

## **‘Four S’: The Gist of Science Communication in Modern China**

**LI HONGLIN**

China Research Institute for Science Popularization (CRISP),  
86 Xueyuan Nanlu, Haidian District, Beijing 100081, China

E-mail: lihonglin@cast.org.cn

### **ABSTRACT**

In modern China, the objectives of science communication and popularization can be classified into four broad categories: popularizing scientific knowledge, establishing scientific thought, advocating scientific method and promoting scientific spirit. Some refer to these as ‘Four S’, for short. The ‘Four S’ (scientific knowledge, scientific method, scientific thought, scientific spirit) embodies the characteristics of contemporary Chinese science communication and popularization, which also largely stems from the context of science entering into and spreading throughout China since the late 19th century. At the same time, the ‘Four S’ encounters a few challenges in the ever-changing environment. It is argued that scientific thought and scientific spirit will determine the direction of science communication and popularization in the future, and thus also regulate the relationship between science and society in China.

**KEYWORDS:** Science Communication and Popularization, Scientific Knowledge, Scientific Method, Scientific Thought, Scientific Spirit

### **Introduction**

History shows that in the olden periods, China made great strides in mathematics, agriculture, medicine and astronomy, and diffused the generated knowledge worldwide. However, due to the complex Chinese traditional culture, which emphasised social order, individual self-cultivation, ethical code or public morality and relatively ignored the exploring technological use of laws of nature, China lagged behind. The exclusive Confucianism and the cultural system that it gave birth to during the Han dynasty, should be largely responsible for this lag. This

was in the late 19<sup>th</sup> century when western science and technology was introduced into China. However, the pace of percolation of science and technology remained slow till the mid 20<sup>th</sup> century.

Science communication and popularization received a big boost after the communist revolution succeeded in establishing the new China in 1949. Communication of science and popularization of scientific information was placed high on the national agenda and thereby institutionalised at the national level. Since 1990, science communication became part of the national strategic planning. Policy documents emphasised promoting 'scientific knowledge, scientific method, scientific thought and scientific spirit' (hereinafter referred to as the 'Four S') in the entire country, with an objective of spreading scientific temper. This period was marked as a historical turning point in Science Communication. The content of science communication and popularization became richer and more resources were mobilised to match the diversified needs of the public.

Generally speaking, the motto 'Four S' reflects the typical characteristics and main objective of science communication in modern China. This paper will firstly focus on the connotation and the relationship between each component of the 'Four S', and then try to articulate the specific context that warranted this policy shift, the present scenario and future directions.

### **The 'Four S' and their Relationship**

'In order to popularize science what should be communicated?' is the most complex question to answer. However, China has identified the broad objective of science communication, which is to disseminate and therefore all popularization activities aim at promoting 'Four S'. It is assumed that this strategy will improve scientific culture and ensure all-round development of society. The 'Four S' in China is notionally quite close to what is known as 'scientific temper' in India, 'public understanding of science' in UK and 'scientific literacy' in America. It should also be noted that there is a difference between 'Four S' and science popularization. What is termed as 'Science Popularization' in China is analogous to the term 'Science Communication' in western countries.

***Scientific Knowledge***

The Online Etymology Dictionary informs us that Science in Latin '*scientia*' means 'knowledge, a knowing; expertness,' and 'what is known, knowledge (of something) acquired by study; information', also 'assurance of knowledge, certitude, certainty'. In Old French science is used for 'knowledge, learning, application; corpus of human knowledge'. However, in practice, science goes beyond its dictionary meaning. It operates as most direct, accessible and convenient form to be utilized in daily life. Transformative property of science makes it obligatory on the part of state to intervene and communicate scientific knowledge through all channels of communication. It should be communicated through formal and informal education system, social and cultural activities, lectures and discussions, media and science and technology museums. At this stage let us look at other individual components of the 'Four S'.

***Scientific Method***

Scientific method is a body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge. To be termed scientific, a method of inquiry must be based on empirical and measurable evidence subject to specific principles of reasoning. As per the definition given in Oxford English Dictionary it's 'a method or procedure that has characterized natural science since 17<sup>th</sup> century, consisting in systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses'. The popularization of the scientific method to the public is to make them know how the scientific knowledge is acquired and what is the process of scientific inquiry, and then help them to understand and master the knowledge. Once imbibed, through scientific method, they can distinguish science and pseudoscience, keeping away from superstitions, and even resolve some problems during the course of quotidian life.

***Scientific Thought***

Compared to scientific knowledge and scientific method, Chinese scholars have laid far more emphasis on scientific

thought. Scientific thought is regarded as 'the overall view of nature, society and life based on science', 'simply speaking, scientific thought is the ideology rooted in the scientific activities... Without scientific thought, scientific fact itself will make no sense; Without scientific thought as a clue, scientific knowledge is not more than documentary material that lacks soul' (Liu, 2000). Lai defines scientific thought as 'a scientific view of the world, including the rational view and law-consciousness about the nature, social history and science itself' (Lai, 2003). It is hard and unrealistic to expect the public to grasp all scientific knowledge and theories, but it is possible for them to master the ideological positions (Liu, 2005). With scientific thought, people can get some new viewpoints in problem resolving and reshaping their ways of thinking.

### *Scientific Spirit*

Scientific spirit refers to the cognition of the essence of science and its practice. It shapes human's understanding of science and gives constraints, regulations and guidelines to scientific practice, which broadly speaking is not only the behavioral norm for the scientist, but also applicable to everyone in society. American sociologist of science Merton once generalized scientists' institutional norms as the 'ethos of science', universalism, communism, disinterestedness and organized skepticism. Chinese scholars have made many efforts to articulate the notion of scientific spirit in different ways. Most of these are compatible and complementary in nature. For example, some people generalize scientific spirit as rational exploration, realistic spirit of experimental evidence, enterprising spirit of innovation, and inclusive spirit of competitive collaboration and persistent dedication (Ren, 2000). Overall, Chinese scholars generally believe that scientific spirit is the most fundamental, positive and rational spirit in the pursuit of the truth, and stretching out to the spirit of skepticism, innovation and tolerance. Scientific spirit is 'the sum of ways of thinking, value orientation, behavior norms and tradition formed in the historical development of science'. Scientific spirit is an effective way to eliminate ignorance and superstition. The cultivation of scientific spirit is the most important aspect of improving public scientific

literacy, which is a long-term process of internalization, hence requiring more attention and efforts to form a scientifically tempered society.

### ***Relationship between the ‘Four S’***

Having defined the individual components of ‘Four S’ let us now probe the inter-notional relationship between scientific knowledge, scientific method, scientific thought and scientific spirit. The four mutually interact and promote each other, continually and together constitute the spirit of scientific culture.

Firstly, the ‘Four S’ takes a stratified structure. Some scholars have pointed out that human beings constituted a complex cultural system classified as scientific culture and humanistic culture (Li, 2001). Scientific knowledge is the foundation of scientific culture. Without scientific knowledge, scientific culture can neither exist nor evolve. However, dissemination of scientific knowledge does not necessarily ensure propagation of scientific culture. For the advancement of scientifically cultured society, propagation of method of science and thought are at one level, while the scientific spirit constitutes the highest level of scientific culture (Li, 2001). Scientific thought guides the direction and process of scientific research and decides the design and use of scientific method. Hence, scientific thought is an advanced element of science rather than specific knowledge, theory or method (Ren and Zhai, 2014). In other words, in order to inculcate scientific temper in the society, each ingredient like scientific knowledge, scientific thought, scientific method and scientific spirit, is equally important (Sun, 2007).

The academician of Chinese Academy of Sciences, Wang summarized the ‘Four S’ in the following words: ‘The purpose of science popularization is to enhance the scientific literacy in society. The popularization of scientific knowledge is like growing a tree that takes ten years, but popularizing the scientific spirit takes hundred years of educating generations. As scientific knowledge is the starting point of science popularization, scientific spirit is the destination; scientific method and scientific thought are on the way’ (Wang, 2002). If we say scientific knowledge is the pearl of the treasure house of human

intelligence, then, scientific thought is the gold thread that strings them together. Scientific method is like a needle, scientific spirit is the glow of the string of pearls of wisdom.

### **Context of the 'Four S' and its Flexibility in Current Circumstance**

#### ***Western Science and the 'Instrumental Rationality'***

After the Opium War, modern science and technology in China was treated as the most effective way to make the country rich and to make the military powerful. 'Chinese culture is the body, western science is the limbs'<sup>1</sup> (Chang, 1900) or 'saving the country with science' were the notions that became popular in China. Advanced western science, technology and scientific thinking spread eastward and were absorbed gradually by Chinese culture (Ren *et al.*, 2012). Meanwhile, the reformists forced abolition of imperial examination system and a new education, that advocated science education, was set up. This resulted in dissemination of scientific knowledge among the nobility, the intellectuals and among the public, at large. During the first decade of the 20<sup>th</sup> century China witnessed emergence of science associations, for example, the Science Society of China in 1915 and *Academia Sinica* in 1928, with their main aim as pursuing scientific research and popularization of science. These societies promoted modernization of Chinese society and indigenization of scientific thought into Chinese culture.

However, the inadequate development of science and the power it brings, led to a unilateral perception of its nature and

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<sup>1</sup> This was the principle guiding the westernization movement after 1860 in the late Ching Dynasty. The westernization movement was a reform initiated and organized by the Yang Wu group, most of whom were imperial officials influenced by western culture who aimed to make the feudalist Ching Dynasty strong and prosperous. The idea of 'Chinese culture the body, western science the limbs' was well expounded in Chang Chih-tung's *Quan Xue Pian* (English edition: *China's only hope*). The work consisted of two parts with 24 separate papers. The first part persuaded people to stick to Confucian ideas and be loyal to the feudalist emperors, while the second part called for learning science and imitating the western institution without shaking the governance of traditional Chinese culture. Those ideas were incorporated into the guiding principle of the westernization movement.

functions. The practicability and functionality of science were overemphasized, while the significance and value of scientific thought were not fully understood, and finally resulted in further ‘scientism’<sup>2</sup>. In short, science was regarded as the most promising way to promote the development of the country, to be against pseudoscience and superstition, to resolve many problems as a panacea, and so on. This ‘instrumental rationality’ affected public understanding of science for a long period, and even became the leading principle of science communication and popularization in China.

### ***Putting Forward the ‘Four S’: The Way of Modernization***

In the framework of ‘instrumental rationality’, propagation of scientific information was thought to be the most important objective. It was considered as a short-cut to catch up with the development of western countries. As many researchers have termed the period, from 1949 to 1978, as the ‘traditional stage’ of Chinese science popularization, during this period the focus was on popularization of scientific information and techniques and its objective was the economic upliftment (Shen, 2003). The period is characterized by the establishment of special departments and associations to promote science popularization, the Science Popularization Bureau and the All China Association for Popularization of Science and Technology now China Association for Science and Technology (CAST), whose main missions were ‘popularizing natural scientific knowledge and improving the public scientific and technological literacy level’. The first governmental document on science popularization

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<sup>2</sup> Chinese-American researcher D.W. Kwok (1965:3), in his book *Scientism in Chinese Thought*, proposes a sound argument on scientism in China in the first half of the twentieth century, 1900–1950: ‘Scientism, in general, assumes that all aspects of the universe are knowable through the methods of science. Proponents of the scientific outlook in China were not always scientists or even philosophers of science. They were intellectuals interested in using science, and the values and assumptions to which it had given rise, to discredit and eventually to replace the traditional body of values. Scientism can thus be considered as the tendency to use the respectability of science in areas having little bearing on science itself. In China, the desire for national growth was accentuated by the weakness in technology, and it is thus not surprising to find among her Western-educated intellectuals great enthusiasm for science.’

pointed out 'the propaganda of scientific knowledge has important role in the formation of people's worldview based on materialism and erasing superstitious and conservative thought' (The State Council of PRC, 1953). During the 1950-60s, activities were launched around health, agricultural production, defence, newborn delivery, and so on. At the same time, keeping in mind the needs of workers and peasants, a series of mass experiment research activities were launched. It included the promotion of inventions, popularization of scientific and technological knowledge, professional and technical training, etc.

Nevertheless, science popularization suffered a severe setback after 1978. Due to the implementation of China's 'reform and opening' policy, the country underwent a social transition from planned economy to market economy. The transition comes with a baggage detrimental to scientific thought that brought ignorance, superstitions, pseudo-science and anti-science ideas. Curiously, many unscientific incidents appeared such as 'Hongcheng Magic Liquid', 'exceptional function' and 'Falun gong'. These episodes showed deficiency of science communication strategy. People did not inculcate basics of scientific method to make a reasonable judgment for simple scientific phenomena. For example, 'Hongcheng Magic Liquid' claimed that they could change the liquid into oil regardless of the law of conservation of the element in chemistry and it was accepted by majority. Similarly, 'exceptional function' or 'Falun gong' caused harm to the public and even some intellectuals were trapped by the claims. Thus, scholars called for a shift in the policy of popularization as a pursuit of truth, such as the method of scientific inquiry as well as the cultivation of scientific thought and spirit (Fan, 2001).

With the implementation of 'rejuvenating the country through science and education' strategy, scholars generally reached a consensus that the country's development depends on the enhancement of science-based consciousness of the public. Accordingly, the core of science popularization should extend beyond scientific knowledge to the 'Four S', especially to scientific thought, scientific methods and scientific spirit.

This consensus also won the acceptance of the state and the government, and gradually evolved as a new concept to guide



the practice of science popularization in China. For example, in the National Conference on Technology Innovation in 1999, Jiang Zemin explicitly put forward the idea of the 'Four S' to 'conquer the ignorance and superstition'. In 2002, the Law of the People's Republic of China on Popularization of Science and Technology was enacted, which made the popularization of the 'Four S' as the legal provision. In 2006, after an intense consultation among scholars and publication of a series of research reports, the programmatic document of science popularization in the new century was promulgated, *The Outline of the National Scheme for Scientific Literacy*, which was accepted by the scholars and the government emphasized the 'Four S' as a basis for citizen's scientific literacy. It was recorded in the policy document that basic scientific literacy involves the 'Four S' and the ability to applying them to resolve practical problems and participate in public affairs (The State Council of PRC, 2006).

Since then, the 'Four S' became the main objective of science popularization and the symbol of modernization of science popularization in China.

### ***The 'Four S' and the Traditional Chinese Culture***

The popularization of science in China has progressed through trial and error, accompanied with a lot of confusion. For example, issues like how do we catch up with the developed countries, where science and technology plays the most important role, did not have any clear answer. Rightly the highest common factor identified in the document on 'the construction of an innovative country' as a prime mover of development was science. The operationalization of this policy resulted in slogans such as 'learn science as a child, grow up talented', 'learn science, love science, use science', etc. However, the policies and their implementation prepared ground for change in public attitude, surveys on public scientific literacy from 2001 to 2010 quite clearly show that the public in China tends to admire science and are optimistic about the contribution of science and technology (CAST, 2001, 2003, 2010; Ren, 2010). An overwhelming majority believes that the benefits outweigh the disadvantages of science and technology.

It should be noted that currently scientific literacy level in China is not so high; at the same time there is widespread imbalance between different regions and different demographic groups. In order to solve the problem of skewedness targeted and step-by-step popularization of 'Four S' is required. For instance, for remote and underdeveloped regions, improving the ability of survival and the quality of life, are the priorities. Therefore, popularization of scientific knowledge and scientific thought must be the focus for such regions. For the developed areas, promoting cultural prosperity and innovation might be more meaningful and thus scientific method and scientific spirit should constitute the core of popularization efforts. For young people, knowledge accumulation and the training of scientific method is an important content while for the decision makers, more attention is required to disseminate scientific thought and scientific spirit. So, the 'Four S' embodies the layered and progressive requirements of science popularization.

As compared with western modern science culture, Chinese traditional culture lacks scientific spirit, rational criticism, the pursuit of strict logic and mathematical method, the experimental method, etc., which adversely affects the current public understanding of science (Liu, 2003). In addition, the culture of witchery prevailed in the traditional culture. Shi goes to the extent of suggesting 'the source of Chinese culture is the culture of witchery' (Shi, 1997). The permeation of witchery culture in the Chinese ancient politics, diversified superstitions, has made it particularly necessary to promote scientific thought and scientific spirit in order to eradicate superstitions. Thus, taking the accumulation of scientific knowledge as the basis for promoting scientific method, scientific thought and scientific spirit, can advance the positive attributes of traditional culture while removing the negatives.

#### **'Four S' or even more 'S': More Open Future of Science Popularization in China**

Recently, few scholars have suggested that the scope of 'Four S' should be expanded by including a few more attributes. Guo and Tang proposed that public scientific literacy should be redefined in terms of scientific knowledge, scientific consciousness and

scientific ability. In his scheme of things scientific consciousness refers to scientific spirit, scientific thought, scientific value and scientific attitude (Guo and Tang, 2009). Scholars have also suggested that 'Four S' be expanded into 'Five S' by adding creation of an understanding of the relationship between science and society (Liu, 2005; Ren and Zhai, 2012) or even 'Six S' by adding promotion of 'Scientific Outlook on Development' based on 'Five S' (Liu, 2008).

No matter how many 'S' are added here, it shows that Chinese science popularization is in the process of being thoughtfully inclusive. Over the past few years the focus has shifted from not merely spreading scientific knowledge but to generating scientific culture. It has shifted to ensure public's participation in scientific affairs, their need to know and ability to express their opinion on what direction scientific development should progress. For the government, it is necessary to listen to the voices and cooperate with other actors (e.g., the NGOs, the enterprises), watch how science is being popularized in other countries around the world, and work inclusively to promote the scientific culture.

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