Independent Development,  
Transmission from the West, and Chinese  
Forerunners: Ideas about the Earth’s Rotation in  
Seventeenth- and Eighteenth-Century East Asia

The idea of the earth’s rotation was one of those salient elements of the modern world picture that differed fundamentally from the corresponding one in traditional East Asia, which pictured a more or less flat earth, more or less at rest, and more or less at the center of the heavens.¹ When the idea entered the East Asian world in the seventeenth century, it was disturbing. It underwent a long period of rejection, confusion, misunderstanding, hesitation, adjustment, and modification before it was eventually accepted by most of the educated population. Various aspects and events in this complicated process have been studied, but the picture is still not totally clear.² In this paper, I will try to add some light by sorting out various events and aspects of the process, and will examine some of them closely.

I begin by comparing the situation of the idea of the earth’s rotation with that of the earth’s sphericity. While both ideas were novel, and out of place, in the established world-views of East Asia, the extents to which they were new were different. Their places in the West at the time of transmission to the East Asian world also differed. This in turn led to differences in the way East Asian scholars responded to

¹ I am using the expression “East Asia” in a very limited manner in this paper. It does not cover the whole of East Asia. All my examples are from China and Korea, and may not represent the situation in other parts of East Asia, notably that of Japan.

the two ideas. Existence of “forerunners” of the idea of the earth’s rotation in earlier Chinese sources further complicated the situation. I will examine the case of Zhang Zai 張載 (1020–1077), mentioned most frequently as such a forerunner, and consider the possible contexts in which such forerunners were “discovered” and “used” by some seventeenth- and eighteenth-century East Asian thinkers. In the light of such factors, modern scholarship has raised both possibilities — independent development of the idea of the earth’s rotation in East Asia and transmission from the West. I will consider both, taking a Korean scholar, Kim Sŏk-mun 金錫文 (1658–1735) as an example. Finally, I will look at another Korean scholar, Sŏ Myŏng-ŭng 徐命膺 (1716–1787), and suggest that the so-called “theory of the Chinese origin of Western learning” provided a context for East Asian thinkers to “discover” and “use” such “forerunners.”

THE EARTH’S SPHERICITY AND THE EARTH’S ROTATION IN THE WEST AND IN EAST ASIA

The situation surrounding the idea of the spherical earth (dìqiú 地球) was more or less clear, both in the West and in East Asia. Its origin was the West, where the idea of the spherical earth at the center of the world had been firmly embedded in Western natural philosophy from ancient times.

In East Asia, in contrast, the idea was new and directly in conflict with certain components of traditional cosmology. For example, there was the widely held ancient idea of “the circular heaven and square earth” (tiányuán dǐfāng 天圓地方). We know, of course, that this expression did not literally mean a square earth, but it is difficult to deny that the idea made it difficult to think of a spherical earth. And although there were some expressions in ancient Chinese texts that seem to imply a spherical earth, some of which were even used as Chinese forerunners, such interpretations do not survive a close scrutiny. For example,

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3 For a brief account of this idea in ancient China, see John S. Major, Heaven and Earth in Early Han Thought: Chapters Three, Four, and Five of the Huainanzi (Albany: SUNY P., 1993), pp. 32–35.
there was the egg analogy in which the heavens and the earth are compared to the egg shell and yolk, respectively.\(^4\) Yet, the emphasis in this analogy was on the spherical and shell-like shape of the heaven’s vault and on the complete enclosure of the earth by the heavens, and not on the shape of the earth. Another example was the ancient knowledge of the variation of the height of the North Pole, that is, that the elevation of the Pole Star from the horizon becomes higher as one goes northward. The observation might have been easily explained in terms of a spherical earth, but it was not impossible to explain it in terms of a flat earth, which in fact was what the traditional Chinese did. Although the above two ideas were among the main evidences used by the Jesuits and their Chinese associates in arguing for the spherical earth,\(^5\) no Chinese seems to have done so before them.

Conflicting more seriously with the notion of a spherical earth was the idea—or ideology—of “Zhonghua 中華” (“Central Splendor”). The idea of the spherical earth upset the accepted world order of the Chinese, namely that China, the “Central Kingdom” (Zhongguo 中国), was at the center of the world, which entitled the Chinese to enjoy the “Central Splendor.” The central position of China on the surface of the flat earth was so important an element of the Chinese—East Asian—world-view that it could be compared only to the central position of man in the traditional earth-centered world-picture of the West. If the earth was to be found spherical, it would have a devastating implication similar to that of the Copernican shattering of a man-centered universe in the West, because there could be no single center on the surface of a spherical earth. Naturally, many Confucian thinkers opposed the idea of the spherical earth when it entered East Asia.\(^6\)

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\(^4\) This analogy first came up in Zhang Heng 張衡 (78–139) and Wang Fan 王蕃 (228–266), and quoted repeatedly by subsequent writers, including Zhu Xi 朱熹 (1130–1200). See, e.g., Cheng Wenguang 鄭文光 and Xi Zezong 喜澤宗, Zhongguo lishi shang de yuzhou lilun 中國歷史上宇宙理論 (Beijing: Renmin chubanshe, 1975), pp. 69–70.


hua world-order, now threatened by the idea of a spherical earth, was as much political and cultural as it was cosmological.\textsuperscript{7}

The situation involving the idea of the earth’s rotation in both the West and East Asia was different from that of the earth’s sphericity. Rotation of the earth was a new idea in the West, and was in conflict with the established world-view. Naturally, it had created a great controversy before coming to East Asia. As is well known, the idea was banned by the Church and suppressed; and sometimes those holding the idea were persecuted.

The idea of the earth’s rotation was new in East Asia also. But the possibility of an earthly motion was not necessarily ruled out of the components of the established cosmology of East Asia, unlike the idea of the spherical earth. To be sure, the above-mentioned idea of “circular heaven and square earth” could be in conflict with the rotation of the earth. But unless the character “\textit{fang 方}” literally meant “square,” it did not make rotation of the earth impossible. Similar was the \textit{Yijing} \textit{易經} expression that “heaven’s motion is strong” (\textit{tianxing jian 天行健}). Although this phrase could mean the movements of heaven, its counterpart expression that “the earth’s tendency is kun” (\textit{dishi kun 地勢坤}) did not mean the earth at rest. Also, while the common association of movement (\textit{dong 動}) with yang and stillness (\textit{jing 靜}) with yin could imply a movement of the heaven (associated with yang) and the stillness of the earth (associated with yin), this association does not seem to have actually inhibited the idea of the earth’s movement. If anything could be in the way of accepting the idea, it would have been the common-sense objections to the notion (that man on earth does not feel the earth’s movement, for example). But from very early times the Chinese knew how to handle such objections, for example, arguing from the analogy of a man on a boat not feeling the movement of the boat.\textsuperscript{8}

Thus, for the Chinese before the coming of the Jesuits, the earth did not have to be at absolute rest. Movement of the earth along an orbit was entirely possible, and the rotation on its own axis was by no means

\textsuperscript{7} For the complex nature of these debates and criticisms, see Yi-long Huang, “Court Divination and Christianity in the K’ang-hsi Era,” \textit{Chinese Science} 10 (1991), pp. 1–20; Pingyi Chu, “Scientific Dispute in the Imperial Court: The 1664 Calendar Case,” \textit{Chinese Science} 14 (1997), pp. 7–34.

\textsuperscript{8} See, e.g., the Han-era apocryphal text, “Kaoling yao 考靈曜”; in explaining the “four wanderings” (\textit{siyou 四遊}) of the earth [discussed below], it says: “The earth constantly moves and does not stop. [It is] like a man sitting in a boat. The boat moves, but the man does not feel [the movement].” Quoted in \textit{Bowuzhi 博物志} (SBBY edn., \textit{j.1}, p. 1b. Zhu Xi also quoted the passage: \textit{Zhuzi yulei 朱子語類} (Zhengzhong shuju 正中書局 edn., hereafter cited as \textit{ZZYL}) 96, p. 3a.
ruled out. Indeed, various ancient sources have passages that speak of, or appear to speak of, the earth’s motions. The foremost example is the so-called “four wanderings” (siyou 四遊), the yearly movement of the earth the true meaning of which is not clear, referring sometimes to ascending and descending motions of the earth, and sometimes to motions of the earth in the four compass directions. There are other expressions of the earth’s motions in various ancient sources. Although such expressions began to disappear from about the fifth century AD with the general waning of interest in cosmological speculations, Zhu Xi 朱熹 (1130–1200) still raised the possibility of the earth’s motion by asking: “How can we know for sure that [while] heaven moves outside, the earth does not follow it and rotate?”

Thus, it is not surprising that the idea of the earth’s rotation did not create much controversy when it entered East Asia. The response to the idea was relatively silent, compared with the noisy controversies in the case of the spherical earth. Some aspects of the actual historical situation surrounding the transmission of the idea of the earth’s rotation complicated the situation and reinforced the “silence.” The timing of the transmission is one such aspect. It fell in the period during which the idea was officially banned by the Catholic authorities, that is, between 1616 (when Copernican teaching was placed on the Index) and 1757 (when the ban was lifted). The fact that the carriers of the idea were the members of the Society of Jesus also complicated the situation. While the Jesuits in China in much of this period were actively appropriating Western scientific knowledge in their efforts to attract the Chinese scholars’ attention, they were forbidden to discuss openly this novel, and potentially interesting, idea. The presence of Chinese assertions about earthly motion further complicated the situation.

Still another complicating factor is that the earth has not one but two principal motions: the daily rotation on its axis and the yearly orbit around the sun. In the West, the idea of an orbital revolution of the earth was a more serious problem because it disrupted the man-centered universe by displacing the earth from the center of the world. In contrast, the possibility of an axial rotation could be raised as long as it was not accepted to be true. The situation was more or less the

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9 The idea of “the four wanderings” appeared in various ancient sources, including the Zhoubi suanjing 周髀算經 (chap. 5), and were variously interpreted as movements of the earth, heaven or the luminaries. For brief discussions of “the four wanderings,” see Zhongguo tian wenxueshi zhengli yanjiu xiaozu 中国天文学史整理研究小组, Zhongguo tianwenxueshi 中国天文学史 (Beijing: Kexue chubanshe, 1987), pp. 171–73.


11 ZZYL 86, p. 9a. For more discussion on this remark, see below.
opposite in East Asia. While the possibility of an orbital revolution clearly existed in traditional cosmological discussions (for example in the above-mentioned theory of the “four wanderings”), the possibility of an axial rotation did not. Thus, we are faced with a paradoxical situation in which the Jesuit transmitters were more strictly forbidden to speak of the earth’s orbital revolution to which the East Asian world would have been more receptive.

It is thus very difficult to document the transmission of the idea of the earth’s rotation from the West to East Asia. Many things remain unclear. When and how did the Western idea actually enter the East Asian world? To what extent could the Jesuits discuss — or did they want to discuss, or were they willing to discuss it? To what extent were the East Asians aware of the existence of — and did they have access to — the idea, one that was forbidden to the Western transmitters themselves? Was it possible that the whole East Asian intellectual world was blocked from it until the Catholic ban was lifted? Perhaps it is impossible to give clear answers. By contrast, the introduction, controversies, and eventual acceptance of the idea of a spherical earth in East Asia can be more or less fully documented, as we have seen.

It is clear, however, that some East Asian scholars began to speak of the rotation of the earth soon after the arrival of the Jesuits. Although it has often been said that the idea did not enter China until 1760, when Michel Benoist (Jiang Youren 蔣友人, 1715–1774) wrote about it in the margins of the world map that he presented to the Qing emperor Qianlong (r. 1735–1796), the idea had previously found its way into the writings of a number of seventeenth- and eighteenth-century Chinese and Korean thinkers.12

Some modern scholars have suggested that the idea of the earth’s rotation was independently discovered (or developed) by East Asian thinkers in the seventeenth and eighteenth centuries. This has given rise to debates involving the originality of their ideas, leading to the questions of whether, and how, they arrived at the ideas of the earth’s rotation. While names of Chinese scholars like Wang Fuzhi 王夫之 (1619–1692) and Huang Baijia 黃百家 (1643–1709) have been mentioned in this connection,13 more frequently noted were the seven-

12 See the references cited in n. 2, above. Benoist’s idea became public after it was discussed in Ruan Yuan’s 阮元 (1764–1849) Chouren zhuan 畇人傳, published in the early nineteenth century.

ZHANG ZAI — A FORERUNNER OF THE IDEA OF THE EARTH’S ROTATION IN EAST ASIA?

In considering the possible East Asian origins of the idea of the earth’s rotation, we first examine the fact that many of these seventeenth- and eighteenth-century East Asian scholars found an East Asian forerunner in the writings of Zhang Zai 張載 (1020–1077). Scholars such as Wang Fuzhi, Huang Baijia, Kim Sŏk-mun, and Hong Tae-yong saw the idea of the earth’s rotation in the following two very ambiguous passages from the “Sanliang” 參兩 chapter of Zhang Zai’s Zhengmeng 正蒙, which I present first in the Chinese, which will be referred to in the close analyses that follow.

(Passage I) 地絶陰凝聚於中, 天浮陽運旋於外, 此天地之常體也。恒星不動, 纖繫乎天, 與浮陽運旋而不窮者也。日月五星, 順天而行, 幷包乎地者也。地在其中, 雖順天左旋, 其所繫辰象隨之, 稍遲則反移徙而右爾。間有緩速不齊者, 七政之性殊也。…

(Passage II) 凡圜轉之物, 動必有機。既謂之機, 則動非自外也。古今謂天左旋, 此直自天之論爾, 不考日月出沒, 恆星昏曉之變。爾謂在天而運者, 惟七曜而已。恒星所以為晝夜者, 直以地氣乘機左旋於中, 故使恒星河漢, 因北為南, 日月因天而見。太虛無體, 則無以觀其運動於外也。

Not only seventeenth- and eighteenth-century thinkers, but also modern scholars have seen the idea of the earth’s rotation in these passages and considered Zhang Zai as a real forerunner.14 Let us first translate by following one such modern scholar, Yamada Keiji 山田慶児, perhaps the most enthusiastic in seeing in this passage the idea of the earth’s rotation. Yamada interprets the bolded portion of Passage I as follows:

The sun, the moon, and the five stars move in the direction opposite to the heaven’s rotation, and they also surround the earth. The earth is inside them, and though [it, i.e., the earth,] follows the sky and rotates leftward, …

For Passage II, Yamada interprets the bolded portion as speaking of the earth’s rightward rotation instead of the heaven’s leftward rota-

tion. But he had to change “zuoxuan 左旋” [leftward rotation] to “youxuan 右旋” [rightward rotation] to do that.

People have spoken about the heaven’s leftward rotation. This is an extremely crude theory, [not knowing that it is the earth that rotates rightward rather than the heaven rotating leftward, and] not considering the rise and setting of the sun and the moon, and the change of the morning and evening of the fixed stars. I would say that what move in the heaven are only the seven luminaries. The reason that the fixed stars have day and night is that the earth’s qi rotates rightward inside relying on the ji 機 [of motion]. Thus it makes the fixed stars and the Milky Ways [appear to be rotating] from north to south, and the sun and the moon appear and disappear following the heaven.15

It is not possible to determine for sure the exact meanings of these ambiguous passages of Zhang Zai. Yet, what is to be noted is that reading the earth’s rotation in these passages does not make Zhang Zai appear creative or imaginative; rather, such a reading makes him appear strange and difficult, if not confused and even ridiculous. For nowhere in Zhang Zai’s sayings and writings does he show any awareness of the possibility of a rotation of the earth. Indeed, in the passage immediately following Passage II, which Yamada and others interpret as referring to the earth’s rightward rotation, Zhang Zai speaks of the heaven rotating leftward. It is quite unlikely that if Zhang Zai really had the idea of the earth’s rotation, he would have spoken about it in such a casual and confusing manner.

On the other hand, there is a perfectly reasonable way to make sense of the passages without reading the earth’s rotation into them. For this new interpretation we should adopt a different punctuation in one place in Passage I: making the phrase “di zai qi zhong 地在其中” as part of the previous sentence, rather than beginning the next sentence with it. Then we take the subject of the previous sentence, “riyue wuxing 日月五星,” to be the subject of the next sentence also: it is “the sun, the
This is perfectly in line with Zhang Zai’s “theory of the leftward rotation” (zuoxuanshuo 左旋說), namely that the sun, the moon and the five stars all rotate leftward along with heaven, which is exactly what the next sentences say. The result is:

The sun, the moon, and the five stars move in the direction opposite to the heaven’s rotation, and they also surround the earth, which is inside them. Although [they, i.e., the sun, the moon, and the five stars,] follow the heaven and rotate leftward, … 日月五星,逆天而行，井包乎地者也，地在其中，[日月五星]雖順天左旋，…

For Passage II, what we need to do is to take “dìqi 地氣” to be Zhang Zai’s, or probably a scribe’s, mistake for “tiānqi 天氣.” True, finding mistakes and changing the text are not choices to be made easily. Yet, if we have to attribute a mistake to the passage anyway, this solution appears far more likely than having Zhang Zai make the mistake of saying “leftward rotation” while meaning “rightward rotation,” and at a crucial place at that. If we accept the alternative, Passage II becomes:

People have spoken about the heaven’s leftward rotation. This is an extremely crude theory, [only speaking about the heaven while] not considering the rise and setting of the sun and the moon, … I would say that what move in the heaven are only the seven luminaries. The reason that the fixed stars have day and night is that the qi of the heaven rotates leftward inside relying on the ji [of the movement of the heaven]. Thus it makes the fixed stars and the Milky Ways [rotate along with it] from north to south … 古今謂天左旋，此直至粗之論爾，不考日月出沒 … 愚謂在天而運者，惟七曜而已，恒星所以為晝夜者，直以天氣乘機左旋於中，故使恆星河漢，因北為南 …

In this way we can avoid the necessity of putting into the thought of Zhang Zai the unlikely idea of the earth’s rotation.

Does this reading rule out Zhang Zai as a possible source of the idea of the earth’s rotation as held by those seventeenth- and eighteenth-century thinkers just mentioned? Or is it still possible that they found the idea in Zhang Zai whether the latter had intended it or not?

What should be noted in this connection is that all readings — by Wang Fuzhi, Huang Baijia and Kim Sŏk-mun, as well as by modern scholars — of the idea of the earth’s rotation in the above-quoted passages of Zhang Zai came after the arrival of the Jesuits. While Zhang’s Zheng-

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16 This is exactly what Zhu Xi did in his commentary to the passage: 真子全書 (SBBY edn.) 2, p. 6b.
meng had been a key philosophical text studied by nearly all Confucian scholars, and while his theory of the leftward rotation contained in it had been frequently discussed and praised, no one until the seventeenth century had read the earth’s rotation from the above passages. Zhu Xi, for example, did not mention these passages of Zhang Zai while speaking of the possibility of the earth’s rotation in the remark seen earlier. That such a reading was never made before the Jesuits bespeaks the remoteness of the possibility of the earth’s rotation in the traditional East Asian mind. It was only after they were introduced to the idea by Jesuit missionaries that East Asian thinkers could make such a reading of a well-known text.

In fact, Zhu Xi’s remark is also worth a close examination because it was considered by some Korean scholars of late-Chos´n as another “forerunner” concerning earth’s rotation.17 What Zhu Xi actually said was the following:

I think that the movement of the heaven has deviations, and the earth rotates following heaven, and [its movement also] has deviations. It is simply that now we sit like this and think only that the earth does not move. How can we know for sure that [while] heaven moves outside, the earth does not follow it and rotate? 想是天運有差，地隨天轉而差。今坐於此但知地之不動耳。安知天運於外而地不随之以轉耶。18

In this remark Zhu Xi does appear to have in mind a rotation of the earth around its own axis, which to him was also the axis of heaven’s rotation. But it is not clear what kind of rotation he had in mind for the earth to make in its “following” heaven’s rotation.19 Nor is it clear how seriously he was committed to the ideas of the earth’s rotation. It may very well have been merely a passing thought about a possibility. His followers seem to have taken it as just that. These passages, in which

17 Yi Ik, for example, spoke of this remark by Zhu Xi when he considered the possibility of the earth’s rotation; Sŏngoho sasol 星湖僿說, “Ch’onji mun” 天地門, chap. 3 (Seoul: Kyŏnggi ch’ulp’ansa, 1967), vol. 1, pp. 76–77.
18 ZZYL 86, p. 9a.
19 In another conversation, Zhu Xi spoke of the earth’s motion in connection with the theory of the “four wanderings,” which, according to him, “refers to the four wanderings and ascending and descending of the earth. ... In spring, [the earth] wanders to the east for thirty thousand li; in summer it wanders to the south for thirty thousand li; in autumn it wanders to the west for thirty thousand li; in winter it wanders to the north for thirty thousand li.” 論地之四遊升降 ... 春遊過東三萬里，夏遊過南三萬里，秋遊過西三萬里，冬遊過北三萬里 (ZZYL 86, p. 10a). Later in the same conversation, when a disciple illustrated these motions with the motion of an empty vessel floating around on water, Zhu Xi approved. In yet another passage he said: “The motion of the earth now is a motion at just one place, and the motion also does not reach far.” 今之地動只是一處動，動亦不至遠也 (ZZYL 100, p. 6a). So he seems to have been thinking about still another kind of motion, smaller than the above two.
Zhu Xi was apparently speaking of some kind of motions of the earth, were not given much attention before the time of the Jesuits.

**KIM SŎK-MUN – INDEPENDENT DEVELOPMENT OF THE IDEA OF THE EARTH’S ROTATION?**

After the Jesuits’ arrival, the sudden appearance of scholars who read such an unlikely idea of the earth’s rotation from early speculative passages suggests that there was a change in the situation. Something seems to have predisposed East Asian thinkers to perceive the idea of the earth’s rotation in these passages. Naturally, one thinks of the possibility of a germination from Western sources. But still, one cannot rule out the possibility that the East Asian thinkers came up with the idea independently in the course of their cosmological speculations. Let us look at the case of Kim Sŏk-mun, perhaps the first East Asian thinker who not only pronounced the idea of a rotating earth but constructed a world system based on it.

Kim Sŏk-mun’s cosmological theory, given in *Yŏkhak isipsado ch’onɡhae* 易學二十四圖總解 (General Interpretation of the Twenty-four Charts in Yiijing Studies) was composed of the following three basic constituents:

1) the cosmological structure of the nine more or less concentric heavenly spheres;

2) the cosmogonic remarks at the beginning of Zhou Dunyi’s 周敦頤 (1017–1073) *Taiji tushuo* 太極圖說;

3) Shao Yong’s 邵雍 (1011–1077) theory of the cosmic cycles of yuan-hui-yun-shi 元會運世.

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20 Ogawa has suggested this also: “Higashi Ajia ni okeru chiten(dō)setsu no seiritsu,” p. 380.


In Kim Sŏk-mun’s cosmological structure of the “nine heavens” (jiutian 九天), drawn in his *Hwang-gûk ku-chan-do* (Huangji jiutiantu) 黃極九天圖, the outermost sphere, “Heaven of the Supreme Ultimate” (taijittan 太極天), is motionless. The next sphere, “Heaven of the Supreme Void” (taixutian 太虛天), moves extremely slowly, which Kim Sŏk-mun referred to as “the slightest motion” (weidong 微動). Further inward in the spheres, the motions become gradually faster: “Heaven of the Fixed Stars” (jingxingtian 經星天), “Heaven of Saturn” (zhenxingtian 鎮星天), “Heaven of Mars” (yinghuotian 燃惑天), “Heaven of Jupiter” (suixingtian 輕星天), “Heaven of the Sun’s Wheel” (riluntian 日輪天, which coincides with the heavens of Mercury and of Venus), and “Heaven of the Moon’s Wheel” (yueluntian 月輪天). The innermost is the “Heaven of Earth’s Wheel” (diluntian 地輪天), the motion of which is the fastest at one rotation a day. And its center is not the center of heaven, but it is removed from it by 180,000 li 里 (1 li is approximately 400 meters).

Kim Sŏk-mun used *Taiji tushuo* to explain the cosmological structure outlined above. He interpreted the *Taiji tushuo* phrase “The supreme ultimate moves and generates the yang 太極動而生陽” as referring to the slightest motion of the Heaven of the Supreme Void emerging from the motionless outermost Heaven of the Supreme Ultimate. The next phrase, “Movement becomes extreme and becomes still 動極而靜,” was interpreted to mean that the earth that moves the fastest nevertheless appears to people on it as motionless. The phrase “It is still and generates the yin 靜而生陰,” then, meant to him that the earth, considered to be motionless, produces shadow (which is yin) on its surface on the opposite side of the sun. Finally, he took the phrase “Stillness becomes extreme, and it moves again 靜極復動” to mean that people on earth, apparently at rest, feel that the heaven moves.

Based on a principle (which he adopted from Giacomo Rho’s [Luo Yagu 羅雅谷] *Wuwei lizhi* 五緯曆指) that the distance covered by one day’s movement of each heaven should be the same 諸天能力必等, and using the known value of the circumference of the earth (the daily movement of the earth), 90,000 li, Kim Sŏk-mun was able to compute the circumference of all the nine heavens, and thus their distances from the center of the heaven. (For example, if the period of rotation of a heaven is \( n \) days, the circumference of that heaven is \( n \) times 90,000 li.) For the period of rotation of the heaven of the fixed stars, he used 25,440 years, the period of the precession of equinoxes. And for “the slightest motion” of the Heaven of the Supreme Void, he took the an-

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23 *Yŏkhak istipado ch’onghae* (hereafter cited as *THISSDCH*), p. 5.
gular speed of $1 \, xu \, \circ$ per day, where “$xu$” is the smallest unit of angle ($1 \, du \, ^\degree = 1 \text{ degree} = 60^\circ \, xu$). The period of rotation for the heaven of the supreme void then becomes:

$$60^\circ (xu/du) \times 360 (du/\text{circumference}) \times 1 (\text{day}/xu) \times 1/365.2425 (\text{year}/\text{day}) = 9.93 \times 10^{15} \, \text{(years)}$$

The outermost heaven of the supreme ultimate does not move, and its circumference cannot be measured.

Having accounted for the structure of the world in this manner, Kim Sok-mun went on to deal with cosmological time. He took up Shao Yong’s theory of cosmic cycles ($1 \, yuan = 12 \, hui = 12 \times 30 \, yun = 12 \times 30 \times 12 \, shi = 12 \times 30 \times 12 \times 30 \, \text{years}$), but gave it his own interpretation and went further than Shao Yong. He associated different periodic motions of the heavens (the ecliptic, or sun’s path) and of the earth with these cycles. One day, to begin with, is associated with the daily rotation of the earth. One year is the period of the yearly revolution of the heaven of the sun. The next time unit for which Kim Sok-mun found cosmological significance is $1 \, yun = 360 \, \text{years}$, the period of oscillation of the size of the sun’s orbit, the ecliptic. His next cosmic period is that of the revolution of the earth along the orbit around the center of the heaven. He took it to be equal to $2 \, hui$. But the number he used for $hui$ was $12,720 \, \text{years}$, and was thus different from that of Shao Yong, $10,800 \, \text{years}$. He chose it to be equal to half the period of the precession of equinoxes ($25,440 \, \text{years}$). Kim Sok-mun had said earlier that because Shao Yong’s numbers did not fit the calendars he had chosen his own numbers for $yuan$ and $hui$ that were different from Shao Yong’s. Finally, one $yuan$ for Kim Sok-mun was $60 \, hui = 763,200 \, \text{years}$, and is the period of the variation of the angle between the equator and the ecliptic from $0$ degrees to $45$ degrees. He noted that his $yuan$ is approximately $6$ times Shao Yong’s $yuan$, which is $129,600 \, \text{years}$. Kim Sok-mun did not stop here, but went on to speak of still greater cosmic periods even mentioning a period of $763,200^8 \, \text{years}$, which is greater than $10^{48} \, \text{years}$.

This is a system based more on numerological speculation than on observations of the actual world. But Kim Sok-mun seems to have believed that in this manner he had constructed a coherent cosmological system. And he assigned two different motions to the earth in the course of this construction. The earth’s rotation constituted an essential part of this system, in which the motion is the fastest at the center, and slower outside, coming to complete rest at the outermost. Another kind of motion, namely the revolution around the heaven’s center (from
which the center of the earth is removed by 180,000 li with the period of 25,440 years, was assigned to the earth to take account of the cosmological cycles. This made some scholars consider that the idea of a rotating earth was a result of Kim Sŏk-mun’s own creative imagination, which he came up with as he tried to construct a coherent cosmological theory. Yet, does this mean that Kim Sŏk-mun came to the idea independently from the Western ideas of the earth’s rotation?

Again, it is not possible to reach a conclusive answer to this question. An argument for independent development can be made based on the absence of a fundamental conflict of the idea with the basic elements of traditional East Asian cosmological systems, and on the commonsense idea that it is natural for round things to turn. For once the sphericity of the earth is accepted, there would be nothing that could prevent an East Asian thinker like Kim Sŏk-mun from thinking of the possibility of a rotation of that spherical earth.

TRANSMISSION FROM THE WEST?

Yet, in my opinion it is extremely difficult to imagine that Kim Sŏk-mun did not know that the idea of the earth’s rotation came from the West. It is far more likely – although I do not have any direct evidence for it – that he had, in some way or other, heard or read about rotation and incorporated it into his cosmological system, or built his cosmological system around it. Copernican ideas were being circulated in China before the aforementioned Chosŏn scholars discussed the earth’s rotation. Indeed, the Jesuits were more or less free to discuss the possibility of the earth’s rotation on its own axis if only they refuted

24 E.g., Jun, “Transformation of the Western Science and Its Role”; Moon, “Traditional Cosmology Associated with the I-ching.”

25 Jongtae Lim, in his comment on an earlier version of the present paper, persuaded me to think about the connection between the idea of the round earth and that of its rotation. Indeed, Hong Tae-yong said that the earth’s “body is a perfect circle and rotates without stop” 其體正圓旋轉不休停; Oisan mundap 聖山問答, in Tamhŏnsŏ 湛軒書, Inner collection (naejip 内集), Supplements (ploy 補遺), j.4, p. 19a. It has to be noted, however, that the notion of the spherical earth, also, did not exist in East Asia before the arrival of the Jesuits (see the first section of this paper). It is only after the Jesuits introduced it that we can find those who inferred the earth’s rotation based on the spherical shape of the earth.

26 See the references cited in n. 2, above. In particular, Shi Yunli has shown that Huang Daozhou 黃道周 (1585–1646) and You Yi 游藝 (1614–1684) had already spoken of the earth’s rotation, and has suggested that Fang Yizhi 方以智 (1611–1671) and Huang Baijia 黃百嘉 read about it in Tianbu zhenyuan 天步眞原 by Jean-Nicolas Smogulecki (Mu Nige 穆尼閣, 1611–1656). Shi Yunli has further suggested the possibility that these scholars’ ideas were the sources of the Chosŏn scholars’ theory of the earth’s rotation. See Shi, “Shiqi shiji Zhongguo de Gebaini xueshuo”; Shi, “Cong Huang Daozhou dao Hong Darong: shiqi shiji Zhong Chao didongshuo de bijiao yanjiu”, Ziran bianzhengfa tongxun 自然辨證法通訊 19 (1997), pp. 60–65.
it afterwards. For example, in *Wuwei lizhi*, Giacomo Rho presented the following argument for the possibility of the earth’s rotation, which he rejected afterwards.

Now above the earth’s surface we see the stars move leftward. But they are not real movements of the stars. The stars do not have the motion of one rotation a day. It is simply that the earth and the surrounding *qi* and fire make one sphere 地及氣火通為一球, and move from west to east, one rotation a day. It is like a man traveling on a boat looking at trees and other things on the shore; he does not feel that he moves but feels as though the shore moved. The reason (理) that people on the earth see the westward motion of the stars is the same. In this manner, one can avoid many motions in the heavens by the one motion of the earth, and large rotations in the heavens by the small rotation of the earth.27

This, then, poses a further question: Why did Kim Sŏk-mun, if he got the idea of rotation from some Western source, keep silent about the source? The question may push us back to the possibility of an independent development. But if one is unable to accept that possibility, what was the reason for Kim Sŏk-mun’s silence? Was he hiding it? And if so, why would he want to do so? Not only Kim Sŏk-mun but Hong Tae-yong too was silent about the source of his idea of a rotating earth. It is likely that the latter read or heard about it in Kim Sŏk-mun,28 but he did not say so. Why did he act in this way?

These questions, in turn, give rise to another set of questions. How important, for Kim Sŏk-mun and for his readers, was the cosmological issue of whether the earth moves or not? We have noted that earthly motion was not an idea in direct conflict with the basic components of East Asian cosmology, and it is thus possible that the issue was not as serious as the one involving sphericity.29 But could it also have been unimportant for Kim Sŏk-mun, who made it an essential ingredient of

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28 For example, Hong Tae-yong was in close contact with Huang Yun-sŏk 黃胤錫 (1729–1791), who was deeply interested in Kim Sŏk-mun’s theory. See Kim Tae-jun 김태준, *Hong Tae-yong Pyŏngjŏn* 洪大容評傳 (Seoul: Min’amsa, 1987), pp. 107–8. Moon Joong-yang has suggested that Hong Tae-yong’s critical attitude towards the correlative mode of thinking made him reluctant to speak of Kim Sŏk-mun, whose cosmological system was rooted in correlative thinking. See Mun Chung-yang 文重亮, “Chŏnt’ongjŏk chayŏn insik ch’e’gye-ŭi sajŏk pyŏnhwa: Sangsuakhchŏk, kironjŏk ujuron-ŭi simhua, chŏn’gae” 傳統的自然認識體系的深化: 象數學的, 氣論的宇宙論的深化, 展開, in *Yŏnse daehakkyo Kuk’hak yŏngu*, ed., *Han’guk sil’hak sasang yŏn’gu* 韓國實學思想硏究, vol. 4, *Kwahak kisul p’yŏn* 科學技術篇 (Seoul: Hyean, 2005), pp. 47–99, on p. 90.

29 Not only the idea of the earth’s rotation, but also the ideas of an infinite universe, of
his cosmological system? Or on the contrary, did he consider it important enough to want to hide it?

Still another question can be asked in this connection. How conscious was Kim Sŏk-mun about the problem, and consequence, of accepting an idea from the West? And, did the fact that he was a Korean, and not a Chinese, make it easier for him to accept the Western idea? Or, were his feelings towards the ideas of the Chinese forerunners like Zhang Zai and Zhu Xi different from his feelings towards the Western ideas? We may note in this connection that Kim Sŏk-mun read about the Western ideas from the books written in classical Chinese with the European authors’ names sinicized. He used the same expression “the calendar specialists” (lijia 曆家) in referring to the Western astronomers as well as to the Chinese.30

SÔ MYÔNG-UNG – THE THEORY OF “THE CHINESE ORIGIN OF WESTERN LEARNING” AND THE SEARCH FOR CHINESE FORERUNNERS

One aspect in the intellectual climate of East Asia in the seventeenth and the eighteenth centuries can help us make sense of this complicated situation. East Asian thinkers’ finding earlier Chinese sources — “discovering” or “inventing” Chinese “forerunners” — can be understood in the context of the so-called theory of “the Chinese origin of Western learning” (xixue zhongyuan 西學中源) that was widespread among seventeenth- and the eighteenth-century Chinese thinkers. According to it, Western scientific ideas that came to China had their origins in ancient China: Chinese had such knowledge in their ancient golden age, but later the knowledge disappeared and fell into the hands of barbarians, who developed it further and brought it back to China.31 This theory was held by many Korean scholars of late Chosŏn also, among whom there was a strong tendency to try to make sense of the new Western knowledge in terms of ancient Chinese ideas. A typi-
cal attitude of many of these Korean thinkers when faced with a novel Western cosmological idea was to try to find precedents or prototypes in ancient Chinese sources.

The best example is that of Sŏ Myŏng-ŭng, whose perceptions of the incoming Western astronomical and cosmological knowledge and of his own natural philosophical system based on Yiijing studies (yixue 易學) were set into this sort of “Chinese origin” theory.32 Even the idea underlying the nineteenth-century slogan, “Chinese substance and Western function” (Zhong ti Xi yong 中體西用), which advocated adopting Western science and technology as “functions 用” while holding on to Chinese value and culture as “substance 体,”33 could be found in Sŏ Myŏng-ŭng’s attitude to Western scientific knowledge. He took Western astronomical knowledge as “function,” and Yiijing studies as “substance.” In particular, Fu Xi’s “Xiantian yi 先天易 (yi as prior to heaven) was the source, or the substance (ti), while the functions (yong) were the computational method of “gougu 句股” and calendrical astronomy.34 This was what Sŏ Myŏng-ŭng meant when he said: “Calendar [systems] and Yiijing ‘mutually [form] the inside and the outside 相爲表裏.’”35

Thus, according to Sŏ Myŏng-ŭng, both the substance and the function existed in ancient China; afterwards, function disappeared and went West, where its various manifestations were developed further before coming back to China. But Western astronomy had deficiencies because it lacked the proper substance, that is, a simple, systematic theory. Sŏ Myŏng-ŭng said:

After the burning [of books] in the Qin 秦, the xiantian yi disappeared into the elixir kitchens; the gougu lost its substance, while xiantian yi lost its functions. . . The gougu of the Western countries . . is like water without origin, and thus does not see its simplicity truly reaching to xiantian yi. It is like a tree whose branches are cut off and thus does not see its great flow.36

35 Sŏn’guje 先句齋, Pomanjae ch’ongsŏ 保晚齋叢書 (hereafter cited as PMJCS, Kyujanggak 奎章閣 edn.), p.32.
36 Sŏn’guje 先句齋, PMJCS, preface.
In this way, he could accept, as many of his contemporaries had to, knowledge of Western astronomy that proved more accurate, while pointing out its deficiency “in substance.” To supplement this and to retrieve such proper substance, Western astronomical knowledge had to be incorporated into the system based on Yijing studies. And that was what Sŏ Myŏng-ŭng did. In fact, his system of Yijing studies accommodated not only the Western astronomical knowledge but traditional Chinese astronomical knowledge as well.\(^{37}\)

Sŏ Myŏng-ŭng seems to have felt more keenly than others about the inevitability of accepting – at least not to avoid – Western knowledge. He said, for example, “How can one dislike something [just] because it has come from a foreign country?”\(^{38}\) Naturally, he felt more strongly for “the Chinese origin of Western learning,” which is quite understandable if one considers the intellectual climate surrounding him. After the humiliating defeat by the Manchus in the early seventeenth century, a strong anti-barbarian sentiment, as well as what can be called the “Korean Zhonghua” (Chosŏn chunghwa 朝鮮中華) theory (the notion that Korea was now the true bearer of Zhonghua since China itself was ruled by the barbarian Manchu), was widespread among Korean Confucians.\(^{39}\) There was a strong feeling against anything barbarian, including the Western barbarians’ scientific knowledge. And along with it “chonjuron 尊周論,” the tendency of admiring the ancient Zhou culture, the culture that was considered ideal by many neo-Confucians, dominated Chosŏn scholars. The need to legitimize the barbarian knowledge of Western astronomy for the Zhonghua was especially keen in this atmosphere.

Thus, it is easy to understand how, in this kind of atmosphere, another Chosŏn thinker, Kim Sŏk-mun, could have made an appeal to Zhang Zai as the originator of the idea of the earth’s rotation while not mentioning the Western sources. When he did mention a Western source in connection with the idea, it was to criticize Westerners for not accepting the possibility of the earth’s rotation. For example, Kim Sŏk-mun criticized Johann Schreck’s (Deng Yuhan 鄧玉函) argument in Cetian yueshuo 測天約說 against the earth’s rotation:

The Western theory says the following. “The body of the earth never moves. It does not leave its own place; nor does it rotate.

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\(^{38}\) Piryejun 膝禮準, PMJCS, preface.

If what does not leave its own place were to leave [its own place], then it would not be at the exact center of the heavens. If what does not rotate were to rotate, man should feel it. Also, if it rotated, it must rotate once every day. Its motion is extremely fast. All the moving birds [will appear to] move slower if they move in the same direction as the earth’s rotation, and faster if they move in the opposite direction. If a man throws a thing upward from the earth, its return to the earth cannot be at its original place. Now [we know] all these are not so, which suffices to make it clear that the earth does not rotate.” What the Western theory takes for the evidence that the earth does not rotate is nothing more than this. It can be said to be an extremely crude argument.40

CONCLUDING REMARKS

The title of this paper lists three different possibilities concerning the origin of the idea of the earth’s rotation in East Asia: “independent development,” “transmission from the West,” and “Chinese forerunners.” The first two are mutually exclusive: the idea was either transmitted from the West or developed independently in East Asia. The third complicates the picture: the existence of Chinese forerunners of the idea could have facilitated both of the two possibilities. We have examined grounds for arguing for, and speculating about, each of the above possibilities. But none has been sufficient, and we have not been able to reach a definite conclusion. Between the mutually exclusive alternatives, however, I am inclined toward “transmission from the West.” I believe that, given the availability of Copernican ideas after the arrival of the Jesuits, and the sudden appearance of the idea of the earth’s rotation afterwards, the “burden of proof” rests with those who argue for independent development, and that no such proof has come forth yet.

Furthermore, concerning the East Asian situation of the idea of the earth’s rotation, it is not only the origin that is not clear, but in fact many other things as well. Perhaps, the only clear thing is that the idea was eventually accepted in the latter half of the nineteenth century by East Asian intellectuals. Except for someone like Kim Sŏk-mun who recorded his views more or less explicitly, it is even difficult to tell exactly what kind of motion these East Asian thinkers meant by “rotation

40 YHISSDCH, p. 33a. Kim quoted Schreck’s ideas directly from Cetian yueshuo, in Xinfa suanshu 11, pp. 13b–14a.
转” of the earth. Frequently, they did not have a clear, fixed conception about the earth’s rotation: some could have doubts while generally accepting it; yet others could have suspicions while rejecting it.

**LIST OF ABBREVIATIONS**

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<th>Description</th>
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<tr>
<td>PMJCS</td>
<td>Pomanjae ch’ongsŏ  保漢齋叢書</td>
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<tr>
<td>YHISSDCH</td>
<td>Yŏkhak isipsado ch’onghae  易學二十四圖總解</td>
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<td>ZZYL</td>
<td>Zhuzi yulei  朱子語類</td>
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