Special Feature

Unchanging Beliefs of Neo-Confucian Natural Science of the Joseon Dynasty in the Early Nineteenth Century: Neo-Confucian Natural Science in *Changnangdapmun* of Ryu Hwi-mun

Koo Mhan-ock

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Preface

Until now, in the history of science and technology, intensive analytical research has focused on the discourses of science and technology of *sirhak* scholars who pursued practical learning instead of the Neo-Confucianist approach in the period of the late Joseon dynasty. The major target figures were Kim Seok-mun (金錫文), Lee Ik (李瀷), Seo Myeong-eung (徐命膺), Hong Dae-yong (洪大容), Park Je-ga (朴齊家), Jeong Yak-yong (丁若鏞), Lee Gyu-gyeong (李圭景), Choe Han-gi (崔漢綺) and the like. This disclosed the process of the formation of new scientific discourse in the late period of the Joseon dynasty. However, recent research has been critical saying that the existing examination had been composed of the preoccupations of researchers. The analysis of historical facts from a contemporary viewpoint and using contemporary concepts is said to have led to a great deal of misunderstanding (Koo 2005 and 2007; Lim 2006). At present, together with the basic skeptical view of "practical learning" (sirhak: 實學) the existing evaluation of the theory of science and technology of realists has suffered harsh criticism. Criticism has centered on the modernity-oriented character of practical learning and has been quickly followed by criticism about its view of nature and its theory of science and technology. Actually, the recent results of research on the history of science and technology in the late Joseon period has shown such a tendency. The existing paradigm of the acceptance of Western sciences, the collapse or substitution of a traditional view of nature and the rise of a new view of nature has been criticized. Instead, a new paradigm has been raised: the introduction of conflict and/or fusion with a traditional view of nature and the partial acceptance or variation based on the traditional view of nature (Lim 2003; Jeon 2004; Park 2006). An extreme argument has been also raised that the theory of science and technology of the *sirhak* scholars in the late Joseon period was basically nothing more than that of the existing Neo-Confucianism (Kim 2006).

There are some prerequisites for solving such disputes. One of them is to enlarge the field and targets of research in the history of science and technology in the late Joseon period. Aside from research on the existing *sirhak* scholars, it is necessary to study a variety of figures in many ways. Put simply, there should be deep research on orthodox Neo-Confucian scholars including experts on Zhu Xi in contrast to the existing *sirhak* scholars. Though there have been comprehensive reviews of the natural science of Zhu Xi, the founder of Neo-Confucianism (Yamada 1978; Kim 2000), no earnest research

on the natural science of orthodox Neo-Confucian scholars of Joseon ha been done (Koo 2003 and 2004). There is a limit to an evaluation that the theory of science and technology of the *sirhak* scholars was progressive in this situation. It is meaningless to characterize scholars as progressive or conservative when it is difficult to ascertain the general standard of discussions at that time about various problems of natural science.

From this point of view, Ryu Hwi-mun (柳徽文, 1773-1832) is a notable figure in many respects. He was one of the distinguished figures among the Southerners of Yeongnam lineage who played an active role between the late eighteenth and the early nineteenth century. He was a successor of the Toegye School that extended from Lee Hwang (李滉, 1501-1570) to Kim Seong-il (金誠一, 1538-1593), Jang Heung-hyo (張興孝, 1564-1633), Lee Hyeon-il (李玄逸, 1627-1704), Lee Jae (李栽, 1657-1730), Lee Sang-jeong (李象靖, 1711-1781) and Ryu Jang-won (柳長源, 1724-1796). Ryu Hwi-mun indulged in learning all his life and left voluminous writings. Among them, not a few dealt with various problems of natural science. His writings were composed of a collection of works, a special collection of works, supplements, an extra collection of works and a sequel to his works. Nineteen volumes and ten books of a collection of works were published as woodblock print books in 1896 (*Hogowaseonsaengmunjip,* Appendix, vol.1, Chronological record, 28a). Eight volumes and four books of a special collection of works and two volumes and one book of supplements were also published as woodblock print books in 1898 (*Hogowaseonsaengmunjip*, Appendix, vol.1, Chronological record, 28a). An extra collection of works comprised of six volumes and three books entitled '*Changnangdapmun* (滄浪答問)' or '*Changnangmundap*' (Great Wave Catechism) that was published posthumously by lithograph in 1972 (*Hogowaseonsaengoejip*, bal(跋), 2a-b). Six volumes and three books of works that had previously been omitted from the collections of works were printed subsequently. (Ryu 1985:3) In addition, such writings as *Sohakjanggu, Sohakdongjamun* and *Yeomnakpungaboyu* have been passed down. A series of writings of Ryu Hwi-mun including his collection of writings are contained in *Jeonjuissisugokpajimunheonchonggan* (A Series of Literature of the Sugok Sect of the Yu Family of Jeonju) published in 1985.[1] As part of *Hangukyeokdaemunjipchongseo*), his collection of writings was also

1. *Jeonjuyussisugokpajimunheonchonggan,* Vol. 9~10, Andongsuryumunheonganhaenghoe, 1985.

published in a photographic facsimile reprint in 1996 by Gyeonginmunhwasa.[2] Recently, the Institute for Toegye Studies, Andong National University has published *Hogowajip* (A Book of Hogowa, Ryu Hwi-mun) as part of *Toegyehakjaryochongseo* (A Series of Materials on Toegyehak).[3]

Accordingly, Ryu Hwi-mun is notable not only as a key figure, but he is important also for the abundance of research data associated with him which facilitates study of the natural science approach of the lineage of the Southerners of Yeongnam. Despite this, it is not too much to say that there have been almost no studies on Ryu Hwi-mun. In the early 1970s, a tentative essay on the career and learning of Ryu Hwi-mun was published (Lee 1971 and 1997). Recently, it was also introduced briefly as part of the history of Confucianism in Yeongnam (Ahn & Kim 2002) and a bibliographical introduction (Seol 2005) to his writings has been made. But it is difficult to view them as an earnest study of his learning and thought. Though not an exclusive study on Ryu Hwi-mun, it is notable that the Korean Studies Advancement Center held a special exhibition focusing on the materials supplied by the Sugok sect of the Ryu family of Jeonju, where meaningful results were produced from an academic seminar (Jeong 2005; Gwon 2005). It paid attention to the fact that, "Ryu Hwi-mun had a proficient knowledge of scriptures, history, astronomy, astronomical calendar, rhythm, divination of *yin* and *yang*, and the like in the academic world of Yeongnam where only 'the theory of justice and mentality' was recognized as proper learning" (Jeong 2005:177; Gwon 2005:187-188). In spite of the limitation that it superficially criticized the writings of Ryu Hwi-mun, it has also raised a problem that research on Ryu Hwi-mun should solve.

This paper aims to critically analyze the content and character of the natural science of Ryu Hwi-mun focusing on *Changnangdapmun*. First, his academic attitude reflecting his perspective as a successor to the Yeongnam school, and then the background to the writing of *Changnangdapmun* and its general content will be reviewed. Based on this, the concrete content of *Changnangdapmun* will be analyzed and his discussions will be reconstructed focusing on the major topics that caused disputes in the academic world of the late Joseon period.

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2. *Hogowamunji,* Vol. 1-3 (*Hangukyeokdaemunjipchongseo* 1860~1862), Gyeonginmunhwasa, 1996.
3. The Institute for Toegye Studies, Andong National Univ. Press, ed. 2006.

The Succession of the 'Yeongnam School' and the Erudite Academic Trend

Ryu Hwi-mun's family came from Jeonju (全州), his courtesy name was Gonghoe (公晦) and his pen name was Hogowa (好古窩). His father, Ryu Man-hyu married the daughter of Kim Hyeon-dong (金顯東) whose family came from Uiseong, and the daughter of Jo Ui-yang (趙宜陽) whose family came from Hanyang. He was born to the daughter of Jo Ui-yang in 1773 (the 49th year of King Yeongjo). (*Jeongjaejip*, vol. 34, *Jangsaranghureungchambonghogowagonghaengjang* (將仕郎厚陵參奉好古窩公行狀), 25a)

Ryu Hwi-mun learned Confucian scriptures from his grandfather Ryu Jang-won (1724-1796) beginning in 1794 (the eighteenth year of King Jeongjo) when he was twenty-two years of age. (*Jeongjaejip*, vol. 34, *Jangsaranghureungchambonghogowagonghaengjang*, 25b-26a) In only a short period, Ryu Hwi-mun inherited the academic tradition of the Toegye School from Ryu Jang-won. Ryu Jang-won was a disciple of Lee Sang-jeong and was known as one of the *Homunsamno* (the three distinguished scholars produced near the Nakdong River) together with Kim Jong-deok and Lee Jong-su. That was because he inherited the learning of the Toegye School of the Southerners of Yeongnam that extended from Lee Hwang to Kim Seong-il, Jang Heung-hyo, Lee Hyeon-il, Lee Jae and Lee Sang-jeong. Meanwhile, Ryu Hwi-mun was academically associated with Jeong Jong-ro (鄭宗魯, 1738-1816) and Nam Han-jo (南漢朝, 1744-1809) who were disciples of Lee Sang-jeong. (*Jeongjaejip*, vol. 34, *Jangsaranghureungchambonghogowagonghaengjang*, 26a)

Ryu Hwi-mun met Nam Han-jo directly after the mourning period for his mother in 1808 (September of the 8th year of King Sunjo). During nearly a month's stay, Ryu Hwi-mun read *Jinsilu* (近思錄) (*Hogowaseonsaengmunjip*, Appendix, vol.1, Chronological record, 8b; *Hogowaseonsaengmunjip*, vol.12, *Dureungilgi* (杜陵日記), 19b-31a). This was the last time they met together because Nam Han-jo died the next year. It is worth noting that Ryu Hwi-mun discussed the learning of Gyeonggi Province with Nam Han-jo. This was a discussion about the academic approach of the Seongho School (星湖學派) represented by Lee Ik (1681-1763) whose pen name was Seongho. When Nam Han-jo visited Ahn Jeong-bok (安鼎福, 1712-1791), the latter said that he had marveled at the great store of knowledge of Lee Ik and that it had been learned not by means of the relationship between a teacher and a disciple but without the assistance of others. Ahn Jeong-bok pointed to the academic approach of Lee Ik in contrast to the method of "inheritance

by hearing and asking" (見聞傳受) of the Southerners of Yeongnam. (*Hogowaseonsaengmunjip*, vol.12, *Dureungilgi*, 28b) Then, Nam Han-jo took a negative stand toward the academic approach of independent learning of the Seongho School (*Hogowaseonsaengmunjip*, vol.12, *Dureungilgi*, 28b).

Ryu Hwi-mun met Jeong Jong-ro in 1810 (the 10th year of King Sunjo). (*Hogowaseonsaengmunjip*, Appendix, vol.1, Chronological record, 9a). In 1812 (the 12th year of King Sunjo), Ryu Hwi-mun discussed music, the King's return to the royal palace, divination, and the like with Lee Man-un (李萬運) (*Hogowaseonsaengmunjip*, Appendix, vol.1, Chronological record, 10a). What is noticeable is the attitude of Jeong Jong-ro Lee Man-un and Nam Han-jo toward Western Learning. They regarded Western Learning as heretical (*Mukheonjip*, vol.2, 3a-b; *Ripjaejip*, vol.25, 22b), and did not allow even a discussion about the partial recognition of the superiority of Western Learning from the viewpoint of natural science (*Sonjaeseonsaengmunjip*, vol.12, 12a-b). They were suspicious of the academic approach of the Seongho School in the line of Southerners near Seoul and were not satisfied even by the criticism of Ahn Jeong-bok against Western Learning. (*Sonjaeseonsaengmunjip*, vol.12, 11b-23b) Moreover, Nam Han-jo criticized the 'self-apprehension' and 'erudition' that were emphasized by the Seongho School as the 'two vices of modern learning' (*Sonjaeseonsaengmunjip*, vol.12, 26b).

Ryu Hwi-mun is said to have had a great deal of respect for Nam Han-jo (*Hogowaseonsaengmunjip*, Appendix, vol.1, Chronological record, 8b; *Hogowaseonsaengmunjip*, vol.12, *Dureungilgi*, 19b) and continued his academic association with Jeong Jong-ro and Lee Man-un who criticized Western Learning and the academic approach of the Seongho School. So, how close was the academic approach of Ryu Hwi-mun to their approach? The academic character of Ryu Hwi-mun can be summarized as 'erudition.' Besides Confucian scriptures, history, and the study of rites that general Confucian scholars pursued, he was interested in a variety of fields classified as miscellaneous studies. He had also a deep knowledge of natural science including the astronomical calendar. There is an interesting anecdote to show his erudition: when crossing Jogang which was downstream of the Han River in 1817 (the 17th year of King Sunjo), he examined the flood and anticipated when the tide would be at its lowest ebb, surprising the boatman (*Hogowaseonsaengmunjip*, Appendix , vol.1, Chronological record, 14b; *Hogowaseonsaengmunjip*, vol.16, *Seoyurok* (西遊錄), 10a-11b).

Thus, Ryu Hwi-mun showed his academic interest in various fields, which resulted in voluminous writings. His was worthy of being called

an erudite academic approach. Nevertheless, the challenge to concluding that he was 'erudite' is his association with Jeong Jong-ro, Nam Han-jo and Lee Man-un who criticized the erudite academic approach of the Seongho School in the line of the Southerners near Seoul. In fact, Neo-Confucianism also mentions erudition. However, it was essentially different from the erudition of the practical learning adherents led by the Seongho School in the line of the Southerners near Seoul. Through the words of Zhu Xi, "It isn't necessary to know everything including heaven, earth, trees, plants, ghosts, manners and the like. What is important is to know human morality" (*Zhuziyulei*, vol.26, pp.660-661), this fact can be assumed. Then, what did 'Neo-Confucian scholars of the late Joseon period think of erudition? Choe Han-gi (崔漢綺, 1803-1877) said as follows: "Worldly erudition means to take pride in exegeses, find out chapters and passages, quote ancient documents frequently when discussing affairs, and criticize writings based on the origin" (Choi, Han-gi, *Injeong*, vol.11, 41b). This suggests the tendency to take concise exegeses of scriptures constitutes erudition. In fact, Song Si-yeol (宋時烈, 1607-1689) defined the meaning of erudition: "It is to be proficient in various scriptures, not to omit a word, to be indulged in justice and to repeat and penetrate chapters and passages" (*Songja daejeon*, vol.106, 21b; *Songja daejeon*, vol.62, 21b). This means so-called scriptural erudition. Keeping this in mind, it is necessary to consider the aim of Ryu Hwi-mun's erudition.

How did the erudite academic approach of Ryu Hwi-mun appear in respect of natural science? He made *Honcheonui* (渾天儀: a celestial globe; an armillary sphere) in 1825 (the 25th year of King Sunjo). According to a sage of old who thought highly of *Seongiokhyeong* (璇璣玉衡: a celestial globe; an armillary sphere) which is abbreviated to *Gihyeong* (璣衡) when making astronomical observations, it is said that Ryu Hwi-mun made *Honcheonui* (*Hogowaseonsaengmunjip*, Appendix, vol.1, Chronological record, 19a). When making *Honcheonui*, he made a hole at the globe's due south, put a sight made of jade there and connected it to the direction of 9 a.m. and 9 p.m. (巳亥). He devised it to accord with the present time (*Hogowaseonsaengmunjip*, Appendix, vol.2, 11b). This constitutes the historical evidence that he seriously studied when mentioning the system of a celestial globe in *Changnangdapmun*. The passage "to connect it to the direction between 9 a.m. and 9 p.m. and to devise it to accord with the present time" attracts our attention. This was the very method of how to connect the track of the sun and the track of the equator within *Samjinui* (三辰儀). *Seojeon* (書傳), annotated as follows: "Make a ring of the track of the sun, mark with degrees to observe

constellations, make it lean to the center of the equator and make it connect to the direction of east and west (卯酉). A half goes inside and becomes the track of the sun after the spring equinox while the other half goes outside and becomes the track of the sun after the autumn equinox" (*Seojeon*, vol.1, Useo (虞書), Sunjeon (舜典)). Ryu Hwi-mun changed the direction of east and west into the direction of 9 a.m. and 9 p.m. in this passage (*Hogowaseonsaengoejip*, vol.3, 12a). The question is why did he change it?

Ryu Hwi-mun understood that as the connecting points of the sun and the equator are the spring and autumn equinoxes and are changed by precession according to the times, the movement of the point of spring and autumn equinoxes by precession should be reflected when making a celestial globe. In short, in the period of Yo-Shun when an armillary sphere in *Shundian* of *Shujing* was made, the sun was connected to the directions of east and west of the equator, which is applicable to *bang* (房) and *myo* (昴) among the 28 constellations. Instead, in Ryu's day, the sun should be connected to the direction of 9 a.m. and 9 p.m. of the equator, which is applicable to *ik* (翼) and *sil* (室) among the 28 constellations (*Hogowaseonsaengoejip*, vol.3, 12b). Ryu Hwi-mun argued that as the explanation of *Shundian* of *Shujing* was made according to the situation of the period of Yo-Shun, the directions of east and west became the center of the equator and therefore the direction of 9 a.m. and 9 p.m. should be applicable to the center of the equator (*Hogowaseonsaengoejip*, vol.3, 13a).

The following comment of Ryu Hwi-mun shows his basic position in respect of changing the system of the celestial globe and is worth examining.

> Nowadays, an artillery sphere and astronomical calendar should be based on the present. Then, there will be no errors in examining and experiencing omens. From now on, if there is any error, it is proper to correct it according to the times. … This is the way of being proficient through change. (*Hogowaseonsaengoejip*, vol.3, 18a)

Here, Ryu Hwi-mun argues that a celestial globe and astronomical calendar should be changed and adjusted to the contemporaneous point of time. In fact, many people at that time understood that the manufacture of a celestial globe by Ryu Hwi-mun was a typical example of changing the old system and, in other words, 'unprecedented.' That was the reason he was recorded in his family history. Then, how did Ryu Hwi-mun himself evaluate it?

The typical writing that shows the erudite academic approach of Ryu Hwi-mun in aspects of natural science is *Changnangdapmun* (Great Wave

Catechism). It was written when he was thirty-two years of age in 1804 (the 4th year of King Sunjo). *Zaohualun* (造化論) of Wang Bai (王柏, 1197-1274) motivated him to write *Changnangdapmun*. Reading *Zaohualun*, it is said that Ryu Hwi-mun came to think that this was the foundation of the harmony of universal nature or what Confucian scholars should study deeply (*Hogowaseonsaengmunjip*, Appendix, vol.1, Chronological record, 7a). Ryu Hwi-mun is said to have written *Changnangdapmun* because "the rules of movement of the universe and harmony of universal nature are not essential to the daily lives of scholars, but scholars should be proficient in them" (*Hogowaseonsaengmunjip*, vol.13, *Gwangyuchameon*(管窺僭言), 29b-30a). *Changnangdapmun* is composed of a catechism between a boatman (fisherman) and a guest wearing a raincoat. This imitated *Yuqiaowendui* (漁樵問對), a catechism between a fisherman and a shepherd written by Shao Yong (邵雍) (*Hogowaseonsaengmunjip*, Appendix, vol.2, 11b). The boatman (fisherman) can be seen as the epitome of Ryu Hwi-mun himself. The phrases at the beginning of the book, "the winter or the summer solstice, year of *gapja*" (歲甲子日長至) (*Hogowaseonsaengoejip*, vol.1, 1a) signify the date of the writing.[4]

The existing *Changnangdapmun* is composed of 184 questions and answers. It is said that 179 items were originally written by Ryu Hwi-mun and the others were supplemented by what Yu Hyeong-jin (柳衡鎭) had recited and passed down (*Hogowaseonsaengoejip*, *bal*, 1a). It is also said that Ryu Hwi-mun's *Changnangdapmun* was actually considered unfinished and the last volume was basically composed of what Yu Hyeong-jin had heard from Ryu Hwi-mun (*Hogowaseonsaengsokjip*, vol.6, 34a). The contents of *Changnangdapmun* are as follows: the process of the formation of heaven and earth; the principle of the composition of the calendar including the establishment of a leap month; chronometry; precession; the theory about the movement of celestial bodies including the movement of the sun and the moon; problems of coordinates; the theories and problems of ancient astronomers; the theory of solar and lunar eclipses; the theory of planets; the problem of the core of the earth; the problem of the coming in and out of the sun and the order of seasons; the size of heaven and earth; the theory

4. At present, *Changnangdapmun* is passed down as *Hogowaseonsaeingoejip* (好古窩先生外集) with six volumes and three books. Ryu Byeong-hi (柳秉熙), who is a descendant in the fifth generation, says what had been passed down in a copying edition among the posthumous manuscripts (omitted in the original and extra editions of *Hogowaseonsaengmunjip*) was published as *Changnangdapmun*. [*Hogowaseonsaeingoejip*, *bal*(跋), 2a-b].

of the highest heavens; the system of an armillary sphere; *Wonhoeunseseol* (元會運世說) (1 *se*=30 years, 1 *un*=12 *se*=360 years, 1 *hoe*=30 *un*=10,800 years, 1 *won*=12 *un*=129,600 years); the theory of *yin, yang* and the five primary elements; music and weights and measures; the theory of the tide; the problem before and after Creation; *Chikdohwagwejiseol* (則圖畵卦之說) that describes the cosmos with diagrams and divination signs; the theory of ghosts; the theory of disasters; the theory of fields; astrology; geomancy; and divination. It can be said that they include a variety of fields of natural science such as astronomy, the calendar, geography, *yin* and *yang* and the five primary elements, music, divination, and the like.

Changnangdapmun dealt with enormous problems of natural science and is said to have imitated *Yuqiaowendui* written by Shao Yong. It describes the ways of heaven extensively, manners a little, *sangsu* (象數: xiangshu) minutely and the problem of mentality briefly. Therefore, Ryu Hwi-mun thought of it as his castoffs (*Hogowaseonsaengsokjip*, vol.6, 33b). As stated above, commenting on his academic results, many people praised Ryu Hwi-mun for his unprecedented achievements. In spite of a certain degree of exaggeration, it can be assumed that such recognition was shared. Nevertheless, Ryu Hwi-mun did not aim for academic creative advancement. The following is a good example showing his academic attitude: "It is a big mistake for a scholar to try to invent what predecessors couldn't invent. Teachings of predecessors should be preserved preciously and the establishment of a new theory should be prevented" (*Hogowaseonsaengsokjip*, vol.6, 33b-34a; *Hogowaseonsaengmunjip*, Appendix, vol.2, 12b). He supported an academic tendency toward preservation rather than creative establishment.

In fact, it is said there was a great deal of unprecedented content in Ryu Hwi-mun's argument and writing. How can it be understood? According to an evaluation of later years, it was said that new arguments of Ryu Hwi-mun were "nothing more than finding the original place of Confucian scriptures." (*Hogowaseonsaengsokjip*, vol.6, 33b-34a) It shows that his erudition was thoroughly an effort to secure the original place of Confucian scriptures. It is also clear that, in terms of his cultivation of the mind, Ryu Hwi-mun constantly took Zhu Xi as a model for the method and "size" of controlling mind in the problem of ruling others (*Hogowaseonsaengmunjip*, Appendix, vol.2, 12b).

Natural Science of *Changnangdapmun*: A Variation of Neo-Confucian Natural Science

Cosmology

Ryu Hwi-mun's thinking on Creation followed the traditional discussion. The ancient times before heaven and earth were in a state of 'chaos'; the remnants of mud mixed with water were not submerged. In the creation of the world, the light and pure energy became heaven, and the heavy and impure energy became the earth. Heaven surrounded the earth and the earth was situated at the center of heaven. The ancient Confucians said the form was that of the white of an egg surrounding the yolk (*Hogowaseonsaengoejip*, vol.1, 1b). The following explains well what Ryu Hwi-mun thought the universe was like.

> Generally speaking, there is heaven above the earth and nothing but energy fills the space. There is heaven below the earth and nothing but water fills the space. (*Hogowaseonsaengoejip*, vol.2, 43b)

The sun, the moon and the stars move in heaven but not because they were suspended from heaven. In accordance with the discussion of Zhu Xi in *Chucijizhu* (楚辭集註) Ryu Hwi-mun argued (*Chucijizhu*, Vol.3) that "Being suspended doesn't mean being bound, and mingled and evolving doesn't mean being pushed and moving. However, where there is fullness of energy, spirit is radiant and is naturally emitted" (*Hogowaseonsaengoejip*, vol.1, 2a).

Ryu Hwi-mun discusses the beginning and end of heaven and earth according to the theory of *wonhoeunseseol* (元會運世說) that has been passed down since Shao Yong. Among 12 *hoe* of 1 *won*, heaven opens at *jahoe*, the earth opens at *chukhoe*, human beings are born at *inhoe*, and at the end of *haehoe*, heaven and earth begin again. The theory is that such creation and circulation repeat endlessly (*Hogowaseonsaengoejip*, vol.3, 32b). That which controls the beginning and end of heaven and earth and which repeats endlessly is just *Taegeuk* (太極: the Great Absolute) (*Hogowaseonsaengoejip*, vol.3, 33a).

Ryu Hwi-mun understood *Honcheonseol* to be an established theory of Zhu Xi. In the process of discussing *Sayuseol* (四游說), Ryu Hwi-mun quoted the passage of *Zhuziyulei* (朱子語類) as follows: "Going up and down so-called 15,000 *ri* means that the distance that the sun moves between the southern continent and the northern continent during the winter and the summer solstice is 15,000 *ri* (*Zhuziyulei*, vol.97, p.2482). That the sun and the moon go up and down 30,000 *ri* mainly signifies whether the distance

from the sun is far or near" (*Zhuziyulei*, vol.2, p.17). Considering that Zhu Xi annotated *Shuchuan* (書傳) mainly according to *Honcheonseol* and omitted other theories in his later days, Ryu Hwi-mun argued that he could determine what was the established theory of Zhu Xi (*Hogowaseonsaengoejip*, vol.1, 32a). Ryu Hwi-mun believed that as *Sayuseol* in *Zhoubisuanjing* (周髀算經) talks about the going up and down of the earth, it is contrary to what the supporters of *Honcheonseol* talk about the high and low of the sun during the winter and the summer solstice (*Hogowaseonsaengmunjip*, vol.3, 21a).

It is interesting that Ryu Hwi-mun mentioned the possibility of combining *Honcheonseol* with *Gaecheonseol*. It seems to have been a phenomenon happening because the theory of earth was generalized since the introduction of Western Learning. He interpreted the passage in *Gacheonseol* as follows: That heaven is like 'being covered with a conical bamboo rain-hat' signifies the northern part of the equator based on half of the round heaven; that 'the earth is like an overturned brass bowl' signifies the north over which the sun is on the basis of half of the round earth. So, Ryu Hwi-mun reinterpreted *Gaecheonseol* based on the theory of earth and tried to combine it with *Honcheonseol* (*Hogowaseonsaengoejip*, vol.1, 33b). In this respect, Ryu Hwi-mun thought that Djamala Uddin during the period of Yuan had presented Hongaedo and had made it clear that the two theories could be combined together (*Hogowaseonsaengoejip*, vol.1, 34a).

Ryu Hwi-mun tried to understand the relationship between the traditional *Gucheonseol* (九天說) and *Jungcheonseol* (重天說) of the West. He did not understand '*gucheon*' (九天) of *Chuci* (楚辭) to be nine heavens. He accepted the opinion of Zhu Xi and viewed it as the nine layers of heaven that happened owing to the difference of strength and weakness caused by the circulation of energy. Since the seventeenth century, the cosmology of Western Learning emphasized *Jungcheonseol*. There were 9, 11 and 12 *jungcheon*. Among them, the theory of 9 *jungcheon* argued that the universe is composed of the nine layers of heaven with the earth as its center as follows: *wolcheon* (the moon), *jinseongcheon* (Mercury), *taebaekcheon* (Venus), *illyuncheon* (the sun), *hyeonghokcheon* (Mars), *seseongcheon* (Jupiter), *jeonseongcheon* (Saturn), *yeolsukcheon* (a fixed star), and *jongdongcheon* (heaven). Ryu Hwi-mun understood them to be nine layers of heaven that are composed of heaven, a fixed star and seven *wi* (the sun, the moon, and five planets). He also thought that the "nine" in *Jungcheonseol* of the West were analogous to the *Gujungcheon* of Zhu Xi. Moreover, he borrowed the traditional theory of *yin* and *yang* and compared heaven and earth to the number of *yang* 9,

and the number of *yin* 6, respectively (*Hogowaseonsaengoejip*, vol.3, 1a-b). His intriguing idea is that it is possible to estimate the extremely remote and endless heaven with the limit of the number of *yang* and that the circumference and the middle of the earth is approximately six *gak* (angles).

Based on *Hado* (河圖), Ryu Hwi-mun classified 7 and 9 as *yang* numbers and 6 and 8 as *yin* numbers among the group of *sasang* (四象) (numbers 6,7,8 and 9). As *yang* aims for advancement, number 9 becomes the sun; *yin* aims for retreat so the number 6 becomes the moon. He viewed them as 'the numbers of heaven, earth and nature,' which fit *sichaek* (蓍策) well (*Hogowaseonsaengoejip*, vol.3, 1b).

Then, what is beyond *gucheon* (九天: the highest heaven)? Ryu Hwi-mun believed that if revolving and endless energy reaches the limit, it becomes a static state of 'stillness.' He also believed that this is the true meaning of the *gugak* (軀殼) of Zhu Xi and Gwon Gu (權榘)'s saying, "Beyond heaven, there is another atmosphere" (*Byeonggokjip*, vol.6, 5a). If motion reaches the limit, it becomes static again and surrounds heaven and earth" (*Hogowaseonsaengoejip*, vol.3, 2a). In short, it can be said that Ryu Hwi-mun developed his idea of a universe full of energy.

The Theory of Movement of Heavenly Bodies

Ryu Hwi-mun held on to the traditional theory of the movement of the celestial bodies, 'Heaven moves while the earth is static.' So, why does heaven move while the earth is static? He tried to solve this problem according to the traditional theory of *yin* and *yang*. His theory was based on the assumption that heaven is energy and *yang*, and the earth is shape and *yin*, the emanation of energy is endless and always moving, and the cohesion of shape is constant and always static (*Hogowaseonsaengoejip*, vol.3, 29a). What makes such movements, *yin,* and *yang* possible is *Taegeuk* (the Great Absolute); that is *ri* (justice; reason) (*Hogowaseonsaengoejip*, vol.3, 29b). In short, the theory was that "Considering that energy makes *ri* move, what moves is energy and what causes movement is *ri*. Considering that *ri* takes energy, there are movements in energy as there are movements in *ri*" (*Hogowaseonsaengoejip*, vol.3, 29b).

In his theory of the movement of the celestial bodies, Ryu Hwi-mun supported the traditional theory of left turning (左旋說). The sun, the moon and a fixed star were equally turning left but there was a difference of

quickness and slowness. According to the traditional explanation, heaven correctly takes a turn a day; the sun turns 1 degree slower than heaven; the moon turns 12 7/19 degrees slower than the sun. For a day, the sun is short of heaven by 1 degree. In 365 235/940 days, the sun is short of heaven by 365 235/940 degrees and heaven comes to meet the sun again. These 365 235/940 days are *sesil* (歲實) which decides the change of seasons. Also, for a day the moon is short of the sun by 12 7/19 degrees. In 29 499/940 days, the moon is short of the sun by 365 235/940 and the sun comes to meet the moon again. These 29 499/940 days are *saksil* (朔實) which decides the change of months. Ryu Hwi-mun believed that the theory of right turning (右旋說) held by calendrical scholars - "Heaven turns left. The sun, the moon and stars turn right" - was a theory of convenience for the purpose of calculation and was not explaining the real situation of the movement of the celestial bodies. Therefore, Ryu Hwi-mun accepted the discussion of Zhu Xi that had supported the theory of left turning of Zhang Zai (張載) (*Hogowaseonsaengoejip*, vol.1, 2a-3a).

There are two main reasons why Ryu Hwi-mun criticized the theory of right turning and supported the theory of left turning. One is that if heaven turns left, it is unreasonable that the sun and the moon in heaven would turn right. The other is that, based on the theory of *yin* and *yang*, *yang* is light and pure, and *yin* is heavy and impure; *yang* is steady and fast, and *yin* is slow and tardy; therefore, it is unreasonable that the *yin*-like moon is fast and the *yang*-like sun is slow (*Hogowaseonsaengbyeoljip*, vol.7, 33a-b). This was the traditional logic employed for criticizing the theory of right turning.

The argument about the theory of left turning vs. the theory of right turning in the late Joseon period was presented in relation to fixing the so-called established theory of Zhu Xi (Koo 2000). In reality, in the annotation of *Relationship in October* in *Shichuan* (詩傳) and *Lunyuhuowen* Zhu Xi maintained the theory of right turning. In contrast, in the annotation of the *300th Anniversary* in *Shuchuan* (書傳) and *Ask heaven* in *Chuci* (楚辭) he followed Zhang Zai's theory of left turning. This caused Confucian scholars in later years to see the theory of right turning as an established theory of Zhu Xi and to reject the theory of left turning as that of Cai Shen. King Taejo of the Ming dynasty once insisted on such an argument (*Hogowaseonsaengbyeoljip*, vol.7, 33b). Ryu Hwi-mun believed that the annotation of *Shuchuan* contained the authoritative theory of Zhu Xi because Zhu Xi made Cai Shen pass the outline down orally. Zhu Xi followed the theory of left turning in *Shuchuansanpian* (書傳三篇) and wrote of it himself

in *Zhuzidaquan* (朱子大全) (*Hoeamseonsaengjumungongmunjip*, vol.65, pp.3148-3198). There is also a part referring to the left turning of heaven and the sun in answers (*Dacaizhongmoshu* 答蔡仲默書) to the letters of Cai Shen (*Hoeamseonsaengjumungongmunjip*, vol.3, p.4717); in *Zhuziyulei*, explaining the theory of left turning of Cai Shen to Huang Yigang, Zhu Xi said, "This theory is correct" (*Zhuziyulei*, vol.2, pp.15-16). "The theory of left turning of Zhang Zai is the best. For fear people should misunderstand, only the ancient theory was recorded in the annotation of *Shichuan*" (*Zhuziyulei*, vol.2, p.16). Ryu Hwi-mun argued that the theory of left turning was, without doubt, the authoritative theory of Zhu Xi on the grounds stated above (*Hogowaseonsaengbyeoljip*, vol.7, 33b-34a).

The Theory of Precession of the Equinoxes

Ryu Hwi-mun explained the problem of precession focusing on *Cheonsesudojiseol* (天歲殊度之說) of Zhu Xi. At the same time, he explained that this is just what Yixing said, "There is a difference in both the sun and the ecliptic" (*Xin Tangshu*, vol.27上, p.601). This is nothing but the summary of the writing of Zhu Xi. Next, Ryu Hwi-mun compared the rates of precession that ancient scholars had suggested. Luo Xiahong during the period of the Han dynasty said that there would be a difference in 100 years. Wang Su during the period of the Jin dynasty did not know about precession. Yi Xi of Jin suggested that the rate of precession would be 1 degree of difference per 50 years. He Chengtien, during the period of the Sung dynasty, considered this rate too excessive and doubled the time period without success. Zhang Zixin, during the period of the North Je dynasty, said that there would be 1 degree of difference per 81 years. Liu Zhuo, during the period of the Sui dynasty, took the median of Yi Xi and He Chengtien, saying that there would be 1 degree of difference per 75 years. However, Zhu Xi thought that this was not precise, either.

Additionally, Ryu Hwi-mun reviewed the precession of Choe Seok-jeong (崔錫鼎) (*Myeonggokjip*, vol.13, 21a-23a). According to him, there are 365.25 days in Li Fan's calendar (*Sabunyeok*); 365.246180 days in Liu Hong's calendar (*Geonsangyeok*); 365.242814 days in Zu Chongzhi's calendar (*Daemyeongyeok*); 365.2425 days in another calendar *susiryeok*. Ryu Hwi-mun compared these numeral values with those of the existing calendar *Manbunyeokbeop*. According to him, *sesil* of *Geonsangyeok* was short by 0.003820 compared to a 1/4 day (0.25-0.246180=0.003820). The same is true of the difference of heaven and the

total of both is 0.007640. Accordingly, in 131 years there will be 1 degree of difference (0.007640x131=1.00084≒1). Based on this, Ryu Hwi-mun ascertained that there had already been a law of precession at the end of the Han dynasty. Meanwhile, in the case of *Daemyeongyeok*, *sesil* was short by 0.007186 (0.25-0.242814=0.007186). The total of the numeral values of heaven and the sun is 0.014372. Accordingly, in 68 years there will be about 1 degree of difference (0.014372x68=0.977296≒1). This is different from the theory of 45 years in *Tanshu* (唐書). *Susiryeok* is short by 0.0075 (0.25-0.2425=0.0075). The total numeral values of heaven and the sun is 0.0150 and there would be a 1 1/2 difference in degrees in 100 years (0.0150x100=1.5). This is because precession is related to the movement of heaven and the sun (*Hogowaseonsaengbyeoljip*, vol.1, 11a-12a). The above is explained according to the calculation of precession based on *Cheonsesudojiseol*.

Finally, Ryu Hwi-mun introduced the theory of precession of *Siheollyeok* (Current Standard Calendar) which differed from the traditional *Cheonsesudojiseol* as follows:

> Today's calendar says that the ecliptic doesn't move but the fixed star moves to the east. This means that precession isn't related to heaven and the sun but is related to the fixed star. Generally, the sun, the moon and the five planets are all slow. The fixed star alone moves together with heaven and it is said to be rather slow. It is short of less than 1 degree in 66 years (*Hogowaseonsaengoejip*, vol.1, 12a).

The Western calendar demonstrated that as the fixed star moves eastward about 51 seconds a year, precession occurs. It argued that as the fixed star moves a little (51 seconds) toward heaven, there occurs a difference of about 1 degree in 66 years (51x66=3366 seconds→3366÷60=56.1 minutes≒60 minutes=1 degree). Ryu Hwi-mun argued that the precession rate of Liu Zhuo (which was the theory of 1 degree in 75 years) was rather insufficient. Indicating that there was a difference of 1 degree in 66 years and 8 months in *Susiryeok* and *Siheollyeok*, he also argued that the precession rate was gradually decreasing from ancient times up to now (*Hogowaseonsaengmunjip*, vol.5, 36b). Ryu Hwi-mun concluded that the recent precession rate would supplement the insufficiency of that of Liu Zhuo contained in *Seojipjeon* (*Hogowaseonsaengmunjip*, vol.11, 17b).

The Theory of Solar and Lunar Eclipses

Ryu Hwi-mun believed that the moon comes in and out of the ecliptic twenty-six times a year, and that the moon doesn't meet the sun twenty-four times but meets it only twice. He also believed that in the case of 'the same degree of east and west and the same way of north and south' (東西同度, 南北同道) a solar eclipse occurs. He concluded that a solar eclipse occurs approximately once every 173 days (*Hogowaseonsaengoejip*, vol.2, 6a). This followed the discussion of Huang Ruijie in the annotation of *Zhengmeng*. In the annotation of the passage in Zhengmeng, "The sun is based on *yin* and the moon, *yang*. Therefore, on the first and the fifteenth days when the sun and the moon meet reverse, light disappears." Huang Ruijie suggested his opinion, putting together the accounts of *Chunqiushu*, Yi Xing and Wang Po. According to the theory, the moon goes around heaven thirteen times a year and comes in and out of the ecliptic twenty-six times. Among these twenty-six times, the moon does not meet the sun twenty-four times but meets it only twice. This is why *Chunqiushu* mentioned that the sun and the moon meet together approximately once in 173 days. It is natural that a solar eclipse should occur when the sun and the moon meet together. The reason why, on occasion, a solar eclipse doesn't occur is that there is a fraction in the way at the time of "the same way of the sun and the moon" (日月同道) (*Xingli daquan*, vol.5, 12a-b). In short, Huang Ruijie(黃瑞節) explained that if the condition of 'the same degree of east and west and the same way of north and south' is satisfied, a lunar eclipse occurs.

When explaining the principle of a solar eclipse, Ryu Hwi-mun paid attention to the connection between a solar eclipse and the theory of disasters. He believed that as the sun and the moon are the constant of *yin* and *yang*, whether energy which is *yin* and *yang* follows the original way is derived from the flourishing and stagnation of morality of the world. Accordingly, at the time of admirable politics, *yang* prospers and *yin* stagnates. He believed that even when a solar eclipse is predicted to occur according to the calculations of degrees, a solar eclipse may not occur because the moon escapes from the sun (*Hogowaseonsaengoejip*, vol.2, 6b). Accordingly, Ryu Hwi-mun accepted the opinion of Zi Shen (梓愼) (*Chunchujwassijeon*, vol.21, 20a-b) of the Lu (魯) dynasty that a solar eclipse that occurs during the summer and winter solstice, and the spring and autumn equinox is not a disaster (*Hogowaseonsaengoejip*, vol.2, 7a).

In the late Joseon period, lunar eclipses were most problematic in

the theory of solar and lunar eclipses. According to Ryu Hwi-mun, a lunar eclipse occurs because *yin* doesn't escape from *yang* and brilliant light is taken on the fifteenth day when the sun confronts the moon directly in front and the sun is underground and the moon above the ground (*Hogowaseonsaengoejip*, vol.2, 7a). As evidence, Ryu Hwi-mun quoted a few passages of *Zhuziyulei* as follows: "A lunar eclipse occurs when the moon fights against the sun" (*Zhuziyulei*, vol.2, p.21). "According to a calendrical theory, a lunar eclipse occurs because sunlight deprives moonlight on the fifteenth day" (*Zhuziyulei*, vol.2, p.21). "When darkness (暗虛) shines on the moon, a lunar eclipse occurs" (*Zhuziyulei*, vol.79, p.2056). Through this, it can be assumed that the lunar eclipse theory of Ryu Hwi-mun was based on Zhu Xi's *Amheososaseol* (暗虛所射說). In reality, Ryu Hwi-mun believed that the shape of the sun is '*rihwa*' (the symbol of fire in a divination sign *ri*), so the inside of the sun is dark and the outside bright, resulting in darkness naturally while it is very bright. According to him, when the sun confronts the moon on the fifteenth day, a lunar eclipse occurs because the energies of *yin* and *yang* arise and fight each other and the outside of the moon is deprived of its brightness by the sun. So, conversely, the darkness of the inside of the sun shines on the moon, and darkness and brightness do not associate with each other (*Hogowaseonsaengoejip*, vol.2, 7a).

In the late Joseon period, there were scholars who criticized Zhu Xi 's lunar eclipse theory and accepted that of the West. There were quite a few scholars in the line of Southerners, among whom Gwon Gu (1672-1749) and Lee Ik (1681-1763) were typical (Koo 2002 and 2003). It is significant that Ryu Hwi-mun paid attention to the lunar eclipse theory of the line of the Southerners. He considered remarkable Gwon Gu's lunar eclipse theory which was derived from Zhang Heng (78-139). Once, Lee Ik indicated that contemporary scholars only knew the lunar eclipse theory of the West and didn't know that it had been derived from Song Lien (宋濂, 1310-1381) (*Seonghojeonjip*, vol.43, 19a). Furthermore, Ryu Hwi-mun tried to discover the origin of the lunar eclipse theory of the West in the (Zhang Heng) tradition of East Asia (張衡) (*Hogowaseonsaengoejip*, vol.2 7b-8a). In reality, the word '*amheo*' (darkness) appeared in *Lingxien* (靈憲) of Zhang Heng and meant the shadow of the earth (*Hou Hanshu*, *Ji* (志)10, *Cheonmun*(天文) *sang*(上), p.3216). Bao Yunlong (鮑雲龍) mentioned that the so-called theory of darkness had been derived from Zhang Heng (*Tianyuanfawei*, vol.2下, 40b) and Ryu Hwi-mun accepted this opinion (*Hogowaseonsaengoejip*, vol.2, 7b).

Despite being familiar with the new lunar eclipse theory of the Southern

lineage, Ryu Hwi-mun did not agree with them. Denying the western theory that lunar eclipses were caused by the shadow of the earth, he held on to the *yin* and *yang*-based lunar eclipse theory. He tried to explain both solar and lunar eclipses according to the same principle. He believed that a lunar eclipse (when the sun eats the moon) is in principle the same as a solar eclipse (when the moon eats the sun) and that brilliant light is taken mutually. He believed that as the cold earth could not make a lunar eclipse occur, a lunar eclipse would occur even though the earth was not intercepted in the middle (*Hogowaseonsaengoejip*, vol.2, 8a). He based his argument on the fact that the shape of the moon that disappears during a lunar eclipse is the same size as the sun and is similar in shape to when the moon shades the sun (*Hogowaseonsaengoejip*, vol.2, 8a). Of course, this is certainly an error. However, Ryu Hwi-mun tried to explain a solar and a lunar eclipse according to the same principle from the viewpoint of the theory of *yin* and *yang*. According to him, the sun is shaded by the moon even during a solar eclipse and invades the moon mutually as if water collides with fire. He understood that when the sun shades the moon, the same thing will happen (*Hogowaseonsaengoejip*, vol.2, 8b).

The Geocentric Theory

Ryu Hwi-mun accepted the geocentric theory that was generally available at that time. His mention that the shape of the earth is a spherical one as a whole in spite of its bumpiness certainly indicates the geocentric theory. Nevertheless, he argued that it was a theory that had already existed in China. The questions and answers between Zengzi and Dan Juli in *Dadaili* and *Honcheonseol* are said to have proved it (*Hogowaseonsaengoejip*, vol.2, 21a). That 'theory of Chinese origin' can be confirmed in his attitude towards *Siheollyeok* (the current standard calendar). Is there a difference between *Siheollyeok* and *Seonwangjibeop* (先王之法: the law of ancient kings)? Ryu Hwi-mun denied mutual interrelation, saying that the precision of the Western calendar is due to its foundation and the errors of Western learning are due to its groundlessness. (*Hogowaseonsaengoejip*, vol.1, 19a) He tried to separate Western science and technology from its learning, religion and thought. Moreover, he strongly argued that though *Siheollyeok* looked like a 'new law,' considering the origin, it was actually nothing but an 'old law' (*Hogowaseonsaengoejip*, vol.1, 19b). For example, he said: it was equal to

Unsejibeop (運世之法) of Shao yong (邵雍) that the orbits of heavenly bodies are divided into 360 degrees; the geocentric theory was based on the comparison of 'the yellow of an egg' of *Honcheonseol* and the 'overturned bowl' of *Gaecheonseol*. Thus, Ryu Hwi-mun believed that the newness of *Siheollyeok* was nothing more than the novelty Westerners attained and were proud of after they had studied various Chinese classical theories (*Hogowaseonsaengoejip*, vol.1, 19b-20a).

According to geocentric theory, seasons and day and night change because of differences of longitude and latitude. The difference of north and south in the polar altitude causes heat or cold while the difference of east and west in time causes day or night. This was the so-called principle of 'reciprocity of heat and cold' and of 'reciprocity of day and night.' Ryu Hwi-mun noted that, saying, "There is a difference of north and south in the coming in and out of the sun. There is a difference of east and west in the order of seasons. Therefore, there is a difference in the length of day and night, in the course of heat and cold and in everything in the world" (*Hogowaseonsaengoejip*, vol.2, 21b). Based on *Shulijingyun*, Ryu Hwi-mun explains that there occurs a difference of 1 degree in the polar altitude every 250 *ri* and a difference of 4 minutes every 1 degree of deviation of east and west (*Hogowaseonsaengoejip*, vol.2, 21b). According to the existing rule of 96 *gak* (a period of 15 minutes) of *Siheollyeok*, the 24 hours in a day become 1,440 minutes (96x15=1440). Then, the circumference of the earth is 360 degrees and the time difference according to the longitude of east and west is 4 minutes per 1 degree (1440÷360=4). Accordingly, there occurs 2 hours (8 *gak* x15=120) of time difference per 30 degrees of longitude (30x4=120 minutes). The statement of Ryu Hwi-mun based on *Shulijingyun* that there occurs a difference of 1 degree in the polar altitude every 250 *ri* north and south is an error. It occurred because *Shulijingyun* actually introduces 250 *ri*=1 degree as an old rule and 200 *ri*=1 degree as a new rule (*Yuzhishulijingyun*, 下, vol.1, *Doryanggwonhyeong*(度量權衡)).

So, why isn't the difference of the coming in and out of the sun the same as the order of seasons? Ryu Hwi-mun explained the reason for the differences as follows: the coming in and out of the sun is decided by the total *ri* of north and south of the polar altitude because of the difference of north and south in the distance of the sun's way; the order of seasons is decided by the total *ri* of east and west of the equator because of the difference of east and west at the time the seasons arrive (*Hogowaseonsaengoejip*, vol.2, 23a).

What mattered in accepting geocentric theory was the fact that it would be a threat to the perspective of geographical Sino-Centrism that China was the center of the world. Ryu Hwi-mun quoted the following passage, "While people are living on earth, they work day and night. Therefore, the number on earth is used for their convenience" (*Xingli daquan*, vol. 11, 6b). He further argued that though heaven and earth is huge, the ground is very prosperous; though the ground is very huge, only China is prosperous, saints are produced and civilization prospers (*Hogowaseonsaengoejip*, vol.2, 39b). He believed that outside China, there were only barbarians, worms, snakes and deformed monsters, or nothing at all in some places (*Hogowaseonsaengoejip*, vol.2, 39b). Evidently, he thoroughly maintained the perspective of cultural Sino-Centrism.

Ryu Hwi-mun still divided heaven and earth from the traditional viewpoint of top and bottom. He believed that heaven is light and pure while the earth is heavy and impure; therefore, something heavy sticks to earth while something light floats to heaven. If we stand upright, heaven is on our head. If we throw a stone, it falls to the ground. Irrespective of the top and bottom of earth, the reason is always the same (*Hogowaseonsaengoejip*, vol.2, 39b).

Jibususangseol (地浮水上說) of Zhu Xi (*Zhuziyulei*, vol.2, p.28) was reinterpreted. Recognizing the geocentric theory, Ryu Hwi-mun said as follows:

> There is top and bottom in the reason of heaven and earth and something without order is not allowed. As China is front and *yang*, there are many famous people. As the north side is back and *yin*, water is insufficient in many cases. Between heaven and earth, there is much water and the physical aspect of China is highest. … The following of Zhu Xi meant this: "There is flowing sea water under the ground and on the four corners of the earth. Earth floats on water and meets heaven while heaven surrounds water and earth." (*Hogowaseonsaengoejip*, vol.2, 40b)

According to this, irrespective of the so-called spherical shape of the earth, China came to gain a relative advantage over other regions in values. "There is top and bottom in the reason of heaven and earth" means that. It was because China was located in a situation of top, front and *yang*. Why did China attain such a situation?

In Ryu Hwi-mun's judgment: underground is where water gathers; water is light, cannot be attached to the pure sky, and is stored on the heavy and impure ground; accordingly, though there is 'creation and change' underground, on the north side where water is sufficient, there is nothing

worth seeing (*Hogowaseonsaengoejip*, vol.2, 40b-41a). He believed that if figures are the same both underground and on the ground, it is as if there is only *yang* without *yin* (*Hogowaseonsaengoejip*, vol.2, 41a).

Geomantic theory explains that good earth is not floating on water but water is attached to good earth. Accordingly, the explanation of Ryu Hwi-mun that water is heavy and is stored on the heavy and impure ground can be applicable to 'underground.' In that case, his argument may meet with a question about whether his theory is contrary to *Jibususangseol* of Zhu Xi. (*Hogowaseonsaengoejip*, vol.2, 42a) Ryu Hwi-mun explained that so-called *Jibususangseol* means earth and water stick together and that water does not actually sustain the heavy and impure earth (*Hogowaseonsaengoejip*, vol.2, 42b-43a).

Explaining the structure of the earth, Ryu Hwi-mun quoted the opinion of Shao yong (*Xingli daquan*, vol.11, 28b; *Xingli daquan*, vol.11, 23a). He believed that all the mountains in the world originate from Kunlun and continue westward of Yonghe and northward of Zizhou and that as the east of Yanzhou and the west of Joseon are low lands and form an enormous valley, all the streams flow here (*Hogowaseonsaengoejip*, vol.2, 41b). He also argued that the disposition of a divination sign *gansan* (艮山, northwest) and a divination sign *taetaek* (兌澤, southeast) in Seoncheondo (先天圖) is suitable to the geography of China and that as the center of the world is near the south and is the most civilized place, it is different from the inauspicious northwest (*Hogowaseonsaengoejip*, vol.2, 41b).

Basically, Ryu Hwi-mun did not reject or deny the theory of fields. Focusing on the content in ancient scriptures and history books, he explained the theory of fields faithfully and its appropriateness more fully, commenting on various historical instances. Nevertheless, he warned against the attitude of interpreting everything according to the theory of fields.

> However, according to the sayings of many people at that time, there is something inevitable when examining shapes while there is something that isn't inevitable when pursuing reason. There are sayings: a sign of repentance has made high winds sink; generous words have made Mars move its position. The mind of a sovereign is the core of harmony. If the sovereign is kind-hearted, a fair wind will blow and a welcome rain will fall. On the contrary, if he is evil-minded, a comet will appear and a ghost will invade. How can we ask good or bad fortune of the blue sky? (*Hogowaseonsaengoejip*, vol.6, 3a)

This is the warning against the attitude of explaining every natural phenomenon

according to the theory of fields and exemplifies the basic attitude of the Neo-Confucian theory of disasters that emphasizes moral cultivation and the virtue of a sovereign.

While geographic information on the new world, including the West, was secured in the late Joseon period, criticism against the existing theory of fields was raised. What often mattered was the problem of the division of fields focusing only on China, in spite of the vastness of the world. When the view that China was the whole world was dominant, the theory of fields did not matter greatly. However, with a new geographical recognition that China is nothing but part of the earth, a question about the theory was raised. The heart of the problem is, whether a China that is nothing but part of the earth can be equivalent to all of heaven. Ryu Hwi-mun escaped from this problem with a theory about the particularity of China, "As China is the most prosperous under heaven, all of the twelve fields are inside China" (*Hogowaseonsaengoejip*, vol.6, 6b).

Conclusion

Ryu Hwi-mun is an important figure in understanding the natural science of the Southern lineage of Yeongnam in the early nineteenth century. His importance can be reviewed in various aspects, as follows.

First, Ryu Hwi-mun was a successor of the Toegye School in Southern lineage of Yeongnam from Lee Hwang to Kim Seong-il, Jang Heung-hyo, Lee Hyeon-il, Lee Jae, Lee Sang-jeong and Ryu Jang-won. Through Ryu Hwi-mun, the natural science of the Southerners of Yeongnam since Lee Hwang can be reviewed.

Second, in the 150 years since *Siheollyeok* (the Current Standard Calendar) was introduced to the Joseon dynasty, Ryu Hwi-mun wrote his *Changnangdapmun* that contained his perspective on nature. As is well-known, since Western Learning was definitively introduced after the middle of the seventeenth century, the discussion of natural science in the late Joseon period underwent more qualitative changes than ever before. The Seongho School of the Southerners near Gyeonggi, the Seo family of Dalseong in the line of the Soron faction, and the Northern Learning School in the Naknon lineageof the Noron faction accepted Western Learning and scholars appeared who raised the discourse of new natural science. It can be seen through Ryu Hwi-mun what discussions were held among the Southerners of Yeongnam under such

changed circumstances in the early nineteenth century.

Third, collecting a variety of discussions that had already existed and adding his own opinions, Ryu Hwi-mun established his own system of natural science. The various elements that had an influence on forming the natural science of Ryu Hwi-mun are as follows: the scholastic family tradition of the so-called 'Sugok sect of the Ryu family of Jeonju'; the academic tradition of the Toegye School since Lee Hwang; academic relations with figures belonging to scholars in the line of Lee Sang-jeong; the results of natural science accomplished by Southern lineage including Gwon Gu and Lee Ik; and extensive reading of the literature of China and Joseon relating to natural science. By comparing the various elements of Ryu Hwi-mun 's system of natural science with that of the other contemporary schools and scholars, it is possible to review aspects of the world of thought in the late Joseon period.

The following is a recapitulation of the natural science of Ryu Hwi-mun focusing on the content of *Changnangdapmun* written in 1804. According to the traditional discussion, Ryu Hwi-mun explained the process of the beginning of the world out of chaos, and the structure, beginning and end of the universe, borrowing from *Honcheonseol* and *Wonhoeunseseol*. He accepted *Honcheonseol* as Zhu Xi's established theory and mentioned the possibility of mutual relationship between *Honcheonseol* and *Gaecheonseol* under the influence of Western Learning. He tried to understand traditional Gucheonseol in relation to the Jungcheonseol of the West. The theory of relation was the traditional theory of *yin* and *yang* and Sangsuhak.

In the theory of the movement of heavenly bodies, Ryu Hwi-mun held on to the traditional theory of 'heaven moves and the earth is static.' He explained why 'heaven moves and the earth is static' using the traditional theory of *yin* and *yang*. He believed that *taegeuk* (the Great Absolute) enables movements, *yin* and *yang*. He criticized *Useonseol* and supported *Jwaseonseol* primarily for the two following reasons: there is no reason the sun and the moon in heaven would move right while heaven moves left; and, considering the theory of *yin* and *yang*, that *yang* is light and pure, while *yin* is heavy and impure, and that *yang* is steady and fast, while *yin* is slow and tardy, there is no reason for the moon (which is *yin*) to be fast and the sun (which is *yang*) to be slow. He firmly believed *Jwaseonseol* was an authoritative theory of Zhu Xi.

Ryu Hwi-mun developed the discussion about precession focusing on *Cheonsesudojiseol* of Zhu Xi. He had already known the theory of precession of the West, *Hangseongdonghaengseol*, and believed such a precession rate

would complement the imperfection of Liu Zhuo's precession rate contained in *Shujichuan*.

Explaining the principle of a solar eclipse according to 'the same degree of east and west and the same way of north and south,' Ryu Hwi-mun paid attention to the relationship between a solar eclipse and the theory of disasters. According to him, the sun and the moon are the essence of *yin* and *yang,* which are energy; and whether energy follows the original way is caused by the waxing and waning of morality of the world. Ryu Hwi-mun explained the principle of a lunar eclipse based on Zhu Xi's *Amheososaseol*. According to him, when the sun confronts the moon directly on the fifteenth day, the sun is underground and the moon is on the ground; and, as *yin* does not escape *yang* and brilliant light is taken by force, a lunar eclipse occurs. Denying the Western theory of a lunar eclipse caused by the shadow of the earth, he still held on to a lunar eclipse theory based on the theory of *yin* and *yang*. He tried to explain a solar and a lunar eclipse by means of the same principle. He believed that both a lunar eclipse (when the sun eats the moon) and a solar eclipse (when the moon eats the sun) occur according to the same principle and that brilliant light is taken by force.

Ryu Hwi-mun accepted *Jiguseol* which was general available at that time. It is said that in spite of the irregularity of the surface of the earth, as a whole it has a spherical shape. Then, he argued that *Jiguseol* had already existed in China. A problem in accepting *Jiguseol* was the fact that *Jiguseol* would be a threat to the perspective of geographic Sino-Centrism that China was the center of the world. Ryu Hwi-mun argued that though the world was vast, only China was prosperous, saints were produced and civilization was developed. He believed that there are ups and downs in the 'morality of heaven and earth' and China was in the position of up, front and *yang*. Irrespective of the spherical shape of the earth, he argued that China had attained a relatively superior position in values to other regions.

Ryu Hwi-mun established his natural science through a wide reading of the classical books of China and Joseon. That tendency is often called 'erudition.' In fact, the erudite tendency in learning in the late Joseon period attracted attention in relation to 'practical learning.' Remembering the academic results and historical meaning of the 'Encyclopedic School', the group of philosophers of enlightenment in France, it was the development of encyclopedic learning in the late Joseon period that scholars have treated in relation to the modernity of practical learning. *Jibongyuseol* of Lee Su-gwang and *Seonghosaseol* of Lee Ik were typical examples. Such an erudite tendency in learning was taken

as historically meaningful because it gave rise to the phase of 'miscellaneous learning', which had been despised by the existing system of learning based on the Chinese classics and Neo-Confucianism and divorced knowledge from practice, criticizing the existing approach of learning that aimed for the union of knowledge and practice. So, can it be said that Ryu Hwi-mun's erudition had such an aim? Referring to the existing discussions about various problems of natural science, he presented his own opinion. The foundation for most of his discussions was the established theory of Zhu Xi and the instrument of discussions was the traditional theory of *yin* and *yang*, and *sangsuhak.* Therefore, the academic tendency in Ryu Hwi-mun can be seen as 'Neo-Confucian erudition' and 'a period variation of Neo-Confucianism.'

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Koo Mhan-ock is an associate professor in the Department of History at Kyunghee University. He received his Ph.D. from Yonsei University. His research focuses on history of cosmology, astronomy and calendrical science in the late Joseon dynasty.

Abstract

Ryu Hwi-mun (柳徽文) is an important figure in understanding the natural science of the line of the Southerners of Yeongnam in the early nineteenth century. Ryu Hwi-mun established his natural science through a wide-ranging reading of the classical books of China and Joseon. This tendency in his learning is often called 'erudition.' In fact, the erudite tendency in learning in the late Joseon period attracted attention in relation to 'practical learning.' Remembering the academic results and historical meaning of the 'Encyclopedic School', the group of philosophers of enlightenment in France, it was the development of encyclopedic learning in the late Joseon period that scholars have treated in relation to the modernity of practical learning. *Jibongyuseol* (芝峰類說) of Lee Su-gwang and *Seonghosaseol* (星湖僿說) of Lee Ik were typical examples. Such an erudite tendency in learning was taken as historically meaningful because it gave rise to the phase of 'miscellaneous learning' that had been despised by the existing system of learning based on the Chinese classics and Neo-Confucianism, and gave independence to knowledge from practice, criticizing the existing approach of learning that aimed for the union of knowledge and practice. Then, can it be seen that Ryu Hwi-mun's erudition had such an aim? Referring to the existing discussions about various problems of natural science, he presented his own opinion. The foundation in most of his discussions was the 'established theory of Zhu Xi' and the instrument of discussions was the traditional theory of *yin* and yang, and *sangsuhak* (象數學: xiangshu xue). Therefore, the academic tendency in Ryu Hwi-mun can be seen as 'Neo-Confucian erudition' and 'a period variation of Neo-Confucianism.'

Keywords: Ryu Hwi-mun, *Changnangdapmun*, Yeongnam School, Neo-Confucian Natural Science, Neo-Confucian erudition

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