov.cn/article/20021100048906_1.xml> (accessed on November 28, 2002).

[39] Available at <http://www.sts.org.cn/REPORT_3/documents/2001/0102.html> (accessed on March 20, 2002).

[40] For example, the *Science and Engineering Indicator 2000* shows a different trade picture from that in the *China Statistical Yearbook on Science and Technology 2000.* The latter has not adopted the internationally used categories of aerospace, office and computing machinery, communications equipment, and drugs and medicines. See *Science and Engineering Indicators 2000* (Arlington, Va.: National Science Foundation, 2000), Appendix Table 7-4: Global Industry and Trade Data, by Selected Countries and Industries: 1980-97.

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in international S&T publications, having 49,678 papers in three major international S&T publication indices—the *Science Citation Index*, the *Index to Science and Technology Proceedings*, and the *Engineering Index* (or 3.55 percent of the publications in the world). This was a 7.5 percent increase over the previous year.[41] Chinese scientists have also been more actively engaged on the international basic research scene. Measured by the number of papers included in the *Science Citation Index* (*SCI*), a database compiled by the Institute for Scientific Information (ISI) in Philadelphia and used as a benchmark for basic research, China was also ranked eighth in 2000. Papers by Chinese scientists in *Science* and *Nature*, two leading international science journals, have gone beyond paleontology and geology to life science, materials science, and other fields.[42]

Despite representing a significant improvement from its 26th ranking in 1985, however, China's total number of *SCI* papers in 2000 was only one-quarter of that of Britain and Japan and only one-eighth of that of the United States. Scientists at Beijing University published 1,105 *SCI* papers in 2000, which was less than one-eighth the output of Harvard University.[43] The impact factor of the journals carrying papers by Chinese researchers also tends to be lower, and few papers are cited (the number of citations of Chinese papers is 0.94, while those of papers by Japanese, Taiwanese, and South Korean scientists are 2.99, 1.45, and 1.24, respectively).[44] The past decade has even seen a decline in first-class achievements in basic research within China itself. On four separate occasions between 1989 and 2001, there were no winners of the first-class prize in China's biennial Natural Science Award.

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[41] Available at <http://www.sts.org.cn/REPORT_3/documents/2001/0121.htm> (accessed on March 20, 2002).

[42] Rao Yi, "Zhongguo kexue de fazhan he tiaozhan: yi shengming kexue lunwen zai guoji qikan shang de fabiao weili" (Advances and challenges in Chinese science: Chinese life scientists' articles in international journals), *Ershiyi shiji* (Twenty-first Century), 2002, no. 2:83-94.

[43] Available at <http://www.chinainfo.gov.cn> (accessed on March 20, 2002).

[44] Zou Chenglu, "My Scientific Career (11)," *Kexue shibao* (Science Times) (Beijing), July 11, 2002.

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Serious measures have been introduced to maintain and safeguard the integrity of the Chinese scientific community and to facilitate the building of a research tradition of quality. For example, peer review mechanisms and regular project and program evaluation have been put in place and improved in NSFC. In addition, candidates vying for the CAS and CAE membership (*yuanshi*)—the highest academic honors for Chinese scientists and engineers, the National Science Fund for Distinguished Young Scholars, and national S&T awards are made known to the public for their comments before the final results are announced. Given both the disruptions in science and education during the Maoist period as well as the strong commercial values which have influenced the academic community during the reform period, however, whether China can build a quality research tradition based on internationally-defined scientific norms is uncertain. Many of the programs mentioned above are mission-oriented and therefore more near-sighted, which could put pressure on scientists to rush out results at the expense of quality and integrity. In recent years, reports of serious cases of scientific fraud have sharpened concern over research ethics, and have even been the focus of attention from the international community.[45] Complicating the issue further is that some high-profile, politically privileged scientists who have engaged in questionable behavior have escaped scrutiny and punishment.

New Initiatives in the 10th Five-Year Plan

China officially debuted its 10th Five-Year Plan (2001-2005) in 2001. The S&T activities for the next five years are again prioritization and resource concentration. In addition to catching up with the international trends in R&D and high technologies, leaders of the scientific community have sensed an urgency to lay a solid foundation for China's national in-

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[45] See, for example, "China's Hopes and Hypes," *Nature* 410 (March 1, 2001): 1; "Biochemist Wages Online War Against Ethical Lapses," *Science* 293 (August 10, 2001): 1039.

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novation system. They have recently begun emphasizing the importance of creative and original research that will yield results capable of obtaining independent IPRs. This represents a fundamental departure from the "follow behind" (跟蹤, *genzong*) R&D strategy; if successful, this strategy will raise China's research capability to a more advanced level. To realize that goal, the 10th Five-Year Plan again calls for the increase of the GERD/GDP ratio to 1.5 percent or above by the year 2005, in order to encourage more mobility of S&T personnel and to improve S&T infrastructure.

In particular, Chinese scientists are also pushing to make breakthroughs in several major priority fields, develop high technologies applicable to industry, enhance sustainable innovation capability, and leap forward in technology. The important programs in the next five years include the further implementation of the 863 Program—especially in the areas of information, biology, modern agriculture, new materials, advanced manufacturing and automation, energy, resources, and environment—and a newly initiated S&T Special Program. Approved by the State Leading Group for Science, Technology, and Education, the S&T Special Program led by the Ministry of Science and Technology will tackle twelve major and critical technologies: super large-scale integrated circuits and software; information security, electronic administrative affairs, and electronic finance system; function genomics and biochips; electrical automobiles; magnet-suspension train; innovative drugs and the modernization of traditional Chinese medicine; deep processing of major agricultural products; development of dairy industry; food security; water-saving agriculture; water pollution processing; and development of important technical standards.[46] The 10th Five-Year Plan period will also see a continuous increase in R&D spending. For example, the 863 Program is expected to receive government funding of RMB15 billion (US$1.8 billion) in five years, while the money allocated to the twelve projects in the S&T Special Program is RMB5 billion (US$600 million). The CAS will invest RMB500 million

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[46] Xu Guanhua (徐冠華), Minister of Science and Technology, "Speech at the National Working Conference on Science and Technology" (January 9, 2002), available at <http://www.most.gov.cn> (accessed on March 20, 2002).

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(US$60 million) in some twenty major projects.

In order to gradually build up indigenous innovation capability and develop a high-tech industry with independent IPRs, China is going to implement three tactic initiatives: talents, patents, and standards. The talents initiative means that China will actively pursue talent, especially attracting top-notch experts from abroad by providing all working and living needs. The government encourages high and new technology enterprises to reform their employment and remuneration systems by installing incentive mechanisms, including shareholding and stock options, designed to utilize and realize the value of S&T and management personnel. Patents will be given enormous attention as they become important criteria in proposing and executing the nation's major S&T programs, such as the redefined 863 Program. Researchers are required to analyze the IPR situation, work out scenarios to skirt around the patent barriers (if any), and assess research projects by the generation of patents. Finally, the standard initiative is to emphasize the monitoring of changes and trends in worldwide technology barriers as well as the policies and potential changes in the major developed and developing countries. In particular, China will support, organize, plan, and coordinate research on technology standards in enterprises, universities, and research institutes. A major standard project has been included in the new S&T Special Program. Through resource concentration, the nation hopes to contribute its own high-tech standard with its own advantages and interests.

Guoxing Kejiao: Revitalizing Science and Education

The *kejiao xingguo* strategy has sought to confirm and reinforce a wide range of policies that were initiated in the mid-1980s. Moreover, the new policy seeks a more critical role for S&T in China's transformation from a closed and planned economy dominated by agriculture and heavy industry to an economy dynamized by information, knowledge, skills, and competence.

However, the development of Chinese science and education in the

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twenty-first century is still facing tremendous challenges. Funding to Chinese science and education is insufficient, and realizing the GERD/GDP target of 1.5 percent by the year 2005 will be extremely difficult, if not impossible, because such a goal implies that R&D expenditure has to double in five years.[47] China today lacks highly-qualified scientists who are active on the research frontier of international science and who are able to lead the nation in its quest for excellence in science and education. Chinese scientists have in the past two decades been unable to achieve breakthroughs commensurate with the level of support and expectation from society. Participating in such projects as the international effort to sequence and map the human genome and the rice genome, as well as the launching and recovery of the Shenzhou (神舟) spacecrafts have more political visibility than scientific significance. Even more unfortunate is that given the emphasis on quick returns and short-term benefits, most Chinese scientists have not had the patience to engage in research that could lead to significant innovation. Until 1999, large and medium-sized companies had spent more money on technology importation than on indigenous R&D.[48] In addition, the problem of how to better link research and the economy has yet to be solved. As the reform has turned the 242 research institutes under the jurisdiction of the 10 industrial bureaus of the State Economic and Trade Commission into S&T enterprises, or merged them into other enterprises or institutions, and as the rationalization of the remaining research institutes under the State Council has continued, the question is whether such a top-down reform approach may yield the expected results. Similarly, quite questionable is whether the merger of universities is in the best interests of the institutions involved and whether such "mega" Chinese universities can make a great leap forward on the list of the world's most distinguished academic institutions.

Members of the Chinese scientific community have reached a con-

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[47] Assuming that GDP grows at an annual rate of 7 percent according to the *xiaokang* (小康) goal set in the CCP's 16th National Congress, GDP will reach RMB12.6 trillion in 2005, which gives a RMB190 billion GERD, more than double that of RMB89.6 billion in 2000.

[48] *Zhongguo keji tongji nianjian 2001*, 66-67.

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sensus: in order to revitalize the nation with science, technology, and education (*kejiao xingguo*), the nation must first revitalize these three fields (國興科教, *guoxing kejiao*). What has been achieved in the past seven years represents the government's efforts toward that goal. However, *kejiao xingguo* should not be merely confined to providing science and education with funding and facilities and then expecting quick returns from such provision. More important is to establish an institutional environment conducive to the development of science and education, including the promotion of the appropriate values and norms, legal support, academic freedom and autonomy, and long-term resource allocation—without being impeded by near-term expectations.

While there are significant economic and institutional factors that explain why expenditures on R&D and education have not reached the goals set by the *kejiao xingguo* strategy, the failure ultimately stems from the lower priority that political leaders have placed on science and education, despite rhetoric to the contrary. For example, compared with the RMB2.5 billion allocated to the now well-publicized 973 Program, the state spent RMB2.7 billion to construct a national theater.[49] The Cheung Kong Scholars Program is no doubt an encouraging sign, but one wonders why the government did not launch such a program itself to show its commitment to education. The Hope Program (希望工程, *xiwang gongcheng*), which solicits donations from both home and abroad, has relinquished the government's obligation to provide compulsory nine-year education to children in disadvantageous areas. Given all the above, if the government continues to pay mere lip service to science and education, China will stagnate on the second tier of the world's science, technology, and education arenas for a long time to come.

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[49] *Wen Wei Po* (Hong Kong), February 6, 2002.

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