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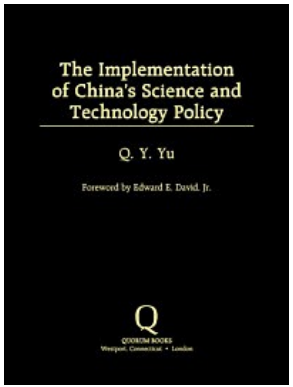
The Implementation of China's Science and Technology Policy
Q. Y. Yu
Foreword by Edward E. David, Jr.
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I wish to extend my sincere appreciation to Dr. Edward E. David, Dr. John W. Garver, Dr. John E. Endicott, Dr. John R. McIntyre and Dr. Mark J. Ballam. Without their encouragement and help, I could not have presented this book to its audience so far away from my home country. I am grateful to the Sam Nunn School of International Affairs and the GT Center for International Business Education and Research at the Georgia Institute of Technology; their valuable support and assistance made possible the finalization of the manuscript of this book. Also, I wish to express my thankfulness to my wife, Xun Dezheng, for her support and assistance.

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Contents

Tables

Foreword

For many centuries, China has had a history of technological progress. Well known are its inventions of gunpowder, pyrotechnics, seismic sensors, the magnetic compass, papermaking, movable type, fine porcelain and silk processing and weaving. In more recent times China has innovated further in technology (the chemical synthesis of insulin during the 1970s was a landmark) and also has become aware of science as a driver of technology. Until the establishment of the People's Republic of China in 1949, China's attention was focused primarily on details, the nuts and bolts of technology and instrumentation. Only since that time has the idea of national policies for science and technology as a means for economic development become a priority. The genesis and progress of such policies is the subject of this book by Q. Y. Yu. It is a look from the inside at events leading to China's emergence as a world player in both science and technology.

Mr. Yu was my personal host on two trips to China. He accompanied me on visits to the far reaches of China. Mr. Yu is a cultured, observant and astute person. He understands the importance of knowledge and scholarly research to the well-being of China. He understands, too, the connection between research and economic development. His wisdom in these matters shows through clearly in his writings and commentary on events in China.

Mr. Yu has extraordinary dimensions, especially his concern for peo-

ple. He has visited the United States many times and has been an invited lecturer at the Georgia Institute of Technology. His thinking about science policy and technological innovation has been broadly and well received.

I highly recommend *The Implementation of China's Science and Technology Policy* to all who visit China and who value an understanding of its ways and its institutions. The book is especially valuable for scientists, engineers, diplomats and businesspeople. It will become an essential part of English language literature on China.

Edward E. David, Jr.

Introduction

China has made great accomplishments in the past 50 years since the founding of the People's Republic. However, she has pursued an uneven and rough path in this process. One may say the same with regard to scientific and technological development.

This book will give an overview of China's science and technology policy as well as its implementation. China began to publish official documents addressing science and technology policy in the mid-1980s. During the period of time before 1966 (the beginning of the Cultural Revolution), under a highly centralized planned economy, the guiding thought and focuses of scientific and technological development had been included in various Party and government documents. These served as administrative orders issued to the government functionaries. During the period of the 10 years of Cultural Revolution, the fundamental policy was to destroy the ''bourgeois intellectuals'' controlling science and technology. In fact, what the ''revolution'' destroyed was science and technology itself. It was not until the late 1970s and early 1980s, when China reopened itself to the outside world, that the government publicly put forward principles and policies addressing the development of science and technology. This effort necessarily involved a large number of scientists and engineers as well as government functionaries in determining the scientific and technological structure and mechanism. During the mid-1980s, a systematic science and technology policy had

been shaped, and with further economic reform, science and technology policy was further developed. The main content of this book gives a detailed description of the science and technology policy as well as its implementation in the 1980s and 1990s. It will begin, however, with a short account of what happened before 1978, since the significance of what happened after that decisive year can be adequately understood only in the context of what had gone before.

It is difficult to give a stand-alone description of the history of China's science and technology. What has happened in the realm of science and technology is inseparable from politics and economy. The impact of the political and economic situation on the development of science and technology is similar for many countries, but that influence has been stronger in China. The influences of the political and economic changes in the past half century have been unprecedented in both depth and scope.

When the Republic was founded in 1949, only a poor legacy in science and technology policy existed. China had been a country with a glorious tradition in the development of science and technology in ancient times. However, in recent history, China's closed door policy isolated her completely from the industrial development in the West and left her ignorant of the rapid economic growth in the outside world. It was as late as the mid-nineteenth century, after China's closed door was broken open by the gunboats of the Western powers in the Opium War, that progressive Chinese intellectuals were awakened from the fond dream that China was still the most powerful country in the world in all respects. The first thing they learned was that the weapons of the Western powers were indeed more powerful than those of China. The progressive intellectuals, as the most sensitive group of people during the time, began to open their eyes to the outside world. It was no wonder that they started with geographical studies, followed up with studies of political and military systems, and finally turned to technological development.

The learning process broadened the vision of this group of intellectuals, which included quite a few high-ranking officials with political power. A new concept gave rise to the question: Why shouldn't we learn skills from the foreigners first and then bring them under our control? A new school emerged under the name ''foreign affairs school,'' which consisted of a group of visionary high-ranking officials who were involved in foreign affairs. The doctrine of the school was: Chinese tradition should be taken as principal, and Western learning should be employed for utilization only. Under the doctrine, young students were sent to study abroad, with the first batch of students sent to the United States. During the early stage of sending students abroad, the focus was on naval training with the purpose of building a Chinese naval force. China's first naval force, the Beiyang Fleet, was established with most of

its officers trained in Britain. It was interesting that the first monograph of the Western scientist T. H. Huxley, *Man's Place in Nature*, was translated into Chinese by an outstanding writer who was also one of the students studying naval matters in Britain. The translation was widely read by progressive intellectuals during that time.

The practice of ''learning from the foreigners'' started with a military purpose (buying foreign weapons and sending students abroad) and followed up with efforts to build up China's own modern industry. The development of modern industry certainly required the study of modern industrial technology. The century-long arduous path of the development of China's modern science and technology had begun.

Industrial and social development required the establishment of a modern educational system. The first university in China, Capital University (later renamed Beijing University), was established in Beijing 100 years ago. However, during that time, Chinese traditional culture was still orthodox, and modern science and technology only played the part of a sort of ad hoc skill. It took decades to break a path through the obstacles of traditional culture to pave the way for the development of modern science and technology. It was as late as the first quarter of the twentieth century that modern physics as a discipline was firmly established in the higher education system in China.

When looking back to the early development of science and technology in China, it is clear that it was owing to a sense of national crisis and the desire to defend national tradition that China started her efforts to develop modern science and technology. In the process, many Chinese scientists felt that they had an obligation to work for development, as it was a way to help the nation become stronger. Therefore, right in China's history, devotion to science stemmed from the sense of national salvation. Many of the scientists of the older generation were stepping into the new People's Republic with this mentality to continue their efforts along the arduous path to prosperity.

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China's Scientific and Technological Development During the Period from 1949 to 1978

A new prospect for scientific and technological development arose when the new Republic was founded in China in 1949. As the country was just coming out of war and concentrating her efforts on the restoration of a national economy, it was impossible for her to expend much of her resources on expensive scientific programs. The efforts made in respect to science and technology were focused on reorganizing the existing scientific undertakings and science manpower. The legacy left by the old China in terms of science and technology was very limited. Before the founding of the People's Republic, there were only 180,000 university graduates, 50,000 scientific and technical personnel, 40 scientific research institutes and a few hundred research scientists. As early as 1949, the Chinese Academy of Sciences was established to devote itself to China's basic research and major applied research. In 1952, when the period of restoration of the national economy was concluded and the first five year plan started, China began to invest substantial resources in the development of science and technology and started her efforts to realize national industrialization.

National industrialization had been a century-long dream of the Chinese people. However, it turned out to be a much longer and tougher process than originally expected. Since the officials of the ''foreign affairs school'' first set out to develop national industry, almost a century had passed, with achievement limited to the sector of light industry. Heavy

industry had been almost completely neglected. With a view to quickening the pace of industrialization, in the early 1950s, 156 large industrial projects were introduced by the Soviet Union. These projects covered the major industrial departments of heavy industry in an attempt to form China's initial industrial system. During the 1950s, large numbers of Soviet experts worked in China to help with installment, operation and management. Since China's initial industrial system was established with technology, equipment and a management system introduced from the Soviet Union, China's industrial development couldn't help but closely follow the Soviet pattern for a fairly long period of time. The influence of the old Soviet system can be found even today. The industrial support of the Soviet Union in the 1950s had both positive and negative sides. It did play an important role in the formation of the initial industrial system in China and help China to take a big leap in the development of industrial technology. However, the rigid and inefficient Soviet management and operation system, as well as the slower technological progress derived from an impotent industrial research and development (R&D) system under a central planning economy, has been a heavy burden for China's industrial development.

In 1952, with a view to preparing for the coming high tide of socialist economic construction, the reorganization of the educational system was launched with the closing of missionary and private universities. Many universities, colleges and disciplines were readjusted and reorganized. The curricula were rearranged generally, so as to gear education to the needs of socialist economic construction.

A central planning economic system was adopted by China right from the outset of economic construction, based on the belief that it was the ideal operational system for a socialist economy. The Soviet Union, being the first socialist country in the world, with several decades of experience in implementing a planned economy, was certainly the example for China to follow. Therefore, ''learning from the Soviet Union'' became the principle in economic construction as well as in science and education. The new scientific research system, of course, followed that of the Soviet Union. Just as in the Soviet Union, China's scientific research was part of central planning. The State Science and Technology Commission was set up and placed in charge of the overall planning of scientific research programs. This commission allocated budgets for scientific and technological research. For a period of 17 years, from 1949 to 1966, China's scientific and technological force grew rapidly. Though the starting point was low, a number of scientists at senior levels studying and working abroad came back to the country in the early 1950s, and in addition a large number of scientists and engineers of a new generation were emerging. By 1952, when the first five year plan started, there were 428,000 scientific and technical personnel throughout the country. By

1966, just before the Cultural Revolution, the number soared to 2,458,000. Of course, the size of the scientific and technological force was still rather small, especially relative to the large population of the country. However, taking advantage of the highly centralized administrative power and the central planning economy, the central government was able to concentrate a scientific research force to tackle the few most urgent and difficult issues and bring about comparatively quick successes. For instance, China succeeded in launching her first large rocket in 1959, made a successful experiment on the first atomic bomb in 1964 and in 1965 accomplished the first totally synthetic crystalline bovine insulin in the world.

Nonetheless, the development of industrial technology had been slow and sometime even stagnant. This was mainly due to the rigidity of central planning. The development of industrial technology is inseparable from the industrial and agricultural systems. Under the centrally planned economy, the industrial research system, instead of being integrated, was parallel to industrial production. Under the centrally planned economy, all State-owned industries were directly under the administrative control of the government departments. There were two different levels: the industries subordinated to central ministries and those subordinated to local government departments. All aspects of industrial production were controlled by related government departments. Each industry obtained its raw materials from government allocation, manufactured its products according to the quota set up by the government department and transferred its end products to the government distribution system. Consequently, no effort needed to be made by the industry in terms of procurement of raw materials or marketing of products. The industry was responsible only for production, or, in other words, to satisfy its assigned quota. The industry didn't need to worry about economic benefits or competition, or about technological renovation or innovation. What enterprises faced was not the market, but administrative orders given by superior government departments. As a result, industry didn't need to take any initiative. Under this situation, it was very difficult for industry to renew products or processes.

A typical example was the automobile industry. China started her automobile industry in the 1950s. The First Automobile Factory in Jilin Province in China's northeast was one of the large industrial projects aided by the Soviet Union. The factory mainly produced trucks, but in the late 1950s it turned out its first limousine. That limousine remained unchanged for 20 years. Such a phenomenon has been called ''a system of twenty year consistency.'' Development research, instead of being subordinated to industry, was put under government departments, subordinated to various industrial ministries. At the central level, the ministries set up their own research institutes for development research.

Plans for improvements in products and processes were decided by the government departments, and the designs were worked out by the research institutes. Only when the blueprint for a prototype was ready would it be handed over to the factory whose job was to turn out the new product or process. Such a system couldn't but bring about the divorce of research from production. People called such a system the ''government directed research system.'' During the post-1978 period, China's reformers tried hard to transform the ''government directed research system'' into the ''enterprise directed research system.''

Even under a rigid centrally planned economic system, as China had the opportunity, for the first time in more than a century, to construct the country in a peaceful environment under a unified, highly centralized authority and organize the masses of people on an unprecedentedly large scale, the first five year plan was completed and turned out to be success. Economic development gave impetus to the further development of science and technology. By 1955, scientific and technological research institutions numbered more than 840; scientific and technical personnel had increased to more than 400,000.

In 1956, at the high tide of economic construction, a national conference on intellectuals was held, during which Zhou Enlai indicated the important role of science and technology in socialist construction and issued the call for ''marching toward science.'' Subsequently, the State Council established a Science Planning Committee made up of more than 600 scientists and experts. This committee was charged with formulating China's first long-range plan for scientific and technological development (i.e., ''National Plan on the Prospect of the Development of Science and Technology [1956–1967]''). In view of the requirements of economic development and national defense, the plan listed 57 tasks, including a series of tasks relating to basic, applied and development research. The most important step was to adopt six urgent measures, to develop computer, semiconductor, automation, radio, nuclear and jet technology. This gave birth to a series of emergent technologies in China and laid the foundation for the growth of a number of new industrial departments. A course for China's scientific and technological development was outlined in the long-range plan. The gap between China and the world in respect to science and technology had begun to narrow.

Nonetheless, the even and ''slower'' pace of the first five year plan didn't satisfy the more ambitious leftists. In 1958, the Great Leap Forward was launched. The next year an anti-rightist campaign consolidated the frantic leftist trend of thought in pushing forward economic construction at unbelievable speed. Goals were set on an impractical basis, which couldn't help but encourage boasting and exaggeration. Blindness in issuing administrative commands and an eagerness for quick success hastened the pace of economic development but created a chaotic

situation in economic construction. This was especially harmful to the scientific work, as results in scientific and technological research could only be the fruits of accuracy and patient work.

The Great Leap Forward was eventually abandoned as the economy collapsed. In order to restore the normal order, which had been sabotaged by the Great Leap Forward, scientific and technological work was readjusted, and a document on the readjustment was worked out jointly by the State Science and Technology Commission and the Chinese Academy of Sciences, entitled ''Fourteen Points of Opinion on the Current Work of the Natural Science Research Undertakings,'' in the early 1960s. The document indicated that various kinds of leftist trends should be rectified and policies regarding scientific and technological work should be clarified. The most notable issue put forward by the document was that the ''fundamental task'' of scientific research undertakings was to achieve results and bring up people of talent. In 1962, during two conferences in Guangzhou, Zhou Enlai and other leaders reiterated that China's intellectuals, like workers and peasants, comprised one group of China's laboring people. Since the anti-rightist campaign in 1957,[1] intellectuals were treated as ''bourgeoisie intellectuals,'' as their outlook was supposed to be of the category of the ''bourgeoisie.'' The new announcement by the leaders actually relieved the intellectuals of the label of ''bourgeois intellectuals.'' These measures helped bring scientific and technological work back to a normal track. Under this situation, the State Science and Technology Commission formulated the ''Scientific and Technological Development Plan for the Period from 1963 to 1972.'' It was an attempt to push forward the development of science and technology along the original track set up in the early 1950s.

Barely had the situation been regularized when the Cultural Revolution began in 1966. This began a 10-year period during which Chinese scientific and technological efforts were seriously sabotaged. The Cultural Revolution was not just a repetition of the leftist trends of the late 1950s. The scientific and technological work of the entire 17 years before the Cultural Revolution was negated and repudiated as a ''reactionary revisionist line.'' Research institutions were dissolved, research facilities and science and technology materials were destroyed, experiment bases were sabotaged, the regular working order was disturbed and the entire scientific and technological apparatus was broken down and paralyzed. A large number of scientific and technical personnel suffered from persecution. Quite a number of veteran scientists and experts were labeled ''reactionary authorities,'' and the scientific and technological force created since the founding of the People's Republic was virtually destroyed. During the Cultural Revolution, it was strictly prohibited to learn from the advanced experiences of foreign countries in respect to science and technology. Any effort to learn from foreign advanced experiences was

repudiated as ‘‘slavish comprador philosophy’’ or ‘‘crawlism.’’ During this time, what prevailed was a closed door policy that isolated the country from the outside world and broadened the gaps in science and technology between China and the world’s advanced levels.

In addition, the educational system was severely injured by the Cultural Revolution. Even high school classes were ended for a few years, as students were mobilized to serve as ‘‘red guards,’’ the motivating force of the Cultural Revolution. But as the inexperienced youth were instigated behind the scenes by political factions, they split into different groups, launched into ferocious fighting against each other and caused a turbulent and chaotic situation in society. With a view to quieting the turbulence, beginning in 1968, millions of youth were sent to the countryside to take part in farming. When most of them came back from the countryside after the Cultural Revolution, they had to restart their education where they had left off or find jobs. From the standpoint of science and education, China had lost a great deal. The Cultural Revolution had a far-reaching influence. In the late 1980s and early 1990s, when most university graduates of the 1950s and early 1960s began to reach retirement age, it was very difficult for the university and research institutions to find qualified individuals to take over their responsibilities as faculty and researchers.

When looking back on the history of the 27 years from 1949 to 1976, it can be seen that all through that long period, an intense struggle was under way between efforts to build up a scientific and educational system suited to a planned economy and an ever stronger leftist force that sought to break up these efforts by putting the top priority on politics and revolution.

During the two years after the Cultural Revolution, much effort went into theoretical criticism and repudiation of the practice of the Cultural Revolution. The Cultural Revolution had brought heavy calamities to China’s educational system. Since the very beginning of the Cultural Revolution, the educational front was taken as an area controlled by ‘‘bourgeois intellectuals.’’ Quite a number of faculty members of universities and research institutes had been persecuted, their positions and reputation not restored until the conclusion of the Cultural Revolution. Right after the Cultural Revolution, the most important issue was how to clarify China’s guiding thought and bring order out of chaos. Initially, the restored ‘‘order’’ was supposed to be the planned economy, which had been overturned by the Cultural Revolution. In 1978, at the Third Plenary Session of the Central Committee of the Eleventh National Congress of the Communist Party, the policy of reform and opening was officially put forward. In 1979 the first National Science Conference was held. It announced that intellectuals were part of the working class and made important contributions to the construction of China’s socialist

modernization. The intellectuals involved in scientific and technological work were greatly encouraged and began to speak with strong feeling at long last: ‘‘Welcome the spring of science.’’

NOTE

1. In 1957, the anti-rightist campaign was focused on criticizing and repudiating intellectuals with remarks that belonged to ‘‘rightist’’ trend. In 1959, the anti-rightist campaign was an inner party struggle that focused on opposing ‘‘rightist opportunists.’’ Most of the victims of these anti-rightist campaigns were redressed after the Cultural Revolution.