Paradigm Academic Press
Studies in Social Science & Humanities
ISSN 2709-7862
JUN. 2023 VOL.2, NO.6

Comparison of Chinese and Western Ancient Mathematical Values

Muyuchen Shi[1]

[1] College of Letters and Science, University of California, Berkeley

Correspondence: Muyuchen Shi, College of Letters and Science, University of California, Berkeley.

doi:10.56397/SSSH.2023.06.04

Abstract

This essay explores the significance of traditional Chinese mathematics culture and its differences compared to Western mathematics. While mathematics is recognized as a vital cultural force in human civilization, the research on mathematical culture has often overlooked the rich heritage of Chinese mathematics. By delving into the history of mathematics culture and examining the development directions and structural pursuits of ancient Chinese and Western mathematics, this paper aims to highlight the contrasting value orientations of mathematics and uncover the reasons behind these differences. Through the analysis of mathematical values, the study sheds light on the distinct mathematical cultures of China and the West.

Keywords: mathematics culture, traditional Chinese mathematics, Western mathematics, value orientation, cultural model, development direction, structural pursuit, mathematical theory, comparative analysis, cultural differences

1. Introduction

Mathematics holds a significant place in human culture and plays a crucial role in the advancement of human civilization. This fact is widely acknowledged among mathematicians, philosophers, and historians. However, the research on "mathematical culture," often represented by scholars like M. Klein, has tended to overlook the profound significance of traditional Chinese mathematics culture.

As the exploration of mathematical culture has deepened over time, an increasing number of scholars have come to recognize the substantial disparities between Chinese and Western traditional mathematics. Chinese traditional mathematical culture stands as a testament to a distinct national civilization, distinct from the Western paradigm. Against this backdrop, this paper aims to investigate the developmental trajectories of ancient Chinese and Western mathematics, as well as the pursuit of mathematical theory within the realm of "cultural models." Through a comprehensive study of the historical portrayal of mathematics culture in the Western mathematical book Elements, this research delves into the distinctions in mathematical value orientations. By uncovering the underlying reasons for these differences, the study provides an analysis of the contrasting mathematical values between China and the West.

2. Traditional Chinese Mathematics Before the Spread of *Elements*

In China, the concept of graphics was formed as early as primitive society. During the Xia, Shang and Western Zhou Dynasties, China has formed the decimal system of notation, and mathematics has developed into a discipline. In the famous divination book *Book of Changes*, rich mathematical ideas are reflected, and yarrow divination developed into China. A unique computing tool in ancient times is called counting rod. The calculation tool is a long-term calculation tool used in ancient Chinese mathematics. It is a long-shaped item, usually made of bamboo or wood. Arbitrary natural numbers can be easily represented by placing arithmetic chips in a certain way, so as to perform four arithmetic operations. In the Spring and Autumn Period, the arithmetic-based four arithmetic operations on integers became very popular. During the Spring and Autumn Period and the Warring States Period, the ancient Chinese culture developed greatly. Many classics in the doctrine of the masters contain certain mathematical ideas. For example, the *Mojing* contains relatively rich geometric content; *Mencius*, *Zhuangzi*, *Laozi* and other works. They all contain infinite ideas, and many famous scholars such as Deng Xi and Hui Shi have certain mathematical ideas.

After the Qin Dynasty, ancient Chinese mathematics began to develop gradually. The *Nine Chapters on Arithmetic*, written in the early Eastern Han Dynasty, is the oldest mathematical work in the existing biography in China. From its writing to the time, it was imported into Western mathematics in the late Ming Dynasty, it has always been a symbolic representative of the ancient Chinese mathematical theory system, influencing the development of mathematics in subsequent dynasties, and has an equally important position in China as the *Elements* in the West.

Nine Chapters of Arithmetic is divided into nine chapters: Fangtian, Shumi, Shuaifen, Shaoguang, Shanggong, Equal Loss, Earnings and Insufficiency Equations, and Pythagorean Chapters. A total of 246 application problems and their solutions are collected. The arithmetic part mainly involves the calculation of fractions, proportions and surplus-deficiency problems; the geometric part mainly includes the calculation of area, volume and Pythagorean; equation problem. It is particularly pointed out that in the chapter on equations, different representations of positive and negative numbers by ancient Chinese mathematicians are also put forward, which is a major achievement in the history of world mathematics.

The mathematical problems of the whole book are all based on real life problems for computational research. The specific problems involved in each chapter of the book are as follows:

Chapter 1: Fang Tian. Computational problems involving flat fields (方田)

Chapter 2: Corn. Exchange issues involving different grains (粟米)

Chapter 3: Decay. Issues such as distribution of goods, taxation, grain buying and selling, etc. are done according to different hierarchies. (衰分)

Chapter 4: Shaoguang. About the calculation of the perimeter of a flat field. (少广)

Chapter 5: Commercial merit, about the engineering application of building cities, opening canals, opening canals, repairing dams, and building granaries. (商功)

Chapter 6: Both lose. The policy of allocating resources according to the local population and distance. (均输)

Chapter 7: Insufficient surplus. The application problem of eliciting and using the “insufficient surplus technique” is a kind of problem commonly used in life and production. (盈不足)

Chapter 8: Equations. Involving calculations related to selling livestock, dividing money, drawing water, and harvesting rice from crops. (方程)

Chapter 9: Pythagorean, solves various measurement calculations for height, depth, and breadth. (勾股)

The *Nine Chapters on Arithmetic* written by the mathematician Liu Hui in the Wei and Jin Dynasties gave the world a better understanding and understanding of the *Nine Chapters of Arithmetic*. *Nine Chapters on Arithmetic* laid the foundation of ancient Chinese mathematical theory. To a certain extent, it turned a practical mathematical work such as *Nine Chapters on Arithmetic* into a mathematical theoretical body with practical properties. The development of ideas plays a key role in integration and promotion. Liu Hui’s typical mathematical thoughts mainly include: the thought that everything counts, the thought of systematic proof, the thought of limit and infinity, and the thought of supplementing the void with surplus.

Liu Hui’s main mathematical ideas and values are expressed in his annotations to the Nine Chapters on Arithmetic. Although limited to the form of annotations, they are profound in nature. In the preface of the annotated translation of the Nine Chapters on Arithmetic, Liu Hui wrote, “In ancient times, Fuxi was the first to use diagrams to communicate the virtues of gods and simulate the state of things. He also created the rule of nine and nine to coordinate with various changes in the six lines. Later, the emperor further developed and extended them to create the calendar, adjust the rhythm, and explore the origin of all things between heaven and earth, thus verifying the essence of the two ceremonies and the four images.” Furthermore, he pointed out, “As you may say, the number nine has the ability to delve into subtleties and uncover the untraceable. It is said that the nine numbers can penetrate the most minute aspects, detecting both the subtle and the vast, transcending the ordinary and defying enumeration.” From this, we can realize that Liu Hui’s mathematical thinking differs significantly from that of ancient Greek mathematicians. The Book of Changes explains the origin of the world and influences people’s spirit, while mathematics serves as its intermediary, applying to all aspects of society and offering solutions to various life problems. It is a tool for people’s use.

The development of Chinese mathematics reached its peak in the Song and Yuan Dynasties. A group of outstanding mathematicians emerged in the Song and Yuan dynasties and made outstanding contributions to the development of ancient Chinese mathematics. Jia Xian used the quadratic expansion coefficient table to solve higher-order equations, Liu Yi solved equations with negative coefficients of higher-order terms, Shen Kuo's research on the summation algorithm of higher-order arithmetic sequences, etc., all represent the ancient Chinese mathematics. important results.

Following the *Nine Chapters of Arithmetic*, another great book in the history of Chinese mathematics, *Nine Chapters of Arithmetic*, was written by Qin Jiushao, a mathematician in the Southern Song Dynasty. The book has 18 volumes, 81 questions, divided into nine categories, still mainly based on practical application problems. The knowledge of arithmetic and geometry involved in it has been greatly improved compared with the previous *Nine Chapters of Arithmetic*. In the book, Qin Jiushao's most outstanding contribution is the mathematical solution of higher-order equations, namely "positive and negative prescriptions" and "DayanQiuyi Shu".

Before Qin Jiushao, calculations involving length, area, and other issues often resulted in higher-order equations with positive constant terms. However, this convention proved to be inconvenient for calculations. Consequently, Qin Jiushao introduced a rule stating that the constant term should be negative. This adjustment allowed for both the constant term and the coefficients of each unknown term to be listed on the same side of the equation, simplifying the calculation process. Additionally, in the equation problems studied by Qin Jiushao, apart from the constant term, there were no restrictions on the positive or negative coefficients of other terms.

Another great mathematical achievement in the Song and Yuan Dynasties was "Tianyuan Shu". Li Ye, a mathematician in the Yuan Dynasty, gave a detailed introduction to the knowledge of "Tianyuanshu" in his two works *Ce Yuan Hai Jing* and *Yi Gu Yan Duan*. Tianyuan means the unknown number is the equation and Tianyuanshu is a method to solve the high order equations.

In addition to their achievements in mathematics, the values of mathematicians in the Song and Yuan Dynasties have also changed from before. Although they still admit that mathematics is closely related to life practice, they advocate that mathematics should be elevated to a rational level for explaining the world. Qin Jiushao clearly expressed his view of using mathematics to explain the world in the self-preface to *Nine Chapters on Arithmetic*, he wrote: "The use of this Taixu is born one and the flow is infinite, large can be through the gods, in line with life; small can be through the world, the class of all things, cursed with shallow fresh peep? ... I have developed the mysteries of He Tu and Luo Shu, the eight trigrams, nine categories of intricate and subtle extremes to the great diffusion, the use of the royal pole, and no change in personnel should not, the feelings of ghosts and gods can not be hidden. The sage is divine, but the words are lost in its coarse, the ordinary people are ignorant, and by and by no one is aware of it, to its return, the number and the Tao are not two." Here, Qin Jiushao already believes that mathematics can be Psychic, and put mathematics and Tao on the same level. Li Ye said in the self-preface from *Yi Gu Yan Duan*: Although art and mathematics are at the end of the six arts, but the application of personnel is the most important thing. In the preface of the *Ce Yuan Hai Jing*, he further believes that it is said that the number is difficult to be poor, but it is said that the number is impossible to be poor. Why? They are in the dark, there is a clear existence. ... If you can push the natural reason to understand the natural number, then although far away and the dry end of the Kun Ni, and the ghosts of the gods have no inconsistency.

It can be seen from this that Li Ye believes that mathematics can be used to explain everything, and the skill of mathematics is also "where the Tao is", and the role of the Tao should be played. Zhu Shijie said in the preface to the *Siyuan Yujian*: The number one is only one, one of the beginning of everything. Therefore, a taiji Yi, one and two, two and four, four and eight endless life is not the number of nature? Hetu Luoshu leak its secret, the Yellow Emperor nine chapters to write the number. Here Zhu Shijie expresses a view of mysticism like numbers, which reflects the extensive role of mathematics beyond the quantitative meaning, and has reached the spiritual level of explaining the world to a certain extent.

As a group of mathematicians in the Song and Yuan Dynasties, we can find such characteristics: these mathematicians study mathematics in a rational sense rather than just at the level of skill, and their mathematical value orientation has been separated from the need of practical problems, and they are trying to put Mathematics has risen to a rationality for explaining the world, which tends to pursue a certain spiritual level of mathematics. This change in values is due to the combination of factors such as wars and dynasties in the Song and Yuan Dynasties, the lost group of officials, the disorder of traditional cultural values, and the rational pursuit of non-technical orientations in a specific historical period. But at this time, their mathematical rational values deviate from the development of traditional Chinese Confucian values and the value orientation of traditional Chinese mathematics.

In the Ming Dynasty after the Song and Yuan Dynasties, social stability, the prospect of literati careers, the restoration of traditional Confucian values and the development of mathematical skills made mathematics in Song and Yuan Dynasties lose the source of talents, the value pursuit of rational structure, and the retention and dissemination among literati. meaning. Therefore, the mathematics of Song and Yuan Dynasties, which has lost its specific cultural atmosphere, is destined to be forgotten by Chinese history.

3. *Elements* in Western

The historical process of Greek culture, historians usually divide it into two periods: the classical period from 600 BC to 300 BC; the Hellenistic period from 300 BC to 600 AD, and the golden period of Greek mathematics era. *Elements* is one of the important achievements of the first period.

Little is known about the life of Euclid, the author of the *Elements*. According to later generations, he lived between 330 BC and 275 BC. He was educated in Athens in his early years and was deeply influenced by the Plato school.

The origin of *Elements* benefited from the entire ancient Greek culture and rational spirit as well as the contributions of several generations of philosophers and mathematicians before Euclid. From its content, we will find that many problems in *Elements* are the sorting and summary of previous mathematical problems; in terms of thinking, we will see that before Euclid, ancient Greece produced many famous and influential Deep mathematics and philosophical schools, such as Pythagoras school, Plato school, Aristotle school, atomic school, etc. Whether it is the Pythagorean school's "everything is number", Plato's "God always does things according to geometry", Aristotle's syllogism on logic, etc., all reflect a kind of philosophical speculation in mathematics. There is no doubt that Euclid must have been influenced by previous mathematicians and philosophers.

In the West, *Elements* is a great work on par with the *Bible*. So far, more than 1,000 versions have been circulated in the world. Its author, Euclid, is also known as the "father of geometry" by later generations, and has been highly valued and respected by people since its inception.

The birth of *Elements* established the main research method of Western mathematics: establishing axiom deduction system, using axioms, postulates and theorems to deduce, and introducing logic into mathematical proof, which finally promoted the formation of ancient Western mathematics axiomatic methods. In the more than a thousand years that followed, Western mathematics basically established the knowledge structure and theoretical system based on the *Elements*. Many mathematicians have pointed out that the book *Elements* was the first to introduce them to mathematical research, and to inspire and motivate them to become mathematicians. Because *Elements* provides them with mathematical thinking methods and models, such as strict axioms, precise definitions, carefully stated theorems and logically consistent proofs. On the other hand, the birth of *Elements* also marks that Western mathematics and geometry have been separated from the practical application and experience in the Babylonian and ancient Egyptian times, but have developed towards pure theoretical thinking.

From the point of view of the history of mathematics, due to the production of *Elements*, it has prompted the production of non-Euclidean geometry and the development of modern axiomatic methods.

Elements, while significant, is not perfect. The fifth postulate of the small flaw (if a straight line intersects with two straight lines, and the sum of two same-side interior angles formed is less than a right angle, then after extending these two straight lines indefinitely, they must be on one side of those two interior angles. Intersect) is dubious due to the use of "infinity". From ancient Greece to 1800, many mathematicians have tried to solve this mystery: the ancient Greek astronomer Ptolemy tried to prove, and later Procorus advocated the removal of the fifth postulate from the axioms and postulates of geometry; medieval Arabic mathematics Omar Khayyam and Nasir al-Din also tried to prove it; Renaissance mathematicians Sakéri, Rüger, and Lambert refocused on the fifth postulate; The research of Bachevsky and Gauss finally established the establishment of non-Euclidean geometry. The establishment of non-Euclidean geometry is a revolution in the sense of mathematics. Although the truth status of Euclidean geometry has been lost for thousands of years, mathematicians have gained a new understanding and understanding of mathematics, making mathematical theory and mathematical philosophy. The research has entered a new era and provided theoretical preparation for the emergence of the theory of relativity.

In addition, people formed the axiom law in the strict analysis of Euclidean geometric axiom system, and the German mathematician Hilbert established a strict axiom system in his *Geometric Fundamentals*, which is usually called the Greek Albert's axiom system: that is, by means of pure logical reasoning, a rigorous Euclidean geometry can be deduced. The publication of *Fundamentals of Geometry* made the pursuit of formal axiomatic methods and the use of formal axiomatization to solve mathematical construction problems, which became a major development direction of mathematics at that time. At the same time, due to the emergence of Hilbert's formalized axiomatic method, it also provides a new research method for mathematics. Many branches of mathematics are reconstructing theoretical systems according to axiomatic methods, such as axiomatic probability theory, which is an important achievement of mathematical abstraction in the 20th century.

In Western culture, *Elements* is not only a great mathematical work, but also a great work that guides the development of rational thinking and represents Western mathematical values. When we break away from the narrow category of mathematics and focus on the entire Western history, and analyze it from the macro perspective of culture, we will see the higher-level significance of *Elements* for the development of Western rationality. The creation of Euclidean geometry, its contribution to mankind is not only the generation of some orderly and logical theorems, but more importantly, it represents a rational spirit, making the entire Western civilization understand the importance of rational power, and prompt people to apply reasoning about rational thinking to other fields. From a methodological point of view, the rigorous and perfect logical system of *Elements* has played an exemplary role in the entire Western cultural system. Theologians, scientists, philosophers, statesmen, and all seekers of truth followed Euclid's geometrical form and deduction.

In the Middle Ages in Europe, the logical deduction model and rational spirit of *Elements* were injected into theology; after the Renaissance, *Elements* became an ideal model for scientific construction, and disciplines such as physics, chemistry, astronomy, medicine, and philosophy followed Geometry Elements mode to build.

From this, we will find that the *Elements* and even Western mathematics are quite different from ancient Chinese mathematics. They are not as keen on practical application as in ancient Chinese mathematics, concerned with concrete life. The mathematical problems and mathematical contents studied in *Elements* are completely out of reality and are purely abstract and deductive knowledge systems. As early as the ancient Greek period, mathematics insisted on using the method of deductive reasoning, and very rejected to obtain conclusions through induction, observation, and experiment. In addition, in the eyes of Western mathematicians, the *Elements* and even Western mathematics play an exemplary role in philosophical interpretation and rational norms. In Western culture, mathematics is a mysterious authority in the religious sense, a tool for understanding and approaching God; in the philosophical sense, it is a rational basis, shining with rational light everywhere; in the structural sense of specific disciplines, it is A pattern, an established norm. Obviously, there is a huge difference between the rational value pursuit of *The Elements* and the practical value pursuit of *Nine Chapters of Arithmetic*.

4. The Spread of *Elements* in China

The introduction, dissemination and even fusion of a cultural achievement to another nation is a kind of collision and cognition from the dissemination of appearance to the concept, and it is an extremely difficult and long process, and the dissemination of *The Elements* in China is no exception. From the translation of the first six volumes by Xu Guangqi and Matteo Ricci to the translation of the last nine volumes by Li Shanlan and Wei Lie Yali, a total of more than 250 years have passed, and the translation process has gone through a lot of sadness and ups and downs. However, after the introduction of *Geometry Elements*, although it had a certain impact on ancient Chinese mathematics, it did not achieve the purpose of extensive preaching as expected by Western missionaries, nor did it change the value of ancient Chinese mathematics in terms of values.

At the end of the sixteenth century, the Western Renaissance was basically completed, and the peasant revolution and religious reform movement gradually rose. The revolution of modern experimental science and the change of humanistic thought brought a great threat to the Catholic rule. For this reason, the Jesuit Society decided to spread its theological spirit to the distant eastern countries, hoping to restore the former grace of the Jesuit Society in the vast land of China. However, the missionary path of the Jesuits was not popular at first, and it was Matteo Ricci's "curve missionary" that really knocked on the door of China. The so-called "curve missionary" means that in order to preach, one must first use Western academics to win over people's hearts, and the most fundamental purpose is to lure people into superstitious belief in the Lord Jesus. Of course, this "curve" route of Matteo Ricci also catered to the needs of Chinese society and culture at that time. First of all, there were frequent errors between the Gregorian calendar and the Hijri calendar used in the late Ming Dynasty. The revision of the calendar has become a major event that must be carried out, but it has been delayed due to the lack of talents proficient in the calendar. After Matteo Ricci came to China, he soon discovered this and took the first step in missionary work by helping to revise the calendar. Secondly, the scientific knowledge of astronomy, geography, mathematics, etc. disseminated by Matteo Ricci was novel and useful to Chinese scholar-officials, not only satisfying their curiosity and desire for knowledge, but also improving the Military affairs, water conservancy, and enriching the country and strengthening the army also helped a lot. Li Zhizao, a Chinese scholar-bureaucrat, showed great interest after seeing the *Complete Map of Mountains, Seas and Geographies* drawn by Matteo Ricci, and was deeply impressed by Matteo Ricci's knowledge cultivation. Be baptized into teaching.

At the end of the sixteenth century, the Western Renaissance was basically completed, and the peasant revolution and religious reform movement gradually rose. The revolution of modern experimental science and the change of humanistic thought brought a great threat to the Catholic rule. For this reason, the Jesuit Society decided to spread its theological spirit to the distant eastern countries, hoping to restore the former style of the Jesuit Society in the vast land of China. "Curve Mission" really knocked on the door of China. The so-called "Curve Mission" means that if you want to preach, you must first use Western academics to win people's hearts, and the most fundamental purpose is to lure people into superstitious belief in the Lord Jesus. Of course, this "curve" route of Matteo Ricci also catered to the needs of Chinese society and culture at that time. First of all, there were frequent errors between the Gregorian calendar and the Hijri calendar used in the late Ming Dynasty. The revision of the calendar has become a major event that must be carried out, but it has been delayed due to the lack of talents proficient in the calendar. After Matteo Ricci came to China, he soon discovered this and took the first step in missionary work by helping to revise the calendar. Secondly, the scientific knowledge of astronomy, geography, mathematics, etc. disseminated by Matteo Ricci was novel and useful to Chinese scholar-officials, not only satisfying their curiosity and desire for knowledge, but also improving the Military affairs, water conservancy, and enriching the country and strengthening the army also helped a lot. Li Zhizao, a Chinese scholar-bureaucrat, showed great interest after seeing the *Complete Map of Mountains, Seas and Geographies* drawn by Matteo Ricci, and was deeply impressed by Matteo Ricci's knowledge cultivation. Be baptized into teaching.

In 1600, Xu Guangqi and Matteo Ricci became acquainted, and later they lived together in Beijing and traveled frequently. In the autumn of 1606, Xu Guangqi talked with Matteo Ricci about mathematics. Matteo Ricci explained the essence of Euclid's geometry, and said that "if this book has not been translated, none of his books will be available" and stated that translation is as difficult as it has always been in China. *The Origin of Geometry*, which Xu Guangqi translated by Xu Guangqi and Matteo Ricci was based on Kravis's 15-volume Latin annotated version, and the translation method was dictated by Matteo Ricci and recorded by Xu Guangqi. After working during the day, Xu Guangqi spent the rest of his time studying and translating the *Elements*. Due to the differences in language and knowledge, the hardships of the translation process can be imagined. The translation of *Elements* took more than a year, with several revisions and revisions. The characteristics of his translations are: a single translation, that is, a fixed technique; the text is popular, without major mistakes; nouns and terms are the basis of today, and there are as many as 20 mathematical nouns with the same meaning as now.

But unfortunately, Xu Guangqi and Matteo Ricci only translated the first six volumes of the *Elements*, and did not translate the whole book. There are many speculations among Chinese scholars as to why Matteo Ricci advocated that only the first six volumes be translated. Mei Rongzhao, Wang Yusheng, Liu Dun and others have analyzed and pointed out that there are two main reasons: First, as a Jesuit, the fundamental purpose of Matteo Ricci's coming to China was to preach, and the dissemination of scientific and mathematical knowledge was only a last resort. Second, from the perspective of the content of *Elements*, the first six volumes are basically self-contained. In the West, in addition to the thirteenth and fifteenth volumes, there are also a variety of volumes circulating. The earliest German and Swedish translations are six volumes. Volumes may be because he only studied the first six volumes of the *Elements* at the Roman Seminary, so he probably did not think it necessary to translate beyond what was taught at the Roman Seminary, or he himself had the ability to translate the last nine volumes. not built.

No matter what Matteo Ricci's thoughts were at that time, only the first six volumes were translated, which had a certain impact on future Chinese mathematics and science. During the late Ming and early Qing dynasties, ancient Chinese mathematics was already very backward, and many important ancient Chinese mathematical works have been lost. However, the translation of *Elements* brought Western mathematical forms to China, injected fresh blood into the long-silent Chinese mathematics community, and to some extent promoted the development of ancient Chinese mathematics. Many mathematicians in the late Ming and Qing dynasties had studied the first six volumes of the *Elements* and were influenced by it, such as Mei Wending's geometry, the Ming'an map's geometric model, and Li Shanlan's apical product formula. geometric methods, etc. In addition, the deductive method of the *Elements* also had an impact on other sciences in China at that time. Dai Zhen, a scholar in the Qing Dynasty, applied the deductive method to his study of the classics.

The first translation of *The Elements* marked the beginning of the process of Westernization of Chinese mathematics.

In modern times, geometry was introduced to China for the second time. Li Shanlan, a native of Haining, Zhejiang, is said to have started studying *Nine Chapters of Arithmetic* at the age of 10, and since then he has developed a strong interest in mathematics. At the age of 15, he studied the first six volumes of *The Elements* co-translated by Xu Guangqi and Matteo Ricci. He was greatly influenced. After the age of 30, his mathematical ability gradually improved, and he began to study mathematical theories and publish mathematical results by himself. Wei Liyali admired Li Shanlan's mathematical talent, so he invited him to translate the last nine volumes of *Elements* together.

By examining the mathematicians and mathematical achievements of the late Qing Dynasty, we will find that the translation of the entire "Elements" did not play a big role in the later development of Chinese mathematics, and few mathematicians or mathematical works made use of the proof methods or Applying the method of *Elements* to other mathematical knowledge, the *Algebraic Mathematics* and *Daiweiji Shijie* (代微积拾级) jointly translated by Wei Lie Yali and Li Shanlan received great attention from mathematicians in the late Qing Dynasty. This had a considerable impact on the mathematical research in the late Qing Dynasty.

Throughout the history of the development of Chinese mathematics, we will find that although the "Elements" has had a certain shock and impact on Chinese mathematics, it is far less profound than its impact on Western mathematics and culture. To investigate its root cause, we will see that ancient Chinese mathematics and ancient Western mathematics played different roles in their respective civilizations, belonged to different cultural systems, and played different roles. From the perspective of mathematical values, it is difficult for mathematics pursued by different values in two cultures to have the same effect.

5. A Comparison of Ancient Chinese and Western Mathematical Theoretical Systems

Just as Western scholars regard the *Elements* as the "Bible of Science", Chinese mathematicians regard the *Nine Chapters of Arithmetic* together with its annotations as the foundation of ancient Chinese mathematics research and writing. From the beginning of the Western Han Dynasty to the end of the Qing Dynasty, the *Nine Chapters of Arithmetic* became the main academic norm of the scientific community of Chinese mathematicians.

Examining the *Nine Chapters on Arithmetic* and the subsequent ancient Chinese mathematical works, we can see that their two most prominent features are practicality and algorithmization.

Similar to *Nine Chapters of Arithmetic*, almost all ancient Chinese mathematics works are inseparable from the social life and practical application problems in which they live. The *Wu Cao Suanjing in the Ten Books of Suanjing* is an applied arithmetic book written for local administrators. The book is divided into five volumes, respectively using Tian Cao, Bing Cao, Ji Cao, Cang Cao, and Jin Cao as the standards. All the arithmetic problems are to solve the needs of production and life problems. After Sui unified China, they began to build the Great Wall, repair the Canal, Wang Xiaotong solved some practical problems in the project in *Ji Gu Suanshu*. During the Sui and Tang Dynasties, astronomers developed the interpolation method in order to study astronomy and revise the calendar. All these show that ancient Chinese mathematics is a practical technique and a tool for solving practical problems. Chinese arithmetic classics are compiled in accordance with actual problem-solving examples, and most of the content involved can reflect the actual situation of all aspects of society at that time and the needs of various specific problems. Therefore, many historians often regard ancient mathematical works as precious materials for studying the life of ancient Chinese people, economic conditions, government systems and regulations, and engineering technology (such as civil construction, map surveying and mapping).

It can be seen from this that ancient Chinese mathematics is rooted in the soil of actual production and life, and only by absorbing the nutrients of life application problems can it be developed and passed down. Dr. Needham once pointed out that ancient Chinese mathematics is fundamentally closely related to bureaucratic government organizations, and is a technique for solving various problems for ruling officials. The most important problems to be solved by mathematics are practical production and living problems related to the measurement of land, the volume of grain, government taxation, the exchange rate of currency, the construction of dams and canals, and so on.

As a skill in ancient China, once it is no longer needed by society, its development will be interrupted or even lost. By examining the history of mathematics in China, we will find that although Chinese mathematics reached its peak during the Song and Yuan Dynasties, the rational construction of mathematics by mathematicians Qin Jiuzhao, Li Ye, Zhu Shijie and others at that time had surpassed the skills and application of traditional Chinese mathematics. They have made great efforts in "mathematics for the sake of mathematics", so their achievements in mathematics will inevitably be forgotten by ancient Chinese mathematics that pursues practicality as its own value.

Corresponding to traditional Chinese mathematics, Western mathematics represented by the *Elements* has almost nothing to do with practical application problems, and often reflects the characteristics of abstraction, logical deduction and axiomization.

Reading through the *Elements*, we will find that there are almost no practical application problems like *Nine Chapters on Arithmetic* in the book, and almost no specific numerical calculations are involved, only the general discussion of abstract geometry and abstract numbers. This not only avoids the particularity of using specific numerical values, but also generalizes mathematical problems and properties. The propositions discussed and clarified have universal applicability to all numbers and shapes, making the content of mathematics more distinct and clear.

In addition, Elements employs a variety of abstract methods, such as "idealization". The "idealization method" means that when forming a concept with a certain property, this property is not possessed by the object of this domain, even an illusion, but this assumption is logically reasonable. Euclid idealized abstraction at the beginning of the *Elements*, which established ideal elements, as in the first volume:

Definition 1: A point has no parts

Definition 2: Lines have only length and no width

Definition 5: A face has only length and width

Introduces the most basic *Elements*, points, lines, and surfaces, which are obviously not available in the real world. No object in the real world can be "without parts" or "only have length and no width" or "have length and width". These are just abstractions that people make of real objects. Discarding many of their properties and considering only the properties dealt with in the book constitute such ideal elements, which are certainly false, i.e., idealized. The result of abstraction is that the main contents of *Elements* are abstract propositions and abstract proofs. Euclid's *Elements* has a total of thirteen volumes. At the front of each volume, he lists the postulates, axioms, and definitions needed for the proof of this volume, and then uses these known postulates, axioms, and definitions from complex to briefly prove the following theorem strictly in terms of logical order.

Aristotle, the founder of logic, pointed out that logical arguments are divided into two methods: inductive method and deductive method, that is, from "individual to ordinary" and "from ordinary to individual" two processes. Aristotle typified and systematized the logic of ancient Greece, and made the mathematics of that time strictly abide by this rule.

The whole book has formed a complete and closed logical deduction system, which rarely involves the calculation method of specific problems, but emphasizes the reasoning and proof that highlights the logic before and after.

It is precisely because of the rigorous logical system of the *Elements* that a method of great significance to later mathematics and even other sciences has been derived: the axiomatic method, and established a theoretical norm, which is very important for mathematics and other sciences in later generations. have had a profound impact.

Through the analysis of ancient Chinese and Western mathematics, it can be found that ancient Chinese mathematics is a kind of practical mathematics, a mathematical system constructed to solve specific problems; while ancient Western mathematics is mathematics for mathematics, constructing mathematics according to abstract logic rules. From the perspective of mathematical values, ancient Chinese mathematics is a practical pursuit of value, while the *Elements* is an abstract and logical rational pursuit of value. It is the different mathematical values and value orientations in Chinese and Western cultures that ultimately caused the huge differences in concepts, methods, structures, and applications of ancient Chinese and Western mathematics.

6. A Comparison of Ancient Chinese and Western Mathematical Value

Looking at the history of ancient China and the history of mathematics in China, it is not difficult to find that most of the mathematicians in ancient China came from humble backgrounds and had low social status. Liu Hui, Zhao Shuang, Zu Hui, Jia Xian, Liu Yi, etc., due to limited historical data, most of their life experience, birth and death years cannot be studied in detail, which reflects that ancient Chinese mathematicians had no status at that time, and they engaged in mathematics. Research did not receive the attention of the mainstream of society at that time. Although the mathematician Zu Chongzhi was born in a scholarly family, and served as an official in the court all his life, his research on mathematics was also to meet some practical needs of the ruling class at that time. In the end, it failed to attract the attention of the society and was buried in the long river of history, and its traces can only be seen in a few historical materials.

The development of ancient Chinese mathematics reached its peak in the Song and Yuan Dynasties. Throughout the Song and Yuan Dynasties, there was no one with high authority. Zhu Shijie was a teacher and Yang Hui was a local official, and they had no social status; Qin Jiushao and Li Ye were hindered by the war, so they chose to live as a hermit and study knowledge to pass the boring life.

It can be seen from this that the mathematicians who studied mathematics in ancient China were never officials who had a significant impact on society. Instead, they were researchers in the lower class. Unfortunately, their research work and results were often not taken seriously at the time, resulting in little impact.

Due to the influence of Confucianism, the traditional Chinese culture, most ancient Chinese and mathematicians pursued practicality, and regarded mathematics as a skill and a tool for solving problems: serving the interpretation function of the Book of Changes, and serving the functions of water conservancy and civil engineering. Architectural services, the revision and reform of the astronomical calendar, and the people's life and production. Liu Hui pointed out in the preface of *Nine Chapters on Arithmetic* that number is a change of six lines. Obviously, Liu Hui established mathematical theory and developed mathematics on the basis of explaining everything in *Book of Changes*.

The Western Han mathematician Liu Xin emphasized the application of mathematics. He pointed out: The calendar, the law, the system; the circle, the square, the weight, the balance, the standard, the amount, the tills, the hidden, the copper deep, to far, all are used. The length of the degree is not lost a millimeter, the amount of the measure is not lost a handful, the power of light and heavy is not lost millet. The preface of *Sun Tzu's Suanjing* points out that the function of mathematics is: We examine the gathering and dispersion of the group, the rise and fall of the two qi, the iterative movement of the cold and heat, and the differences between far and near. We can observe the subtle signs of heaven and the length of geography.

The understanding of mathematics by ancient Chinese mathematicians such as Liu Xin and Liu Hui reflects their practical mathematical values. For a long time, ancient Chinese mathematics has been developing in the direction of practical application. By the Song and Yuan Dynasties, although mathematical theory reached its peak, mathematics at this time had been divorced from actual life and presented a fictional and fabricated construction form. At this time, mathematicians no longer simply attached mathematics to the “Book of Changes” and real life like Liu Hui and others, but regarded mathematics as a kind of “Tao”, a rational structure that can explain the world. In the sense of social needs, mathematics in Song and Yuan Dynasties has surpassed the needs of ancient Chinese civilization, and the mathematical theories created by mathematicians have little application value. However, this rational reconstruction without application could not be brought into play at the level of social application at that time, and it contradicted the explanation of everything in the *Book of Changes*, which eventually led to the elimination of mathematics in the Song and Yuan Dynasties from Chinese history.

During the Ming and Qing Dynasties, although Chinese mathematicians represented by Xu Guangqi had improved their understanding of mathematics, they still did not break away from the practical significance of mathematics. Xu Guangqi pointed out: The science of elephant and number, the largest for the calendar, for the law, to other tangible and qualitative things, there are degrees of things, all rely on for use, the use of all the ingenuity of the most wonderful. To a certain extent, he believes that mathematics has a certain ideological height.

It can be seen that his mathematical values are not fundamentally different from those of Liu Xin and Liu Hui, and mathematics is still regarded as a useful tool for learning other disciplines, and ultimately achieves the goal of saving the country and becoming stronger. In the book *Westernization of Chinese Mathematics*, Professor Tian Miao pointed out that there may be two reasons for Xu Guangqi’s direct motivation to study European mathematics. One of the reasons is that mathematics is closely related to social stability, people’s daily life and national security. Obviously, this kind of thinking still has a strong utilitarian color, and it has not fundamentally elevated mathematics to a kind of thinking, a kind of abstract reason.

After the outbreak of the Second Opium War, a Westernization movement was launched in China, which was to learn Western technology in order to save the country by self-improvement. In this movement, mathematics has an important position because it is closely related to both civil and military technologies such as machine manufacturing. Li Shanlan once pointed out: Nowadays, the countries of Europe and Brazil are getting stronger and stronger, and they are the border problems of China. The reason for this is that they are good at arithmetic. ... In the future, everyone will learn arithmetic and become better at arithmetic, so that they will be able to intimidate overseas countries and pay tribute to them. Here Li Shanlan believes that the country needs to use the study of mathematics and the development of mathematics to achieve the purpose of enriching the country, strengthening the army, and saving the country. This idea is also inherently utilitarian.

It can be seen that from the *Nine Chapters of Arithmetic* to the Song and Yuan Dynasties to the Ming and Qing Dynasties, the practical values of ancient Chinese mathematicians have been in the same strain. They have a history of thousands of years in the Chinese cultural tradition and have always dominated ancient Chinese mathematicians. Views on mathematics and the construction and application of mathematical knowledge.

In the Chinese cultural tradition, the Confucian culture that dominates and has a deep-rooted influence on people’s thinking has been enduring in Chinese culture for more than two thousand years, and played a leading role in the thinking and spiritual aspects of ancient China. The basic content of Confucianism mainly discusses ethical and moral issues, and as a result, a relatively complete system of ethical guidelines has been established. That is to say, the basic aspects of Confucianism are composed of political and ethical education, while other aspects of knowledge have not entered the research field of Confucianism. It focuses on “interpersonal relationships” and ignores the discussion of natural sciences such as the view of nature and the view of the universe. Therefore, it is not the natural sciences that dominate ancient Chinese culture, but the humanities such as sociology, ethics, political science, and morality. The requirements of Confucianism on subjects such as mathematics are limited only to their practicality. Although ancient Chinese philosophers also observed and thought about the natural world, they were ultimately used as tools to serve social ethics.

In addition, in Chinese history, only those who practice Confucianism can be called “scholars”, and those who engage in mathematics and other natural sciences can only be “craftsmen”. In such a situation, the direction of Chinese intellectuals’ efforts is to cultivate one’s own family and govern the country and bring peace to the world, and the study of mathematics can only be the skills of “craftsmen”.

Correspondingly, China’s technical mathematical values are rarely able to attract and cultivate talents at the spiritual level, which has resulted in the historical situation that the study and teaching of mathematical achievements can only become the technical training of practical craftsmen, and also determines the ancient Chinese mathematicians. It is also impossible to integrate into the upper class of Chinese society.

By studying the history of the West, we will find that, compared with China, most of the ancient Western mathematicians were born in famous families and had prominent and respected social status. Descartes, Fermat, Leibniz, etc. were born in a famous family or in a scholarly family, and were nurtured by a good family. The study of mathematics was paid attention to by the society at that time, which had a certain impact; Gauss, Lobachev Skye, Riemann, Lagrange, Cauchy and others are university professors, and their mathematical research is highly respected and sought after by students and future generations; the heads of Euler, Gauss and others are also printed on Swiss francs and German marks. to show his great contribution to mathematics.

On the other hand, from Pythagoras, to Descartes, Leibniz, Russell and other ancient Greek mathematicians, they may have philosophical thinking beyond themselves, or have strong religious plots. Many mathematicians in the West are philosophers, and philosophers in the West are proficient in mathematics.

The famous school of ancient Greece, Pythagoras, was founded by Pythagoras. This is a religious, political organization. Pythagoras believed that everything in mathematics was an abstraction of thinking, and his great idea of "everything is number" had a profound impact on the mathematical circle in the future; although Plato, the founder of the Plato school, was not a mathematician, he is very enthusiastic about this science, firmly convinced of the significant role that mathematics plays in philosophy and our comprehension of the universe, and encouraged mathematicians to study mathematics and use it to describe the world. Plato regarded mathematical thought as a ladder to philosophy, and pointed out that mathematics is a preparatory tool for understanding the world. In addition, he advised future philosopher kings and state rulers to spend a certain amount of time specializing in spiritual disciplines: arithmetic, plane geometry, solid geometry, astronomy and acoustics. The philosophical school he founded had a great influence on both then and later generations.

Euclid, the author of *Elements*, believed that the study of mathematics should not have some specific, practical purpose, but should focus on mathematics itself. This is a typical value concept of mathematics for mathematics' sake.

Through the investigation of Western mathematics and philosophy, we will see that the attitude of Western mathematicians towards mathematics reflects their rational pursuit of mathematics. In the concept of ancient Western mathematicians and Westerners, mathematics is a rational spirit that transcends reality, expresses the absolute truth of objective reality, and has the status of philosophy and reason. Mathematics is no longer a tool for people's production and life, it has risen to a kind of belief, which is a spiritual and rational level above life, and has philosophical speculation and rational guiding significance. The famous mathematician M • Klein believes: "In the broadest sense, mathematics is a spirit, a rational spirit. It is this spirit that inspires, promotes, inspires and drives human thinking to the greatest extent possible. It is the degree of perfection that is the very spirit which tries to influence decisively the material, moral and social life of man; tries to answer questions posed about man's own existence; tries to explain and control nature; tries his best to seek and establish the most knowledgeable Profound and most perfect connotation." This fully reflects the status of mathematics in the West.

Likewise, Western mathematics will appeal to literate people on a spiritual level, influenced by such mathematical values. Out of a spiritual pursuit to describe the world and explain all things, the cultural elites in every society will actively and consciously learn mathematics, use mathematics, strengthen their self-cultivation through mathematics, enrich their knowledge, and complete the pursuit of truth. It is precisely because of the attention, learning and participation of elites of various disciplines in Western mathematics that it can shine in Western culture.

7. Inspiration and Conclusion

Through the previous introduction and analysis, we can see that the *Elements* was introduced into China twice, to a certain extent, it supplemented the shortcomings of ancient Chinese mathematics, especially in geometry. Before the introduction of the *Elements*, ancient Chinese mathematics did not have complete knowledge of geometric theory. After the introduction of *Geometry Elements*, it had a lot of positive influence on ancient Chinese geometry, promoted Xu Guangqi, Mei Wending, Li Shanlan and other ancient Chinese mathematicians to further study and research on geometry, and promoted the development of Chinese mathematics. However, after the *Elements* was introduced into China, due to the influence of Confucian culture, its rational brilliance in Western culture disappeared, and it was virtually put on a practical shackle, and eventually became a Chinese classic. Such a result is contrary to the original intention of the Western missionaries in importing the *Elements*, and it is also something they did not expect. Through this phenomenon, we should further think and reflect on its deeper meaning.

Through the introduction of *Elements*, we will find that ancient Chinese and Western mathematics are two completely different theoretical systems, and the value pursuits of Chinese and Western ancient mathematicians are also completely different, and Chinese and Western ancient mathematics played different roles in their respective cultures. Comparing Chinese and Western ancient mathematics, we can find that Western mathematics has exerted a far-reaching influence on the cultural system. In the long history of human beings, Western mathematics has shone with dazzling rational brilliance, bringing epoch-making changes to Western science and even Western civilization. However, the mathematical values of Chinese pragmatism have obvious defects in the development and function of mathematics itself. For China to move towards the world and modernization, we should attach great importance to the cultivation of modern rational spirit. Instead, think of it as a way of rational thinking.

Under the background of the cultural tradition of emphasizing the application of the world and emphasizing the pragmatism, the mathematics education in ancient China was also aimed at the application of the world. In ancient China, mathematics was taught as a skill that could meet the needs of society. Since the Opium War, our mathematics education has gradually adopted the methods prevailing in the West. However, as a cultural tradition, our mathematics education is still influenced by the traditional concept of technical application, lacking metaphysical rational speculation and inner rational education.

Through the analysis of the two introductions of *Elements* into China, we can see that when the two cultures communicate, contact, collide and learn, the first part is the form part, and the most difficult part is the value concept. When the *Elements* was introduced to China, we only saw its mathematical content at first, and it was only after a hundred years that we began to examine and think about the values of mathematicians after mathematics. And this value of Western mathematics is exactly what we should learn from and learn from.

Based on the investigation of the introduction of *Elements* into China, based on the investigation of Chinese and Western mathematical values, we should pay special attention to the differences between Chinese and Western mathematical cultures and different mathematical value orientations, and pay attention to the rational spirit of Western mathematics that transcends practical significance. The understanding of mathematics, the role played in the learning of mathematics.

References

Jean-Claude Martzloff, (2006). *A History of Chinese Mathematics*. Berlin, Heidelberg, Springer-Verlag.

Needham, Joseph, (1956). Mathematics and Science in China and the West. *Science & Society, 20*(4), pp. 320–343, www.jstor.org/stable/40400462. Accessed 27 Apr. 2023.

Zhou, Minhang & Lina Gao, (2019). (PDF) a Comparative Study of Chinese and Western Mathematical Thoughts.www.researchgate.net/publication/331337049_A_Comparative_Study_of_Chinese_and_Western_Mathematical_Thoughts. Accessed 12 Feb. 2022.

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/).