Joseph Needham’s inspiration for research on agricultural history in China

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Abstract
Ancient Chinese civilization was agricultural. To grasp the essence of science and civilization in China, Dr Joseph Needham drew attention to its agricultural development. He maintained close academic relations with Chinese historians of agriculture and obtained their help from time to time for the compilation of his Science and Civilisation in China. Needham also had a far-reaching influence on research on the agricultural history of China, both on its institutionalization and on transitions in the directions of research. The so-called ‘Needham puzzle’ was first proposed systematically in his address titled ‘Science and agriculture in China and the West’ at the annual conference of the China Agronomic Association in Chongqing in 1943. He believed that science is not isolated from society but is an indivisible part of civilization and that civilization has evolved as the result of the interactions of science, society and the environment.

Keywords
Joseph Needham, Science and Civilisation in China, agricultural history, agricultural heritage, history of science and technology

Research on China’s agricultural history began as early as the 1920s. In 1920, in cooperation with the US Department of Agriculture and the Library of Congress, the University of Nanking (now Nanjing University), which was established by American missionaries, set up the Research Department of Agricultural Books. Ms Catherine Howes Wead of the Library of Congress was sent to Nanjing to systematically gather and collect ancient Chinese books on agriculture, which had been handed down to the Institution of Chinese Agricultural Civilization of Nanjing Agricultural University. In 1932, the Research Group on Agricultural History was set up within the Department of Agricultural Economics of the university, and a course on agricultural history was established for undergraduates. In general, however, research on agricultural history remained sparse and was sporadic during most of the Republican era (1911–1949). Circumstances changed from the 1940s onward, and one of the major instigators of that transformation was Dr Joseph Needham.

I. Falling in love with the history of science and technology in China

Dr Joseph Needham (1900–1995) was a well-known biochemist and founder of chemical embryology, for

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which he was elected as a Fellow of the British Royal Society in 1941. He became interested in the history of science and technology in the late 1920s. In 1931, he attended the second International Conference on the History of Science held in London and was deeply impressed by Marxist perspectives on the history of science. In 1936, he began delivering a series of lectures on the history of science at the University of Cambridge. He had no idea of Chinese attainments in science and technology until he became familiar with them in 1937 through Shen Shizhang, Wang Yinglai and Lu Guizhen (Lu Gwei-Djen, 1904–1991), who were pursuing their PhDs at Cambridge. He was amazed by the advanced accomplishments in science and technology in ancient Chinese times and devoted himself to the study of Chinese history.

In 1939, Needham published his first paper on the history of science in China in cooperation with Lu Guizhen, who was the daughter of Lu Shiguo, a well-known physician of traditional Chinese medicine in Nanjing.

In February 1943, Needham was sent to China by the British Government. He later established the Sino-British Science Cooperation Office in Chongqing. During his 3-year stay in China, he had a number of opportunities to share ideas and knowledge with scholars from various institutions and universities and learned more about Chinese history and ancient China’s accomplishments in science and technology. He had the idea of writing a book to introduce those remarkable achievements to the West.

In 1948, when he returned to Cambridge from Paris, Needham started a book project titled Science and Civilisation in China (SCC). Its first volume was published in 1954. By 1995, when Needham passed away, 16 volumes of SCC had been published and had earned him a worldwide reputation. SCC was awarded the First Prize for Natural Science in China, and Needham was elected as a member of the Chinese Academy of Sciences. For his accomplishments, Needham also won the George Sarton Medal in 1968.

2. Needham’s circle of agricultural historians

Needham realized that ancient China was an agricultural society, and hence focused on its history of agricultural development and how that affected Chinese society and civilization. In February 1943, he delivered a famous speech titled ‘Science and agriculture in China and the West’ at the annual conference of the China Agronomic Association in Chongqing, proposing for the first time the well-known ‘Needham puzzle’: China had led the world in science and technology for two millennia, but why did it fail to do so in modern times? That question aroused worldwide interest and sparked heated debates for decades.

During his work on science and civilization in ancient China, Needham became acquainted with numerous scholars and established cooperative relationships with them that lasted decades. Among them there were a number of historians of agriculture, such as Professor Shi Shenghan (1907–1971) of National Northwest College of Agriculture (now the Northwest Agriculture and Forestry University), Professor Wan Guoding of the University of Nanking, Mr Hu Daojing (1913–2003) of the China Press in Shanghai, Professor Wang Yuhu (1907–1980) of the Beijing Agricultural College (now China Agricultural University), and Professor Liang Jiamian (1908–1992) of the College of Agriculture of Zhongshan University (now South China Agricultural University).

Professor Shi Shenghan received his PhD in plant physiology from the University of London under the supervision of Professor F.F. Blackman. He served as a professor of biology at Tongji University, Wuhan University and National Northwest College of Agriculture...
Agriculture. From the 1950s on, he devoted all his efforts to studying Chinese agricultural history.

Needham first met Shi at Sichuan University in Leshan. As Needham was a biochemist and Shi was a biologist who spoke excellent English, Shi soon became an ideal companion for Needham’s academic investigations and they became good friends.

Shi was erudite in both Chinese and Western scholarship and gave Needham considerable assistance. Needham benefitted a great deal from Shi’s work, especially his *Annotations of Qi Min Yao Shu* (Shi, 1957) and many other works. While initiating the *SCC* project, Needham had hoped initially to have Shi as his collaborator for the volume on biology and agriculture. He wrote to the Chinese Government about it but failed owing to Shi’s politically precarious situation in China at the time. Needham did not forget their friendship and the enlightening help he had received from Shi. He dedicated the *SCC* volume on botany to Shi (Needham, 1986).

Needham also wished to help Shi in any way Shi needed. In the late 1950s, when the Science Press prepared for the publication of English translations of Shi’s books *A Preliminary Survey of the Book Chi Min Yao Shu* (Shi, 1958) and *On Fan Sheng-chih Shu* (Shi, 1959), Needham offered his help on collation and annotation. Shi expressed his gratitude to Needham in the prefaces of the books.

Needham also had contact and academic exchanges with Professor Chou Io (Zhou Yao) of the National Northwest College of Agriculture. Chou was a distinguished entomologist who had graduated from the Universita degli studi di Napoli Federico II in Italy under the supervision of world-renowned entomologist Filippo Silvestri. Chou (1957) published the first treatise of *A History of Chinese Entomology in Early Times*, and was a pioneer in the history of biology in China. Needham attached importance to Chou’s research and cited a number of his results in *SCC*.

Mr Hu Daojing was a well-known editor and bibliographer (Figure 2). He graduated from Chizhi University in Shanghai (now the Shanghai International Studies University) and wrote numerous articles and books on ancient Chinese classics; the most famous ones are *Annotations of Shen Kuo’s Meng Xi Bi Tan* (Hu, 1956) and *Ancient Agronomic Books and Essays on Agricultural History* (Hu, 1985). Because of his experience in collection and publication, he became an important source for Needham’s research materials for *SCC*. They corresponded frequently (there are 14 folders of their correspondence in the Needham Research Institute (NRI) archives). In 1964 alone, Hu sent Needham more than 30 books on science and technology in ancient China.

In 1980, Hu gathered Chinese scholars distinguished in the history of science and edited a book titled *Explorations in the History of Science and Technology in China* (Hu, 1981) as a gift to celebrate Needham’s 80th birthday. It was published by Shanghai Classics publishing house. Needham appreciated Hu’s contribution to the bibliography of ancient science and technology and agricultural history, and wrote a dedication to Hu in his book *Meng Xi Bi Tan Bu Zheng*. Needham was also an important advocate for Hu’s membership of the International Academy of the History of Science in 1981.

Professor Wang Yuhu was a distinguished scholar in agricultural history and ancient agricultural bibliography. He studied economics at the Technische Universität München (Germany) and the Université de Paris (France) and initiated world agricultural history and comparative agricultural history studies in China. He returned to China in 1933 to serve as curator of the university library of the Beijing College of Agriculture for nearly 30 years. His best known work is *A Collection of Agronomic Books in Ancient China* (Wang, 1957). Needham drew attention to his
works and had them listed as important reference works for SCC. When the SCC biology volume was published, Needham wrote on the title page in memory of Wang Yuhu, Shi Shenghan and Amano Motonosuke and stated that, without their pioneering work in agricultural history, the volume on agriculture could not have been completed (Needham, 1984).

Professor Liang Jiamian studied at the College of Agriculture of Zhongshan University and became interested in agricultural history under the influence of Professor Ding Ying, the dean of the college. In 1941, he was engaged to work in the university library and made agricultural history studies as his lifelong career. Needham first met Liang in May 1944 in the company of Dr Huang Xingzong. Because of the war with Japan, Zhongshan University moved to Zhangyi in Hunan Province. As Liang was in charge of the university library and had accumulated much knowledge of the history of agriculture, Needham spoke to him twice in detail regarding Chinese agricultural history (Figure 3). From then on, they maintained a close academic relationship. Because Liang acted as director of the university library for decades and was familiar with ancient sources, he offered Needham considerable assistance by sending books or providing valuable duplicates of ancient Chinese texts on farming and biology.

Professor Wan Guoding was the first scholar to research the agricultural history of China. He was born in Wujin (Jiangsu Province) in 1897 and graduated from the University of Nanking in 1920. Wan fell in love with agricultural history in the early years of his university education and wrote his first paper on the history of sericulture in ancient China. In 1924, he was appointed director of the Research Department on Agricultural Books and, in 1932, head of the Agricultural History Research Office of the Department of Agricultural Economics in the university. In 1955, he was appointed as the first director of the National Institute of Chinese Agricultural Heritage under the dual leadership of the Chinese Academy of Agricultural Sciences and Nanjing Agricultural College (now Nanjing Agricultural University).

Needham made three visits to Professor Wan and his research team, in 1943, 1958 and 1964. When Needham first visited the University of Nanking in 1943, he became acquainted with Wan through Zhang Zhiwen (1900–1982). Zhang graduated from Cornell University and was a well-known agronomist specializing in cotton. He was dean of the College of Agriculture at the University of Nanking from 1931 to 1948. During the war with Japan, along with other universities, the University of Nanking was moved to Chengdu. In June 1943, Needham was told that Wan and his colleagues had been involved in a major project called *A Complete Collection of Ancient Agricultural Works* since 1920, and Needham hoped that Wan could provide him with the academic materials he needed. Before long, Needham received a piece on the outline of the project and Professor Zhang Zhiwen’s treatise, *Plan of Post-war Agricultural Construction in China*.

On 17 October 1948, Needham wrote again to Zhang, requesting more academic resources for the compilation of SCC and expressed hope that he would get two copies of *A Complete Collection of Ancient Agricultural Works*. In 1951, Needham also tried to communicate with Wan Guoding through their old friend Zhu Kezhen (1890–1974), a former president of Zhejiang University and then vice president of the Chinese Academy of Sciences. In a letter, he told Wan about his grand project and enclosed ‘an advance schedule of the various chapter-headings’ (Figure 4).

The archives show that Needham not only received a lot of academic resources from Chinese
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scholars but also arrived at important findings through discussions with his Chinese colleagues. For instance, on 25 June 1958, Needham and Lu Guizhen visited the Institute of Chinese Agricultural Heritage and had a long discussion with professors Wan Guoding, Chen Hengli, Zou Shuwen, Hu Xiwen, Song Zhanqing and Li Changnian and other researchers at the institute. Needham’s diary contains a detailed description of the event (Figure 5). The topics they dealt with were extensive: the origin of the soybean and its use; comparisons of economic and political institutions in China and the West; the reasons why farming practices in ancient China had been more advanced than those in Western countries; and special histories of various crops, pest control and hydraulic engineering. Some of those discussions are reflected in *SCC*. During his visit to the institute on 27 August 1964, Needham discussed with Professor Hu Xiwen the use of green manure in ancient China. He believed that Chinese civilization could have developed over thousands of years because of this perfect combination of the use and nurturing of farmland.9

Later in the same year, Needham had another long exchange in Beijing with Professor Zou Shuwen, who visited the Science Press to prepare his book *The History of Chinese Entomology* (Zou, 1981) for publication.10 They discussed in detail ways of using beneficial insects, such as silkworms, honeybees, white wax insects and the like, as well as ways of controlling various pests in ancient China.

Some of their discussions are recorded in the volume on agriculture in *SCC* (Needham, 1984).

3. Needham and the institutionalization of the history of science in China

Although China had a long history of achievements in science and technology, no effort had been made to study them before the 20th century. Needham’s *SCC* inspired and stimulated work on the history of science and technology as an independent discipline in China.

After the publication of the first volume of *SCC* in 1954, systematic research on the history of science in China flourished. One of the leading figures in the field was Zhu Kezhen, who was a distinguished meteorologist. Zhu was born in Shaoxing (Zhejiang Province) in 1890. He obtained his PhD from Harvard University in 1918 and became the first chairman of the Department of Geography of Southeast University in 1921. He became the founding figure of modern geography and meteorology in China. In 1934, together with Weng Wenhao and others, he set up the China Geography Association. From 1936, Zhu served as president of Zhejiang University for 13 years. In 1948, he was elected as a member of the Chinese Academy of Sciences and, in 1949, he was appointed vice president of the academy.
Zhu was not only an outstanding meteorologist and leader in scientific activities but also a historian of science. He conducted pioneering work in a number of fields, such as historical meteorology, historical phenology and historical seismology. His magnum opus is ‘A preliminary survey of climate change in China for five thousand years’ (Zhu, 1972). Needham became acquainted with Zhu as early as March 1943, when he met him at a welcoming banquet held by Zhu Jiahua, the Minister of Education, in Chongqing. In April and October 1944, Needham visited Zhejiang University at Zunyi (Guizhou Province) and established a lifelong friendship with Zhu.

Zhu was also a constant supporter of Needham’s research. He sent dozens of boxes of ancient Chinese academic materials to Needham, including a set of the Gu Jin Tu Shu Ji Cheng (Complete Collection of Illustrations and Writings from Past to Present). From their correspondence, one notes that Zhu even drew up a list of leading Chinese scholars in different fields of the history of science and technology for Needham’s reference, including Li Yan and Qian Baocong for the history of mathematics, Liu Zhaoyang for the history of astronomy, Liu Xianzhou for mechanical history, Wan Guoding for agricultural history, Li Tao for the history of traditional Chinese medicine, Liu Dunzhen for the history of architecture, Zhang Hanying for the history of hydraulic engineering and others.11 Because there was no stable funding for Needham’s SCC project early on, Zhu even persuaded the Chinese Government to give Needham some financial support for 3 years and entrusted Wang Ling to assist Needham with the compilation of SCC. Needham expressed his gratitude to Zhu in the preface of the first volume of SCC, describing him as the most generous and persistent donor and supporter of Needham’s huge, lengthy project.

Needham’s ideas and his SCC have had a far-reaching impact on the institutionalization of the history of science in China. Inspired by the first volume of SCC, Zhu published an article in the People’s Daily on 26 July 1954 titled ‘Why should we study the history of science and technology in ancient China?’ drawing people’s attention to Needham’s work and stressing the importance of the history of science. In 1956, with Needham’s help, Zhu led a group of historians of science to Italy to take part for the first time in the International Conference on the History of Science (Figure 6).

After returning home, Zhu and some other well-known scholars asked the Chinese Government to set up a special institute for the history of science. In 1957, the Chinese Academy of Sciences established the Institute for the History of Natural Science and started the publication of The Collection for the History of Science, with Qian Baocong as chief editor. Before long, a number of universities and institutions in other parts of China established special institutes or research offices in this field, including the Institute for the History of Science at the University of Science and Technology of China in Hefei (Anhui Province).

In 1954, the Ministry of Agriculture held a symposium on investigating the agricultural heritage of ancient China. In 1955, with the support of Jin Shanbao,12 the president of Nanjing Agricultural College, the national Institute of Chinese Agricultural Heritage was formally established in Nanjing, with Professor Wan Guoding as its first director.

In 1957, the institute was reorganized and affiliated under the dual leadership of the newly established Chinese Academy of Agricultural Sciences in Beijing and Nanjing Agricultural College (where the institute was located). Similar research units were
later set up in other agricultural universities, such as the Research Office on Ancient Agronomy of the National Northwest College of Agriculture at Wugong (Shaanxi Province), led by Professor Shi Shenghan; the Research Office on Agricultural History of Beijing Agricultural College, led by Professor Wang Yuhu; and the Special Collection of Ancient Agricultural Classics of South China Agricultural College in Guangzhou, led by Professor Liang Jiamian. Although there was no special unit for agricultural history, similar research was conducted by scholars at Zhejiang Agricultural College (now Zhejiang University), the Chinese Academy of Forestry Sciences and the Chinese Academy of Hydraulic Science and Technology.

In the early decades of the People’s Republic of China, the nation was isolated, but Needham was one of a few scholars to maintain a friendly relationship with the country. He was the founder and first chairman of the Sino-British Friendship Association. As early as in 1943, Needham met with Zhou Enlai, one of the leaders of the Communist Party of China, in Chongqing. In 1964, on the 15th anniversary of the People’s Republic of China, Needham met Chairman Mao Zedong. Mao praised Needham’s wonderful work on the history of science and technology in China and sought his suggestions on the development of modern industry.

With the encouragement of China’s leaders, Needham gained some privileges in China. Not only did he have opportunities to visit many academic institutions, but he also made series of rural field trips throughout China and collected much firsthand material on rural areas and traditional Chinese farming practices.

4. Needham’s influence on research into the agricultural history of China

In the late 19th century, China was invaded by a succession of imperialist powers. To survive, the country was forced to learn from the West. During the Westernization Movement and later periods, a number of talented people were sent to Western Europe and the United States to study advanced science and technology. Under the influence of a Eurocentric ideology, it was widely believed that science was derived from the West and that there had been no natural science in ancient China. Ren Hongjun (1915), the founder of the China Science Society, wrote a paper titled ‘Why was there no science in ancient China?’ for the first issue of Science. Needham and Zhu Kezhen disagreed with Ren and claimed that a clear distinction should be made between traditional science and modern experimental science.

Many thought that Needham first raised the Needham puzzle in the first volume of SCC in 1954, but he had already posed the question at the annual conference of the China Agronomic Association in Chongqing in February 1944 in his lecture on ‘Science and Agriculture in China and the West’.

In that lecture, Needham refuted the argument that there had been no science in ancient China and claimed that a large number of inventions and advances in science and technology had been made in that period, including the compass, gunpowder, paper-making and printing. In agriculture, the ancient Chinese began raising silkworms and using their cocoons as early as thousands of years ago. China was the motherland of tea planting and tea making, which later spread throughout the world. The ancient Chinese were also the first to invent biological controls of pests in fruit production.

Western scholars had focused on contributions made by the Egyptians, Babylonians and Arabs, ignoring achievements by China and India. In Needham’s view, China had been far superior to the West in science and technology, at least until the 15th century. Chinese civilization was rooted in agriculture, and Chinese farming technology had been a model for European countries, exerting a deep influence on the agricultural revolution in Western Europe in the 17th and 18th centuries. Yet, a stunning reversion had occurred in the past 100 years.

Chinese farmers began using the iron plough extensively as early as 2000 years ago, while European farmers used wooden ones. However, by the time Europeans started using steel ploughs, Chinese farmers were still using iron ones. Hence, Needham raised the question, ‘Why did these great beginnings of agricultural science not arise in China,
one of the greatest agricultural countries in the
world?’ (Needham, 1948).

It is not an easy question, and Needham tried to
give a brief answer from geographical, environmen-
tal, economic and social perspectives. He was deeply
influenced by Karl Marx’s philosophy and Karl
Wittfogel’s (1957) *Oriental Despotism*. Their dif-
ferent natural environments and cultural traditions
meant that China and European countries had fol-
lowed different paths of development. The ancient
Chinese had invented gunpowder but failed to make
advances in gun-making and military technology.

Modern agriculture was based on the engineering
and chemical industries, so, to improve Chinese
agriculture, China would have to accelerate the
development of modern science and technology. The
 Needham puzzle stimulated generations of Chinese
scholars to examine traditional China’s culture, its
national strategy and shortcomings, and encouraged
people to carry out social and cultural reforms.

What is most important is not whether Needham’s
argument is correct, but rather his broader vision of
exploration and the ways he suggested engaging
with the history of science and technology. His intel-
lectual heritage had a profound influence on the
direction and content of agricultural history in China.
According to Hu Daojing’s recollection, Needham
sent an outline of the *SCC* volume on agriculture to
Chinese historians of agriculture for comments and
suggestions in 1979. Inspired by Needham and his
*SCC*, Chinese historians of agriculture discussed the
possibility of compiling what became *A History of
Agricultural Science and Technology in China*
(Liang, 1989) at a conference in Zhengzhou (Henan
Province). With financial support from the Ministry
of Agriculture and the joint efforts of scholars from
dozens of institutions, the work was published in
1986 and won the National Prize for the Advancement
of Science and Technology.

The true intellectual legacy of Needham and his
*SCC* is not only the series of books and records he
brought together on the history of science and tech-
nology in ancient China (Chinese scholars may well
be more familiar with the academic resources). The
real value of his work lies in his ideas, his theoretical
analysis, his comparative view of cultural develop-
ment and his probing of interactions among
civilizations. I suspect that is why he gave his book
the name ‘*Science and Civilisation in China*’, plac-
ing technology in a certain historical context, and
exploring the interactions between technology and
civilization.

At the beginning of the compilation of *A History of
Agricultural Science and Technology in China*,
Chinese agronomists and historians of agriculture
had planned to deal exclusively with the historical
development of agricultural science and technology,
without considering other factors related to agricul-
ture. However, inspired by Needham’s *SCC*, they
realized that farming is a complex socio-economic
activity involving not only tools and technology but
also productive activities such as land ownership,
marketing and distribution. They had previously
limited the scope of the research to a narrative con-
cept of the history of planting, but they realized that
ancient Chinese agriculture had been an organic
combination of cropping, forestry, husbandry, fish-
ing and sideline production; hence, the concept of
‘comprehensive agriculture’ was adopted to guide
the compilation. The effort proved to be a great
success.

From the 1920s to the 1980s, nearly all efforts by
historians of agriculture in China were focused on col-
lating and annotating ancient agronomic works and
the history of agricultural technology, especially in
the fields of crop breeding, fruit, vegetables, pest con-
tral, farming implements and husbandry. Needham’s
vision of comparative history encouraged Chinese
scholars to explore the broader background of agricul-
tural development and the social and economic set-
tings for the transformation from the traditional to the
modern. Inspired by Needham and *SCC*, they came to
recognize that technology never develops in isolation,
and that technology alone cannot explain the develop-
ment of Chinese agriculture; every technique has its
own historical and cultural background. From the
1980s onward, Chinese historians of agriculture
began to pay more attention to comprehensive
research on Chinese agricultural developments and
the interactions among civilizations.

Civilizations are interconnected, and Needham
drew attention to the spread and interactions of the
world’s civilizations. He listed 26 important Chinese
inventions and probed their far-reaching influence. In
recent decades, increasing attention has been devoted to research on agricultural diffusion and communication between China and other parts of the world. Examples include the National Social Science Foundation’s ‘Agricultural Communications between China and Abroad through the Silk Road’ and ‘The Introduction and Extension of American-originated Crops and Their Long-term Impacts in China’ projects. In October 2012, the first International Conference on Agricultural Origination and Diffusion in the World, sponsored by Nanjing Agricultural University and the University of Reading in the United Kingdom, was held in Nanjing. In addition, the Series on Crop Introduction and Localization in China has been in progress at the Institute of Chinese Agricultural Civilization of Nanjing Agricultural University, and dozens of books have been published.

Needham shifted to study the history of science, but he was not pedantic about history. He believed that people could learn from historical enlightenment and was thus concerned about ongoing developments, showing his passion for economic and rural development. As early as in the 1940s, he made rural field trips to different parts of China, especially Sichuan, Guizhou, Shaanxi, Gansu and Jiangxi, to investigate agricultural production, the daily lives of farmers and irrigation systems. After the founding of the People’s Republic of China, when he returned to China, he also chose to visit Nanyuan People’s Commune in Beijing; Jiajiazhuang People’s Commune in Taiyuan; and the national model in agriculture, Dazhai in Xiyang County (Shanxi Province).

Needham paid great attention to traditional Chinese farming and its achievements. He collected a set of documents and pictures of the National Exhibition of Agricultural Implements in 1956. Based on those materials, he wrote a paper on the development of steel technology in modern China and had it published in a special issue of Newcomen Society. In his position as chairman of the Sino-British Friendship Association, he wrote to the leaders of China, helped the London Science Museum duplicate some agricultural implements from the China National History Museum and held a special exhibition in London.15

When he visited the South China Institute of Tropical Crops in Hainan, he revealed a great interest in rubber technology and production. During his visit to the Chongqing Institute of Citrus and Tangerines of the Chinese Academy of Agricultural Sciences, he held detailed discussions with researchers there and took 18 pages of notes about citrus varieties and related technologies.

Chinese historians of agriculture also recognize the importance of historical studies on agricultural and rural development. Several studies have been published in recent decades. The inaugural rotating workshop of the Joint Conference of Purdue and Nanjing for China Studies was held at Nanjing Agricultural University in October 2015. Scholars from China and the United States got together to explore economic and social transformations in modern times.

Needham valued the traditions of Chinese agriculture and thought they could play an important role in sustainable development in the future. In line with that view, there have been two core areas of research on the agriculture of China since the 1990s. The first is research on the interactions between agricultural development and environmental change. The second is ways of preserving the excellent Chinese agricultural heritage and making it better serve rural development.

In 2014, the Expert Committee on Globally Important Agricultural Heritage was set up in Beijing under the Ministry of Agriculture to steer the conservation of Chinese agricultural heritage. At present, 11 sites in China have been selected and nominated by the Food and Agriculture Organization of the United Nations as ‘globally important agricultural heritage system’ sites, and more than 100 have been selected as ‘nationally important agricultural heritage system’ sites. In cooperation with the Institution of Chinese Agricultural Civilization of Nanjing Agricultural University, the China Agricultural Science and Technology Press has published a series on Chinese agricultural heritage studies. Dozens of books have been published as part of the series, including A Directory of Agricultural Heritage in China (two volumes), On Agricultural Heritage, On the Conservation of Agricultural Heritage in China, and Memories of Traditional Villages in China. The first Forum on Chinese Agricultural Heritage Conservation and the Symposium on the Protection of Traditional
Villages were held in Nanjing in 2010 and 2012, respectively.

To summarize, Joseph Needham was an outstanding scholar with a profound vision of the world. His wide-ranging knowledge of science and history, in both the West and China, helped him create his great work, *SCC*, which brought him world renown. Because of his peculiar status as an ‘old friend of the Chinese people’ and a famous scholar, he and his *SCC* became an important impetus for the institutionalization of the history of science and agriculture. Given that Chinese civilization was agricultural, Needham paid attention to its agricultural development. In his compilation of *SCC*, he received a lot of assistance from Chinese historians of agriculture and established close relationships with them.

Needham and *SCC* had a far-reaching influence on the institutionalization of research into agricultural history in China and on transitions in the direction of that research. Chinese historians of agriculture have drawn on comprehensive and comparative studies in their academic research to learn about history and better serve rural and agricultural development.

Needham taught us that science is not isolated from society and other parts of the world, but is an indivisible part of civilization, and that civilization evolves as a result of the interactions of science, society and the environment.

He probably posed the Needham puzzle not as a real question with a real answer, but as a way to inspire us to think of world civilization and humankind’s future from a more balanced and sustainable perspective.

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**Notes**

1. Lu Guizhen was born in 1904 and obtained her PhD in nutritional science from Cambridge University. She had an important impact on Needham’s lifelong interest in the history of science and technology in China, acting not only as his cooperator, but also as his translator and teacher of Chinese. Allegedly, Needham’s Chinese name, Li Yueze, was coined by Lu Guizhen. Needham dedicated the first volume of *SCC* to her father, Lu Shiguo. Lu married Needham at the age of 85.

2. Shi Shenghan was born in Kunming (Yunnan Province) on 19 November 1907 and received his bachelor’s degree from Zhongshan University. He was a pioneer in plant physiology in modern China and a major leader in agricultural history. He founded the Office of Ancient Agronomy at Northwest College of Agriculture and served as the first director. He died on 28 June 1971.

3. Chou Io was born in Yin County (Zhejiang Province) on 8 June 1912. He was a pioneer of entomology in modern China and founder of the history of Chinese entomology. His book *History of Chinese Entomology* won the First Prize for Excellent Books of Science and Technology and has been translated into five languages. He also setup the first museum of entomology in China. Chou died on 15 December 2008.

4. Hu Daojing was born in Shanghai in February 1913. He was a distinguished scholar in bibliography. In addition to editorial work, he also served as part-time professor at Fudan University, East China Normal University and Shanghai Normal University. He was one of the founding members of the China Agricultural History Association and a corresponding member of the International Academy of the History of Science.

5. Wang Yuhu was born in Gaoyang County (Hebei Province) on 16 April 1907. He was a well-known historian of agriculture; was the founder of the Research Office of Agricultural History at the Beijing Agricultural College; and made pioneering contributions to the comparative history of agriculture, agricultural thought and world agricultural history. He died on 27 November 1980.

6. Liang Jiamian was born in Nanhai County (Guangdong Province) on 25 April 1908. He was a distinguished historian of agriculture who wrote more than 90 papers on agricultural history. He was the founder of the Special Collection of Agricultural Classics and the Research Office of Agricultural History and Heritage of South China Agricultural College, and the first president of the Agricultural History Society of Guangdong Province. He died on 12 March 1992.
7. Wan Guoding was born in Wujin County (Jiangsu Province) on 26 December 1897. He was the initiator of research on agricultural history in China and the first director of the National Institute of Chinese Agricultural Heritage in Nanjing. He published the *Series of Chinese Agricultural Heritage* and *Collections of Agricultural History Research*, which were the first journals in this field. He authored 10 books and more than 130 papers, and his magnum opus – *History of Chinese Agronomy* – won the First Prize of the Ministry of Agriculture in 1987. Wan died on 15 November 1963.

8. Zhang Zhiwen (1900–1982) was born in Lai'an County (Anhui Province) and graduated from the University of Nanking in 1922. In 1930, he went to Cornell University to pursue further studies in agronomy and received his master’s degree in 1931. In 1949, Zhang was engaged as adviser to and executive secretary of the World Rice Association. On 5 January 1982, he passed away in the United States.

9. This is similar to the view expressed by Franklin King, who was the director of the Soil Bureau of the US Department of Agriculture and wrote the famous book *Farmers of Forty Centuries: Or Permanent Agriculture in China, Korea, and Japan* after researching in those countries in 1911.

10. Zou Shuwen (1884–1980) graduated from Peking University in 1907 and obtained his bachelor’s degree from Cornell University and a master’s degree from the University of Illinois. He was one of the founders of entomology in modern China. He served as dean of the College of Agriculture at the University of Nanking and as an adviser to the Institute of Chinese Agricultural Heritage of the Chinese Academy of Agricultural Sciences.

11. From Zhu Kezhen’s letter to Needham on 16 February 1958, SCC2/2/36-44 in the Needham Research Institute (NRI) archive.

12. Jin Shanbao was born in Zhuji County (Zhejiang Province) on 2 July 1895. He was the founder of wheat science in modern China and an outstanding leader in agricultural education and research. He obtained his bachelor’s degree from Southeast China University in 1926 and a master’s degree from the University of Minnesota in the United States in 1932. In 1952, the colleges of agriculture of Central University and the University of Nanking merged into the independent Nanjing Agricultural College. Jin was appointed its first president. In 1957, he moved to work in the Chinese Academy of Agricultural Sciences and served as its president for decades.

13. In *Science and Civilisation in China*, Needham lists 26 Chinese inventions that had a significant impact on the world.

14. Karl A Wittfogel, born in Germany on 6 September 1896, was a well-known scholar of China studies and a professor at Washington State University in the United States. He believed that any culture having an agricultural system dependent on large-scale government-managed waterworks for irrigation and water control was by nature a ‘hydraulic’ civilization, and advanced that term in his book *Oriental Despotism* (Wittfogel, 1957).

15. From Huan Xiang’s letter to Needham on 17 December 1958, SCC2/238/1/17 in the NRI archives. Huan was chargé d’affaires at the Chinese Embassy to the United Kingdom. After the exhibition, Needham and the Sino-British Friendship Association donated duplicates of ancient agricultural implements to the London Science Museum.

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