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# Study on differences between Chinese and Western sciences and their causes

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**Science constitutes the theoretical foundation of technological innovation. And science develops on the basis of specific philosophical thoughts and cultural gene. The differences between Chinese and western philosophies and cultures determine the differences of their sciences. Some inspirations are offered based on profound analysis of the differences and the root cause of the development of Chinese and Western sciences. The way is proposed to China to authentically overtake western science and then create new knowledge out. It plays a very important role in whether it can catch up with the western developed countries in scientific and technological innovations or not.**

**Key words:** The eastern and western sciences, philosophy, cultural gene, innovation.

## INTRODUCTION

Before the 16th century technologies in China which were based on skilled practices, surpassed the western technologies in many aspects. Modern technologies that is, scientific technologies were born in the western countries, rather than in China. The reason for this is that science is the foundation for technological innovations. The reason modern sciences and technologies could be born in the western countries rather than in China lies in the obvious differences in the Chinese and the western sciences. Then, what are the differences? What has led to them? These are the important questions we must be clear about. Before we discuss about the differences between Chinese and western sciences, we must gain a clear idea of what science is.

## METHODS

### What is science?

Generally, science is a logically self-consistent system of knowledge consisting of concepts, laws, theorems, formulae and theories and other factors. From a

dialectical materialist point of view, science is at least a kind of rational knowledge rather than perceptual knowledge.

### The essence of science

In ancient times, science and philosophy have not parted company with each other. Science is in essence a kind of natural philosophy. This means that different philosophical and cultural soils may produce different types of sciences. In general, the essence of science, from the western point of view, is the guess about the cause of some phenomena and its explanation. And the explanation can be tested within human experience. Although the foundation of science is the metaphysical natural philosophy and science was born from natural philosophy, science itself is not philosophy; the object that science studies is the natural phenomena, but it is not a simple description of it; scientific test must rely on human experiences. Science itself is not a simple summing up of experiences; science is the theoretical base of technology and it can be transferred into the later, but science itself is not technology.

Scientific laws, theorems, formulae can be proved for infinite times to be in accordance with human experience, but science itself has nothing to do with correctness or truth (Qian, 1999).

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### The difference between science and technology

Some people in China habitually combine the term science with the term technology and use the phrase. However, the connotations of them are completely different from each other. And science cannot be confused with technology. Science is in essence the study on what the world is and technology is the study on how to do it. Science aims at correct, simple and logically self-consistent system, and technology effectiveness, economy, convenience in use and long service life. The driving force for science is the curiosity of mankind on nature, and the desire for exploring nature and that of technology is the unending desire of man for getting the most with the least effort. The forms of the achievements are concepts, laws, theorems, formulae and theories and other intellectual products; those of technology are material products. Science regards public ownership and universalism as its principle and specification, while technology regards private ownership and closed-door policy as its principle and specification.

## RESULTS

### The difference between Sino-western sciences

When being looked through the history of science, the reason why modern science was born in the west lies in the profound philosophical foundation and cultural background. The reason why modern science was born in the west rather than China lies in the traditional philosophical thoughts and cultural gene. It is the differences between China and western thoughts and cultural gene that determine the differences of the two sciences. The differences between traditional Chinese sciences and western sciences can be summarized as follows (Qian and Ma, 2003):

1) The traditional sciences in China emphasize on description of natural phenomena and summing up of experiences; and the western science is keen on research on the cause behind natural phenomenon. "Brush talks from dream brook", "Mohist Canon" and "Xu Xike's travel records and diaries", none of them did not emphasize on the description of natural phenomena. Moreover, "Qi Min Yao Shu" (Important Arts for the People's Welfare) "Nongzheng Quan shu" (An Agricultural Encyclopaedia of Ming Dynasty) "Tian Gong Kai Wu" (Exploitation of the Works of Nature), and "Shanghan Zabing Lun" all emphasized on description of natural phenomena and summing up of experiences; however, the summing up of experiences cannot be proved or falsified by experiences. The definition of Yin and Yang theory of traditional Chinese medicine is man-made, it is visible and tangible. But, the guess about the cause behind natural phenomena by western science is

invisible and intangible. It is an explanation for the natural phenomena. For example, Aristarchus used the heliocentric theory to explain why the sun goes up in the east and set down in the west and Eudoxus did so by means of the geocentric theory.

Archimedes used his Buoyancy theory to explain why a wood floats on the water while a stone sinks. Gilbert regarded the earth as a big magnetic body, and used his theory to explain why the magnetic needle directs to the south and the north. And Newton used the law of universal gravitation to explain why the Projectile always falls down on the ground.

2) Traditional Chinese sciences emphasize on understanding a problem by means of intuition and tacit, neglecting strict definition of a concept, which the western sciences pay great attention to. Based on these concepts, the westerners use logical and strict reasoning and experiment method to examine and prove knowledge strictly which guarantee the exactness and perspicuity of the western sciences. And guarantee the consistency and systematic characteristics inside the scientific knowledge. For example, in Zhang Heng's theory of Sphere-Heavens, whether the earth was regarded as a round globe, the space relationship between the earth and the sky in the theory of Canopy-Heavens. What on earth are Vigor, Chinese Medical Meridian, Vital Essence/Essence and Energy/Essence-Qi? People are arguing over these questions, without satisfactory answers. But in the west, in Europead's geometry, on the basis of 23 such concepts of point, line, plane, angle, parallel lines, set out from 5 Axioms and 5 formula, through a serial of logical reasoning, 467 Propositions about Elementary Geometry were derived, all these constitutes a perfect Geometrical system. Principle of leverage was derived with axiomatization by Archimedes on the basis of the definition of concepts such as fulcrum, centre of gravity, lever and actuating arm.

3) The traditional Chinese sciences emphasize on practicality, while the west sciences are keen on pursuit for knowledge, exploration of the secrets of nature and putting an end to foolishness or stupidity. The Chinese people learn from the west mainly for practical purpose. For example, "Zhou Bi Suan Jing" (The Arithmetical Classic of the Gnomon and the Circular Paths of Heaven), "Gan and Shi's Astronomy Book", "Armillary Sphere", "Neng Sang Thi Yau" (Essentials of Agriculture and Sericulture) "Shen Nong's Herbal", "An Outline Treatise of Medical Herbs" and "Gehong's Paopuzi about Alchemy" are all based on practical ideas. However, the important processes and the naissance of important scientific theories in the west history of science hardly have anything to do with practical purposes. For example, Europead's geometry, Aristotle's study of biology and physics, Archimede's study of statics, Gilbert's study of the magnetic and electronic phenomena, Galileo's study of the falling body and regulation of objects on the oblique plane, Descartes'

study of collision and his establishment of analytic geometry, Faraday's study of electromagnetic induction, Maxwell's study of electromagnetic theory, Planck's quantum hypothesis, Darwin's study of biological evolution, and Einstein's study of the theory of relativity. Historian of science Dampier wrote in his book "History of Science" as follows, which set people thinking: Unfortunately science is mainly used for developing economy, as the concept spread to many other countries, the freedom of scientific study is threatened. If the realistic interest follows, it is byproduct, even though they are discoveries achieved by means of the government support, if the free, pure science is neglected, the applied science will soon or later wither and die. So, science cannot be regarded as services for practice.

In the west, practice is not the main motive force to drive science to move forward. The purpose of science is not completely for improving the productivity and developing economy.

4) Traditional Chinese sciences emphasize on acquisition of knowledge, neglecting inspection and argumentation, while in western sciences any knowledge is tested and verified strictly. Knowledge is divided into three groups: objective, subjective and reasoning knowledge. Objective knowledge mainly includes natural science knowledge and social science knowledge, which must be logical and can be tested within the range of experiences and measured in terms of correctness or false. It must be tested by means of logic and experiences. Subjective knowledge includes literature, arts, comments, religion and philosophy etc. They are man-made with no distinction of correctness or false. They are the opinions of people on the problems. All they need is to make one's argument consistent and not self-contradictory. Reasoning knowledge refers to logic and mathematics. They do not need to be checked by experiences. They are always correct. Subjective knowledge and reasoning knowledge only need to be checked by logic method. Scientific knowledge is only one part of sciences.

In ancient times China take the lead in the world in Scientific knowledge not in sciences, in experiences and skills based mainly on experiences, not in scientific technology. For example, related knowledge in such works as "Mohist Canon", "the Nine Chapters on the Mathematical Art", "Qi Min Yao Shu", "Nongzheng Quanshu", "Baopuzi, Brush Talks from Dream Brook" cannot be analyzed logically or verified or disproved by strict experiment or observation. And the reason why the past quantum hypothesis, the hypothesis of continental drift and the Big Bang hypothesis are called theories now is that they were proven through undisputed observations and facts.

### **Analysis of the cause of some differences behind Sino-western sciences**

As we pointed earlier, the differences of sino-western

sciences are determined by the differences of sino-western philosophical thoughts and cultural gene. Likert said: "science is an extenuation of cognition development from individual level to cultural level, a developing growth upon traditional cultural knowledge and a variety and extenuation of specialized understanding of cultural evolution" (Richter, 1972).

### **The philosophical foundation and cultural gene of western science (Qian, 2003)**

#### **The western sciences strove to acquire knowledge and get rid of stupidity and ignorance, not for practical purposes, but for the exploration of the secrets of nature:**

Almost all the philosophers were natural scientists in the ancient Greek times. For example, Thales, Anaximande and Anaximene are all natural scientists. Pythagoras School, Aristotle's Peripateticism and Zeno's Stoicism were all natural philosopher schools. Aristotle himself created politics, physics, ethics, logic, biology, meteorology and metaphysics, all of which studied the nature. They all applied logic reasoning to explore the nature. They all were keen on the study on geometry. Aristarchus's Heliocentric Theory was wrong quantitatively, yet right qualitatively which was derived from logic reasoning and geometrical method. Plato hanged on his gate "those who does not study geometry cannot enter the gate." And works like Euclid's elements all showed that the west were keen on the study of geometry. Russell said in his book the history of western philosophy, "Euclid looked down upon practical values, which is inculcated by Plato" (Russell, 2007). Moreover, the western offered a reward for soliciting articles. Early in 1774, Germany Academy offered a reward for soliciting articles. Later in 1809, Denmark Academy offered a reward for soliciting articles titled "the relationship between the change of magnetic needles and dip with all kinds of physical quantities." 1820 Oster found the magnetic effect of electronic current.

In 1818, the French Academy offered a reward for soliciting articles. Fresnel viewed light as a transverse wave, he explained the result when light wave pass through obstacles with the half-wave zone method and got the Poisson spot at last.

#### **Western science is keen on research on the cause behind natural phenomena:**

As the Principle of Circular and Causation of Leucippus, Plato divided the world into perceptible part and knowable part. Perceptible world, namely: phenomena world is changeable, illusory and unreal, that is a facsimile, while knowable world, namely: idea world is steady and real, which is the cause behind the phenomena. Democritus said that he would prefer an explanation about cause and effect rather than a kingdom of Persia. Aristotle thought that "cognition is the target of our research; people would not deem that they have

known a kind of thing before they grip the root cause of it.”

**Western science enjoys and is adept in applying reasoning to observation, analysis and solution of problems:** Western culture is characterized by analysis, accuracy and logic, and the rationalism tradition is related to science. Influenced by these two things, the western sciences are good at applying ‘rational thinking’ to observing and analyzing of problems, which conforms to self-consistency in logic. It is the production of “should be so”. Heraclitus was the first one who suggested applying ‘rational thinking’ to learning about the World. He thought that Logos dominated the whole world and it was eternal which man could not use organs to learn about or grasp. Parmenides thought all those that you cannot conceive are impossible even if the sense organs tell us that it has come into being indeed. This means that we should prefer trusting our thinking rather than our eyes and ears when we try to understand the world. The reason for this is that “sense organs cannot find the truth; only our thinking can do it. Sensory perception is not true or existent, only our thinking is real and existent” (Dampier, 1930). Plato set up his ontology theory based on rationalism. In Aristotle’s opinion, formal logic as the rule of rational thinking is an indispensable tool by which people can gain the gnosis to the objective world, that is to say, people can know the cause of anything through formal logic. So he made rules for rational thinking--formal logic.

The same is true of “ego cogito ergo sum” of Descartes, Leibniz’s Monadism and “synthetic judgment a priori” of Kant, and so on.

**Western sciences pursue the logical stringency, understandability and accuracy of thinking, so they are used to defining a notion rigorously and reasoning:** Rational thinking is essentially logical reasoning. And the notion with clear connotation is the premise of logical reasoning. If the notion is confused, logical reasoning is out of the question. It is very important for us to comprehend scientific knowledge accurately, and first of all we must define a notion austerely. Aristotle said, “All of our notions express some generic things, that is to say, the notion denotes some inevitable and unvarying attributes of one specific thing.” Rational thinking is the premise of logical reasoning. It is also a tradition of the western culture, which is completely different from the Chinese way of catching on a notion, the so-called “It is perceived rather than expressed.”

**Western sciences believe that the world is simple, harmonious, ordered and uniform, so the law of the world can be found by reasoning:** What is discussed in Chapter 2 of Whitehead’s “science and the modern world” is mathematic, which is one of the constituents of intellectual history (Whitehead, 1925). In their “Principia Mathematic”, Russell and Whitehead said that all

phenomena in nature are all results of order of things (Whitehead and Russell, 1927). Pythagorean which lasted over 500 years in ancient Greek thought, “Anything is the numbers”, that is to say, nature is made up of numbers. For example, Copernicus and Kepler are enthusiastic followers of Pythagoreanism. Einstein’s special relativity reckons that the principle of constancy of light velocity is the principle of relativity, and its general relativity is equivalent to Mach principle. Einstein’s theory of relativity, Einstein’s simplicity thinking and Kepler’s contribution mainly come from Pythagorean and Christian ideology.

**Western sciences have intense skepticism and critical spirit, and they enjoy creating what is new and original and creating theories by themselves:** If we want to replace old theories with a new theory, we must have suspicion and criticism, as well as creativity. There are some examples such as Pyrrho’s skepticism in the third century BC and Abelard’s “Sic et Non” in the twelfth century. And there are also some other examples about understanding nature by the suspicion- verification - truth process: Einstein created his theory of relativity as he suspected that “time is one-dimensional and space is three-dimensional.” He created the quantum theory as he suspected that “energy is continuous”, and he created non-Euclidean geometry as he suspected that “we can only draw one line parallel to another line through a dot outside the line.” Then he created general relativity and concluded that the universe is curved. Copernicus created the heliocentric theory as he suspected the geocentric theory, and Darwin created the theory of evolution as he suspected that species would not vary.

**Western sciences emphasized on strict checking or reasoning for knowledge by means of logic and experiments:** Logical and experiential methods are two important methods with which the western sciences could verify any knowledge. Logic is a tool by which human beings can acquire knowledge. Aristotle called logic the “instrumentalism”. In the westerners’ opinion, knowledge without being tested or demonstrated is unreliable. They distinguish distinctly conjecture and theorem, as well as hypothesis and theory. The reason why Goldbach conjecture is still called “conjecture” till now is that it hasn’t been proved by logic yet. Pythagorean theorem, Fermat theorem and four-color theorem are called “theorems”, because they have been strictly proved. And why the universal gravitation hypothesis, quantum hypothesis, hot molecular motion hypothesis and light wave motion hypothesis are called theories nowadays? It is because they have been corroborated by experimentations. Undoubtedly it owes to Galileo that experimental methods were founded and widely used.

**Western sciences have a consistent tradition of “subject-object dichotomy”:** Knowledge studies objects

objects which are the targets of cognition. Nature is the object of scientific research. The reason why sciences are called so is that the targets of scientific research, namely: objects are objective existences which would not change with the subject's will. "subject-object dichotomy" resulted from Platonism. Plato set the opposites relationship between the objects' substance world and the subject, and on the basis of which he found his "knowledge theory". When Russell was talking about Plato's "Theory of Knowledge", he quoted a section of interpretation in his "Utopia": As Parmenides said knowledge must have an object that must be an existence; otherwise there would be no knowledge (Russell, 1988). Aristotle succeed to this ideology of Plato critically, who deemed that senses are not senses themselves, there are surely something which exists outside senses, active things are always prior to passive things, and these two correlative nouns are also applicable to the issue of senses (Princeton University Press, 1984).

### **The philosophical foundation and cultural gene of traditional Chinese sciences**

#### **Traditional Chinese sciences had their specific cultural gene (Qian, 2005)**

Traditional Chinese sciences emphasized on intuitive and tacit thinking: The intuitive and tacit thinking draw a conclusion without strict definition of concepts and deduce without rigorous logic, but describing and understand relational propositions on the basis of imagination, experiences of human beings, namely: "it is perceived rather than expressed." For example, Chuang-Tzu proposed to abolish thinking and learning, then to perceive Tao, the principle of objective world, with an innocent, thoughtless and unselfish heart. "The great learning" pointed out, "acquiring knowledge rests on studying the principle of nature." Within the 42 chapters of "Lao-tzu" we find that "Tao gives birth to one, one gives birth to two, two gives birth to three and three gives birth to everything." In "Book Chunqiu Fanlu Li Yuanshen" we can see the heaven and the terra and the people are arches of everything. The heaven fixes destiny, the terra brings up circumstance, and people recasts the world."

**Traditional Chinese sciences were based on a kind of middle-of-the-road philosophy and emphasized on dialectical thinking:** Confucius said, "going too far is as bad as not going far enough", "listen to both sides and choose the middle course", and "remaining neutral without deflection", these lines means that we should not care for one while lose another when we are pondering and handling problems, rather, we should compromise without leaning towards any one end. Here are some other examples which belong to "golden mean", such as

"Lao-tzu" says, "Existence and nothingness bears each other, difficulties and easiness depend on each other, long and short show by each other, as well as high and low." "Zhouyi Dazhuan" says "people should assist the nature to become feasible while it gives life condition. "Chuang Tzu, the Adjustment of Controversies points out," (The disputants) now affirm and now deny; now deny and now affirm" and in the "Book Chunqiu Fanlu" and "Heaven-earth and Yin-yang" says that "between heaven and earth the void looks like reality. All these things are in accordance with middle-of-the-road philosophy.

#### **Traditional Chinese sciences had less interest in exploring the nature, so China was poor in natural philosophy:**

Natural philosophy in ancient China was not well developed Except for dialectical world outlook. The central research area of Chinese Philosophy is human and society, while the western mainly study the nature. None of the three religions and the nine schools of thoughts in China made research on the nature as its main purpose. Taoism, the Mohists, the Yin-yang and Agriculturists were the main researchers of nature. However, Taoism just aims at everlasting life and attaining wisdom and becoming fairy by practicing and feels at one with the whole world, but not reveal the secrets of nature. The natural knowledge related to the Mohists were mostly concrete knowledge of geometry, mechanics and optics, which did not belong to the category of natural philosophy. The Theory of Yin and Yang as well as 'five elements' just foretold the destiny of countries, society and individuals believing the unity of the Heaven and man is an integral part of nature and interaction between heaven and mankind but is not interested in exploring the nature itself.

Agriculturists researches mainly in how to do farm work and how to raise live stocks, how to intensify water-control projects and so on, However, they do not discuss the existent and evolutive mode of nature as a whole, therefore it is not natural philosophy either.

#### **Traditional Chinese science advocated the ancients and worshiped authority, lacking skepticism and critical spirit:**

Within the memory of China, influenced by the mentality of overly advocating the ancients and authorities, together with the tradition of "believing and loving the archaic" and "passing on the ancient culture without adding anything new to it", people dare not challenge and criticize the theories of the ancients and authorities. Since Western Han and Eastern Han Dynasties, philosophers or ideologists in Chinese history are mostly Confucian continuators, and few of them are against the Confucianists. There are scarcely any philosophers or ideologists in Chinese history who separate with their teachers and went different ways, Criticized their theories and founded their own following the slogan "I love Plato, but I love truth more." Actually

skepticism and critical spirit are the critical factors that promoted the progress of sciences. Lacking of these characters results in difficulties to found China's own theories.

**Superstition is rife:** "Zhouyi" (the book of changes) is an all-important Confucian classic in ancient China which is always popular in Chinese history. However, it is a book about divination. Confucius as the founder of Confucian theory said, "a man of noble character fears three things, the words of providence, milord and the sage." He also said, "ones who do not know providence cannot be called men of honor." The Book of Changes and Yin-Yang ideology were mature theory of man and the nature. Dong Zhongshu of Han dynasty developed the theory that man is an integral part of nature to a even more mysterious theory that thought man and the nature could influence each other, which is a composite of Confucian and Yin-Yang ideology under the social conditions of that time. Obviously the superstition is relatively grievous in traditional Chinese culture.

**Traditional Chinese sciences deemed that nature is so inexhaustibly profound that man can not reveal the law of nature:** For example, in Ruanyuan's "Chouren's biography", he considers that "Natural law is too deep inside information and delicate details to be pried by manpower". Most of the genes of traditional Chinese cultures were born from the warring state period, which last many centuries till now. And the characteristics of traditional Chinese sciences are in accordance with these culture genes.

## DISCUSSION

Owing to the difference of Chinese-western philosophic basis and culture genes, synchronously owing to the difference in the mode of thinking, value orientation and ideas between Chinese and occidental, there are many essential differences between Chinese and western science. Chinese experiential technology which mainly depended on experiences before 16th century exceeded the western in many aspects. However, after revival of learning, latter-day technology which mainly relies on science born in the west but not China, which deserves us to cogitate deeply. According to the exploration and analysis to certain differences in Chinese and western science and their causations, we have gotten some inspirations as the following six points:

- 1) Neoteric science in the western sense cannot be born in China.
- 2) The causation why Chinese neoteric science has dropped behind is not external factors, but intrinsic ones

such as inherent mode of thinking, value orientation and ideas in China, that means featured philosophic basis and culture genes have brought this up.

3) Science is the foundation of technology. If one country wants to innovate in technology, firstly it should innovate in science.

4) Philosophy is the foundation of science and its core of culture. China must emancipate the mind authentically, envisage the causation of the difference between Chinese and western science, dare to know autologous deficiency and enhance philosophy first.

5) Being hung behind is predeterminate if we just learn western science and copy their technology. Simultaneously when China is learning western philosophy and culture, it oneself must stage an arduous revolution about "culture genes" drastically.

6) When China is learning from the western, it should hold doubting and critical spirit simultaneously, and shouldn't blindly adore the authorities of western science. There is no other way to China to authentically overtake western science and then create new knowledge.

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