



# From “Supreme Oneness” (‘Taiyi’) to “Principle” (‘Li’): A Comparison of Xing Yunlu and Wang Xichan’s Astronomy System

Haohao Zhu<sup>1</sup> and Miao Wang<sup>2\*</sup>

<sup>1</sup>Department for the History of Science and Scientific Archaeology, University of Science and Technology of China, China

<sup>2</sup>Department of Philosophy, Zhejiang University, China

\*Corresponding author: Miao Wang, Department of Philosophy, Zhejiang University, Hangzhou Zhejiang 310058, P. R. China, Tel: 86 0571-88273350; Email: wangmiao@zju.edu.cn

Research article

Volume 4 Issue 4

Received Date: September 20, 2021

Published Date: October 19, 2021

DOI: 10.23880/phij-16000201

## Abstract

This article introduces the two Chinese calendrical astronomers Xing Yunlu (c.1549-c.1621) and Wang Xichan (1628-1682), and their treatises completed during the late Ming and early Qing dynasties in China. The former only focused on traditional Chinese astronomy, who compiled *Gujin lili kao* (Investigation into Harmonics and Calendrical Astronomy from Antiquity to the Present) and constructed the system under the concept *Taiyi* (Supreme Oneness). However, the latter completed his calendrical astronomy work under the influence of European astronomy which was introduced into China by Jesuit missionaries during the late Ming and early Qing dynasties, Chinese traditional astronomy and Neo-Confucianism. Furthermore, it compares their astronomical system and academic background. More significantly, this paper also re-explores the influence of European science in China at that time in a metaphysical approach.

**Keywords:** Xing Yunlu; Wang Xichan; Calendrical astronomy; Neo-Confucianism

## Introduction

The late Ming and early Qing dynasty of China is a very special and important period of the development of Chinese astronomy. During this period, the study of Chinese traditional astronomy was renewed after the long silence. Many scholars, such as Zhu Zaiyu (1536-1611), Yuan Huang (1533-1606) and Wei Wenkui (1557-1636) devoted to traditional astronomy research. Meanwhile, Jesuit missionaries came to China to spread Gospel. They also introduced European astronomy under the guidance of “Missionizing through science”. Finally, two European astronomy books were introduced into China. One was *Chongzhen lishu* (CZLS, Chongzhen-reign Treatises on Calendrical Astronomy) which was compiled during the astronomical reform of Chongzhen reign led by Xu Guangqi (1562-1633). This work, which was re-edited lightly and renamed *Xiyang Xinfu Lishu* (Treatises

on Calendrical Astronomy according to the New Method from the West) by Johann Adam Schall von Bell (1592-1666), became official astronomy in the beginning of Qing dynasty. The other book was *Tianbu zhenyuan* (True Principles of the Pacing of the Heavens) which was compiled in 1653 by the Polish Jesuit missionary Nikolaus Smogulecki (1611-1656,) and his Chinese disciple Xue Fengzuo (1600-1680). Mainly because of the immense influence of CZLS, European astronomy finally replaced Chinese traditional astronomy and became the main stream astronomy in Qing dynasty. Many Chinese scholars, such as Wang Xichan (1628-1682), Mei Wending (1633-1721), as well as Xue Fengzuo devoted themselves to it and developed their own system.

On this exciting history, many studies have been done in different aspects and from different perspectives. But in this paper, we will try to explore it in a special approach

which few scholars paid attention to. We will first focus on the academic system of astronomers' works, not about their computational methods or celestial bodies' model, but the system which was comprised of philosophical categories and their learning. Then we will compare different systems. Our comparison will especially pay attention to the metaphysical part, and try to combine philosophical background to analyze. Specifically, we will focus on two astronomers' works during this period in this paper. One is Xing Yunlu (c.1549-c.1621), an important astronomer in late Ming dynasty. His work was typically about Chinese traditional astronomy which was represented by Guo Shoujing's (1231-1316) *Shoushi li* (Time Granting System of Calendrical Astronomy)<sup>1</sup>. Another was Wang Xichan, who was influenced by European classic astronomy work *CZLS*, and developed his own system under the Neo-Confucianism. We will analyze their system respectively and combine the thought background of that period to compare them. We hope we can reveal the features of two systems and the influence of European astronomy from a new perspective.

### The Astronomical Aystem under *Taiyi* ("Supreme Oneness"): Xing Yunlu

Before our discussion about Xing Yunlu's system, we would like to discuss our method of analyzing. Science isn't an isolate entirety, but the production of culture. This is extremely obvious before modern society. In pre-modern period, different cultures generate different sciences. We can find their differences in different aspects. For example, contrasting to ancient Chinese astronomy, ancient European astronomy is definitely another system, not only in the way of calculation or presentation, but also their function, methodology and metaphysical foundations.<sup>2</sup> Therefore, when we try to analyze pre-modern sciences, we should avoid conceiving of them in certain mode-usually in the way of modern science, but combine their own culture, follow their own way of thinking, such as their philosophical conceptions in their texts or background to understand their own system.

Xing Yunlu, whose courtesy name was Shideng, was born in about 1549 and died between 1621 to 1626. He was the administrative official of Ming Empire and studied astronomy in his free time. As his achievement and enthusiasm to the calendrical reform, he participated twice calendrical reform

during Wanli reign-period and became the leader in the second one. Although the reforms were not successful, they could be viewed as the prelude of calendrical reform in the late Ming dynasty. His representative works of astronomy include *Gujin lili kao* (*GJLLK*, Investigation into Harmonics and Calendrical Astronomy from Antiquity to the Present) and *Taiyi shu* (The Book on "Supreme Oneness").

According to his discourse, we can divide his work into two parts or steps, viz, *Bo* (to be erudite ) and *Yue* (to reduce). The first step *Bo* meant widely learning calendrical astronomy which Xing considered as *Li* (principle) and *Shu* (number). The second step *Yue* meant getting basic category *Taiyi* (Supreme Oneness) from *Bo* and applied it in the calendrical astronomy, so that he could master or understand calendrical astronomy completely. As he said in the preface to *Taiyi Shu*:

I, as a not smart man, try to study and understand calendrical astronomy. I study widely. So carefully did I collate and correct *Li*(principle) and *Shu* (number) during all the times! Now when I try to attain the essence from my wide study, to explore the origin directly, I get what is called *Taiyi*.<sup>3</sup>

Then which book did represent the first step? The answer was *GJLLK*, which was completed no later than the 27<sup>th</sup> year of Wanli-reign (1599) and first published in 28<sup>th</sup> year (1600). *GJLVK* involved 72 volumes, and could be divided into 8 parts. In these 8 parts, Xing mainly reviewed and summarized the calendrical astronomy from early period to the Ming dynasty. For example, from volume 9 to 19, he discussed different kinds of calendrical astronomy recorded in official history books and other literatures. In volume 28 he even introduced the astronomy knowledge in the Taoist and Buddhist canons. Among these calendrical systems, what he paid most attention to were *Shoushi li* and *Datong li* (Great Unification System of Calendrical Astronomy), especially *Shoushi li*. From volume 36 to 59, he studied the contents of *Shoushi li* and *Datong li* specifically. In other volumes, he also tried to recover the underlying mathematical principle of *Shoushi li*'s computational method. Actually, *Shoushi li* was the best calendar before Ming dynasty in Xing Yunlu's opinion. He wanted to recover it and find deficiencies, so that he could correct them and achieve his goal of reforming calendar.

Besides calendrical astronomy, Xing Yunlu also expressed some important thoughts about calendrical astronomy in *GJLLK*. He emphasized calendar should be reformed perpetually. The celestial phenomenon should be observed at any time. He also proposed an interesting physical mechanism which employed Chinese traditional conception

1 For the latest study on Xu Guangqi's *Shoushili*, see, Kiyoshi Yabuuti and Shigeru Nakayama, *Jujireki: Yakujū to Kenkyū* (Kawasaki: Ai Kei Corporation 2006); Nathan Sivin, *Granting the Seasons: The Chinese Astronomical Reform of 1280, with a Study of its many Dimensions and a Translation of its Records* (New York: Springer, 2009).

2 The relative discussion could be seen in David Pingree, *The Logic of Non-Western Science: Mathematical Discoveries in Medieval India, Daedalus*, 2003, 132 (4), pp. 45-53.

3 Xing Yunlu, *Taiyi shu*, in additional vol. of Xing Yunlu, *Gujin lili kao*, printed by Sun Wei in 1608 at Baoding, p.1a.

*Qi* (pneuma) to interpret the movements of moon and five planets. He thought their cycle movements were caused by the pull of sun's *Qi*. Moreover, Xing Yunlu also employed volume 29 to 35, less than 10 percent of whole book, as his musical harmonic part. Obviously, they were secondary part in *GJLLK*. The reason may be music harmonics was based on calendrical astronomy in Xing Yunlu's opinion. In the preface to *GJLLK*, he said:

However, the musical harmonics comes from calendrical astronomy. Hence, the calendrical astronomy is more important."<sup>4</sup>

Just as he said in the preface to *Taiyi shu*, in *GJLLK*, Xing Yunlu really studied the *Li* and *Shu*, viz. calendrical astronomy widely. However, as he said, *GJLLK* was just the step of *Bo* of his academic system. There was also another step *Yue* which attached his calendrical astronomy work to *Taiyi*. The book representing Yue was *Taiyi shu*.

*Taiyi shu* is a very brief book, just including 19 pages in one volume. We only find one existing version by now which is attached in the end of Sun Wei's Baoding *GJLLK*. It can be divided into four parts. The first, from page 1a to 5a, discussed the meaning of *Taiyi* and a constellation of constants coming from *Taiyi*. The second, from page 5b to 10a, introduced the computational methods of diameter, the area of *Huangzhong* pipe, the diameter and circumference of golden ball, the length of a side of golden cube, the length of the sides of right triangle, the geometric data of square or circle field in the circle or square field and so on. In Xing's opinion, we could understand the computational algorithms of calendrical astronomy through these methods, because they were similar to calendrical methods and easier to comprehend through these examples than the ones of calendrical astronomy. The third part, from page 10a to 18b, was about the application of *Taiyi* in the calculation of calendrical astronomy. Xing Yunlu gave two examples -the calculation of numbers of the diameter of heaven<sup>5</sup> and the length of two sagittal sides of ecliptic and equator- at first. And then he deduced a series of Chinese traditional astronomical data. In this part, Xing Yunlu directly expressed that *Taiyi* was the basis and key to calendrical astronomy. All the methods of calendrical astronomy were based on *Taiyi*. All the numbers of calendrical astronomy came from *Taiyi*. Just as he said: "*Taiyi* is the law of ten thousand of methods

(of calendrical astronomy)."<sup>6</sup> "The ten thousand and irregular numbers of the *Qizheng* and *Siyu* of heaven during millions and the thousand years all come from the one, thus (I) call *Taiyi*."<sup>7</sup> The last part, from 18b to 19b, was the conclusion, in which Xing Yunlu criticized *Shoushi li* and spoke highly of *Taiyi*.

If we probe the meaning of *Taiyi*, we will find *Taiyi* isn't just the origin of calendrical astronomy. It's the most basic and important essence or the most primary noumenon as well as the creator of the world. In other words, it is typically the universal noumenon in Chinese traditional philosophy which usually includes the double features of cosmology and ontology. For example, Xing Yunlu said:

It's the one, but why do I say *Tai* (highest or most basic)? *Taiyi* is *Wuyi* (no the one). There is no the one before the *Wushi* (no beginning), but becomes the one in the beginning of that there is the one. This the one, can't be named but is named forcedly, can't be restrained in square and cube (the figure or material), doesn't attach and dwell (on matters), however not doesn't attach and dwell. Hence it is called *Tai*.<sup>8</sup>

The heaven and the earth as well as ten thousand of things can't avoid this (*Taiyi*). The ghosts and the gods, the changes and the forms are all involved in it (*Taiyi*).<sup>9</sup>

Being identical with *Wuyi*, existing before the beginning of world, becoming the one in the beginning of the world and that everything can't avoid it imply the cosmic ontology feature of *Taiyi*. Therefore *Taiyi* is not only the noumenon of natural phenomenon such as celestial bodies' movements, but also the one of humanity, as the Way or *Tao* in traditional Chinese philosophy:

*Taiyi* is the beginning of the Way. Yao and Shun pass it on by Only One. (The *Tao* of) Yu, Tang, the King of Wen, the King of Wu, Duke Zhou, Confucius and Mencius are all this *Tao*.<sup>10</sup>

From above discussion, it's also easy for us to guess that *Taiyi* was similar to *Taiji* (Supreme Ultimate), the typical category of Chinese philosophy. Actually, we could find evidence in Xing Yunlu's discussion:

*Taiyi* moves and generates *Liangyi* (two elementary

6 Xing Yunlu, *Taiyi shu*, 16b.

7 Xing Yunlu, *Taiyi shu*, 18b. *Qizheng* refers to the moon, the sun and five planets. *Siyu* is an astronomical term designating the four invisible celestial bodies, Rahu (*luohou*), Ketu (*jidu*), *Yuebo*, and *Ziqi*.

8 Xing Yunlu, *Taiyi shu*, 3b.

9 Xing Yunlu, *Taiyi shu*, 4b.

10 Xing Yunlu, *Taiyi shu*, 1a.

4 Xing Yunlu, *Gujin lili kao*, in vol.787 of *Siku quanshu* (Taipei: Taiwan shangwu yinshuguan, 1983), p.3. About the contents of *GJLLK*, see Wang Miao, A Study on Xing Yunlu's *Gujin lili kao*. *Journal of Dialectics of Nature*, 2005, 27(4): 92-98.

5 It's not about the real length of the diameter of heaven, but the numbers of degrees of the it. Xing Yunlu thought the length of the circumference of heaven is 365.25.

Forms). Those two forms part and produce *Sixiang* (Four emblematic Symbols), which evolve and breed *Bagua* (eight Trigrams).<sup>11</sup>

This sentence obviously comes from the Chinese classic treatise *Yijing (Book of Changes)*: “Therefore in (the system of) the Yi there is the Grand Terminus, which produced the two elementary Forms. Those two Forms produced the Four emblematic Symbols, which again produced the eight Trigrams.”<sup>12</sup> In *GJLLK* Xing Yunlu also expressed that if the calendrical astronomy was rooted in *Taiji*, we could obtain the everlastingly correct calendar: “The number of *Huangzhong* is 81. The number of *Dayan* is 2040. These have been farfetched. However (Wang) Pu presented these numbers immediately, and seems come from *Taiji*, *Yinyang* and *Wuxing* (five elements). If this is true, the calendrical astronomy should everlastingly errorless. Why do (the calculation of Wang Pu’s calendar) more than (the movements of) Heaven? (Wang’s behaviors) just let *Yinyang*’s imprecise and leave *Taiji* unjust.”<sup>13</sup> This is similar to *Taiyi shu*, in which Xing Yunlu originated his calendrical astronomy to *Taiyi* and thought he has gotten the best way.<sup>14</sup> Therefore we can say, *Taiyi* is similar to *Taiji*. It’s the development of *Taiji* which Xing Yunlu expressed in *GJLLK*.

The similarity between *Taiji* and *Taiyi* reveals the close relationship between *Taiyi shu* and Yi-ology. Above we have mentioned Xing Yunlu’s critique of Wang Pu, whose calendrical astronomy was combined with the *Yizhuan* (The Commentary of *Yijing*) of *Guan Lang*. Hence, obviously the *Taiji*, *Yinyang* and *Wuxing* in Xing Yunlu’s discussion are the terms in Yi-ology. In *Taiyi shu*, Xing Yunlu used *Wuxing*, *Dayan* (great evolution), *Sancai* (three powers), *Liangyi* (two forms), *Liulü* (six bamboo pitch pipes among the twelve), *Bagua*, *Jiugong* (nine modes of ancient Chinese music) etc. to construct terms, such as *Liangyi Bianlü* (The two elementary Forms changing rate) and *Bagua Bianlü* (The eight Trigrams changing rate). This also showed the close relationship between *Taiyi shu* and Yi-ology. Moreover, Xing Yunlu even expressed the opinion that calendrical astronomy was under Yi-ology: “This Yi-ology, manifests the Way and assists the spiritual. Which thing is not in it? The calendrical astronomy belongs to it doubtlessly.”<sup>15</sup>

The interesting question is how did Xing Yunlu let his calendrical astronomy system under *Taiyi*? As we know,

*Taiyi* was the origin and primary noumenon of the cosmos. It produced the universe and was in everything. Contrasting to *Taiji*, *Taiyi* doubtlessly contains the feature of number. Therefore, the process that *Taiyi* produced the universe was also the evolvement of number, just as Xing Yunlu said:

The Way comes from the One, and goes back to the One. What is the one? It’s  $\circ$ . The one produces the Two. The Two produces the Three. (The Three) produces three one two five five seven, which is the heaven, manages the circle. (The Three) produces four four six nine nine eight, which is the earth, manages square. (They) all go back to the One.<sup>16</sup>

The evolution of universe was not only from *Taiyi* to heaven and earth, but also from the One to Two, Three and the numbers of heaven and earth. Numbers were not just for calculation, but obtain the cosmologic and ontological meaning. They were attached with the Way. Obviously, Xing Yunlu presented a kind of very special numerical cosmology here. It’s reasonable for us to deduce that Xing Yunlu would give other numbers about things between heaven and earth in his next step. Because according to traditional Chinese philosophy things would be produced after the appearance of the heaven and earth. But maybe Xing Yunlu was aware of the difficulty and mass of this way, he instead tried to give a series of constants which came from *Taiyi*. He divided these constants into three parts: *Taiyi Wuxing Sancai Yuanlü* (*Taiyi Wuxing* and *Sancai* circle rate), *Taiyi Liangyi Sixiang Fanglü* (*Taiyi Liangyi Sixiang* square rate) and *Taiyi Fangyuan Dongjing Shenghualv* (*Taiyi* circle square movement stillness producing change rate). These three parts represented the circle, square and exchange between circle and square respectively. As the circle meant heaven, square meant earth. The exchange of them obviously meant the exchange of heaven and earth. Actually, these three aspects were the whole view of universe in ancient Chinese. But these constants were not the numbers of heaven, earth and their exchange directly. They were the rates used in the calculation of circle and square as well as of heaven and earth. After giving these rates, Xing Yunlu showed some examples that used these constants to calculate. Although we could find these rates could be used in the calculation of the existence such as field, *Huangzhong* and golden ball, his main goal was to apply them to his calendrical astronomy so that he could base astronomy on metaphysical categories. This can be proved by the facts that the examples of field, *Huangzhong* and golden ball were used to explain the calculation of

11 Xing Yunlu, *Taiyi shu*, 2a.

12 The I Ching, translated by James Legge (New York: Dover Publications, Inc. second version), p.373.

13 Xing Yunlu. *Gujin lüli kao*, p.195.

14 Xing Yunlu, *Taiyi shu*, 18b, 19b.

15 Xing Yunlu. *Gujin lüli kao*, p.14.

16 Xing Yunlu, *Taiyi shu*, 1b. In this fascinating sentence in which we can find the influence from Zhou Dunyi’s (1017-1073) *Taiji tushuo* (Explanation of the Diagram of the Supreme Ultimate) and *Daode jing* (Classic of the Way and its Virtue). The one produces the Two, and then the Three. We can find the influence of *Daode Jing* here. Producing heaven and earth after the Three and regarding the figure  $\circ$  as the Way partly come from Zhou Dunyi’s *Taiji tushuo*.



calendrical astronomy. Besides, he also gave two examples of calendrical astronomy directly. For example, one of them was:

The circumference of heaven is three hundred and sixty-five degrees twenty-five minute and seventy-five second.

**Question:** how long is the diameter of heaven?

**Answer:** diameter is one hundred and seventeen-degree two minute and two second.

**Method:** Place three hundred and sixty-five degrees twenty-five minute and seventy-five second of heaven. Look (divide) *Taiyi Sancai Jilü* three one two one three two zero three four as one. Get the value of diameter of heaven. Answer the question.<sup>17</sup>

As heaven is circle according to Xing Yunlu, this is a very simple mathematical question about the diameter of circle actually. *Taiyi Sancai Jilü* is also just the approximate value of  $\pi$ . But the application of *Taiyi Sancai Jilü* was significant for Xing Yunlu. It meant he attached his work to *Taiyi*, the origin and noumenon of universe. This was an important way that Xing Yunlu connected his work to *Taiyi*. Besides, Xing Yunlu also thought the observation of astronomy was based on constants of *Taiyi*:

*Taiyi* is the law of ten thousand of methods (of calendrical astronomy). Observing heaven through *Taiyi*'s conference and diameter rate (we) get the conference of heaven. Observing sun through *Taiyi*'s legs of right triangle rate (we) get the value of tropical year.<sup>18</sup>

Then he discussed many important astronomical terms which were related to tropical year and mutually related. As the observation of tropical year was relate to *Taiyi*'s constants, it's reasonable for us to say that these terms were also related to *Taiyi* in Xing Yunlu's mind. Actually, we can also conjecture that the calculation and observation of these terms were also based on them.

Therefore, we can say the way that Xing Yunlu applied *Taiyi* in the practice of calendrical astronomy was to calculate and observe astronomical problems and terms with constants of *Taiyi*. These constants were produced by *Taiyi* in a numerical cosmology way.

### To Obtain the *Li* (Principle): Wang Xichan

Wang Xichan was one of the most important astronomers in the early Qing period, born in Wujiang, Jiangsu province, also known as Zhaomin, with the courtesy name Yin Xu,

17 Xing Yunlu, *Taiyi shu*, 10b.

18 Xing Yunlu, *Taiyi shu*, 16b.

art name Xiao An, also known as Tiantong Yisheng, Yu Bu, Caifang Shijun. His main works include two volumes of *Xiao An xiansheng shiji* (Master Xiao An's Poetry Collection), three volumes of *Xiao An xiansheng wenji* (Master Xiao An's Anthology), and *Xiao An xinfafa* (Xiao An's New Method), *Datong lifa qimeng* (The Enlightenment of the Great Unification System of Calendrical Astronomy), *Zazhu* (Miscellaneous Works, later included in *Xiao An yishu* (Xiao An's Legacy of Book)).

Wang Xichan paid close attention to Confucianism all his life. He hoped to carry forward the Neo-Confucianism and trace it back to the Six Classics of primitive Confucianism, so as to grasp the true meaning of Confucianism. He said, "I think that the profound meaning of the Six Classics has already been understood by Cheng Hao (1032-1085), Cheng Yi (1033-1107), Zhu Xi (1130-1200), Hu Anguo (1074-1138) and Cai Yuanding (1135-1198). However, their thoughts are too profound for future generations to really understand, so these Classics are usually packaged and abandoned, and the future generations even put up flags and beat the drums to compete with each other ... I hope people can try to understand the classics within the biographical notes and don't doubt the classics with the content other than the biographical notes."<sup>19</sup> He severely criticized "learning of the mind" (*xinxue*) which was proposed by Lu Jiuyuan (1139-1193) and Wang Shouren (1472-1528), "Some scholars of younger age had an severalfold faith in these theories, so that they finally became the meditators."<sup>20</sup> At the same time, he also criticized Buddhism.<sup>21</sup> Therefore, generally speaking, Wang Xichan advocated Cheng- Zhu School and opposed Lu-Wang school of mind, hoping to achieve the true meaning of Confucius and Mencius through the Cheng-Zhu school.

As to Wang Xichan's studies on calendrical astronomy, *Xiao An xinfafa* is his representative work. Wang Xichan opposed the practice of only using Western calendars and abandoning Chinese calendars in *CZLS*, so he created this almanac combining Chinese and Western methods of calendrical astronomy. He said, "Therefore, I took both Chinese and Western methods of calendrical astronomy into consideration, removed the dross, combined with my own point of view, and wrote a six-volume book on

19 Wang Xichan, *Xiao An xiansheng wenji*, vol.2, edited by Zhang Haishan in 1821. See also: Zhang Yongtang, *Mingmo qingchu lixue yu kexue guanxi zailun* (Re-discussion on the Relationship between Neo-Confucianism and Science) (Taipei: Taiwan xuesheng shuju, 1994), pp. 190-191.

20 Wang Xichan, *Xiao An xiansheng wenji*, vol.2, edited by Zhang Haishan in 1821. See also: Zhang Yongtang, *Mingmo qingchu lixue yu kexue guanxi zailun*, p. 186.

21 For the Confucianism thought of Wang Xichan, see: Zhang Yongtang, *Mingmo qingchu lixue yu kexue guanxi zailun*, pp. 185-186.

calendrical astronomy.”<sup>22</sup> This book has six volumes. The first volume discusses the basic mathematical knowledge used in astronomy at that time, which is mainly to find trigonometric functions by cyclotomic method. The second volume is about basic astronomical data. The third volume combines Chinese and Western methods to calculate the phases of the moon in the lunar month and the positions of sun, moon and five planets. The fourth volume discusses the wax and wane of the planets in the moon, the five planets and the apparent diameter of the moon, etc. The fifth volume is about the difference of air and time, and the light and spirit orientation of the moon. The sixth volume is the calculation of solar and lunar eclipses, transit of Venus, etc.<sup>23</sup> On the whole, Wang Xichan’s calendrical astronomy is based on the Western calendar and has been innovated and improved, while retaining some characteristics of Chinese traditional calendrical astronomy.<sup>24</sup>

Wang Xichan admired the academic thought of Cheng-Zhu school, so when Xu Guangqi introduced *Euclid’s Elements*, *CZLS* and other Western mathematical astronomy works in the name of the study of investigating things and pursuing the principles, he naturally treated them as the study of investigating things and principles. Therefore, he paid special attention to the discussion of the principles of the calendrical astronomy, emphasizing that we should know why in the study of the calendrical astronomy. “There were two perfect discussions about the calendrical in ancient times: it says in the Great Symbolism of the *Yijing*, ‘in accordance with the form *Ge* (revolution), the superior man formulates his astronomical calculations and makes clear the seasons and times’; Mencius once said, ‘If we have investigated the *Gu* (principle), we may, while yet sitting in our places, go back to the solstice of a thousand years ago.’ The key to the calendrical astronomy is *Ge*, so there is no calendar that has not changed for hundreds of years; However, if people do not understand the *Gu*, there is no starting point for changing the calendar.”<sup>25</sup>

He also lamented that, in the early Ming dynasty, Li Defang could not surpass Yuan Tong, because the former did not know the principle of the calendrical astronomy, which led to the promulgation and implementation of the rough

*Datong li* designed by the latter, “The level of calendrical astronomy of Yuan Tong was not as good as that of Guo Shoujing, and the ministers at that time were not as good as that of the Yuan dynasty, which eventually led to the continuing using of the old method. Although Li Defang tried to change it, he did not understand the *Li* (principle) of the calendrical astronomy. Thus, he had to stick to the old ways and failed in the end, which is very regrettable.”<sup>26</sup> Wang Xichan also refers to the study of calendrical with the study of *Li*, “In the study of astronomy ... must deeply understand the changes of numbers and the profoundness of the *Li*.”<sup>27</sup> He also called a person who knows the calendrical astronomy as a reasonable person, “The so-called theory of ghosts and gods is just a false statement of astrology, and people who understand the *Li* of calendrical astronomy will not agree with it.”<sup>28</sup> In addition, Wang Xichan sometimes referred to the *Li* of calendrical astronomy as method and implication. For example, he thought that the reason why the Chinese traditional calendrical astronomy was defeated by the Western calendar during the change of calendar in Chongzhen-reign was that people don’t understand the method and implication, that is, the *Li*, “The old calendrical astronomy lost to the Western astronomy, not because the calendrical astronomy itself is bad. This is because there is no one who understands the *Li* of the calendrical astronomy.”<sup>29</sup>

Wang Xichan emphasized the principle in the study of the calendrical astronomy, but this principle was really not tenderminded. On the contrary, it was closely related to numbers. When he summarized the development of calendrical astronomy in the past dynasties, he believed that calendar researchers were divided into two groups in the Song dynasty, namely the calendrical astronomy of Confucianist and of the calendrical astronomer. But neither of these two is on the right way. Because they either only know the *Li* or only know the *Shu*, “To the Song dynasty, the study of calendrical astronomy divided into two groups, namely the Confucian Calendar and the calendrical astronomy of astronomer, the Confucian scholars don’t know the *Shu*, they only study the calendrical astronomy through quoting the empty *Li*. The astronomers don’t know the *Li*, and they only study the calendrical astronomy in a fixed way, which leads to the inability to obtain the truth.”<sup>30</sup> Therefore, the calendrical astronomy research requires a deep understanding of *Shu* and *Li*, “Since ancient times, there have been more than 70 theories of studying calendrical astronomy, all of which have

22 Wang Xichan, *Xiao An yishu*, in vol. 78 of *Congshu jicheng xubian* (Taipei: Xinwenfeng chuban gongsi), 1988, p. 637.

23 For the content of *Xiao An xianfa*, see: Xi Zezong, *Shilun Wang Xichan de tianwen gongzuo* (Discussion on the Wang Xichan’s astronomical works), in *Wang Xichan yanjiu wenji*, edited by Chen Meidong and Shen Rongfa, Shijiazhuang: Hebei kexue jishu chubanshe, 2000, pp. 1-20.

24 See: Jiao Xiaoyuan, Wang Xichan jiqi *Xiao An xinfa* (Wang Xichan and his *Xiao An xinfa*), in *Wang Xichan yanjiu wenji*, pp. 39-46.

25 Wang Xichan, *Lice* (On calendrical astronomy), in *Xiao An xiansheng wenji*, vol.2, edited by Zhang Haishan, 1821. See also: Zhang Yongtang, *Mingmo qingchu lixue yu kexue guanxi zailun*, p.196.

26 Wang Xichan, *Xiao An yishu* (Xiao An’s Legacy of Book), in vol. 78 of *Congshu jicheng xubian* (Taipei: Xinwenfeng chuban gongsi, 1988), p. 635.

27 Wang Xichan, *Xiao An yishu*, p. 805.

28 Wang Xichan, *Xiao An yishu*, p. 636.

29 Wang Xichan, *Xiao An yishu*, p. 782.

30 Wang Xichan, *Xiao An yishu*, p. 635.

made some achievements. They all claim to be superior to their predecessors. But it didn't take long for the calendrical astronomy to be deviated and eventually abandoned. Why is this? The reason is that the person who made the calendrical astronomy did not have a deep understanding of *Shu* and *Li*, but simply echoed the laws summarized in the past and accumulated data."<sup>31</sup> The *Shu* and *Li* also became the standard for him to retain and abandon the concepts in the calendrical astronomy, "The people who make calendars say that solar terms should use the new calendar, and lunar terms should use the old calendar. What is the relationship between this and the *Shu* and *Li*?"<sup>32</sup> That is to say, in the face of the dispute between Chinese and Western calendars at that time, Wang Xichan believes that the calendar calculation method proposed by the calendar reformers in the Chongzhen-reign has nothing to do with the *Shu* and *Li*.

However, what is the relationship between *Li* and *Shu*? In short, he believes that *Shu* and *Li* are different, but *Shu* are produced from *Li*. So, people can understand *Li* through *Shu*, "The ultimate thing in the world is *Li*, but people can only understand it vaguely. If people want to explain the principle precisely, they must use *Shu*. The *Shu* is not *Li*, but *Shu* is produced from *Li*. Therefore, *Li* can be understood through *Shu*."<sup>33</sup> The final state achieved by *Shu* and principle is similar to the state of sudden enlightenment described by Cheng Hao, Cheng Yi and Zhu Xi in the investigating the things and pursuing the principles. In the *Ceri xiaoji* (Notes on Measuring the Sun), he once said, "In the study of astronomy, there is *Li* first, then *Shu*, and then method. Therefore, those who want to create method must deeply understand *Shu* and *Li*."<sup>34</sup> The deep understanding of *Shu* and *Li* can fully comprehend the logic of astronomy, and can be "integrated", so that people can reach the state of creating astronomical calculation methods. This is also the state of integration of method, *Li* and *Shu*. It is the ultimate state of Wang Xichan's astronomical research. In addition, Wang Xichan often said: "I think the advantage of the Western astronomy lies in its accuracy of measurement, rather than a deep understanding of the meaning of the methods and implications. It is feasible to pursue the integration according to its *Li*, but it is not feasible without distinguishing its shortcomings."<sup>35</sup> These are similar to what Zhu Xi said, "Encountering things in the world, one must base oneself upon the *Li* of what one has already known and exhaust it further so that one may seek to reach the extreme. After having exerted efforts for a long time, one day one suddenly 'penetrates thoroughly', then, of the

outside and the inside or the refinement and the coarseness of many things, there will be none that one cannot reach, and of the entire substance and the great function of one's mind, there will be none that is not bright."<sup>36</sup> As discussed above, it has been connected with Wang Xichan's background in the Neo-Confucianism.

### The System about the Way and Two Kinds of Metaphysical Foundation: From Xing Yunlu to Wang Xichan

Now we can begin our comparative part about these two scholars' astronomic system. We will especially concentrate our comparison on the metaphysical foundation parts of their system.

It's easy for us to figure out that both Xing and Wang connected their systems to the supreme existence of the world. They constructed their system based on this supreme existence and secondary categories relating to it. The supreme existence and secondary categories also penetrated and combined different kinds of learning in their systems. As for Xing's system, he connected his system to *Taiyi*, which was supreme existence in his system. The secondary categories in his system were a series of constants. They came from *Taiyi* and represented heaven, earth and mutual action of heaven and earth. *Taiyi* and these constants closely combined his calculation and observation. As for Wang, he connected his system to *Li*, the supreme existence in Neo-Confucianism which was his faith. The secondary ones were *Shu*, which came from *Li*. Through *Li* and *Shu* in calendrical astronomy, Wang can obtain the human's supreme goal *Li* according to Neo-Confucianism.

Constructing their scientific system under the supreme existence revealed an important feature of some Chinese scholars' astronomy works in imperial China. Astronomy was not just the learning to calculate the celestial bodies' movements or to guide our daily life, but also the way to pursue the supreme existence or the origin of the cosmos, the way to understand world through the application of the supreme existence and the elements related to supreme existence. We can't say that all scholars' astronomy works possessed this feature. But it really had a sort of universality. Besides Xing Yunlu and Wang Xichan, we can also find other scholars who were similar to them. For example, Zhou Shuxue, who was an important astronomer in the middle of Ming dynasty, said:

31 Wang Xichan, *Xiao An yishu*, p. 782.

32 Wang Xichan, *Xiao An yishu*, p. 784.

33 Wang Xichan, *Xiao An yishu*, p. 783.

34 Wang Xichan, *Xiao An yishu*, p. 805.

35 Wang Xichan, *Xiao An yishu*, p. 635.

36 Zhu Xi, *Daxue zhangju*, in *Zhuzi quanshu*, vol. 6, *Sishu zhangju jizhu* (Hefei: Anhui jiaoyu chubanshe), 2002, p. 20. See also: Yung Sik Kim. "Analogical Extension" (*leitui*) in Zhu Xi's Methodology of "Investigation of Things" (*gewu*) and "Extension of Knowledge" (*zhizhi*). *Journal of Song-Yuan Studies*, No. 34 (2004), pp. 41-57.

Yi-ology was the Way of heaven, the origin of calendrical astronomy. Understanding the calendrical astronomy means understanding the heaven. Understanding the heaven means understanding the Yi-ology.<sup>37</sup>

In Zhou Shuxue's opinion, the study on calendrical astronomy was the way to understand the Yi-ology which contained the supreme category of world.

Actually, constructing systems under *Taiyi* and *Li* is also a way to gain the Way as Daoism or Confucianism does. This meant astronomy which was not the mainstream learning in ancient China also shared the same goal with Daoism or Confucianism. In fact, we could find more similarities between them. For example, there were two steps *Bo* and *Yue* in Xing's system. We can also find discussions about them in *The Analects of Confucius* and its commentaries. If we compare the meaning of these two steps, we will also find that they are similar to *Xiaxue* ("study down below") and *Shangda* ("attain up above") in Confucianism.<sup>38</sup> This means the steps employed in Xing's system were typically Confucian pattern. Moreover, the discussion of Wang that the supreme state of studying calendrical astronomy is similar to the discussion of Zhu Xi, the representative scholar of Neo-Confucianism. We can also find the influence from Lao Tseu and Zhou Dunyi on Xing's notion of *Taiyi*. Obviously, the academic systems of two astronomers were not independent from the mainstream learning in ancient China.

Although Xing Yunlu and Wang Xichan all constructed their systems under the supreme existence and had the similar goal, the categories they employed were very different. They were *Taiyi* and constants coming from *Taiyi* in Xing's system, but *Li*, *Shu* in Xue Fengzuo's system. Actually, we could find *Li* and *Shu* in Xing's work, but they were not the main categories as in Xing's system. This was different from the one which was the supreme category in Wang's system. The period of Xing and Wang are not so different. According to modern Chinese scholars' division, both of them can be classified to the period of the late Ming and early Qing dynasty, which was an important period of academic development. So, how could we understand this phenomenon? Besides, Xing's *Taiyi* was closely related to *Taiji* in Yi-ology. We also mentioned that Zhou Shuxue related calendrical astronomy to the Way of Yi-ology. Actually, many astronomers in the second half

of Ming dynasty, such as Tang Shunzhi (1507-1560), Yuan Huang and Zhu Zaiyu also attached their astronomical work to Yi-ology in order to connected to the Way.<sup>39</sup> However, we can't find the similar relationship between Wang's categories and Yi-ology. So why did not Wang construct his system in a way similar to Xing, but in another way? In order to answer these questions and understand these differences, we should discuss the influence of European science and other thought background in late Ming and early Qing China.

Many scholars have pointed out that the compilers of *CZLS*, especially Xu Guangqi, denied the relationship between calendrical astronomy and Yi-ology. On the one hand, they didn't accept the connection between two kinds of learning. On the other hand, they discarded the opinion that numbers have mystery and divine ability. This kind of ability was emphasized in Yi-ology, especially Shaoyong's (1011-1077) work. Moreover, Zhou Dunyi's *Taiji tu* (Diagram of the Supreme Ultimate), *Hetu* ([Yellow] River Diagram), *Luoshu* (Inscription of the River Luo) in Yi-ology which related to astronomy closely began being criticized heavily in the early Qing dynasty. Many works, such as Huang Zongxi's (1610-1695) *Yixue Xiangshu Lun* (On the Images and Numbers School of the Book of Changes), Mao Qiling's (1623-1716) *Zhongshi Yi* (My Second Elder Brother's Comment on the *Book of Changes*), engaged in this critical movement.<sup>40</sup> Although the books of this movement were written mainly after Shunzhi reign-period, the emergence of its tendency must be earlier. These factors led scholars to begin giving up the close relationship between astronomy and Yi-ology. Considering the system of Xing, we would find the metaphysical foundation of his system was closely related to Yi-ology. This revealed that giving up the relationship between calendrical astronomy and Yi-ology meant giving up the metaphysical foundation of traditional calendrical astronomy. However, for the scholars who were influenced by Chinese traditional culture such as Xing, it's important for them to pursue the supreme existence through calendrical astronomy and construct their systems with metaphysical part. Therefore, when European astronomy replaced Chinese traditional astronomy in early Qing China and had wide influences on the scholars, how to construct their systems with metaphysical part became an important problem.

As the believers of God, the compilers of *CZLS* were impossible to keep the supreme existence as Xing's *Taiyi* in astronomy. It's also impossible for them to prove God or manifest the glory of God in the official compilation

37 He Jigao, The Preface to the *Yunyuan xiansheng wenxuan*. *Yunyuan xiansheng wenxuan* (The Anthology of Master Yunyuan), edited and printed by He Jigao in 1592, p.1a.

38 Yung Sik Kim, 'Confucian Scholars and Specialized Scientific and Technical Knowledge in Traditional China, 1000-1700: A Preliminary Overview', *East Asian Science, Technology and Society: an International Journal*, 2010 (4), 207-228 (pp. 209-210, 215).

39 The way Tang Shunzhi, Yuan Huang and Zhu Zaiyu employed was different. They attached their astronomical works to *Hetu* and *Luoshu*, which were important images in Yi-ology.

40 Zhu Bokun, *Yizue Zhexue Shi*, vol.4 (Beijing: Huaxia chubanshe, 1995), pp.230-292.



of calendrical astronomy. Actually, previous study has revealed that when Xu Guangqi, the main compiler of *CZLS*, integrated European natural philosophy into Chinese culture as the learning of *Gewu qiongli* (investigating things and principles), he stripped the metaphysical part of western natural philosophy and only kept the physical part which corresponded to the “below physical form” in Chinese philosophy.<sup>41</sup> Nevertheless, analyzing *CZLS* and relative discourses, we would find although Xu Guangqi discarded the metaphysical part of western natural philosophy, his classification of western learning and the categories in *CZLS* provided another way to construct astronomical systems with metaphysical part.

In the preface to *Jihe yuanben* (*Euclid's Elements of Geometry*), Xu Guangqi expressed his notion of the classification of western learning through the introduction of Matteo Ricci (1552-1610):

Teacher (Matteo Ricci) has about three kinds of learning: The high one is cultivating moral character and serving the heaven (theology). The low one is *Gewu qiongli*. The one branch of *Wuli* (principle of things) is “learning of images and numbers”. Every kind of learning is precise, standardized and undeniable.<sup>42</sup>

In this sentence, Xu Guangqi actually distinguished two kinds of learning: the theology and the investigation of things. Among the investigation of things, he emphasized the “learning of images and numbers”, which included mathematics and astronomy. We can also see his similar discussion in the preface to *Taixi Shuifa* (*Hydraulic Methods of the Great West*):

(When the Jesuit missionaries) discuss the Way, (they) take practicing their bodies and exhausting their nature, respecting and serving the God as the standard .....And their minor part (of their learning) is the learning of *Gewu qiongli*. All principles in and out the society as well as principles of ten thousand of affairs and things, could be answered clearly and quickly if (you) ask.....Among (the learning) of *Gewu qiongli*, there is a branch called “learning of images and numbers”. (Among the learning of images and numbers), the important ones are calendrical astronomy and musical harmonics. As for the other things possessing form and body, affairs having degree and number, we are all based on it to deal and handle and deal with. We can handle and deal

with them marvelously and fantastically.<sup>43</sup>

From this discourse, we could find although astronomy was an important learning, it was not about the Way. The Way was discussed in the theology. It was about God. The “learning of images and numbers” was an important conception related closely to Yi-ology. But Xu Guangqi used it with new meaning that has no relation to Yi-ology. The most important point was Xu Guangqi regarded astronomy which belonged to the “learning of images and numbers” as the learning of *Gewu qiongli*. *Gewu* (investigating of things) and *Qiongli* (investigating of principles), important categories in Neo-Confucianism. Through *Gewu* and *Qiongli*, people could understand or gain the Way. This is typically expressed in Zhu Xi's *Gewu buzhuàn* (Supplementary Comment on Investigating Things).<sup>44</sup>

Besides, in *CZLS*, the compilers emphasized *Li*, *Shu*. For example, in *Xinli Xiaohuo* (Understanding the New Calendrical Astronomy), Schall von Bell said:

If it can be based on *Li*, there is discussion (about it). It can be measured by *Shu*, there is calculation.<sup>45</sup>

In *Wuwei Lizhi* (Astronomical Guide for Five Planets), the compiler said:

According to above two observations, (we) know that the numbers (we) set are all right. The reason is that (they) match the (number of) heaven.<sup>46</sup>

What needs to be point out is that the name of *Li* and *Shu* in *CZLS* is as same as the ones in Xing Yunlu's work, even as same as the ones in Chinese traditional Yi-ology book. However, their meanings have been changed thoroughly. Influenced by Jesuits and the style of Chinese traditional scholarship in late Ming, Xu Guangqi thought the traditional *Li* and *Shu* which were related to Yi-ology were mysterious and void. Therefore, the new *Li* and *Shu* should be used in scientific work in China. He said: “The study of arithmetic was abandoned in recent centuries. There are two reasons for the abolition: firstly, the famous Confucians look down on practical learning and take it as dross. Secondly, superstition holds that there are gods in numbers, which can know the ancient and modern times. In the end, there is no manifestation of gods, and none of the practical studies survive.”<sup>47</sup> Therefore, when he introduced western geometry

43 Xu Guangqi, *Taixi Shuifa* Xu, Xuguangqi Quanji. Xu Guangqi, The Preface to the print of *Taixi shuifa*, in *Xu Guangqi quanji*, vol. 5, p.290.

44 See: Chan, Wing-tsit (trans. and comp.), *A Source Book in Chinese Philosophy* (Princeton, NJ: Princeton University Press, 1963), p.89.

45 Xu Guangqi, *Chongzhen Lishu*, vol.2, edited by Pan Nai (Shanghai: Shanghai guji chubanshe, 2009), p.1772.

46 Xu Guangqi, *Chongzhen Lishu*, vol.1, p.383.

47 Xu Guangqi, The Preface to the print of *Tongwen suanzhi*, in *Tianxue chuhan*, edited by Li Zhizao (Taipei: Taiwan xuesheng shuju,1965), p.1775.

41 Shang Zhicong, *Mingmo qingchu de gewu qiongli zhi xue (1582-1687)* (Chengdu: Sichuang jiaoyu chubanshe, 2003), p.34.

42 Xu Guangqi, The Preface to the print of *Jihe yuanben*, in *Xu Guangqi quanji* (Complete Works of Xu Guangqi), vol. 4, edited by Zhu Weizheng and Li Tiangang (Shanghai: Shanghai guji chubanshe, 2011), p.5.

and mathematical astronomy, although he still used the concept of *Li* and *Shu*, he had eliminated the characteristics of *Yi*-ology and replaced it with what he thought was the “reality” in order to become “practical”. From the perspective of *Euclid's Elements* which he introduced into China, this kind of “reality” is characterized by geometric axiomatic system, that is, a series of propositions are deduced by logical deduction through basic definitions, axioms and postulates. From the perspective of *CZLS*, “reality” is based on a certain geometric model of the cosmos and certain observation data, and uses geometry to deduce the results that conform to the astronomical phenomena. This is something that China's previous study of calendrical astronomy didn't have. The ancient Chinese calendrical astronomy mainly studies the operation of the sun, the moon and the five stars by means of algebra. Cosmology and calendar calculation are relatively independent, and the sources of calculation methods are not carefully introduced in the calendar books. For this reason, the calculation method of calendar shows strong characteristics of constructivism and gives people a feeling of being groundless. However, European astronomy based on geometric models and derived from geometry is different. As long as the model is determined and the basic data parameters are given, European astronomy can be inferred according to geometric principles. Therefore, the calculation sources of various astronomical data are also rooted in their models and other quantitative factors, so it shows strong “real” characteristics.

Wang Xichan's astronomy system was based on European astronomy, and his *Li* and *Shu* were mainly influenced by *CZLS* compiled by Xu Guangqi and missionaries, so it basically does not have the characteristics of *Yi*-ology. He has equated the *Li* here with the “*Li*” in the *Gewu qiongli*, which is based on a definite geometric model of the universe and mathematical calculations, is the principle of mathematical deduction in Geometric cosmos model and premise or basis of this deduction. Through specific mathematical deductive way according to the real geometric model of cosmos, we can get the precise numbers in astronomy, so he said that “the *Li* gives birth to the *Shu*”. Because mathematical calculation can test whether the model and calculation principle are correct or not, he said that “numbers can comprehend reason”. In another words, *Shu* are important supplements to *Li*, and also a way to study *Li*. Through the study of *Shu*, he can obtain *Li*, and eventually get the thorough understanding and enlightenment which was supreme state in Neo-Confucianism. Obviously, the theology had no attraction for scholars such as Wang Xichan who was the believer of Neo-Confucianism but not Christianity. However, they could discuss the Way through “learning of images and numbers” which belonged to the learning of *Gewu qiongli*. This Way was not the God, but the Way with Confucian background. Influenced by *CZLS* and Neo-Confucianism, Wang completed

metaphysical foundation of his system in a new way.

## Conclusion

Late Ming and Early Qing dynasty was an important period of the development to Chinese ancient astronomy. In this paper, we studied the systems of two important astronomers -Xing Yunlu and Wang Xichan- and compared them in a metaphysical approach. We found Xing's system was divided into two parts -*Bo* and *Yue*. *Bo* was the step in which he studied astronomical works widely. It's represented by *GJLLK*. *Yue* meant gaining the *Taiyi* which was the *Tao* in Xing's opinion from *Bo* and constructed his system with *Taiyi*. It's completed in *Taiyi Shu*. The way that Xing constructed his system under *Taiyi* was very special. He let *Taiyi* produce some constants in a numerical cosmology way first. And then he applied *Taiyi* and these constants which came from *Taiyi* in the calculation, observation and terms of calendrical astronomy. Through this way, he thought he gained the supreme existence of the world.

Wang Xichan was an important astronomer in early Qing. The contents of Wang Xichan's calendrical astronomy were mainly based on innovated and improved European calendar, meanwhile remained some characteristics of Chinese traditional calendar. These contents were rooted on two basic concepts- *Li* and *Shu*. *Li* was the principle of mathematical deduction in Geometric cosmos model and premise or basis of this deduction. *Shu* was the result of the deduction, the constants and calculation of astronomy. *Shu* came from *Li*, but through *Shu*, we could understand *Li* better. Finally, through the understanding of *Li* in astronomy, we can obtain the supreme sate in Neo-Confucianism- the thorough understanding and enlightenment of astronomy.

Through the comparison of their systems, we find both Xing and Wang tried to pursue the supreme existence, the Way in their works. Both of them constructed their system with the supreme existence and combined the learning in their system with it. This shows astronomical works in ancient China was not only the leaning to observe and calculation the movements of celestial bodies, but also the learning to gain the Way, just as Confucianism and Taoism did. However, we can also find the difference between these two systems. The basic categories of Xing's system were *Taiyi* and constants coming from *Taiyi* which related to *Yi*-ology. Actually, the relation between *Yi*-ology and astronomy is a general phenomenon before late Ming China. However, Wang's were *Li* and *Shu* which has no relation to *Yi*-ology. This change mainly came from the influence of European science, especially *CZLS* during late Ming and early Qing. *CZLS* denied the relationship between calendrical astronomy and *Yi*-ology, which meant giving up the metaphysical foundation of traditional calendrical astronomy. Meanwhile, the fact Xu

Guangqi regarded astronomy as the learning of *Gewu qiongli* provided another way to connect astronomical work with the Way. Wang developed this way and constructed his system through employing the basic categories and way in *CZLS* as his metaphysical foundation. This phenomenon told us the influence of *CZLS* was not only confined to the epistemology, calculation and cosmological model<sup>48</sup>, but the metaphysical

foundation of astronomy. It changed the metaphysical foundation of the traditional astronomy.

### Funding

This work was supported by National Social Science Fund of China [grant number 18CZX031] and Specialized Project for the Development of Teaching and Scientific Research of the Teachers of Liberal Arts in Zhejiang University [grant number 105000-541903/061].

---

48 Nathan Sivin. Why the scientific revolution did not take place in China — or did it? in *Explorations in the History of Science and Technology in China: A Special Number of the "Collections of Essays on Chinese Literature and History"*, edited by Li Guohao (Shanghai: Shanghai Chinese Classics

---

Publishing House, 1982), pp. 89-107.

