

Hong Tae-yong's Idea of the Rotating Earth

Park Seong-Rae

Hankuk University of Foreign Studies

洪大容 地轉說의 뜻

朴 星 來
韓國外國語大學

요 약

洪大容(1731—1783)의 地轉說은 코페르니쿠스의 太陽中心說에 해당하는 큰 발견이라는 평가는 우리나라는 물론 日本, 中國學者들에 의해서도 지적돼 왔다. 그러나 유명한 中國天文學史家인 戴內清가 1968년 이것은 독창이 아니고 중국에서 耶蘇會士들로부터 들은 것이리라는 의견을 내자, 洪大容의 地轉說은 이제 독창이 아니라고 인정되게끔 되었다. 특히 최근에는 李龍範·閔泳珪 등에 의해 地轉說의 시작을 金錫文(1658—1735)에게까지 끌어 올리려는 노력이 진행되고 있다.

이 논문은 李瀾의 참신한 西洋科學 수입태도를 개관하고, 洪大容의 과학사상을 훑어본 뒤, 洪大容의 北京訪問 日程과 당시 中國에 알려졌던 太陽中心說 내용을 살펴 다음과 같은 결론을 얻고 있다.

1) 地轉說이 중국에 소개된 것은 사실이다. 그러나 이 說은 天動說을 주장하면서 「틀리는 學說」로서 소개됐을 뿐이었다. 洪大容은 「틀리는 學說」이 맞다고 생각해낸 독창적 과학자였다.

2) 그러나 그의 독창적 「半發見」은 그후 重視되지도, 계승되지도 않았다. 코페르니쿠스의 태양중심설은 서양의 사상체계의 근본을 뒤흔드는 혁명적 생각이었으나 洪大容의 거의 비슷한 생각은 한가닥 한가로운 상념에 지나지 않았기 때문이다. 地球가 움직이진 해가 돌건 東洋의 傳統社會에는 전혀 無關한 일이었기 때문이다.

3) 「地球」說에서 얻은 李瀾의 결론은 中國이 꼭 세계의 「中心에 있는 나라」가 아니라는 인식에서 儒敎의 알맹이인 人間至尊의 생각을 집어 던진다. 여기 華夷論을 뛰어넘는 民族의 自覺과 脫儒敎의 태도가 科學思想과 긴밀한 연관 있음을 본다.

In his *Yŏrha ilgi* (Jehol Diary) Pak Chi-wŏn (1737-1805) related his friend Hong Tae-yong (1731-1783) as the discoverer of the theory of diurnal rotation of the earth.¹⁾ Then in 1783, Pak wrote the epitaph for Hong with the following words:

Originally the Westerners said of the spherical earth, yet they failed to understand its rotation. Tokpo [Hong's style name], however, had already illustrated that the earth rotates once to make one day. It is a very profound theory. Though he did not write [a monograph] on this, he became more and more convinced about the diurnal rotation of the earth in his later years.²⁾

It was from such remarks by Pak that some Korean, Japanese, and Chinese scholars had

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1) There are two places where Pak discusses it. The better one is in "Hokchong p'ildam" (Brush dialogue with Hokchong), another in "T'aehak yugwan-rok" (Stay in college). Both in his *Yŏrha ilgi*. See his *Yŏn-am chip* (Collected works of Yŏn-am=Pak Chi-wŏn).

2) Pak Chi-wŏn, *Yŏn-am chip*, 2:47a-48b, "Hong Tŏkpo myojimyŏng".

appraised Hong's "independent discovery" of the diurnal rotation of the earth.³⁾ An apparent analogy with the Copernican revolution—the harbinger of the modern West and modern science—has very much to do with the enthusiasm shown by these scholars.

More recently, however, a distinguished historian of Chinese astronomy took up the issue to refute any originality for the part of Hong Tae-yong. Yabuuchi Kiyoshi had even suggested that Pak might have knowingly falsified the case for his friend's sake.⁴⁾ Yabuuchi's weight was enough to curb the undue enthusiasm displayed by many scholars. Nevertheless, Yabuuchi's observations are not convincing, because he did not even read Hong's own writing.

This paper explains briefly Hong's cosmology in general, hopefully to derive some characteristics from it. This shall help us locate Hong's position in the history of science in Korea and more broadly in the intellectual history of Korea.

There are two probable routes that Hong might have known of Copernican theory. The first route is through the books available to him at the time; the second through his direct contact with the Jesuits in China during his visit there in 1766. The first possibility deals with more than one hundred and fifty years' period. From the end of the sixteenth century the disciples and friends of Matteo Ricci were busily engaged in the reforms of Chinese calendar, with energetic translation of Western astronomy as its byproduct. Since Copernicus published his book in 1543 and the final Inquisition of Galileo was in 1633, Jesuits in China had several decades comparatively free for the discussion of Copernicanism.⁵⁾

3) They are Hong I-söp, *Chosön kwahak-sa* (Seoul, 1946), p.255; Tamura Sennosuke, "Chosen richo gakusha no chikyū kaiten-setsu ni tsuite," *Kagaku-shi kenkyū*, 30(1954), pp.23-24; Ch'oe Ik-han, *Sirhak-p'a wa Chōng Ta-san* (Pyōngyang, 1956), p. 135; Chōng Chin-sok, and others, *Chosön ch'ölhak-sa* (Pyōngyang, 1962), p.215; Ch'ōn Kwan-u, "Hong Tae-yong ūi ch'i jōn-söl ūi chae kōmt'o," *Chō Myōnggi paksa hwagap kinyōm pulgyo sahak nonch'ong* (Seoul, 1965), p.649; Hsi Tse-tsung, "Chao-hsian Pak Yōn-am 'Yōrlha ilgi' chung de t'ien-wen-hsueh ssu-hsiang," *Ko-hsueh-shih chi-kan*, 8(1965), p.75; Chōn Sang-un, *Han-guk kwahak kisul-sa* (Seoul, 1966), pp. 42-44; Yamaguchi Masayuki, *Chōsen seikyo-shi* (Tokyo, 1967), p.55. A PhD dissertation completed in the United States has following to say on this: "The Copernican theory of the earth, introduced by Hong Tae-yong met a shocked reception in Korea." This rash verdict is given in Yoo, Hyungjin, "An Intellectual History of Korea from Ancient Times to the Impact of the West with Special Emphasis upon Education," (Unpublished PhD Dissertation for Harvard Graduate School of Education, 1958), p.237.

4) See his note added to his article, "Kinsei chūgoku ni tsutaerareta seiyo temmongaku," *Kagakushi kenkyū*, 32 (1954), p.18. Also see Yabuuchi Kiyoshi, "Richo gakusha no chitensetsu," *Chosen gakuho*, 49 (1968), pp. 427-434. For similar opinions, see Son Yōng-jong, "Tamhōn Hong Tae-yong ūi sōnjin-jōk sasang e taehayō," *Ryōksa kwahak*, 5(1959), pp.42-61. In his English version of *Han-guk kwahak kisul sa*, Chōn Sang-un reversed his previous position. See Sang-woon Jeon, *Science and Technology in Korea* (Cambridge, Mass., 1974), pp. 21-22. From the mechanism of an astronomical clock constructed in 1669, Chōn (Jeon) argues that "the contemporary astronomers of Korea had independently arrived at the discovery of the diurnal rotation of a spherical earth." *Ibid.*, p.19.

There have been efforts to date back the origin of the idea of the diurnal rotation of the earth. For this, see Yi Yong-tōm, "Yi Ik ūi chidongron kwa kō non-gō," *Chindan hakpo*, 34(1972), pp. 35-59; and Min Yōng-gyu, "Sipch'il segi Yiyo hagin ūi chidong-söl," *Han-guk sa yōng'-u huibo*, 1(1973), pp.3-4; and his "Sipch'il segi Yiyo hagin ūi chidongsöl," *Tongbang-hak chi*, 16(1975), pp.1-17 and 18-64. Prof. Min discovered that the idea of the diurnal rotation of the earth was held by Kim Sōng-mun (1658-1735), almost a whole century before Hong Tae-yong. It is not clear whether Hong had known Kim's work or not. Since my paper, which was prepared far before Professor Min's work, emphasizes the intellectual climate that had made Hong's idea insignificant, any dating back of the idea itself would mean little to the body of the paper.

5) For the early Jesuits' views on Copernicanism, see Joseph Needham, *Science and Civilization in China*, Vol. III, (Cambridge, 1959), pp. 445-446; Boleslaw Szczesniak, "Notes on the Penetration of the Copernican Theory into China from the 17th to the 19th Centuries," *Journal of Royal Asiatic Society*, 1945, pp.30-38; Pasquale d'Elia, *Galileo in China* (Cambridge, Mass., 1960), pp. 51-56; Nathan Sivin, "Copernicus in China," *Colloquia Copernicana* (Warsaw, 1973).

To be sure, there were some records on Copernican system in several writings of the period.⁶⁾ James Rho, for instance, wrote as follows:

How does one explain the motion of the *primum mobile* heaven? The answers are two. There is he who says: The *primum mobile* is not the sun which completes its revolution in a day, traveling around the earth and dragging all the other heavens towards the west. One who stands on the earth and looks at the stars believes that they move towards the left; nevertheless this is not the proper motion of the stars since they do not complete their revolution in a day and a night; but the earth, the air, and the fire form a single globe which goes from the west to the east and completes its revolution in a day. It is like one who is making a voyage in a boat and looks at the bank, the trees, and so forth. He does not have the impression that it is he who proceeds but thinks that it is the bank which proceeds. For the same reason, the man who stands on the earth has the impression that the stars go toward the west. The earth's motion spares the many motions of the heavens, as the earth's small revolution spares the great revolutions of the heavens. However, ancient and modern scientists have thought that really this is not the true explanation. In fact, the earth is the center of the various heavens, and the center, like the pivot of a waggon, is fixed and immobile. Besides, if it is true that one who stands in a boat sees the bank as if it were moving, why not consider that those who stand on the bank see that the boat is moving? Pure comparison, thus, is not a proof.⁷⁾

Then it continues to explain the "correct" system of immobile earth in detail. In the long quotation the following two things should be noticed, which were common in every account of Copernican system in this period until Hong's visit to China. In the first place, Copernican system was made known as a *wrong hypothesis* instead of the correct theory, and it was used to illustrate the supposedly correct theory of the immobile earth. Secondly the hypothesis was not related to any of the famous Western astronomers already known in China. Most of these translations of the Western astronomy mentioned the names of Copernicus, Galileo and Tycho Brahe among others; but Copernicus and Galileo were related to other achievements rather than to this hypothesis.

All in all, the Jesuits in China, comments Szczesniak, "intentionally avoided calling the attention of Chinese students to the new theory of Copernicus."⁸⁾ Since the teaching of Copernican theory was prohibited by the Papal Index which continued to include this clause until 1835, any Jesuit doing otherwise would have found guilty of apostasy.⁹⁾ In practice also there was no single reason for them to adopt Copernican system in place of the old one Ricci and his followers had already firmly established. The major purpose of astronomy for the Chinese was correct calendar-making, for which both the old geocentric and the Copernican heliocentric systems did not make any difference at all. Copernican theory had no definite advantage over the revised old system called Tychonic in calendar-making. By putting the planets on solar orbits, Tycho Brahe ingeniously solved some serious difficulties of the Ptolemaic system. Furthermore any switch from the established Tychonic to another system in the interpretation of the heaven and the earth would surely have raised doubts among the

6) In addition to the above-cited, see George Wong, "China's Opposition to Western Science during late Ming and early Ch'ing," *Isis*, 54(1963), p.31; Yabuuchi Kiyoshi, *op. cit.*, p.429.

7) Translated by Pasquale d'Elia, *op. cit.*, p. 54.

8) Szczesniak, *op. cit.*, p.33.

9) For the Church's attitude toward Copernicanism, see Andrew D. White, *A History of the Warfare of Science with Theology in Christendom* (New York, 1908), Vol. I, pp. 120-170, especially pp. 154-157.

Chinese about all the Christian teachings of the Jesuits.¹⁰⁾ In the final analysis, they were Catholic missionaries before being scientists; and they would not and did not jeopardize their mission by indulging into a "heretical" hypothesis. As Needham correctly put, the Jesuits in this sense "retarded, rather than advanced, Chinese science."¹¹⁾

Nevertheless the fact remains that Copernican hypothesis was described in the earlier works of astronomy. Did Hong Tae-yong know this then? Before answering this question, let us consider the second possible route of transmission of Copernican idea to Hong. Such a possibility is raised by Yabuuchi Kiyoshi as following:

In 1780 Pak Chi-won went to Peking. He was a man interested in Western culture and civilization. Yet he wrote that the Westerners did not know the theory of the rotating earth. Considering various circumstances, I cannot but say that this is strange. How, then, can we explain his argument that the idea of the rotating earth was discovered by Hong Tae-yong? Hong, who had visited Peking four years before Pak's visit, met three times with Director of Chinese Imperial Observatory Hallerstein (stayed in China, 1738-1777) and Vice Director Gogeisl to discuss Christianity and Western science in detail. Therefore, even if nothing were said of Copernicus' theory on the rotation and revolution of the earth, was it not possible that he heard of the theory of the round earth as described in the *Li-hua hsi-chuan*? It is very probable that Hong heard of the theory of the rotating earth from the Jesuits, and it must be seen that Pak Chi-won, knowing this, intentionally emphasized this as Hong's discovery.

12)

This invites a closer look at Hong's travelogue, which Yabuuchi did not read. In the twelfth month of 1765, fourteen years before Pak's visit—not four years before, as Yabuuchi wrote—Hong went to Peking as a member of Korea's new year embassy to China. According to his itinerary he spent three days, out of his sixty odd days' stay in Peking, for his three visits to the South Church, where he met Director of the Chinese Imperial Observatory Augustin von Hallerstein (Liu Sung-ling) and Vice Director Anton Gogeisl (Pao Yu-kuan).¹³⁾ In his "Yu-P'o mundap" (Dialogue with Liu and Pao) Hong recorded details of these three visits to the Jesuits.

The first visit on the 9th day of the first month, 1766, was spent for sightseeing there. Ten days later he made his second visit with a Korean astronomer. Since there was no interpreter around, they exchanged some words in writing about Christianity and astronomy. Here Hong for the first time saw the sun through a telescope and asked about sun-spots. The third visit was similar to the previous one, although his questions this time included such as "Why did you not marry?"¹⁴⁾

During his visit to Peking, Hong had also visited the East Church, where he could get into the hall for a quick look-around, thanks to an immigrant Korean guard there. But he was not allowed into the observatory building in the church. He could only peep into the window to find some astronomical instruments familiar to him.¹⁵⁾ He also went to the Im-

10) Needham, *op. cit.*, p.449.

11) Needham, *op. cit.*, Vol. II, p.496.

12) Yabuuchi Kiyoshi, *op. cit.*, p.433.

13) Hong Tae-yong, "Kyōngsōng kiryak," in his *TamhōnYōn-gi* (*Yōnhaengnok sōnjip*, Seoul, 1960, Vol. I, pp. 297-8). This itinerary does not appear in the 1969 reprint of Hong's collected works, *Tamhōn-sō* (Seoul, 1969).

14) Hong Tae-yong, *Tamhōn Yōn-gi*, pp. 240-245, "Yu-P'o mundap."

15) *Ibid.*, III, pp. 315-6, "Tonng ch'onju-dang."

perial Chinese Observatory one early morning in the third month. The doorman there allowed him a quick look, for there was nobody around in that early hour of the day.¹⁶⁾ Even with frequent bribes to door-keepers and attendants, his inquisitiveness was never fully satisfied, thanks to the official secrecy of the things concerning astronomy in traditional China. Nowhere in his detailed report on his trip to Peking we can find any indication that he had ever discussed Copernican hypothesis or had serious discussions on astronomy with anyone.

Then did he not know the Chinese description of Copernican hypothesis such as that quoted above and Yabuuchi assumes Hong might have heard of in Peking? There is no place for any assumption on this matter, because we know that Hong Tae-yong knew it and knew it very well. As we shall soon see Yi Ik, some fifty years before Hong, had already discussed the Copernican hypothesis without calling it "Copernican."

A brief survey of Yi Ik's natural philosophy will serve well as a starting point. Not only was Yi Ik (1682-1764) a great natural philosopher on his own right, he also was a well known intellectual forerunner of Hong in the *sirhak* school tradition. He was an encyclopedic writer who left innumerable ideas and opinions about nature in writing. Influence and stimulus of the Western astronomy is clearly seen nearly every cosmological item on which he wrote. Though he rejected the religion from the West, he embraced science with expressed open-mindedness. He was an avid reader of the Western astronomy and read many Jesuit writings including Adam Schall, Diaz, de Ursis, etc.¹⁷⁾

For Yi Ik, as for other scholars of his period, the basic material element in the universe was *ch'i* (*ki* in Korean). *Ch'i* fills the heaven and the earth, leaving no smallest space unfilled, and the material things in the world were formed by its condensation.¹⁸⁾ This is nothing new, for Chang Tsai and Chu Hsi had written that "*ch'i* condenses to form solid matter."¹⁹⁾ *Ch'i*, according to Yi, can even form ghost or devils, which as being *ch'i* can penetrate into wood and stone to surprise man.²⁰⁾ Here again there are parallel ideas in Chinese philosophy.

What makes Yi Ik interesting is his departure from Chu Hsi orthodoxy. Unlike Chu Hsi, who gave dualistic emphasis on *li*, Yi Ik put *ch'i* under the command of *li*, thus actually emphasizing *ch'i as material*.²¹⁾ One may suspect an influence of Chang Tsai of Sung China, or trace it back to *li-ch'i* discussions between Yi Hwang and Yi I. No matter what the origin was, Yi Ik's departure from Chu Hsi was combined with his readiness to accept fresh ideas.

So he did not hesitate to quote as many from the Jesuit writings as he could in his writings, and showed his admiration at the exactness of the Jesuit sciences. He wrote on the Western calendar:

Present calendar is made by a Westerner named Adam Schall. Indeed this is the best of calendar-

16) *Ibid.*, III, p.315, "Kwansang-dae."

17) Hong I-sŏp, "Western Science in Yi Korea," *Korea Journal*, 4(1964), pp. 4-7 and 11.

18) Yi Ik, "Chukt'ong insu," in his *Sŏngho sasŏl*, 2:54b-55a.

19) Quoted by Needham, *op. cit.*, II, p.471.

20) Quoted by Chŏng Chin-sŏk, *op. cit.*

21) Hyŏn Sang-yun, *Chosŏn yuhak-sa* (Seoul, 1949), p.336.

making, and there was no error yet in the predictions of solar and lunar eclipses. If the Sage were reborn in this world, he would surely follow this method.²²⁾

Scientific prowess of Jesuits in China had a lasting influence on some of the Korean scholars thereafter. And a remarkable example of the influence was in the area of geographical knowledge of the earth—that the earth is a globe, not a flat square. In his answer to a Korean interpreter's letter, one of the Jesuits in China, John Rodriguez, wrote: "On the world map China occupies the center, as they saw. Truly on the terrestrial globe any country whatever can be the center."²⁴⁾

The Koreans' attitude toward Ch'ing was not the same as it used to be toward Ming China. To their eyes Ch'ing was a "barbarian" Manchu dynasty. For some time they had been vacillating between the idea about the traditional cultural superiority of China and the idea of the "barbarian" dynasty residing in it. Now they seemed to find that the cultural superiority of China was questionable, for they saw that the Westerners were far superior in the exactness of sciences. This served as a powerful psychological factor in undermining Sinocentrism among the Korean scholars. Thus Yi Ik wrote, a century after Rodriguez's letter, that "every man around the globe thinks that his place is the highest in the world."²⁵⁾

Now Koreans could at least envision a new world picture where Korea lies at the highest central place on a globe. There was no absolute physical center of the globe; nor any absolute frame of reference in cultural superiority among the peoples of the world. We may call such an attitude "relativistic." Great interest shown by the *sirhak* scholars in things Korean was nothing else but a logical development from such "relativism."

Keeping this in mind, let us go to some more of Yi Ik's cosmological ideas. His comment on the "Globe" reads:

The theory of man both above and below the globe started with the arrival of the Westerners.....Deputy Minister Kim Si-jin considered it wrong. But Nam Kuk-kwan discussed it and said, 'An ant on an egg can go around the surface of it without falling down. What is wrong with man living on the surface of the earth?' I would say that Nam's rejection of Kim is to attack one error with another. When an ant does not fall from the surface of an egg, it is because its feet stick to it. So if it is separated from the surface, it will fall down. Then how can we explain this? This must be done by the theory of the center of the earth, that is to say, it flows toward the center of the earth, from above from below, and from every direction. This is deducible, considering that the big earth stands in the center without moving.²⁶⁾

By using the idea of terrestrial gravitation Yi showed that men could live everywhere on the globe always keeping their heads up.

Yi Ik apparently read many books on Western astronomy and knew very well about the rotating earth hypothesis, not to mention Hong Tae-yong of half a century later. Using exactly the same analogy of boat and coast, Yi repeatedly brought up the question of the

22) Yi Ik, "Yöksang," *op. cit.*, 2:43a-b.

23) *Ibid.*, 2:6b-9b. "Pun-ya"

24) See Hong I-sŏp, *Chosŏn kwahak-sa*, p.243, and Pasquale d'Elia, *op. cit.*, p.43.

25) Yi Ik, *op. cit.*, 2:20a-b. "il churip"

26) *Ibid.*, 2:53a-b. "chi-gu"

rotating earth.²⁷⁾ And only with reluctance he supported the revolving heaven theory. For example, in one of those writings, he, in addition to the boat-coast analogy, introduced the question of the enormous speed the heaven would need for its revolution around the earth, and continued,

It is said that even with the speed of a cannon ball, one round travel of ninety thousand *li* circumference of the globe will take more than seven days. We do not know how many tens of thousands times the heavenly circumference is, compared with that of the earth. So it is doubtful whether the heaven is really possible to turn itself once a day.....To this argument I used to say, "Though this theory has its point, heavenly phenomena tell us that the heaven is actually moving. Can we not believe it?"²⁸⁾

Indeed even to Yi Ik the speed of the revolving heaven was too stupendous, yet he could not shut his eyes to those apparent motions of the stars, the moon, and the sun. With such a searching mind as he had, he surely wished he could have an opportunity to watch the heaven through a telescope.²⁹⁾ For him the reason the earth could stand in the middle of the heaven was because of the revolution of the heaven.³⁰⁾ And once put into motion, heavenly bodies could not stop their motion by themselves.³¹⁾ This reminds us of Galilean idea of circular inertia.

An able synthesizer of science though he was, we can not go into too much of the details he covered. It would be sufficient here if this section on Yi Ik can give us a point of departure for our study of Hong Tae-yong's cosmology.

Like Yi Ik, Hong considered *ch'i* as the fundamental base of material phenomena. But for Hong *ch'i* had more materialistic meaning than Yi's *ch'i*. Not only man and material substances but also human mind were made of *ch'i*.³²⁾ For him existence itself meant sensory perception. So he wrote:

Where there is sound, there is an existence. Where there is color, there is an existence. Where there is smell and taste, there is an existence. Without these four, it means without form or place. Yet it is said that such a thing exists. What kind of thing can it be? Furthermore, it is said that something exists without sound or smell. They are so-called the axle of the changes and the base of the material objects. Since there is nothing to work on, how can they be considered as the axle or the base?³³⁾

For him nothing exists beyond human sensory experiences. Here we can see Hong's empiricism was far more thorough than Yi's. He also denied the existence of the five elements, considering them as a mere expediency to explain phenomenal world.³⁴⁾

Hong Tae-yong's iconoclastic ideas did not stop there. He added more to Yi Ik's relativism by pulling China down to where Korea stood. Hong argued that no difference could be given between China and the Eastern Barbarians, i.e., the Koreans. For the Chinese the Eastern Barbarians (Koreans) were outsiders, but on the same ground the Chinese were out-

27) *Ibid.*, 3:14a-15a, "Ch'ŏn haeng kŏn"; 3:40b-41b, "Ch'ŏnmun ch'ŏndae"; 3:46a-47b, "Tamch'on"; 3:47b-48a, "Ch'ŏnsu chijŏn."

28) *Ibid.*, 3:46a-47b. "Tamch'ŏn"

29) Quoted by Hong I-sŏp, *Chosŏn kwahak-sa*, p.246.

30) Yi Ik, *op. cit.*, 3:47b-48a. "Ch'ŏnsu chijŏn"

31) *Ibid.*, 3:40b-41b. "Ch'ŏnmun ch'ŏndae"

32) Hong Tae-yong, *Tamhŏnsŏ. naejip*, 1:30.

33) *Ibid.*, 1:1a

34) *Ibid.*, 4:30b "Uisan mundap."

iders to the Korean eyes. So Hong concluded that if Confucius were born in another country, he would surely have written his *Spring and Autumn Annals* in praise of that country, and not Chou.³⁵⁾

Essentially Hong's attitude toward nature was an expansion of Yi Ik's. What Hong excelled over Yi seems to be his development of his own cosmology. Hong was certainly a man of talent in natural sciences. He wrote *Chuhae suyong* to introduce Western mathematics and astronomy into Korea, and even built his own private observatory called Nongsugak.³⁶⁾ The following episode from Pak Chi-wŏn's *Yŏrhailgi* well illustrates how Hong was devoted to astronomy.

Those instruments in the garden [of the Imperial Chinese Observatory Pak visited in Peking] looked like what I saw in the house of my friend Chŏng Sŏk-ch'i.....One day Hong Tŏkpo (Tae-yong) and I paid him a visit. Two of them talked about the ecliptic, the equator, the north pole and the south pole. Sometimes one nodded, while other occasions the other shook his head. All their talkings were too profound and difficult for me, so I fell to sleep without hearing any more. In the dawn when I woke up, they were still talking beside a dim lamp-light.³⁷⁾

Hong wrote an essay covering many ideas on natural phenomena. This essay, "Ŭisan mundap" (Dialogue in Mount Ŭi) is in the form of dialogue between a hermit in Mount Ŭi on the border of China and the Eastern Barbarians, Sirong (Oldman Practical), and a visitor from the East, Hōja (Mr. Empty). On the diurnal rotation of the earth this essay has these to say:

The earth.....its shape is spherical and rotates itself without stop.³⁸⁾

The earth rotates itself once a day. The circumference of the earth is 90,000 *li* and one day is 12 hours. To cover 90,000 of distance in 12 time-limit, the speed is faster than lightning and faster than bullet. Since the earth rotates so fast, the air presses so hard, cutting from the sky and congesting toward the earth. Thus there is downward pressure. This is the pressure on the surface of the earth and there would be no such pressure at a distance far from the earth.³⁹⁾

Mr. Empty asked—Even with the accuracy of the Westerners, they say that the heaven moves and the earth stands still. Confucius, being a sage of China, also said that the heaven moves vigorously. Then are they all wrong?

Oldman Practical answered—It is what man sees that the earth stands still and the heaven moves. There is no harm to people and meaning does not contradict in calendar-making.....Chang Tsai of Sung China had briefly mentioned on it. The Westerners also had shown diverse ideas using the analogy of a moving boat or moving coast. Yet in actual observations they solely depend upon the heavenly motion, because of its convenience in measuring. Whether the heaven moves or the earth rotates, the final effect is the same. There is no need for separate discussions. But think about the great speed of turning 90,000 *li*. The distance of the stars from the earth makes only half of the diameter (of space) and still we do not know the billions or trillions. Furthermore there are more stars beyond those stars; space finds no boundary and stars are innumerable. To talk of its one turn, the distance is beyond measurement. To think of its speed, comparison with lightning or bullet is not adequate. This cannot

35) *Ibid.*, 4:33b-37a.

36) *Ibid.*, oejip, 3:31b-32a; purok, 7b-8a, 8b-9b.

37) Pak Chi-wŏn, *Yŏn-am chip*, 15:25a. "Kwansang-dae" in *Yŏlha ilgi*

38) Hong Tae-yong, *Tamhon-sŏ, naejip*, "Ŭisan mundap," 4:19a.

39) *Ibid.*, 4:20b.

be measured, no matter how ingenious calendar-making technique may be. Nor the best speech can explain it. The irrationality of the moving heaven requires no more explanations.⁴⁰⁾

Hong's view on the diurnal rotation of the earth is also described in some details in Pak Chi-won's diary on his Peking trip. Since he was a close friend of Hong, so close that Hong once had asked him to write on his theory of the rotating earth,⁴¹⁾ it would not be stretching too much if we use his description as Hong's ideas. After discussing that the earth is spherical, Pak continues:

If the earth stays still in the heaven without moving or turning, water will be polluted and the soil will die.....The Westerners know the sphericity of the earth, yet do not say about the rotation of it. It is because they do not understand that spherical things must turn around, even though they know the earth is spherical. So I dare say that the earth's one rotation makes one month; one revolution of the sun around the earth makes one year.....⁴²⁾

Hong Tae-yong, however, did not allow the idea of the revolution of the earth around the sun, as is shown in the quotation above. He raised the possibility only to refute it. In fact, Hong's solar system was that of Tycho Brahe, putting the earth at the center of the revolutions of the sun and the moon, while making five planets to go around the sun.⁴³⁾ Of course, the only difference between the official Tychonic system and Hong's system was that Hong made the earth rotate, while Tycho stuck to the revolution of the heavens. Then why did Hong refute the revolution of the earth, giving every heavenly bodies two motions of rotation and revolution? This question is answered in Hong's essay:

In the genesis of various worlds, there were differences of heavy or light in substances and quick or slow in character. Light and quick ones can revolve as well as rotate, but heavy and slow ones cannot revolve though they rotate.⁴⁴⁾

With all of his great enthusiasm and talent in astronomy, it is no wonder that he knew all the astronomical knowledge available at the time. He knew some of Galileo's basic discoveries by the use of telescope, Western arguments on the sphericity of the earth, and the hypothesis on the rotation of the earth refuted by the Jesuits.

All Hong Tae-yong did, as far as the idea of the diurnal rotation of the earth is concerned, was to discard the theory preferred by the Jesuits and to give his support to the refuted hypothesis. In so doing he developed his unique cosmology, of which his idea on the rotation of the earth makes only a part. According to him, the universe was created by spontaneous aggregation and evolution of material element *ch'i* under nobody's command.

Originally the universe was filled uniformly with *ch'i* with no distinction between inside and outside, or between the beginning and the end. But eventually *ch'i* coagulated to form substances in the various places in space, keeping rotation. These are the sun, the moon, and the stars.⁴⁵⁾

This idea on the genesis resembles the theory of nebular hypothesis, proposed by Immanuel Kant in 1755 and elaborated later by Laplace. And Hong believed that the universe

40) *Ibid.*, 4:22a-b.

41) Pak Chi-won, *op. cit.*, 14:8a. "Hokchōng p'iltam" from his *Yōlha ilgi*

42) *Ibid.*, 14:7b-8a.

43) Hong Tae-yong, *Tamhōnsō*, naejip, "Ŭisan mundap," 4:22b.

44) *Ibid.*, 4:25b.

45) *Ibid.*, 4:19a.

will go back to its original state of *ch'i* in a distant future.⁴⁶⁾ Like many other of his fellow Confucian scholars, his historical sense on the birth and death of the world was cyclical.

His cosmology seems to have made another great leap forward when he pushed it through into the idea of infinite universe, as we can see from the latter part of the quotation (No.40) above. By its very nature, the infinite universe does not have any natural center. Therefore, though Hong gave the earth the central position of the solar system (which he called "earth system"), he denied the existence of the center of the universe.⁴⁷⁾ For him, the earth was only one of the innumerable stars.

We have already seen how Yi Ik's relativism on the global cartography freed his thinking from Sinocentrism. Now Hong Tae-yong's relativism on the infinite and evolutionary universe brought his denial of anthropocentrism. Once untied from the anthropocentric closed world view, only a short step was needed for Hong to imagine about the plurality of the different worlds for different living beings. It was obviously under the influence of Hong's cosmology that his friend Pak Chi-won wrote on the imaginary life on the moon. One summer night during his visit to China, Pak was invited by one of his Chinese friends out for a chat. There he said of the possibility of someone in the moon looking up his moon (namely, the earth for us) as Pak and his friend were doing then.⁴⁸⁾ Next day another of his Chinese friends asked Pak to elaborate his view on the other worldly lives. At this request he explained that everything on the earth is made from "dust." And man, also of the same element, belongs to "one kind of various worms."⁴⁹⁾ Then he continued that the basic element of the moon might be different from that of the earth, thus allowing possibilities of the existence of such living forms as water-man or fire-man as distinguished from the air-man in this world.⁵⁰⁾

This study was initiated to examine whether Hong Tae-yong's idea of the diurnal rotation of the earth was a simple diffusion of Copernican theory into Korea or his own "discovery." In the process of my research I found that the Copernican idea was well known not only to Hong but also to Yi Ik, who flourished half a century prior to Hong, but not as an established theory but as a wrong hypothesis. Hong embraced this supposedly wrong hypothesis, while Yi Ik after some sign of hesitation rejected it. This much was Hong Tae-yong's "discovery."

More importantly Hong developed a complete cosmology of his own in his essay "Ŭisan mundap," which I examined briefly. And it is demonstrated that Hong's cosmology can be characterized by his relativism.....the relativism, which Hong shares with Yi, that was born at the introduction of the Western sciences into Korea, particularly the new cartography of the spherical earth which allowed no geographical center on the globe. Already in Yi Ik we saw protonationalism in his refusal to give the central position to China and his

46) See Chōng Chīm-sōk, *op. cit.*, pp.215-6

47) Hong Tae-yong, *Tamhōn-sō*, "Ŭisan mundap" 22b.

48) Pak Chi-wōn, *op. cit.*, 12:79b-80a. Item on August 10 from "T'aehak yugwan-rok" in *Yō'ha ilgi*. Hong's own view on the plurality can be found in his book cited above, "Ŭisan mundap" 23b-24b.

49) Pak Chi-wōn *op. cit.*, 14:6b-7a.

50) *Ibid.*, 14:7a.

ready acceptance of Western scientific knowledge, a trademark of *sirhak* scholarship.

Yi Ik duly rejected Christianity, but received Western astronomy with enthusiasm. In so doing, he accepted "Christianized science," that is, the anthropocentric closed world view. When Joseph Needham concluded that the Jesuits in China "retarded, rather than advanced, Chinese astronomy,"⁵¹⁾ he was pointing exactly at such influences as Yi Ik had received. In contrast to Yi Ik, Hong Tae-yong developed his kind of new cosmology on the basis of new informations he learned from the Jesuit writings. In Hong's cosmology Yi Ik's anthropocentric closed world view was replaced with a new idea of infinite evolutionary universe, where the earth lost its central position and man lost his status as the only intelligent being of the world.

Historical significance of Hong Tae-yong's cosmology in general and his theory of the diurnal rotation of the earth in particular, however, should not be overemphasized. For one thing, Hong's ideas were unnoticed by his Korean contemporaries, not because the intellectual milieu of the times were hostile to his views, but because his ideas were irrelevant to the intellectual climate of the late Yi Korea. The idea of the spherical earth seems to have given a nudge for Korean scholars, particularly of *sirhak* school, toward proto-nationalistic self awakening, searching for intellectual independence from cultural Sinocentrism. That, however, was as far as they could go. And this was already accomplished with Yik.

Hong Tae-yong's ideas remained solely as Hong's own ideas, no matter how revolutionary they may sound to us who are familiar with the over-dramatized episodes of Galileo and Bruno. Here lies the significance of Hong's ideas in the study of Korean history.....that they are merely historically significant for us today. They were not revolutionary ideas, and this very fact is an evidence of how different the traditional Korean view of nature was from that of the Europeans.

GLOSSARY

Chang Tasi	張 載	ch'i	氣
Ch'ing	清	Chōng Sōk-ch'i	鄭 石 癡
Chu Hsi	朱 熹	<i>Chuhae suyong</i>	籌解需用
Hōja	虛 子	Hong Tae-yong	洪 大 容
ki	氣	Kim Si-jin	金 始 振
li	理	<i>Li-hua hsi-chuan</i>	曆法西傳
Liu Sung-ling	劉 松 齡	Nam Kuk-kwan	南 克 寬
Nongsu-gak	籠 水 閣	Pak Chi-wōn	朴 趾 源
PaoYu-kuan	鮑 友 管	sirhak	實 學
Sirong	實 翁	Sung	宋
Tōkpo	德 保	Ūisan mundap	鰲山問答
<i>Yōrha ilgi</i>	熱河日記	Yi Hwang	李 滉
Yi I	李 珥	Yi Ik	李 穡
Yu-P'o mundap	劉鮑問答		

51) Needham, *op. cit.*, Vol. II, p.496 fn.