Deng Yinke

ANCIENT CHINESE INVENTIONS

Thousands of Years of Science and Technology

Translated by Wang Pingxing

CHINA INTERCONTINENTAL PRESS

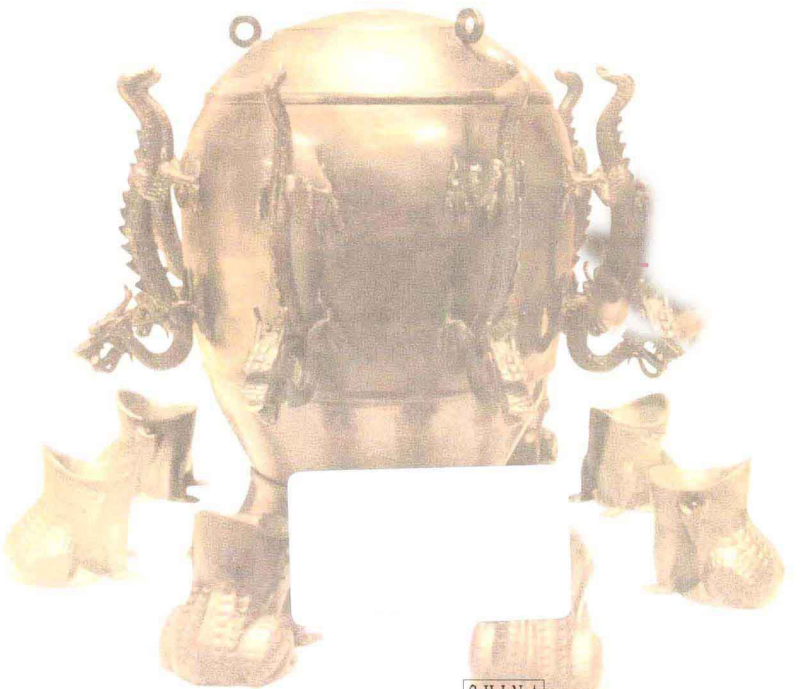
Cultural China Series

Deng Yinke

ANCIENT CHINESE INVENTIONS

Thousands of Years of Science and Technology

Translated by Wang Pingxing



CHINA INTERCONTINENTAL PRESS

图书在版编目（CIP）数据

中国古代发明：英文／邓荫柯著；王平兴译.—2版.—北京：五洲传播出版社，2010.1
ISBN 978-7-5085-1689-9

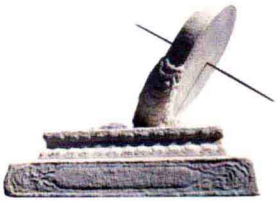
Ⅰ.①中… Ⅱ.①邓…②王… Ⅲ.①创造发明－技术史－中国－古代－英文 Ⅳ.①N092

中国版本图书馆CIP数据核字（2009）第191068号

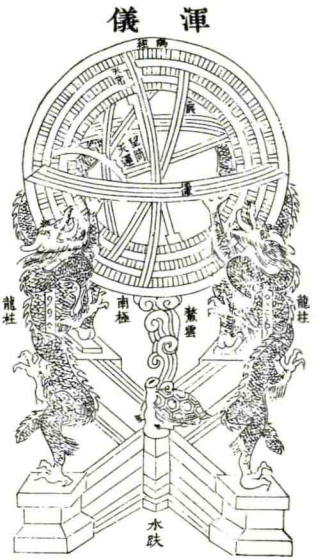
ANCIENT CHINESE INVENTIONS
Thousands of Years of Science and Technology

Author: Deng Yinke
Translator: Wang Pingxing
Executive Editor: Deng Jinhui & Wu Yamin
Art Director: Tian Lin
Production: Primary Colors Design CO.
Publisher: China Intercontinental Press (6 Beixiaomachang, Lianhuachi Donglu, Haidian District, Beijing 100038, China)
Tel: 86-10-58891281
Website: www.cicc.org.cn
Printer: C&C Joint Printing Co., (Beijing) Ltd.
Format: 720×965mm 1/16
Edition: Jan. 2010, 2nd edition, 3rd print run
Price: RMB 94.00 (*yuan*)

Contents



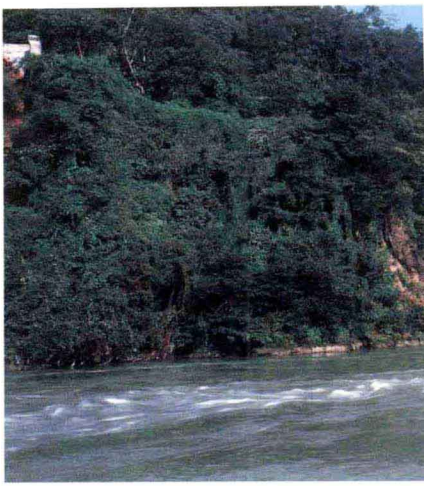
Foreword
Hotbed of Invention



The *hun yi* (armillary sphere), one of the major astronomical instruments in ancient China. Here is a sketch of the *hun yi* made by Su Song of the Song Dynasty.

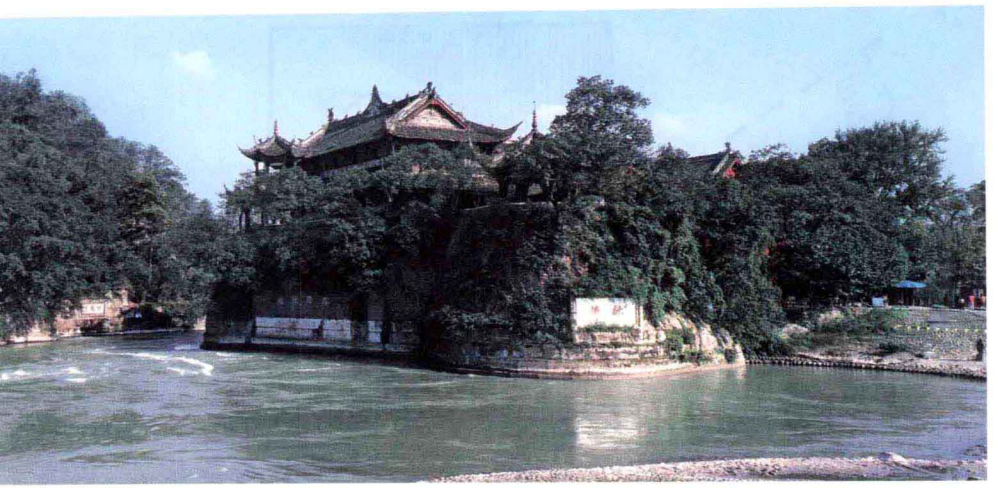
China has captivated the world's attention with its high-speed economic growth. As the country is expanding its influence worldwide, people throughout the world fix their eyes on this ancient yet great nation. They are eager to learn about its past, which might provide a clue to the driving force behind its current rapid economic growth. The West world used to know little about China's past except for the four major inventions. As a matter of fact, China as an important source of human civilization had given birth to brilliant ancient science and technology and led the world in most of the history of world civilization, and till the mid-19th century its economy was the largest in the world. The development of science and technology in ancient China was based on the observation and study of the human body, the objective world, the heavens, and the earth, which led to the concept of "Integration of nature and man." The achievements nourished Chinese culture and civilization, and contributed greatly to mankind. Ancient Chinese inventions and discoveries are rich and numerous.

In either prehistory or human civilization, China had been in a



leading position in science and technology for several thousand years. It is noted that this position was achieved all by its own in an enclosed environment. In the Neolithic period, though in their embryonic stage, animal husbandry, farming, construction, pottery, weaving, brewing, and medicine have reached international advanced level. The bronze culture of the Shang (1600–1046 BC) and Zhou (1046–256 BC) dynasties opened a new chapter of civilization, paving the way for the development of the economy, culture, and science and technology. The Spring and Autumn (770–476 BC) and Warring States (475–221 BC) periods were a prime time full of creation enthusiasm, when ancient philosophers competed in exploration of truth. The most important discoveries and inventions in the periods were the making of iron and steel, the basic elements of all inventions and innovations, which led to a qualitative change of the times from bronze culture to iron culture. Rapid development of farming, water conservation and handicrafts helped form the four disciplines of astronomy, medicine, mathematics, and agronomy.

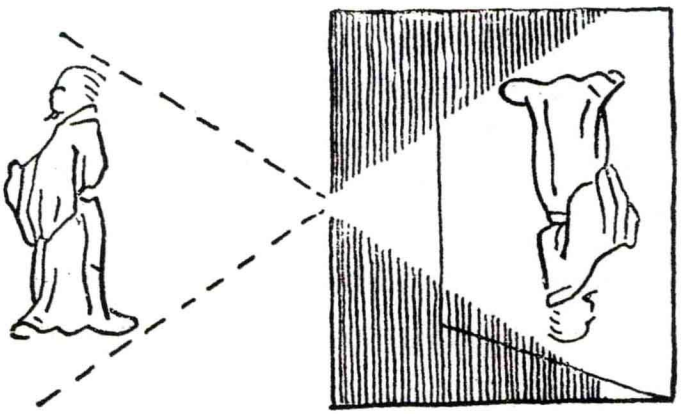
The achievements of the Spring and Autumn and Warring States periods laid a solid foundation for the development of science and technology in ancient China. From then on the productive forces kept expanding and science and technology kept advancing in China, though sometimes with ups and downs. That was true in the Han (206 BC–220 AD) and Tang (618–907) dynasties, which were strong and unified with vast territories; or the periods of the Wei, Jin, and Southern and Northern Dynasties (220–589), when the country was temporarily divided; or the Song (960–1279) and Ming (1368–1644) dynasties,



Baopingkou, the opening cut in the east bank of the Minjiang River, an important part of the ancient Dujiangyan irrigation system.

Lu Ban, a legendary carpenter and inventor.

which enjoyed relative stability and prosperity; or the Yuan (1206–1368) and Qing (1616–1911) dynasties, whose rulers came from among ethnic minorities. The Chinese with their diligence and wisdom scored great achievements in natural sciences as well as in art and literature, history, and philosophy. They kept inventing and creating everything that was needed in production and daily life. Apart from carrying on earlier scientific achievements and completing the four major inventions, ancient Chinese made other discoveries and inventions, such as copper and iron, coal and petroleum, porcelain, silk and cotton cloth, wine and liquor, and Chinese medicine. They also made discoveries in the studies of



The principle of camera obscura—light that passes through a pinhole in a box forms an inverted, backward image of the subject on the back of the box.

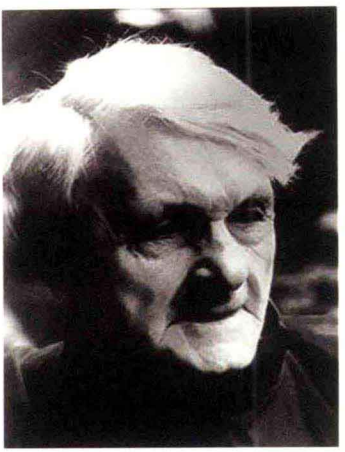
mathematics, physics, chemistry, the heavenly bodies and the universe. They manufactured wonderful machines and devices, created accurate calendars, built the Great Wall and the Grand Canal, as well as put forward the theory of "equal temperament." Mozi (c. 468–c. 376 BC), a great philosopher, thinker and scientist of the Warring States period, was the first to discover the principle of camera obscura—light that passes through a pinhole in a box forms an inverted, backwards image of the subject on the back of the box. His discovery was made earlier than that of the Platonic school in Greece. Lu Ban (c. 507–c. 444 BC), a celebrated craftsman, established the basic standards for carpenters: Use no nail or glue. According to legend, Lu Ban once made a seemingly rough and shaky chair and dropped it down a city wall, and when the chair touched ground, it became a sturdy, perfect chair. This story shows the advanced level of practical techniques of ancient Chinese.

Dr. Joseph Needham (1900–1995) firmly believes that China was the cradle of world inventions. In his *Science and Civilization in China*, this British scientist listed from A to Z 26 major Chinese

inventions and the related time lags between China and the West. The inventions include cast iron, gunpowder, papermaking, compass, movable type printing, porcelain, and waterwheel. Needham noted that China had scored one after another "world's firsts," and that Francis Bacon (1561–1626) was correct in recognizing that the inventions of gunpowder, paper and printing and the magnetic compass transformed the antique and Medieval worlds into a modern age.

American scholar Robert G. Temple stated: The modern world in which we live is a joint creation of China and the West; more than half of the basic inventions and discoveries which led to the creation of this modern world are Chinese, and are not Western at all; even Newton's first law of motion and William Harvey's discovery of blood circulation can be traced to Chinese sources; the Industrial Revolution was made possible in Europe by the preceding European Agricultural Revolution, which was brought about entirely by the importation of Chinese inventions and agricultural techniques and their dissemination.

When we discuss inventions and discoveries in ancient China, we should first of all mention the British historian of science Joseph Needham. A foreign scholar yet a recognized authority on the history of science and technology in ancient China, Needham devoted his life to the study of the history of Chinese science, technology and medicine. This is a much-told story among students of science, and a vivid proof that human civilization knows no boundary. Although wars and conflicts are still frequent, international friendship and cooperation with its lasting vitality will remain the main theme of human life. Joseph Needham was at first a leading biochemist. He took his Chinese name Li Yuese after ancient Chinese thinker Li Dan (Laozi) whom he adored. In the mid 1930s, Needham's interest in China was awakened by Chinese students at Cambridge when he began to learn the Chinese language and study Chinese history of science



Dr. Joseph Needham.

in 1939. During the War of Resistance Against Japan, Needham went to China as Head of the British Scientific Mission and later Scientific Counselor to the British Embassy at Chongqing, then the "acting-capital" of China. Under the auspices of the British Council Needham established the Sino-British Science Cooperation Office (SBSCO), and got to know a large number of Chinese scientists.

While culturally supporting the Chinese people who were resisting Japanese aggression, Needham also began a new phase in his study of Chinese history of science, which also gave a great encouragement to the Chinese who were fighting the Japanese fascists. Needham had a deep love for the enterprising spirit and great achievements of ancient Chinese scientists, and he devoted all his energy to his study. He read extensively Chinese classics, visited cultural sites of various Chinese dynasties, and even rode horseback to Northwest China for field study. After the founding of New China in 1949, Needham visited China eight times, traveling widely, collecting large quantities of historical materials on Chinese history of science, and obtaining first-hand knowledge of China's political, economic, cultural and scientific development. He was one of the founders of the Britain-China Friendship Association and served as its president in the 1950s. In 1954 he published the first volume of his monumental work *Science and Civilization in China*, with the help of Dr. Lu Gwei-djen, who awoke his interest in Chinese scientific history, and others. This work shocked Sinologists in the West and enhanced the national pride of the Chinese. Needham was the only British scientist who won the double title of "Fellow of the Royal Society" and "Fellow of British Academy." He was

also one of the first foreign academicians of the Chinese Academy of Sciences.

While admiring the brilliant achievements of science and technology in ancient China, Needham could not but wonder why modern China had a poor record in science and technology. This led to Needham's Grand Question or the Needham Puzzle. It should be noted that before Needham Chinese scholars had raised this question in 1915. Answers to this question are numerous and complicated.

For quite a long time Chinese bureaucracy had promoted and protected the growth of science and the productive forces. But in the mid- and late-Ming Dynasty the feudal rule was strengthened, politics was dominated by eunuchs, and the country was closed to the rest of the world, which severely hindered the development of productive forces and science and technology. In the meantime, Europe was experiencing its late Renaissance. For two to three hundred years thereafter science and technology in China remained in a backward state, especially when Emperor Yongzheng (r. 1723–1735) of the Qing Dynasty stepped up the self-closure of the nation. Yet in that period the Industrial Revolution was prevailing in Europe. When science and technology in Europe advanced at an ever-increasing accelerated pace, which thanks to the Renaissance and the Industrial Revolution, their counterparts in China were mired by rapidly worsening political and economic conditions.

The closed-door policies of the Ming and Qing dynasties undoubtedly stifled the development and even the existence of science and technology in China, as without exchanges with the outside world there was no vision and rational understanding of world science nor absorption of alien elements for self-enrichment. In the meantime the feudal high-handed rule and clampdown on freedom of thinking prevented emancipation of the mind and enterprising exploration.

After the extraordinary advance of the world's science and technology in the mid-19th century, China was subjected to aggression and suppression by imperialist powers, which in turn controlled its economy and extorted huge war reparations from the Qing government. The nation was depleted of its strength, its scientific and cultural undertakings rapidly declined, and its previous glory of science and civilization was but lost.

Science and technology in ancient China also suffered from another deficiency: lack of conscious exchange and extension, let alone governmental guidance and institutional protection. Scientific research was quite often the endeavor of an individual, therefore it was not to meet the demand of society, and its findings usually disappeared with the death of the individual. For instance, equal temperament invented by Zhu Zaiyu (1536–1611) of the Ming Dynasty is a great achievement in music, but his findings were almost forgotten and there was no successor after him. Again, Emperor Kangxi (r. 1661–1722) of the Qing Dynasty was a great enthusiast of mathematics and took algebra calculations as a pastime, but that was only his personal hobby. The emperor never linked his love of mathematics with the promotion and development of science and technology.

Ancient China had an extreme bias for arts and against science. Ancient Chinese learning included only literature, philosophy, history, and language; or the study of classics, stereotyped writings, and poems. Science and technology, which were needed in production and daily life, were regarded as something trivial and vulgar. Intellectuals in ancient China had a very poor understanding of natural sciences. Among those who had contributed to the development of science and technology in ancient China, there were very few who were funded and rewarded by the government, except for a few imperial historians who made astronomical and calendar-related findings. Students of the whole nation devoted their efforts to the study of classics

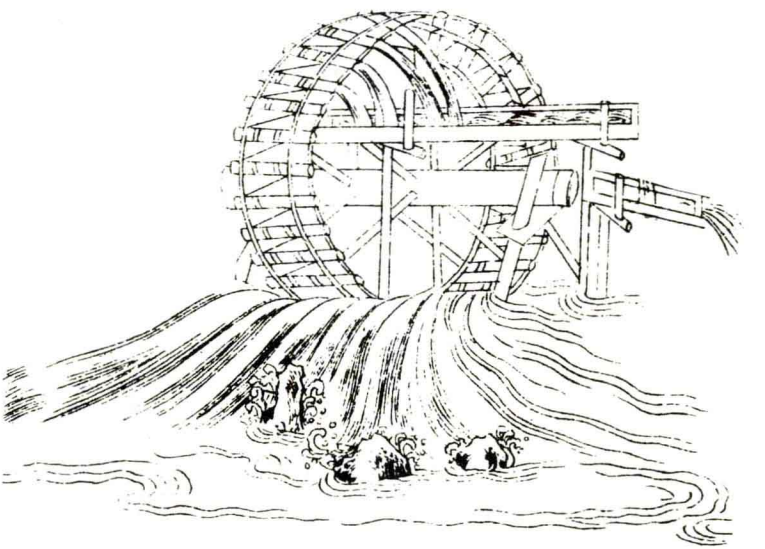
and stereotyped writings. All the schools were for arts; there was hardly any institution for the training of scientific personnel in a certain profession. Although the country had a large population and a large number of students, very few of them devoted themselves to natural sciences and technology. With the further implementation of the imperial examinations, by which the officials were chosen according to the quality of the eight-legged essays they had written, the shortage of scientific personnel became more acute.

In addition, the few Chinese who did study science quite often focused their efforts on questions related to philosophy and some practical techniques but not issues in terms of basic sciences such as physics, chemistry and biology. They also had little interest and experience in purposeful scientific experiments. As European scientists experienced an explosive advance in science and technology in the past two or three centuries, naturally their Chinese counterparts were left far behind.

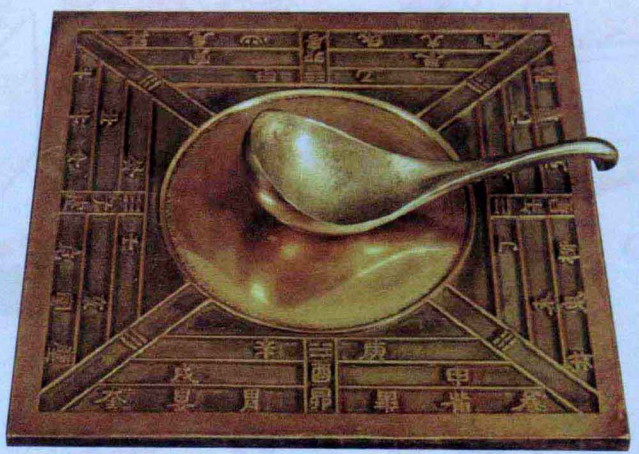
A review of inventions and discoveries in ancient China would help people recognize the wisdom and creativity of the Chinese, as well as the internal dynamic behind China's rapid growth of the economy, culture, science and technology in recent 30 years. The wisdom and strong will of the hundreds of millions of Chinese constitute an immeasurable power. The years of reform and opening up to the rest of the world is but a second in Chinese history, yet China's economy has expanded greatly, the gap between China and advanced Western countries has been rapidly reducing, and in some fields the country has moved to the forefront.

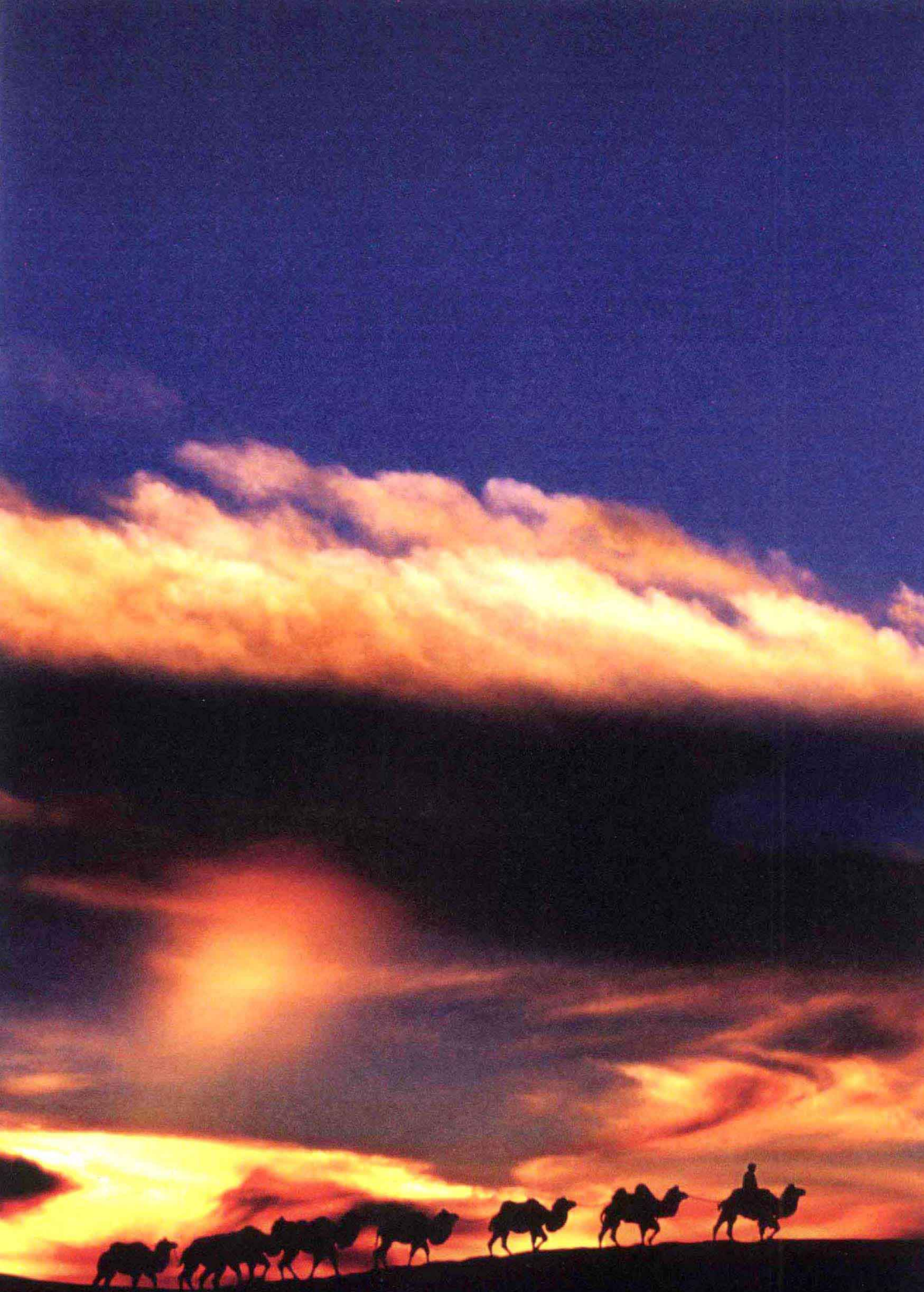
Deng Xiaoping, who was chief architect of China's reform and opening up, said, "Science and technology constitute a primary productive force." The Chinese government has recognized the vital role of science and technology in promoting productive forces, and regarded it as a basic state policy to rely on science

for the development of the country. China has made substantial progress in making long-term planning for the development of science and technology, building infrastructure facilities, training scientific personnel, and exchanging information on science and technology. The nation is losing no time and going all out to catch up with advanced countries. There is a bright future for the renewal of China, including the renewal of its science and technology.



The Four Major Inventions





A scene from the Silk Road. For a thousand years the Silk Road was a major channel for exchanges between China and the rest of the world.