

How Did a Confucian Scholar in Late Joseon Korea Study Mathematics? HWANG Yunseok 黃胤錫 (1729-1791) and the Mathematicians of Late Eighteenth-Century Seoul*

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Introduction

From the late seventeenth century, when the Qing Dynasty of China became stabilized, numerous Western texts were introduced into late Joseon society. This process sparked enthusiasm for Western learning among the literati intellectuals to such an extent that “there was no prominent government official or Confucian scholar who had not read Western texts” 西洋書, 自宣廟末年, 已來于東, 名卿碩儒, 無人不見.¹ Hwang Yunseok was an important intellectual whose activities exemplify the circulation of Western texts in late eighteenth-century Joseon society. His journal, titled *Yijae nango* 頤齋亂藁, is a voluminous record from 1738 to 1791 that covers diverse academic interests, including studies on Confucian classics, history, astronomy, geography, and phonology.

But what attracts our attention most among the contents of *Yijae nango* from the perspective of the history of scientific ideas in late Joseon period are the records about calendrical astronomy and mathematics. Indeed, many scholars at the time, including Hwang, were discussing the excellence of Western science, both in matters of mathematics and in actual observations.² Therefore, the task of analyzing the process of Hwang’s mathematical study as recorded in his journal is at once an investigation into the ideas about mathematics prevalent among late Joseon intel-

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¹ An Jeongbok 安鼎福, “Cheonhak go” 天學考 [A discussion of the learning of heaven], *Sunam jip* 順菴集 [Complete works of Mr. Sunam (An Jeongbok)], *gwon* 17, 1a, in (photocopy edition) Institute for the Translation of Korean Classics (ed.), *Hanguk munjip chonggan* 韓國文集叢刊 [Comprehensive collection of Korean literary works], hereinafter *HMC*, vol. 230, 138.

² Koo Mhan-ock, “Joseon hugi ‘jayeon insik’-ui byeonhwawa ‘silhak’” 朝鮮 後期 自然認識의 變化와 實學 [Changes in the concept of ‘nature’ and the ‘solid learning’ in late Joseon period], *Dasi, silhak-iran mueosinga* 다시, 實學이란 무엇인가 [Again, what is the ‘solid learning’?] (Seoul: Pureunyeoksa, 2007), 191-97.

lectuals and an examination of their attitudes toward the newly introduced Western mathematics.

According to Yi Deokmu's 李德懋 (1741–1793) words, recorded in Hwang's *Journal* in 1778, there were people in Seoul who specialized in Western mathematics. They included Seo Myeong-eung 徐命膺 (1716–1787) and his son Hosu 徐浩修 (1736–1799), Yi Byeok 李檠 (1754–1786), and Jeong Hujo 鄭厚祚.³ Considering the personal connections of those mentioned in Yi Deok-mu's account, the group of professional researchers in Western mathematics included the following: first, Seo Myeong-eung's Dalseong Seo 達城 徐 clan; second, members of the Seongho 星湖 school of the "Near Seoul Southerner faction" (*geungi namin gye* 近畿南人系) centered on Yi Byeok, Yi Gahwan 李家煥 (1742–1801), and Jeong Yakyong 丁若鏞 (1762–1836),⁴ and, third, the brothers Jeong Cheoljo 鄭結祚 (1730–1781) and Hujo 鄭厚祚 as well as the "Northern Learning" (*Bukhak* 北學) school members such as Hong Daeyong 洪大容 (1731–1783) and Bak Jiwon 朴趾源 (1737–1805), who were friends with the Jeong brothers.

Hwang Yunseok was a member of the "Westerner–Doctrines of the Elder faction" (*seoin noron gye* 西人老論系), the ruling political group in the late Joseon Dynasty. He studied under Kim Wonhaeng 金元行 (1702–1772), the leader of the "Doctrine of Seoul" school (*nakron* 洛論) of the "Doctrines of the Elder faction." Owing to this background, Hwang befriended several prominent members of the political circle and academia at the time. After failing the civil service examination, he was appointed to a government office at Seoul in 1766 by recommendation, and associated with various people during his many years in Seoul. When he studied at the prestigious government school Sungkyunkwan 成均館, and served various subordinate official posts of the central administration, he had a large circle of friends amongst other Confucian scholars. They included important intellectuals in the history of science and the history of thought in late Joseon period. Among them were representatives of literati astronomers in late eighteenth century such as Jeong Cheoljo, Hong Daeyong, Seo Hosu, and Yi Gahwan. In this sense, Hwang Yunseok is an attractive character to study from the perspective of history of mathematics as well.

Yet until recently there has not been a study devoted to Hwang Yunseok's mathematics. Although Hwang's mathematical study drew attention early on from

³ *Yijae nango* 頤齋亂藁, *gwon* 27, Musul 戊戌 (1778)/11/26, in the Academy of Korean Studies (ed.), *Yijae nango*, hereinafter YN, *gwon* 27, Musul (1778)/11/26, vol. 5, 346: 李德懋言, 近日京中, 以西學數理專門者, 徐命膺及子浩修, 而又有李檠, 卽武人格之弟也。廢舉不出, 爲人高潔, 方居紵洞。又有鄭厚祚, 卽文官結祚之弟也, 專意於天下輿圖之學, 嘗言大清一統志輿圖固精, 而猶不如大清會典所載者云。

⁴ About the relationship between Yi Beok, Yi Gahwan, and Jeong Yakyong, see Kim Okhui 金玉姬, *Hanguk Cheonjugyo sasangsa I—Gwangam Yi Byeok-ui seohak sasang yeongu* 韓國天主教思想史 I—曠菴李檠의 西學思想研究 [A history of Korean Catholic thought I—A study on Yi Byeok's Western Learning] (Seoul: Sunkyoui maek, 1990).

a few historians of Korean mathematics,⁵ it is difficult to conclude that sufficient attention has been given to his mathematics. Some work has been done on the relationship between Park Yul's 朴繡 (1621–1668) *Fundamentals of Mathematical Learning* (*Sanhak wonbon* 算學原本) and Hwang Yunseok's *Origins of Mathematical Learning* (*Sanhak bonwon* 算學本源).⁶ Hwang Yunseok's mathematics was also mentioned in the context of discussing the introduction of a Western mathematical text, titled *Essence of Numbers and Their Principles* (*Shuli jingyun* 數理精蘊), into late Joseon society.⁷ More recently, *Introduction to Mathematical Learning* (*Sanhak ipmun* 算學入門) and *Origins of Mathematical Learning*, the two representative mathematical texts authored by Hwang Yunseok included in the *Lisu shinpyeon* 理數新編, have been translated into Korean,⁸ based on which an overview of Hwang's mathematics has been published.⁹ Yet, little work has been done on such important aspects of Hwang's mathematics as the basic motivation that initially led him to focus on mathematics, the scope and level of his mathematical research, and the goals he was pursuing.

This article examines the course of Hwang Yunseok's mathematical study—how it came about and how it progressed. By examining the circumstances surrounding the community of mathematicians in the late eighteenth century and the scholars with whom Hwang interacted during his mathematical studies, as were recorded in Hwang's *Journal*, this article also investigates who played a central role in mathematical studies in late Joseon period and how such studies were carried out. This will serve as a foundation for a better understanding of the history of mathematics of late Joseon period.¹⁰

⁵ Kim Yong-un and Kim Yongguk, *Hanguk suhaksa* 韓國數學史 [A history of mathematics in Korea] (Seoul: Gwahakgwa ingan sa, 1977 [revised: Yeolhwadang, 1982]), 253–56.

⁶ Kim Yeong-uk, Hong Seongsa, and Hong Yeonghui, “Bak Yul-ui *Sanhak wonbon*” 朴繡의 算學原本 [Bak Yul's *Sanhak wonbon*], *Hanguk suhaksa hakhoeji* 韓國數學史學會誌 18, no. 4 (2005), 1–16.

⁷ Hong Yeonghui, “Joseon sanhakgwa *Shuli jingyun*” 朝鮮 算學과 數理精蘊 [Mathematics of Joseon period and the *Shuli jingyun*], *Hanguk suhaksa hakhoeji* 19, no. 2 (2006), 25–46.

⁸ Hwang Yunseok (translated by Kang Shinwon and Jang Hyewon), *Sanhak ipmun* 算學入門 (Kyousa, 2006); Hwang Yunseok (translated by Kang Shinwon and Jang Hyewon), *Sanhak bonwon* 算學本源 (Kyousa, 2006).

⁹ Jang Hyewon, “Sanhak ipmun, Sanhak bonwoneul tonghae bon Yijaeui suhak yeongu” 算學入門, 算學本源을 통해 본 頤齋의 數學研究 [A study of Yijae's mathematics through *Sanhak ipmun* and *Sanhak bonwon*], *Yijae Hwang Yunseokui hakmungwa sasang* 頤齋 黃胤錫의 학문과 사상 [Hwang Yunseok's learning and thoughts] (景仁文化社, 2009).

¹⁰ Jun Yong Hoon, “19segi Joseon suhak-ui jijeok pungto—Hong Gilju(1786–1841)-ui suhakgwa geu yeonwon” 19世紀 朝鮮 數學의 知的 風土—洪吉周의 數學과 그 淵源 [Intellectual environment surrounding mathematics in nineteenth-century Joseon—mathematics of Hong Gilju (1786–1841) and its origin], *Hanguk gwahaksa hakhoeji* 韓國科學史學會誌 26, no. 2 (2004), 275–314, contains detailed discussion about intellectual environment and issues of mathematics in late eighteenth- and early nineteenth-century Korea.

1. The Motive for and the Sequence of Hwang's Study of Mathematics

Hwang Yunseok is known for “broad learning (*bakhak* 博學).” When he was reading *Cai Shen's* 蔡沈 *Commentary of the Classic of Documents* (*Shuzhuan* 書傳) for the second time at around the age of ten, his father, Hwang Jeon 黃壇 (1704–1771), encouraged him to study harder, pointing out that some of the prominent scholars of the country had by an early age completed studying annotations on the meridian stars (*jungseong* 中星), “Ki sambaek” 稽三百, the armillary spheres (*kihyeong* 璣衡), and the harmonics (*yulryeo* 律呂) contained in *Cai Shen's Commentary*. With his father's encouragement, Hwang delved into those topics and made some achievements in these subjects. Later on, he expanded his interests to “the doctrines of the *Yijing*, the Great Plan (*hongfan* 洪範) [chapter of the *Classics of Documents*], (Shao Yong's 邵雍) *Supreme Rules Governing the World* (*Huangji jingshi* 皇極經世), harmonics, calendrical astronomy, and mathematics (*yeokbeom gyeongse yulryeok sansu ji seol* 易範經世律曆算數之說).¹¹ It is in this context that Hwang came to declare that his main academic interest lay in the *Complete Collection on Nature and Principle* (*Xingli daquan* 性理大全, *Complete Collection* hereinafter).¹²

Hwang was already deeply fascinated by the *Complete Collection* by his late teens. According to the records of 1745 in the *Yijae nango*, he mentioned, “I copied a few books of the *Complete Collection* last month and started having an eye problem because of this. I am worried that I have yet to be cured of it.”¹³ Indeed, journals from this time reveal that Hwang added a few brief comments of his own on various books included in the *Complete Collection* such as the *Supreme Rules Governing the World*, the *Introduction to the Study of the Yijing* (*Yixue qimeng* 易學啓蒙), and the *New Book on Harmonics* (*Lülu xinshu* 律呂新書).

In fact, Hwang recalled that only after delving into the *Complete Collection* had he come to realize that “the teaching of the sages” existed outside of the world of studies for the civil service examination.¹⁴ He was in his late teens when this happened. He thought long and hard about “the doctrines of the *Yijing*, the Great Plan, the River Diagram (*Hetu* 河圖) and the Luo Writing (*Luoshu* 洛書), harmonics, calendrical astronomy, and phonology (*yeokbeom harak yulryeok seongwun ji seol* 易範河洛律曆聲韻之說) contained in the *Complete Collection*, and when he came

¹¹YN, gwon 2, Jeongchuk 丁丑 (1757)/09/05, vol. 1, 179. “小生十餘歲，再讀書傳，父親教之曰，我國先賢少日，多於中星稽三百璣衡律呂諸註究恆者，倘得如此否。小生遂生妄意，究索有年，不無一班之見，故復因此逶迤旁通，轉及於易範經世律曆算數之說，殆悉汎濫。近雖廢閣，而聞有此等書，見有此等書，輒未免起念如舊。”

¹²*Ibid.* “小生所視，只是性理大全，而其中所編經世則非全書，洪範則未成之書，雖曰畧約究觀，豈可謂之無疑乎。”

¹³YN, gwon 1, Eulchuk 乙丑 (1745), vol. 1, 15.

¹⁴YN, gwon 1, Mujin 戊辰 (1748), vol. 1, 70. “日余讀性理大全書，始知聖賢之學，別在科學之外。”

to an understanding of even a very small matter, he would be so exhilarated that he would jump with joy and even forget to eat and sleep. In addition, Hwang deepened his understanding of the *Complete Collection* through extensive study of various subjects ranging from geographical treatises (*jiji* 地志), mathematics, studies of characters (*jahak* 字學), rules of poetry (*sigyeok* 詩格), military formations (*byeongjin* 兵陣), paintings (*hwapum* 畫品), and sheet music (*geumbo* 琴譜) to various arts (*japye* 雜藝). Commenting on such efforts, Hwang expressed his pride in his endeavor, saying that although he had yet to reach the point where he “found something profound and achieved something far,” he had not been without achievements, either.¹⁵ In sum, in his teens Hwang focused all his energy on elucidating the *Complete Collection*,¹⁶ and such efforts lasted for the rest of his life.

Along with his investigation into the *Complete Collection*, Hwang concurrently worked on harmonics and calendrical astronomy. From early on, Hwang started analyzing the “Treatise on Pitchpipes and the Calendars” (*Lüli zhi* 律曆志) of the *History of Han Dynasty* (*Hanshu* 漢書) clause by clause.¹⁷ He thought that the *History of Han Dynasty* included many incorrect statements and misused words, and believed that the “Treatise on Pitchpipes and the Calendars” even required correction.¹⁸ While correcting this book, he used various methods such as inference (*uichu* 意推), mathematical validation, and reasoning from circumstantial evidence, and was confident that other people could also approach the “Treatise on Pitchpipes and the Calendars” easily through such methods.¹⁹

Hwang often reminisced that among the achievements of the elders in his family and colleagues, he paid his utmost attention to the subject of “the *Yijing*, the Great Plan, harmonics, and calendrical astronomy (*yeokbeom yulryeok* 易範律曆).”²⁰ In-

¹⁵ *Ibid.* “遂於是書所載易範河洛律曆聲韻之說，大覃思歷歲，頗覺一二窺班，乃踊躍喜悅而忘寢食者，又不日月，則外此書，共如地志算術字學詩格兵陣畫品琴譜雜藝，蓋亦不無旁及，而碍者通，疑者信，晦者明。噫，易繫所謂鉤深致遠，則吾豈敢然，亦不可謂之無得也。”

¹⁶ *Ibid.* “向余之勞神焦思，心欲究闡是書者...”

¹⁷ “Jeonhanseo yulryeokji hae” 前漢書律曆志解 [An explanation about the “Treatise of Pitchpipes and the Calendars” in the *History of the Former Han Dynasty*], YN, gwon 1, Byeonggin 丙寅(1746), vol. 1, 33–36; *ibid.*, 40–41; *ibid.*, 41–42; *ibid.*, 45–47; *ibid.*, 48–49; *ibid.*, 49–54; “Jeonhanjihae” 前漢志解 [An explanation about the “Treatises” in *History of the Former Han Dynasty*], YN, gwon 1, Mujin 戊辰(1748), vol. 1, 78–80.

¹⁸ “Yeo Yu jeongmin Yeongri seo—Eulsa” 與柳定民永履書乙巳 [A letter to Yu Yeongri in the Eulsa year], *Yijae yugo* 頤齋遺藁 [Posthumous works of Mr. Yijae], gwon 8, 33a (HMC, vol. 246, 181). “曾閱漢書，其有錯簡訛字，如律曆志者，不免爲之釐正。”

¹⁹ “Je gajang Goryeo Seonmyeongryok ji” 題家藏高麗宣明曆志 [A preface to the “Treatise on the *Xuanming li* calendar” in the *History of Goryeo Dynasty* in our family collection], *Yijae yugo*, gwon 12, 1b (HMC, vol. 246, 259). “余於此般處，蓋嘗病之，既校正漢律曆志，或以意推，或以算驗，或又旁證他書，庶後我而覽者，可易通透。”

²⁰ “Yeo Kim jinsa Shijun seo—Eulhae” 與金進士時準書己亥 [A letter to Kim Shijun in the Eulhae year], *Yijae yugo*, gwon 9, 13a (HMC, vol. 246, 195). “抑平日所承於父師者，元自不少，而喪威奔走，拋荒強半，其中最留心易範律曆諸說，又十忘八九...”

deed, Hwang had made an ambitious plan to explore the connection between heaven and man (*cheon-in ji je* 天人之際) as a young child and studied extensively from “the doctrines of the *Yijing*, the Great Plan, harmonics, calendrical astronomy, characters and numbers (*yeokbeom yulryeok seosu ji seol* 易範律曆書數之說)” and “the records on mountains and rivers, prefectures and towns, and their customs (*sancheon gunhyeon pungsok ji ji* 山川郡縣風俗之志)” to “the discussions about *yin*, *yang*, *guishen*, mind and nature, and emotion and intention (*eumyang guisin simseong jeongeui ji byeon* 陰陽鬼神心性情意之辨)”. His taste for broad learning even led him to study what were generally considered unworthy, miscellaneous subjects, and later he recalled that he had come to realize the danger of studying such subjects, thanks to advice from his colleagues.²¹ We can learn from this that from early on Hwang had been very interested in the subject of the relationship between heaven and man, and that he focused on harmonics, calendrical astronomy, and mathematics to tackle the subject. Those three fields were very closely related to each other in the traditional system of learning. Hwang believed that if he could tackle mathematics, it would naturally lead to solving questions in harmonics and calendrical astronomy as well.²² It is with this understanding that Hwang embarked on his mathematical studies.

In what order did Hwang Yunseok study mathematical texts? Thus far, it has been confirmed that he first became interested in mathematics as he was studying the *Complete Collection*, and that he studied Zhu Shijie’s 朱世傑 *Introduction to Mathematics* (*Suanxue qimeng* 算學啓蒙), one of the traditional mathematical texts, and that he approached various Western texts as an extension of such a study. Later, Hwang perused Western mathematical and astronomical texts, the *Essence of Numbers and Their Principles* (*Shuli jingyun* 數理精蘊) and the *Thorough Investigation of Astronomical Phenomena* (*Lixiang kaocheng* 曆象考成), and then made a summary of the two books in the *Brief Account of the Arc and Hypotenuse Method* (*Hohyeon yakseol* 弧弦約說, written in 1768).²³ In this book, Hwang recalled that he had learned “the method of mutual relationship between the method of arc and sagitta, and the method of base, leg, and hypotenuse (*hosi gugohyeonsangu ji seol* 弧矢勾股弦相求之術)” through Zhu Shijie’s 朱世傑 *Introduction to Mathematics*, Zhang Tingyu 張廷玉 (1672–1755)’s “Treatise on Calendrical Astronomy” of the *Ming History* (*Mingshi lizhi* 明史曆志) and Shen Gua’s 沈括 *Brush Talks of Dream Brook* (*Mengxi bitan* 夢溪筆談) and Yang

²¹ “Su Hong geukji Nakjin seo” 訓洪克之樂真序 [Preface responding to Hong Nakjin], *Yijae yugo*, gwon 11, 4b (HMC, vol. 246, 236). “自余之少也，竊不自揣，妄擬一究天人之際，其於易範律曆書數之說，山川郡縣風俗之志，以至陰陽神鬼心性情意之辨，謂未始留念則不可也。顧乃駸駸於流於雜，而及夫就質於師教，始乃瞿瞿於覺其爲可病。”

²² “Je Suri jeongon sabon” 題數理精蘊寫本 [Preface to a manuscript copy of the *Shuli jingyun*], *Yijae yugo*, gwon 12, 11b (HMC, vol. 246, 264). “明乎數，鮮不括乎律曆。”

²³ “Hohyeon yakseol” 弧弦約說 [Brief account of the arc and hypotenuse method], YN, gwon 11, Muja (1768)/09/10, vol. 2, 235–238.

Hui's *Mathematical Methods* (Yang Hui suanfa 楊輝算法). He confessed that he acquired specific methods through Li Zhizao's 李之藻 *Illustrated Explanation of the Sphere and the Astrolabe* (Hungai tongxian tushuo 渾蓋通憲圖說) and *Meaning of Compared Figures Inscribed in a Circle* (Yuanrong jiaoyi 圓容較義), Xu Guangqi's 徐光啓 *Principles of the Base and Leg of the Right-angled Triangle* (Gougu yi 句股義), Zhou Ziyu 周子愚's *Explanation of the Gnomon* (Biaodu shuo 表度說), etc.²⁴ This indicates the order in which Hwang's study of mathematics progressed.

In 1758, at the age of 30, Hwang obtained the *Instructions for Calculation in Common Script* (Tongwen suanzhi 同文算指) by Li Zhizao.²⁵ According to his journal, in 1761, Hwang stayed at the house of No Pil's uncle in Yuchon and discussed the subject of mathematics with a person named Jo Gwangsa every night.²⁶ In the first month of 1762, Hwang tried hard to borrow the *First Collection of Heavenly Learning* (Tianxue chuhan 天學初函).²⁷ This is significant because this collection included various books on Western mathematics such as the *Elements of Geometry* (Jihe yuanben 幾何原本), the *Instructions for Calculation in Common Script*, the *Methods and Principles of Measurements* (Celiang fayi 測量法義), the *Meaning of Compared Figures Inscribed in a Circle*, and the *Principles of the Base and Leg of the Right-angled Triangle*. In the fourth month of the same year, he heard that he could obtain the *Elements of Geometry* from Kim Pileui 金必義²⁸ and wrote a letter to Kim in the sixth month asking if he could borrow the book. The letter suggests that Hwang was accepting his seniors' view that "the *Elements of Geometry* sheds bright light on numbers and thus should not be neglected just because it was authored by a Westerner."²⁹

In 1766, Hwang heard from someone that Seo Hosu kept "the Table of the Seven Luminaries" (Chiryō pyō 七曜表) at home.³⁰ A few days later, he asked Jeong Donggi 鄭東驥 if Seo indeed had the Table at home. After Jeong answered that

²⁴ Ibid, 235.

²⁵ YN, gwon 2, Muin戊寅(1758), vol. 1, 193. "又得李之藻[藻]同文算指, 觀之."

²⁶ YN, gwon 3, Sinsa辛巳(1761)/09/13, vol. 1, 267. "余姑留柳村, 觀彥晦兄試券, 每夕就其伯丈宅以宿, 與士仰談話, 趙君匡師, 逐日來問, 算學疑義."

²⁷ "Yeo Yi Pilseon Jeongeon hyeongje seo" 與李弼善正言兄弟書 [A letter to Yi Pilseon and his brother], YN, gwon 3, Yimo壬午(1762)/01/28, vol. 1, 273. "記昔己卯冬, 許得天學初函, 以爲傳借, 豈其書果在玉郎尊府, 與流聞不差耶. 然則或易得窺一二, 而亦何可必也."

²⁸ YN, gwon 3, Yimo (1762)/04/10, vol. 1, 276. "性之以幾何原本, 方有可得處..." "Seongji 性之" is Kim Pileui's name.

²⁹ "Yeo Kim Euibaek seo" 與金宜伯書 [A letter to Kim Uibaek], YN, gwon 3, Yimo (1762)/05/19, vol. 1, 281. "曾求利氏原本, 未知已來而一覽否. 前輩多言, 此書於理數, 大有相發, 不可以西方遠人而忽之. 兄既熟之, 則何惜一糟粕不令如弟者更飽耶. 兄前已惠諾, 中心藏之久矣. 茲輒討便, 以去踐之, 幸甚."

³⁰ YN, gwon 6, Byeongsul丙戌(1766)/03/05, vol. 1, 536. "李子容座上, 聞徐正言浩修(命膺子, 命善姪)家有七曜表(此人精此於法云)."

Seo should have the book in possession,³¹ Hwang asked Park Hwijin 朴徽鎮, who had an acquaintance with Seo Hosu's family and was from the same hometown, if he could borrow Seo's copy of the Table. To Park Hwijin, who visited his house, Seo responded that he would meet with Hwang Yunseok and discuss the book before deciding whether to lend it to him.³² The next day, Hwang paid a visit to Seo Hosu at his residence. After meeting Seo, who had mastered Western calendrical science through the *Origins of Pitchpipes and the Calendar* (*Lüli yuanyuan* 律曆淵源), the *Elements of Geometry*, and the *Instructions for Calculation in Common Script*, Hwang lamented that "a man must live in the capital."³³ Ten days later, as an extension of this meeting, Hwang paid a visit to Seo Myeong-eung, Hosu's father, to discuss several matters of calendrical science.³⁴

At the previous meeting with Seo Hosu, Seo asked Hwang about the latter's level of understanding in mathematics, explaining that if Hwang, anxious to read the "Table of the Seven Luminaries," was to understand the book at all, he should be well versed in mathematics in the first place. Hwang's answer to this question reveals the mathematical texts that he had read thus far. These were the *Introduction to Mathematics*, the *Instructions for Calculation in Common Script*, the *Elements of Geometry*, the *Principles of the Base and Leg of the Right-angled Triangle*, and the *Meaning of Compared Figures Inscribed in a Circle*. Among these, apart from the *Introduction to Mathematics* by Zhu Shijie, which is a text of traditional Chinese mathematics, all other books were Western texts that were written in China after Matteo Ricci. They were all included in the "Part of Concrete Things" (*Qibian* 器編) of the *First Collection of Heavenly Learning* (*Tianxue chuhan* 天學初函) compiled by Li Zhizao.³⁵

This can be reconfirmed by the subsequent conversation between Hwang and Seo Myeong-eung. Up to this point, Hwang recalled, he had read the *Illustrated*

³¹ YN, gwon 6, Byeongsul (1766)/03/09, vol. 1, 541. "余問聞今清人時憲曆法之七曜表在此家云, 然否。鄭君曰, 此人應儲此冊矣。"

³² YN, gwon 6, Byeongsul (1766)/03/14, vol. 1, 545. "頃日, 余語朴上舍徽鎮曰, 久聞徐參判父子(子浩修正言教山林竄宥)盛名, 欲一見而未果。近聞正言旁通象數, 家有西洋曆法七曜表, 卽今清人時憲法也, 未知能借出否。蓋朴上舍以彼家相親往來故也。余自果川歸, 則朴上舍果言, 近日往徐正言家, 問有七曜表否, 正言驚問曰, 何以知之。吾答曰, 有一親舊聞知欲得借見矣。正言曰, 誰也。吾曰, 同道人黃上舍胤錫, 自是往來漢上者, 博學旁通, 切欲借此冊一見矣。正言笑曰, 其人苟來訪我, 相議此冊說話, 則借之不難, 其於他人, 則曾不借之矣。其言如此, 君意如何。余答朴上舍曰, 其父子願一見久矣, 且老親曾有所命, 一見足矣。"

³³ YN, gwon 6, Byeongsul (1766)/03/15, vol. 1, 545. "朝飯後, 轉訪其西北鄰徐參判命膺家, 則徐令方在刊籍中, 出次莘村亭子未歸, 其子正言浩修在矣。其人丙辰生, 頗有學識熟於經書, 又通西洋曆法。如數理精蘊·曆象攷成, 此二書又并律呂正義者, 謂之律曆淵源, 合一百卷。七曜表, 卽曆象攷成中一目也。又如幾何原本·同文算指, 以至八線真數, 三角比例, 莫不涉獵。信乎人不可不居京華也, 使生遐方, 雖有敏才, 安能直探捷路耶。"

³⁴ YN, gwon 6, Byeongsul (1766)/03/25, vol. 1, 550–552.

³⁵ For the list of books included in the "Qibian" of the *Tianxue chuhan*, see, Nicolas Standaert (ed.), *Handbooks of Christianity in China, Volume 1: 635–1800* (Leiden: Brill, 2001), 692–693.

Explanation of the Sphere and the Astrolabe, the *Hydraulic Methods of the Great West* (Taixi shuifa 泰西水法), the *Explanation of the Gnomon*, the *Principles of the Base and Leg of the Right-angled Triangle*, and the *Meaning of Compared Figures Inscribed in a Circle*. Hwang said he had read these books intensively, and even perused a manuscript of the *Elements of Geometry*.³⁶ Hwang also wanted to borrow the *Essence of Numbers and Their Principles* and the *Thorough Investigation of Astronomical Phenomena* (Lixiang kaocheng) at Seo Hosu's house, and even wished to purchase them despite Seo Hosu's advice against it.³⁷

In 1768, Yi Junghae 李重海, Yi Wunhae's brother, told Hwang he would lend him the *Elements of Geometry*, housed then at Yi Yonghyu's (李用休 1708–1782) place.³⁸ Upon hearing this, Hwang wrote several letters to Yi Junghae asking him to send him the book.³⁹ When Yi Junghae paid a visit to Yi Yonghyu, the latter told the former that the *Elements of Geometry* in his possession was actually a book his son Yi Gahwan had borrowed from his brother-in-law, Jeong Cheoljo, for a month of perusal and had already returned it to the owner. Yi Junghae then visited Jeong Cheoljo, but Jeong explained to Yi that the book in question was not the *Elements of Geometry* but the *Essence of Numbers and Their Principles*, which belonged to Yi Deokseong 李德星, an official at the Royal Bureau of Astronomy (Gwansang gam 觀象監). Jeong added that he had heard about Hwang from early on and expressed his wish to meet Hwang in person to discuss the delicacy of mathematics, and also said he would lend Hwang the complete set of the *Essence*.⁴⁰ The meeting between Hwang and Jeong finally came about, thanks to help from Yi Junghae, who was Jeong's close friend,⁴¹ and thanks to Yi, Hwang managed to obtain a volume of the *Essence*, a property of Yi Deokseong that was in Jeong

³⁶ YN, gwon 6, Byeongsul (1766)/03/15, vol. 1, 551. “數年來，僅得西洋文字若干，如渾蓋通憲·泰西水法·表度說·句股義·圓容較義等文字，已常熟閱，而幾何原本，則只看寫本，方借唐本，受諾於其主耳。”

³⁷ YN, gwon 6, Byeongsul (1766)/03/25, vol. 1, 550. “余曰，徐當更為借看矣，然有可以買處，則好矣。正言曰，此是閑漫冊子，何為必欲入手也。余曰，自少所欲見者故也。”

³⁸ YN, gwon 11, Muja 戊子(1768)/08/04, vol. 2, 208. “潤父言，李上舍用休家，在小貞陵洞，有幾何原本一帙，徐當躬往借示。”

³⁹ “Yeo Yi Yunbu seo” 與李潤父書 [A letter to Yi Yunbu], YN, gwon 11, Muja (1768)/08/8, vol. 2, 213. “所諾貞洞之行，果得原本否。”; YN, gwon 11, Muja (1768)/08/16, vol. 2, 217. “送書李潤父，更請幾何原本借示...潤父伯氏代答書來，要送馬，潤父騎往貞洞李上舍用休家，借送幾何原本一帙”; YN, gwon 11, Muja (1768)/08/17, vol. 2, 218. “送奴馬于李潤父，申以書懇請，往李用休家，借送幾何原本一帙。”

⁴⁰ YN, gwon 11, Muja (1768)/08/17, vol. 2, 218. “李潤父歷訪李用休，覓幾何原本則云，其子家煥得諸其妻娼鄭詰祚，看過一月還之。乃訪鄭詰祚，覓之則云，非幾何原本，乃數理精蘊，而觀象官李德星所有也。借留多時，渠亦聞余先聲，切願一面，商議數理之微，又許盡借送示。”

⁴¹ YN, gwon 11, Muja (1768)/08/23, vol. 2, 226. “朝食後出番，歷訪李子用潤父兄弟，因與潤父，偕行至邵洞之最高處，訪鄭糸判運維(曾經戶曹糸判，新遞都承旨云)家，與其長子詰祚相話。蓋潤父與鄭君親熟，而要余往也。”

Cheoljo's possession at the time.⁴²

A little while later, Hwang met Jeong Cheoljo and together they had a look at and discussed the *Essence* and the *Thorough Investigation of Astronomical Phenomena*. During this meeting, Hwang returned what he had previously borrowed from Jeong, and borrowed another volume in the Final Sections (*mobu* 末部) of the *Essence* titled "Explanation of the Proportional Compass" (*Birgui jie* 比例規解).⁴³ Later, Hwang borrowed some volumes of the *Essence* and the *Thorough Investigation* from Jeong Cheoljo as well.⁴⁴ After reading the *Essence* and the *Thorough Investigation*, Hwang understood that their main focus was on "the use of lines" (*yongseon* 用線) and "the proportions" (*birye* 比例).⁴⁵ Hwang came to see that the traditional Chinese "method of mutual relations between base, leg, and hypotenuse of the right-angled triangles" (*gugohyeon sanggu ji seol* 勾股弦相求之術) had limitations in their uses, whereas Western trigonometry could encompass all countless changes of the three sides and angles (right, acute, and obtuse) of the right-angled triangles. This was something, he exclaimed, that could be described indeed as "what comes after is more accurate (*huchulja gyo* 後出者巧)."⁴⁶ Despite this assertion, Hwang showed an attitude of maintaining the traditional classicism by saying that the scope of Western knowledge did not depart from the *Mathematical Classic of the Gnomon of the Zhou* (*Zhoubi suanjing* 周髀算經), and its principles were all contained in the words of the ancients.⁴⁷

Jeong Gyeongsun 鄭景淳 (1721–1795), a member of the "Doctrine of the Junior" (*Soron* 少論) faction, was another important person that Hwang associated

⁴² YN, gwon 11, Muja (1768)/08/17, vol. 2, 218. "乃訪鄭詰祚覓之則云, 非幾何原本, 乃數理精蘊, 而觀象官李德星所有也, 借留多時, 渠亦聞余先聲, 切願一面, 商議數理之微, 又許盡借迭示潤父, 乃袖一卷以來示余."

⁴³ YN, gwon 11, Muja (1768)/08/23, vol. 2, 226. "又方討閱數理精蘊·曆象考成...乃出精蘊末部, 借根方比例類輦一卷, 頃所轉借者還之曰...余因借精蘊末部, 比例規解·八線圓弦所論一卷."

⁴⁴ YN, gwon 11, Muja (1768)/09/06, vol. 2, 231. "鄭君詰祚答書來, 因促數理精蘊一卷借來者"; "Yeo Jeonggun Cheoljo sochal" 與鄭君詰祚小札 [A short letter to Jeong Cheoljo], YN, gwon11, Muja (1768)/09/10, vol. 2, 235; YN, gwon 11, Muja (1768)/09/11, vol. 2, 238. "鄭君詰祚答書來, 因送曆象考成一二三共三冊"; YN, gwon 11, Muja (1768)/09/18, vol. 2, 242. "又送曆象考成一二三共三冊于鄭君詰祚, 因懇早晚更得借看"; YN, gwon 11, Muja (1768)/10/07 vol. 2, 266. "鄭君詰祚答書來, 因借曆象考成中, 五星合論, 土木火金水恒星各論, 共三冊, 及渾蓋通置[憲]模本二紙"; YN, gwon 11, Muja (1768)/11/04, vol. 2, 293. "因送曆象考成三冊于鄭君詰祚."

⁴⁵ "Yeo Jeonggun Cheoljo sochal" 與鄭君詰祚小札, YN, gwon 11, Muja (1768)/09/10, vol. 2, 235. "大抵弧弦之論, 始意西人必有古未到者, 幾年思量, 終未得其所準. 今閱此書, 大意卒止用線比例而已."

⁴⁶ "Hohyeon yakseol" 弧弦約說, YN, gwon 11, Muja (1768)/09/10, vol. 2, 237. "古者, 雖因以勾股弦相求, 而其用也有窮, 必也名以三角然後, 勾股弦直鈍銳, 凡諸千變而萬化者, 無不舉皆包括, 亦無不可以通攷, 後出者巧, 豈謂是歟."

⁴⁷ *Ibid*, 237–238. "至其曆象範圍, 又不越乎周髀, 則其說雖若新奇, 而其理已有古人言之矣."

with. Through Jeong's son Donggi 鄭東驥 (1750–1797) and his cousin Dongyu 鄭東愈 (1744–1808), Hwang accessed a great deal of information related to calendrical astronomy. He visited Jeong Donggi in the fifth month of 1769 and borrowed five volumes of the *Essence*—the *Explanation of the Classic of the Gnomon of Zhou* (*Zhoubi jingjie* 周髀經解) in Volume 1 of Part I, the *Elements of Geometry* from Volumes 2 to 4, and the *Elements of Calculation Methods* (*Sanxue yu-anben* 算學原本) in Volume 5.⁴⁸ Of these, Hwang added a comment, “the *Classic of the Gnomon of Zhou* originated from the dialogues between the Duke of Zhou and Shang Gao 商高, and it is also from this that the Western methods originated.” He said that China had lost the methods a long time ago, and thus the Kangxi emperor added new interpretations, which were the *Explanation of the Classic of the Gnomon of Zhou*.⁴⁹ This can be seen as an assertion based on the theory of the Chinese origin of Western science.⁵⁰ Two days later, Jeong Dongyu visited Hwang, and discussed the *Essence*. After two more days,⁵¹ Hwang sent a letter to Jeong saying that he liked the *Essence* very much, but complained that he could not fully digest the work because the complete set was not available to him at that time. He thus made an earnest request to borrow the remaining volumes.⁵² Upon this request, Jeong Dongyu sent Hwang three books on “Base and Leg” (*gougu* 勾股) and trigonometry.⁵³ In early sixth month, Hwang sent another letter to the Jeong brothers while returning the volumes of Part I of the *Essence* that he had previously borrowed, and requested them to lend him the books belonging to Part II of the *Essence*.⁵⁴ Jeong Dongyu sent Hwang the ten volumes of Part II, and it seems that only then Hwang finally gained a full picture of the table of contents of the *Es-*

⁴⁸ YN, gwon 12, Gichuk 己丑(1769)/05/11, vol. 2, 399.

⁴⁹ *Ibid.*, 399. “其周髀經，本出周公商高問答，此其本文，而西法之所由出者，但中國前輩，失其指歸，故清主爲之新解。”

⁵⁰ With regards to the “Chinese Origin” theory, see Park Seong-rae, “Seoyang seongyosa-ui gwahak” 西洋宣教師의 科學 [Science of the Western missionaries], *Jungguk gwahak-ui sasang* 中國科學의 思想 [Thoughts of Chinese science] (Seoul: Jeonpa gwahaksa, 1978); Noh Daehwan, “Joseon hugi-ui seohak yuip-gwa seogi suyongnon” 朝鮮後期の 西學流入과 西器受容論 [Influx of Western learning and the idea of accepting Western utensils in late Joseon period], *Jindan hakbo* 震檀學報 83 (1997), 121–154; Noh Daehwan, “Jeongjo daeui seogi suyongnonui—‘Jungguk wollyuseol’-eul jungshimeuro” 正祖代의 西器受容論議—‘中國源流說’을 中心으로 [Discussions of accepting the Western utensils in king Jeongjo's reign—centering on the ‘Chinese origin’ theory], *Hankuk hakbo* 韓國學報 94 (1999), 126–167.

⁵¹ YN, gwon 12, Gichuk (1769)/05/13, vol. 2, 402. “好賢洞鄭君東愈(忠州長兄尙淳之子)來訪，問及數理精蘊說話。”

⁵² “Yeo Jeonggun Donyu” 與鄭君東愈 [A letter to Jeong Dongyu], YN, gwon 12, Gichuk (1769)/05/15, vol. 2, 404–405.

⁵³ YN, gwon 12, Gichuk (1769)/05/15, vol. 2, 405. “鄭君適出，其從弟東驥答書，送精蘊之勾股三角共三冊以來。”

⁵⁴ YN, gwon12, Gichuk (1769)/05/03, vol. 2, 422. “送書于好賢洞鄭君從兄弟，問忠州使君，自果川入來消息，因付數理精蘊之上編，又請借下編勾股以上諸卷...鄭君東愈答書來，因送數理下編十卷，并前來勾股割圓五卷，共十五卷。”

sence.⁵⁵ The news of Hwang's investigation of the *Essence* came to be known among those who were well versed in mathematics at the time, including Mun Gwangdo 文光道.⁵⁶

2. The Purpose and Orientation of Hwang Yunseok's Mathematical Studies

Hwang recollected that he liked perusing the *Complete Collection of Nature and Principle* from early on, and this led him gradually to an understanding of mathematics by studying "texts related to principles and numbers" (*risu* 理數).⁵⁷ This indicates that Hwang's study on mathematics is related to his learning of the *Complete Collection*. The "mathematics" included in the *Complete Collection* is the "studies of images and numbers" (*xiang shuxue* 象數學) represented by Shao Yong's *Supreme Rules Governing the World* (*Huangji jingshi*). Hwang based his extensive study of traditional mathematics, as represented by the *Introduction to Mathematics* (*Suanxue qimeng*), on the "studies of images and numbers," and accepted Western mathematics, such as the *Elements of Geometry* and the *Essence of Numbers and Principles*, as an extension of such a study.

Hwang's study of the *Complete Collection* was related to his interest in the *Yijing*. While recollecting his intellectual journey, he said that he had set his heart on the learning of the ancients (*gohak* 古學) early on, and studied a variety of classics including the *Yijing*. Based on this, Hwang's recollection continues, he exerted efforts on the *Complete Collection*, adding his own comments while also incorporating discussions with previous scholars. Hwang said that he worked on adding detailed comments on "subtle expressions or profound meanings," and "questionable sentences or missing words." As a result, Hwang claimed, his study covered a wide range of subjects from "the origins of the *Yijing*, the Great Plan, nature and destiny, principles and *qi*" (*yeokbeom seongmyeong ligi ji won* 易範性命理氣之原) to "the specialties on harmonics, calendrical astronomy, and mathematics" (*yul ryeok san ga* 律曆算家). However, he lamented that his studies were only broad without being precise, and ended up being not even broad. He even said modestly that he was pursuing precision based on the breath but with little achievement.⁵⁸ In

⁵⁵ YN, gwon12, Gichuk (1769)/05/4, vol. 2, 422. "細閱康熙御製數理精蘊編第如左..."

⁵⁶ YN, gwon12, Gichuk (1769)/07/23, vol. 2, 461. "又言義盈主簿文光道, 亦來大監宅, 語及案前曰, 近聞黃直長, 精於算學, 方看數理精蘊矣."

⁵⁷ YN, gwon14, Gyeongin庚寅(1770)/04/02, vol. 3, 125. "余笑曰, 少也, 學于家庭, 愛觀性理大全一帙, 因之演繹理數文字, 漸通數學..." Koo Mhan-ock, "Joseon hugi cheonmunhak-ui juyo jaengjeom: Hwang Yunseok-ui *Yijae nango*-reul jungsimeuro" 朝鮮 後期 天文曆算學의 主要爭點: 黃胤錫의 <頤齋亂藁>를 中心으로 [Main issues of calendrical science in late Joseon period: centering on *Yijae nango* of Hwang Yunseok (黃胤錫, 1729–1791)], *Hanguk gwahaksa hakhoeji* 31, no. 1 (2009), 91–96.

⁵⁸ YN, gwon11, Muja戊子(1768)/08/21, vol. 2, 221. "蓋自少, 舊學于家庭, 已得妄意學古, 而先從周易以下諸經, 次第貫熟, 因就性理大全一帙, 尤加工夫, 或記管見, 或援前輩說話,

his conversation with Seo Myeong-eung also, Hwang said that since childhood he had always liked the *Yijing* most among all the classical texts, and understood about “image and numbers” (*xiangshu* 象數) and “the [River] Chart and the [Luo] Writing” (*tushu* 圖書), albeit incompletely, and that he always gave a careful perusal to the *Complete Collection*.⁵⁹

In this manner, Hwang’s study of the *Complete Collection* was related to the “*Yijing* studies focusing on images and numbers” (*xiangshu yixue* 象數易學). He considered the *Yijing* studies to be the root of human nature and destiny (*xingming* 性命), and in doing so, acknowledged the intellectual authority of the *Yijing*. While studying the *Yijing*, he frequently showed interest in harmonics and calendrical astronomy. To him, calendrical astronomy was a branch of the *Yijing* studies. Hwang studied harmonics and calendrical astronomy in order to supplement missing elements in the *Complete Collection* by adding his own commentaries to it.⁶⁰ Of the works compiled in the *Complete Collection*, the *Supreme Rules Governing the World* (*Huangji jingshi*), the *New Book on Harmonics* (*Lülü xinshu*), and the *Great Plan’s Supreme Rule* (*Hongfan huangji neipian* 洪範皇極內篇) were related to the *Yijing* studies. Here, we need to pay attention to Hwang’s attitude towards the relationship between the changes (*yeok* 易) and the calendrical astronomy (*yeok* 曆). Hwang asserted that “*yeok* 易” consisted of only four elements: meanings (*eui* 意), words (*eon* 言), images (*sang* 象), and numbers (*su* 數). If numbers already existed, he claimed, the numbers in harmonics and calendrical astronomy could not depart from this.⁶¹ This seems to be his attempt to encompass harmonics, calendrical astronomy, and mathematics within the system of the *Yijing* studies and the studies of images and numbers. Western mathematics was no exception.

Hwang recognized the excellence of Western mathematics and astronomy, which were the basis for the *Shixianli* 時憲曆 calendar. But, he argued that its principle was no different from that of “the ancients” (*goin* 古人). On the 13th day, 11th month of 1768, Hwang visited his teacher, Kim Wonhaeng. That evening, Hwang conversed with Kim’s son Ian 金履安 (1722–1791), and one of the topics was the *Essence of Numbers and Their Principles* that Hong Daeyong had pur-

微辭奧義，疑文闕字，一一各有箋註，而上自易範性命理氣之原，以至律曆算家，亦庶幾汎濫矣。雖然博而不精，猶不博也。今方因博求精，而未有所成。”

⁵⁹ YN, gwon 6, Byeongsul (1766)/03/25, vol. 1, 551. “徐令曰，諸經則何者是所好也。余曰，周易是自少所好者也。徐令曰，然則其於象數圖書，已經理會否。余曰，非曰理會，亦不全無所事也。至如性理大全書一帙，則是所居常熟覽者也。”

⁶⁰ YN, gwon 15, Gyeongin (1770)/05/11, vol. 3, 251. “余以末路遠人，爲養薄游都下，自顧所學空空，況於易乎。易者，性命宗祖，特以所賞願學，而又時時出入律曆二家，謂是易之支流也，庶幾可補平日所筭性理大全書中所闕而已。世猥以知易目之，至煩大臣，誤達於天聰，得此虛名，寧不惶愧。”

⁶¹ YN, gwon 11, Muja (1768)/08/21, vol. 2, 222. “易者，意言象數四者而已。既有數焉，則律曆之數，亦豈排出於此耶。”

chased in China and brought to Korea two years back. When Kim Ian said that the *Essence* showed the precision of Western mathematics, Hwang initially acknowledged this. Yet, he went on to argue that its principles were no different from what the ancients had already set forth. Hwang said, “The ancients said in a ‘vertical way’ (*suseoul* 豎說) and Westerners without fail said in a ‘horizontal way’ (*hoengseoul* 橫說). They like oddities and strive for novelties this much. While the ‘vertical’ and the ‘horizontal’ are different from each other, the principles are the same.”⁶²

The text titled “Preface to the Manuscript Copy of the *Essence of Numbers and Their Principles*” (*Je suri jeongon sabon* 題數理精蘊寫本) was written by Hwang after perusing the *Origins of Pitchpipes and the Calendar* (*Lüli yuanyuan* 律曆淵源). Here, Hwang described himself as “a subject of the Fallen Great Ming Dynasty (*daemyeong yumin* 大明遺民).” Yet, he praised the *Origins of Pitchpipes and the Calendar* compiled by the Qing dynasty profusely, saying, “It is profound, precise, and detailed, and a book like this had never existed in the three fields—harmonics, calendrical astronomy, and mathematics—since the time of Chin and Han 秦漢 dynasties.”⁶³ Hwang pointed out that previous Korean scholars gave their attention only to the classics (*gyeong* 經) and the rites (*rye* 禮) and refused to deal with the subtleness of the principles and numbers (*risu* 理數), saying that it was not a subject to be pursued first. In his view, however, calendrical science was an essential element in the managing of a state and rule all under heaven, and “one of the most essential subjects that any Confucian scholar must complete.”⁶⁴ Thus, Hwang took the *Essence* from the *Origins of Pitchpipes and the Calendar*, and reduced redundancies, supplemented missing parts, and added his own ideas for elements yet to be clarified. The result of this effort was the “Manuscript Copy of the *Essence of Numbers and Their Principles*” (*Suri jeongon sabon* 數理精蘊寫本).⁶⁵ In sum, Hwang paid attention to matters of harmonics and calendrical astronomy from the perspective of principles and numbers. As mentioned above, he believed that once he shed light on principles and numbers, the matters involving harmonics and calendrical astronomy could be naturally covered as well.

Hwang’s interest in the three fields—harmonics, calendrical astronomy, and

⁶² YN, gwon 11, Muja (1768)/11/13, vol. 2, 299. “又言洪大容新購數理精蘊一帙於燕行，此是西洋算法至精處耳。余曰，誠然，但此理古人已皆言之，假如古人豎說，則西洋必橫說，其好奇務新如此。豎橫雖異，而其理一也。”

⁶³ “Je suri jeongon sabon” 題數理精蘊寫本, *Yijae yugo*, gwon 12, 11a (HMC, vol. 246, 264). “大明遺民黃子，既得清主所撰律曆淵源，閱之歎曰深矣遠矣精矣密矣詳矣明矣，誠秦漢以下律曆數三家所未始有。”

⁶⁴ *Ibid*, 11a (HMC, vol. 246, 264). “蓋東人先輩已能言經禮矣，亦往往有差，乃若理數之微，無過律曆，而初未或過其門而窺其堂第，大言曰非急務而已。此自獨善自好者論之，不為無當，將以經國理天下，此書詎在可略。夫體明用適，方是儒者大全之學，是不可不知也。”

⁶⁵ *Ibid*, 11b (HMC, vol. 246, 264). “我乃姑取數理一部，繁者節之，缺者補之，未發者引而伸之，庶備私攷。”

mathematics—can be confirmed in many records in his journal and other writings. According to records of 1788, he evaluated the four fields of Western learning—calendrical astronomy (*yeoksang* 曆象), mathematics (*suri* 數理), harmonics (*ylryeo* 律呂), and various manual techniques (*gongjang* 工匠)—as outstanding throughout history, and emphasized that they should not be abandoned merely because of their association with Christian teachings.⁶⁶ Such an attitude could be clearly seen in the record of the 11th day, 4th month of 1791, just before his death. He asserted that Western Christian teachings (*seogyo* 西教), represented by the *True Meaning of the Lord of Heaven* (*Tianzhu shiyi* 天主實義), were heterodox and pernicious, but praised the three fields of harmonics, calendrical astronomy, and mathematics and the techniques of manufacturing, metallurgy, and paintings (*gong ya dancheong ji beop* 工冶丹青之法) of the West highly, saying that these should be passed down to generations to come.⁶⁷ This illustrates Hwang's positive attitude towards Western mathematics, calendrical science, technology, and the art of painting. At the same time, it acutely demonstrates how greatly Hwang was interested in the matters of harmonics, calendrical science, and mathematics.

Hwang's interest in calendrical science ultimately converged on the *Origins of Pitchpipes and the Calendar*. While answering a question regarding a theory of logarithms (*daesu ji seoul* 對數之說) in his conversation with a certain Hong in 1770, Hwang said that the *Origins* written by Qing scholars was “nothing but a new look on the surface without changing the fundamentals of the old method.” But, he still acknowledged that “the theory of logarithms is related to the new method (*sinbeop* 新法) and is easy to use.” When Hong asked if it was possible to understand the method of logarithms, Hwang said that only an expert would be able to use it freely, but he soon added that it was not difficult to interpret the meaning sentence by sentence. Anyone can do it, Hwang said, but no one was taking the initiative in studying this.⁶⁸ This example shows that he had reached a certain level in understanding Western mathematics.

Hwang exerted great effort in purchasing the *Origins*. On the 15th day, 4th month of 1770, he was visited by book traders (*chaek ain* 冊牙人) who proposed to purchase 70 volumes of the *Origins* belonging to the family of Kim Seonhaeng at the price of 130 *tael*. Hwang tried very hard to buy those books, even by borrowing money from his acquaintances, because he had a strong wish to stock a room with books on all four walls back at his country home so that he could read them when-

⁶⁶ YN, gwon 41, Musin戊申(1788)/04/26, vol. 8, 94–95. “蓋西洋人之曆象數理律呂工匠四家, 真卓絕千古...然其曆象數理律呂工匠之法, 則有不容因彼而廢此爾。”

⁶⁷ YN, gwon 46, Sinhae辛亥(1791)/04/11, vol. 8, 485. “余謂天主實義, 真異端邪說, 雖自謂別文於三教以外, 而亦只偷老佛之糟粕者爾。然西洋之律曆數三家, 與夫工冶丹青之法, 亦不可無傳, 烏可一向盡禁哉。”

⁶⁸ YN, gwon 14, Gyeongin(1770)/02/13, vol. 3, 53–54. “洪又言...且清人律曆淵源對數之說, 如何。余曰, 生晚居僻, 未有知解...而清人所著, 亦只就舊法改頭換面而已。惟其對數之說, 係是新法, 便於入用耳。洪曰, 對數之法, 果入思量否。余曰, 此須專門, 乃可無碍, 而若其沿文解義, 則夫孰不可, 但人自不究耳。”

ever he wanted.⁶⁹ However, all his efforts failed.⁷⁰ Even after this, Hwang tried to form a complete picture of the *Origins* through various other channels.

On the 7th day, 11th month of 1778, Hwang visited Kim Chiik 金致益, Hong Daeyong's maternal cousin, and borrowed a total of 50 books, 32 of which were the *Essence of Numbers and Their Principles* and 18 of which were the *Thorough Investigation of Astronomical Phenomena* (*Lixiang kaocheng* 曆象考成).⁷¹ Previously, on the 2nd day of the month, Hwang wrote letters to Hong Daeyong and Kim Chiik saying that he wished to borrow the two titles.⁷² But he started copying the second part of the *Thorough Investigation* in earnest from the 16th day of the next month, when he was working as an official in charge of the *Jangneung* royal tomb (*jangneung ryeong* 長陵令).⁷³ In his letter to Kim Jongsu (金鍾秀, 1728–1799) in 1785, Hwang said “a book like *Origins of Pitchpipes and the Calendar*, which includes the *Essence*, *Thorough Investigation* and *Correct Interpretation of the Pitchpipes* (*Lülü zhengyi* 律呂正義)” was needed for studies on the six arts (*yugye* 六藝). However, it is difficult to obtain such books in a remote area like Jeolla Province.” Hwang asked Kim if he could purchase the books for him in Seoul.⁷⁴

Why did Hwang work so hard to obtain the *Origins*? This cannot be discounted simply as Hwang's strong desire for owning books. To understand his obsession with the *Origins*, one must bear in mind his perspective on “the science of harmonics and the calendar (*yulryeok ji hak* 律曆之學).” Hwang felt that while “the science of harmonics and the calendars” is not essential for the studies of a Confucian scholar in nurturing his mind and body, it nevertheless was “the great letters between heaven and earth” (*cheonji gan dae munja* 天地間大文字) and thus was indispensable. He noted that the country was lacking the study of this subject and added: “if I could obtain it [the *Origins*], I could pass my knowledge down to younger scholars and, in doing so, contribute to making the legacy of the Joseon

⁶⁹ YN, gwon 14, Gyeongin (1770)/04/15, vol. 3, 144–145.

⁷⁰ YN, gwon 15, Gyeongin (1770)/05/14, vol. 3, 262–263.

⁷¹ YN, gwon 27, Musul 戊戌(1778)/11/07, vol. 5, 326. “將詣闕受牌, 先訪金碩士致益仲謙(即洪泰仁大容內兄)於宗簿寺大門之外東邊, 所謂長生殿洞也...今十月行經泰仁也, 洪使君既爲余留書, 因附書于金, 以爲兩間紹介相見之道, 又請轉借數理·曆象兩書全函, 故余始躬訪金, 亦欣瀉有欲縷縷, 而其家有兒病, 方迎醫診, 視余不須久留, 故只借數曆全函共五十冊(數理精蘊三十二冊, 曆象考成一十八冊), 付部隸先去。”

⁷² YN, gwon 27, Musul (1778)/11/02, vol. 5, 318. “附泰仁洪使君大容德保, 與其內兄金致益(故南原倅魯子)書。黃都事胤錫, 執事之曾所聞名而願見者, 欲借見數曆全函, 幸出借勿疑, 待其還而藏之, 如何。”

⁷³ YN, gwon 27, Musul (1778)/12/16, vol. 5, 368. “始手鈔曆象考成下編...”

⁷⁴ “Yeo Kim Panseo Jongsu seo” 與金判書鍾秀書 [A letter to Kim Jongsu], YN, gwon 36, Eulsa 乙巳(1785)/01/11, vol. 7, 6–7; “Yeo Kim Panseo Jongsu seo, Eulsa” 與金判書鍾秀書 乙巳 [A letter to Kim Jongsu in the Eulsa year], *Yijae yugo*, gwon 7, 24b (HMC, vol. 246, 154). “昔歲下教教學者先以六藝, 極實且確, 而窮鄉苦僻此等文字, 如數理精蘊·曆象考成前後編及律呂正義, 總名爲律曆淵源者, 或有可令轉購者, 則因北風惠德音如何。”

Dynasty shine brightly in the future.”⁷⁵

In this manner, Hwang legitimized the sciences of harmonics, calendrical astronomy, and mathematics (*yulryeok sansu ji hak* 律曆算數之學) by calling them “fields that form inside and outside of the *Yijing* and the Great Plan, and investigate systematically into heaven and earth,” while also asserting that even “Master Cheng” 程子 and “Master Zhu” 朱子 a long time before had not abandoned it. He noted that the country had rarely seen scholars who investigated these fields, and that it was only after the new calendrical methods of the West were introduced into this country that Kim Seokmun 金錫文 (1658–1735) wrote the *Illustrated Explanation of the Yijing Study* (*Yeokhak dohae* 易學圖解) to include both the new Western methods and the traditional learning of “images and numbers.” Despite this, he added that he still had some regrets in this regard. In short, Hwang desired to study the *Origins*, which was known at the time to be a book of the highest caliber in the field, perceiving it as the science of harmonics, calendrical astronomy, and mathematics. He hoped that he would be able to supplement insufficient research by previous scholars while also complementing historical records of the Joseon Dynasty.⁷⁶

“Making the historical legacy of the Joseon Dynasty (*seongjo sajeon* 聖朝史典) shine brightly” and “complementing the historical records of the Joseon Dynasty (*seongjo saji* 聖朝史志)” were the goals of Hwang’s study. Acceptance of Western science was an important means to achieving these goals. In the 7th month of 1768, Hwang requested of Kim Deokjun, who was a lower clerk at the Ministry of Personnel (Ijo 吏曹) and close to officials at the Royal Bureau of Astronomy (*Gwansang gam* 觀象監), that he obtain the *Preface to Calendrical Astronomy According to the New Methods* (*Xinfa liyin* 新法曆引) and other books related to the Western *Shixian li* calendrical method. On this occasion, Hwang explained his reason for taking interest in Western calendrical science as follows:

Literati of today are engrossed in their official posts, and few are aware of or pay attention to the Western *Shixian li* calendrical method. However, we must

⁷⁵ YN, gwon 14, Gyeongin (1770)/04/19, vol. 3, 152. “蓋律曆之學，在儒者身心實工，雖稍不緊，亦天地間大文字，不可無者，況我東尤稱寥寥。余若得之，尚可傳於後學，而異日貴我聖朝史典，豈小故哉。”

⁷⁶ “Yeo Im Seongman seo” 與林成滿書 [A letter to Im Seongman], YN, gwon 14, Gyeongin (1770)/04/21, vol. 3, 156. “夫律曆算數之學，前輩固不以爲當急，而表裡易範，經緯天地，亦洛建諸老先生，所不廢者。獨我東方，上下三千年，未有一言及之，豈不以地偏書稀。理奧之數頤，雖一二卓識獨見，未或從事其間藉曰，有意又無奈。宋明以前，諸家立法之猶疎，得彼失此，輾轉幽晦而然歟。天啓奎運，人文益彰，而西洋新法，自華而東，爰有大谷金公，作易學圖解二十五篇，包并利熊，叅合孔邵，今其遺文，雖未梓行，而博雅之士，已爲之快觀，惜乎猶有餘憾爾。比年律曆淵源一大帙，又自燕購至，而世之聰明特達者，庶幾究蘊到底矣。胤亦聞有此書，幾年于茲，朝暮寤寐，如物在喉。使能得之而南，以貴四壁圖書，則不惟下可以舉先賢之闕典，抑亦上可以補聖朝之史志，而精誠所孚。書僧遽以此來，噫，天其以之餉我哉。”

not neglect this method, because this is something to be included in the country's historical records. All the more so, when everything about the [Western] method had already been revealed in the Chongzhen period of the Ming Dynasty. Yet, the *Ming History* did not cover this topic in detail. I wish to obtain these books [on the *Shixian li* method] to revise the *Ming History* and, based upon this, to complete the records of the institutions and historic exemplars (*Jeongo* 典故) of our country. But I simply cannot find these books. You must have some familiar acquaintances among the officials of the Royal Bureau of Astronomy, and I would appreciate it if you could borrow them for me.⁷⁷

Here, Hwang expressed his ambition to revise the *Ming History* on the basis of his understanding of the *Shixian li* calendrical method, while taking further steps to complete the records on the institutions and historic exemplars of his own country.

In sum, Hwang's "broad learning" was a result of his study of the *Complete Collection on Nature and Principle*. Just as he said, his long study of the *Complete Collection* from childhood on naturally expanded into various other fields, and he had a general interest in various subjects ranging from characters, numbers, rites and music (*seosu yeak* 書數禮樂) to the teachings of the Nine Schools (*guryu* 九流).⁷⁸ Although the subjects that those surrounding Hwang emphasized did not go beyond the classical studies (*gyeonghak* 經學) and the studies on rites (*yehak* 禮學), Hwang was interested in the *Yijing* and the Great Plan (*yeokbeom* 易範) and paid due attention to matters of harmonics and the calendar. This is because he thought them to be essential parts of learning necessary for composing commentaries on the *Complete Collection*. The purpose behind all these efforts was to complete the scholarly endeavor that his predecessors had failed to accomplish.⁷⁹ His investigation of mathematics and his acceptance of Western mathematics were byproducts of this endeavor.

3. The Spread of Mathematical Texts and Association among Scholars in the Late Eighteenth Century

What was the environment in the mathematical community of late eight-

⁷⁷ YN, gwon 11, Muja (1768)/07/12, vol. 2, 161. "又言西洋時憲曆法, 當今士大夫汨沒科宦, 無一人留意寓目者, 而此係國朝史記中所當編入者, 不可忽也. 況大明崇禎年間, 已啓此法源委, 而明史未及詳焉. 吾欲得此書, 以之修正明史, 因備國朝典故, 而無可得處. 爾則於觀象官員輩, 想有親熟者, 亦須借送可也."

⁷⁸ YN, gwon 20, Gabo甲午(1774)/07/19, vol. 4, 143. "蓋自幼已於性理大全一帙, 用功久矣, 自然旁通許多路, 自書數禮樂, 以至九流文字, 既皆略綽用意耳."

⁷⁹ YN, gwon 20, Gyeongin (1770)/05/13, vol. 3, 260. "念平日庭訓師教, 不越乎經禮, 顧餘力易範, 而時時出入, 又止律曆二家, 謂是二十年來所筭性理大全之中一二之闕, 庶可並與東賢之未遑而舉之耳."

eenth-century Korea? One can speculate on that environment through the accounts of Yi Yeongok 李英玉 (1740–?). On the 8th day, 12th month of 1767, a debate took place between Hwang Yunseok, Jo Jintae 趙鎮宅 and Yi Yeongok, which included topics on astronomy and mathematics. On this occasion, Yi gave his own summary of the academic environment at the time. According to Yi, although Western learning had indeed been introduced to Joseon thanks to the influx of Westerners into China, there were few people who understood the whole range of Western science. Yi Yeongok considered Hong Yanghae 洪量海 (? -1778),⁸⁰ who at the time resided in Hongju 洪州, to be the best in the field of mathematics, and reported that Seo Hosu had lent all the volumes of the *Origins of Pitchpipes and the Calendar* (which he himself had bought in Beijing) to Hong Yanghae. Yi added that even Mun Gwangdo 文光道, who was widely known for his calculations of eclipses, had also learned mathematics from Hong. In other words, Mun Gwangdo learned the *Elements of Geometry* from Hong Yanghae and Seo Hosu learned mathematics from Mun Gwangdo.⁸¹ If Yi's report is true, we can say that Western mathematics was passed down from Hong Yanghae to Mun Gwangdo and from there to Seo Hosu.

Meanwhile, on the same day, Jo Jintae asked Hwang if he had read the *Essence of Numbers and Their Principles*, and added that officials of the Royal Bureau of Astronomy had told him that it was not in the Bureau. To this, Yi Yeongok said, there were four copies of the *Essence* in Seoul at the time; three of them were at the houses of Seo Myeong-eung, Yi Maenghyu, and Hong Gye-hui, and the other one had gone missing. Yi also said that the *Elements of Geometry* was at Won Uison's house.⁸² It is a well-known fact that people belonging to Seo Myeong-eung's Dalseong Seo clan and Yi Maenghyu's Yeoju Yi clan were very interested in Western learning. Hong Gye-hui 洪啓禧, too, was known among the pupils of Yi Jae 李紱 (1680–1746) for his interest in the studies of images and numbers. Hong was known to learn mathematics from Bak Shinwon 朴新源, who was famous for his work in elucidating mathematical principles, as elucidated in the *Essentials of the Six Arts* (*Yukye ryak* 六藝略). Bak not only was immensely interested in Yu Hyeongwon's (柳馨遠, 1622–1673) *Jottings of Bangye* (*Bangye surok*

⁸⁰ Hong Yanghae was executed for high treason in 1778. See *Joseon wangjo shillok* 朝鮮王朝實錄 [Veritable records of the Joseon dynasty], the 2nd year in king Jeongjo's reign/07/18.

⁸¹ YN, gwon 9, Jeonghae (1767)/12/08, vol. 2, 51. “談及古今文章經禮，轉至曆象算數之說，而曰一自西洋人入中國以來，其說又東來，而今人鮮窺其涯。惟洪量海，當爲第一，方居洪州。徐浩修得燕市購來律(未詳)一書，及洪因人請借，即舉全帙遺之，不獨暫借而已。京城中路(市井百姓之地處表著者，俗號中路)文光道，曾經主簿，能算交蝕者，亦學算數於洪，如幾何原本一書，皆洪所教，而徐亦學於文光道，略有聞見云矣。”

⁸² YN, gwon 9, Jeonghae (1767)/12/09, vol. 2, 52. “昨夜仁叔言，得見數理精蘊否，近者問之觀象官，則曰本監無之矣。李君英玉曰，此冊京中只有四件，一則徐命膺家，一則李孟休家，一則洪啓禧家，其一則忘之矣。幾何原本，則元義孫家有之矣。”

礪溪隨錄)⁸³ but he was also very well versed in the *Yijing*.⁸⁴ One can assume that Hong Gye-hui's interest in the *Jottings of Bangye* may also have something to do with Bak Shinwon.

Mun Gwangdo gave a similar testimony. On the 29th day, 7th month of 1768, Hwang visited Mun, who had become a professor of astronomy of the Bureau of Astronomy upon recommendation by Kim Chiin, the prime minister at the time. During their meeting, Mun Gwangdo said that *Elements of Geometry* was at the Hong family house in Gyedong 桂洞 in Seoul, and at Yi Yonghyu's house, and evaluated the book as "extremely rare and hard to obtain." Mun added that Hong Yanghae of Hongju was the most prominent figure of mathematics of their time.⁸⁵ That the *Elements of Geometry* was housed at Yi Yonghyu's residence in Sojeongneung dong 小貞陵洞 in Seoul seems to have been widely known among the scholars of the time.⁸⁶ It seems that the *Elements of Geometry* was actually in the possession of Yi Gahwan, who was a son of Yi Yonghyu and a brother-in-law of Jeong Cheoljo.⁸⁷

In terms of Hwang's social interaction, as related to mathematics, the brothers Jeong—Jeong Cheoljo and Hujo—and their brother-in-law Yi Gahwan, are notable. Jeong Cheoljo was very close to Hong Daeyong and Bak Jiwon, and in close relationships with the Bannam Bak clan of Bak Jiwon and the Yeosu Yi clan of Yi Gahwan through marriage.⁸⁸ Jeong Cheoljo was renowned for his "outstanding artistic talents," and his brother Hujo was a renowned scholar in the field of geography, whereas Yi Gahwan was known for his general erudition.⁸⁹

On the 23rd day, 8th month, of the same year, Hwang came to meet Jeong Cheoljo through Yi Junghae. Hwang evaluated Jeong Cheoljo as a person who had

⁸³ YN, gwon 14, Gyeongin (1770)/04/2, vol. 3, 126; YN, gwon 14, Gyeongin (1770)/04/13, vol. 3, 124; YN, gwon 14, Gyeongin (1770)/04/22, vol. 3, 158. "新源留心算學，自著六藝略二冊，其發明數理，亦深矣...洪啓禧從而學之，得算法大略。其人又酷喜柳氏隨錄，頗有知識，薦授禮賓參奉。"

⁸⁴ Yi Gyusang, Translated by Chinese Classics Department, Korean Literature History Institute, *18 segi Joseon inmul ji* 18世紀 朝鮮人物志 [Prominent figures of the eighteenth-century Joseon] (Seoul: Changjakgwa bipyeong, 1997), 31, 252.

⁸⁵ YN, gwon 11, Muja (1768)/07/29, vol. 2, 203. "是朝余出直，向津中，歷訪文主簿光道于禁府後洞，即典醫監洞，西邊僻巷也。聞其以金傾相(致仁)別薦，方爲天文學兼教授。余語及曆象說話，因及幾何原本孤弦之說。彼云，此冊六篇，或作三卷，方今桂洞洪家及李上舍用休家有之，誠至貴難得之書也。洪州即洪量海，又是一代算學之最也。"

⁸⁶ YN, gwon 11, Muja (1768)/08/04, vol. 2, 208. "是日，李子用潤父兄弟，座上相話時，潤父言，李上舍用休家，在小貞陵洞，有幾何原本一帙，徐當躬往借示。"

⁸⁷ YN, gwon 11, Muja (1768)/08/23, vol. 2, 226. "原本方在其妹夫李家煥處云。"

⁸⁸ An Daehoe, *Joseon-ui Peuropeshyeoneol* 朝鮮의 프로페셔널 [Joseon's professionals] (Seoul: Humanist, 2007), 143.

⁸⁹ YN, gwon 38, Byeongo (1786)/05/01, vol. 7, 313. "頃，鄭生時養言，鄭詰祚，同宗人也，才藝絕倫，登文科而逝。其弟厚祚，蔭工正，以地理學名世，即天下欲國山川郡縣道里，瞭然心目者也。今文官李家煥，即詰祚婦弟，亦有博識擢用。"

dedicated his whole life to the science of astronomy from the West.⁹⁰ At the time, Jeong showed to Hwang a book titled the *List of Queries* (*Munmok* 問目), which had been written by himself. The book contained questions regarding Western calendrical science and general ideas of Catholicism. Jeong wrote this book to ask his questions of August von Hallerstein, a Western missionary in Beijing, through Yi Deokseong 李德星, an official of the Royal Bureau of Astronomy who was to join the embassy to Beijing scheduled to depart on the tenth month that year.⁹¹

Hwang knew about Yi Gahwan from early on, through Jeong Cheoljo. However, it took a long time for Hwang to finally meet Yi Gahwan in person, on the 2nd day, 8th month of 1778. At the time Hwang was serving in an official post called *dongbudosa* 東部都事 and Yi Gahwan was a *jeongrang* 正郎 of the Ministry of Rites. The two reportedly met each other by chance and debated vehemently about the history of institutions (*munjang jeongo* 文章典故), characters and rhymes (*jahoeok seongwun* 字畫聲韻), and harmonics, calendrical astronomy, and counting-rod calculations (*yulryeok jubeop* 律曆籌法) all day long. Although the details of these debates cannot be known,⁹² matters of astronomy and mathematics seem to have been the main topics of their discussion. At the time, Yi Gahwan spoke of methods of making gunpowder by the people of the Ming dynasty and of making spyglasses (*gyuwon gyeong* 窺遠鏡), the latter of which was included in the *Sino-Japanese Edition of the Assembled Pictures of Heaven, Earth, and Man* (*Wakan sansei zue* 倭漢三才圖會),⁹³ and also mentioned a map at Seo Hosu's house. According to Yi, the map drawn by people of the Qing, titled "Map of the Eight Provinces of Joseon Dynasty Using Lines of the Longitude and Latitude, a Manuscript Copy" (*Chaoxian balu chidao jingweixian ditu xieben* 朝鮮八路赤道經緯線地圖寫本), was so precise that no one in the country had the ability to draw it.⁹⁴

On the 16th day, 8th month of 1769, Kim Yonggyeom 金用謙 promised to Hwang that he would borrow a set of the *Origins of Pitchpipes and the Calendar* in his relative Kim Seonhaeng's possession.⁹⁵ The next day, Kim indeed borrowed 29 volumes of the *Thorough Investigation of Astronomical Phenomena* and sent

⁹⁰ YN, gwon 11, Muja (1768)/08/23, vol. 2, 226. "蓋鄭君一生專治西洋曆象之學."

⁹¹ *Ibid.*, 226. "又示問目一冊，蓋舉西曆疑義，及西學所謂天主教大旨，將付觀察官李德星，十月燕行，欲令就質於西洋人劉松齡。松齡來住燕京，已四十餘年矣，雖其不習於中華文字，而在西方，不減利瑪竇者也。"

⁹² YN, gwon 26, Musul (1778)/08/2, vol. 5, 243. "是日，遇祝史禮曹正郎李家煥，終日劇論文章典故·字畫聲韻·律曆籌法。"

⁹³ YN, gwon 26, Musul (1778)/08/3, vol. 5, 243–244. "昨日，李禮正家煥言，明朝人製火藥法有云...又言，日本人所撰倭漢三才圖會有云，製窺遠鏡，須以玻璃..."

⁹⁴ *Ibid.*, 245. "昨聞李禮正家煥言，徐浩修家新購清人所撰朝鮮八路赤道經緯線地圖寫本，甚精，而我國人顧莫之能者。"

⁹⁵ YN, gwon 13, Gichuk (1769)/08/16, vol. 2, 504. "是夜，金丈又言，吾族人金善行家有律曆淵源一帙，徐當爲尊借送也。"

them to Hwang.⁹⁶ It seems that Hwang by then had perceived a general picture of the entire organization of the *Origins of Pitchpipes and the Calendar*. Hwang said that the reason why the use of the letter *li* 曆 was avoided in its entirety in Parts I and II of the *Thorough Investigation* was because the Qianlong Emperor's name was "Hongli 弘曆." He explained that it was for the same reason that "Shixian li 時憲曆" was renamed "Shixian shu 時憲書," and the four letters of the "Lixiang kaocheng" 曆象考成 were always erased with black ink. Hwang asserted that Part I, Part II, and the Table (*biao* 表) of the *Thorough Investigation* could not survive individually, and that the three works, the *Correct Interpretation of the Pitchpipes* (*Lülü zhengyi* 律呂正義), the *Essence*, and the *Thorough Investigation* were in a relationship of "substance and function" (*cheyong* 體用).⁹⁷ During his meeting with Shin Eunghyeon, a descendant of Shin Heum 申欽 (1566–1628), Hwang said that he was passing his time reading a set of the *Origins* that he had not had any chance to read in his hometown.⁹⁸ On the 5th day of the 9th month, Hwang returned the *Thorough Investigation* to Kim Yonggyeom.⁹⁹ In his letter to Kim Yonggyeom, Hwang expressed his regrets that he could not read thoroughly the *Thorough Investigation*, which he had borrowed from Kim, due to his illness, and pleaded to be allowed to borrow the book again in the future.¹⁰⁰

In 1770, Hwang heard from Shim Yujin 沈有鎮 that Yi Hyeonjik 李顯直 (1735–1773),¹⁰¹ a descendant of Yi Huwon (1598–1660, also known as Wannam buwongun 完南府院君), wanted to be friend with him. Yi Hyeonjik thought Hong Yanghae was the most prominent mathematician of the time, but after hearing about Hwang Yunseok's reputation, Yi wanted to befriend Hwang.¹⁰² In fact, Hong Yanghae, Yi Gilhwan 李吉煥, Seo Hosu, and Mun Gwangdo were often mentioned at the time as mathematical experts.¹⁰³ Through Shim Yujin, Yi Hyeon-

⁹⁶ YN, gwon 13, Gichuk (1769)/08/17, vol. 2, 506. "金丈借曆象考成於金叅判善行之子，二套二十九冊，送報于余。"

⁹⁷ YN, gwon 13, Gichuk (1769)/08/19, vol. 2, 509. "今按律曆淵源全部，有曆象攷成上下編，而清人以乾隆名弘曆之故，一切曆字悉避，如時憲曆，改稱時憲書，而曆象攷成四字，亦必墨抹。大抵攷成上編下編及表，不可相無，而律呂正義·數理精蘊，又與攷成，相須并資，一體一用，信乎，康熙製作之該且密也。"

⁹⁸ YN, gwon 13, Gichuk (1769)/08/22, vol. 2, 513. "近日愁寂之中，適得鄉居時所未見者，律曆淵源一帙，消日而已。"

⁹⁹ YN, gwon 13, Gichuk (1769)/09/05, vol. 2, 531. "送曆象考成二匣于金丈，并書。"

¹⁰⁰ "Yeo Kimjang seo" 與金丈書 [A letter to Mr. Kim], YN, gwon 13, Gichuk (1769)/09/05, vol. 2, 532. "曆象二匣，來留非不有日，而身病眼妨，未及窺遍，茲又不敢留，付下人敬遣呈上，所謂積珠俱還，他日若容更借而卒惠，則受賜大矣。"

¹⁰¹ See, *Manseong daedongbo* 萬姓大同譜 [Lineages of ten thousands surnames](Seoul: Myeongmun dang, 1983), vol. 1, 21, 26, 266.

¹⁰² YN, gwon 14, Gyeongin (1770)/02/29, vol. 3, 81. "沈君有鎮來話，言及古今算家，因言完南相公後孫李顯直，聞風願交，因學算法曰，吾但知今世有洪度量(洪量海，居洪州)一人，能知算法名世而已，不意更聞有黃直長耳，早晚吾當相面論此。"

¹⁰³ YN, gwon 14, Gyeongin (1770)/03/17, vol. 3, 96. "世稱當今明數者，曰洪量海，曰李吉煥，

jik asked Hwang Yunseok to provide solutions to eight questions. Upon this request, Hwang wrote down the solutions¹⁰⁴ and forwarded them to Yi through Shim again.¹⁰⁵ After reviewing Hwang's solutions, Yi said that the solution to the problem of the *tianyuan shu* (*ip cheonwon* 立天元) was the most precise, and the remaining problems concerning *hwagyo birye* 和較比例 could be solved through *seonsang huje* 先商後除.¹⁰⁶ Yi Hyeonjik was already well learned in mathematics, and simply wanted to discuss some questions on his mind with Hwang in person.

Hwang met Yi Hyeonjik on the 2nd day of the 4th month through Shim Yujin and discussed mathematics with him. During the meeting, Yi Hyeonjik gave an overview of the history of mathematics in Joseon. According to him, after Kim Shijin 金始振 (1618–1667), only Im Jun 任濬 could figure out the principles of the *tianyuan shu* 天元術, and more recently, Hong Yanghae was gaining prominence in the subject. He also noted that Mun Gwangdo was well skilled at mathematics related to calendrical astronomy, and added that, in the case of *tianyuan shu*,¹⁰⁷ Mun relied only on the “proportions of borrowed roots” (*jiegenfang bili* 借根方比例) of the *Essence*; if he were to encounter an unexpected question, he would not know how to solve it. Compared to this, Yi Hyeonjik thought very highly of “the method to establish *tianyuan yi* 天元一” suggested by Hwang as a solution, saying that it was very precise.¹⁰⁸ Here, “the borrowed roots (*jiegenfang*)” refers to algebra, or the equations and their solutions in Western mathematics,

而朝士則徐浩修，中路則文光道，是已，而徐父子，實與洪最密云。”

¹⁰⁴“Dap Yigun Hyeonjik Jagyeong sanhak palmun” 答李君顯直子敦算學八問 [Response to the eight mathematical problems given by Yi Hyeonjik], YN, gwon 14, Gyeongin (1770)/03/17, vol. 3, 96–97.

¹⁰⁵YN, gwon 14, Gyeongin (1770)/03/27, vol. 3, 109. “昨日以所答李君顯直算學八問者，送于沈君有鎮，要令轉示。今日沈君答書來言，當以李君回答，早晚送示。”

¹⁰⁶YN, gwon 14, Gyeongin (1770)/04/01, vol. 3, 123. “又歷訪沈有鎮甫乍話，則沈君言，頃以所示算學八條，送示李君顯直，則李君謂八條之中，立天元一法最精，其餘和較比例(參黃腦及鷄兔六足獸)，似是先商後除而得之。蓋先商之法，在小數則易測，而大數則難測云矣。李君，故進士昌輝之孫，漪之子...其人詞翰自佳，但不屑屑科場，酷好書畫，又好游眺，以散人自處，自聞風於左右，甚欲一去會話。其性雖不喜沈思，而算學則自許不輕，殊可一會，但吾無識於此學，奈何。余曰，良佳。”

¹⁰⁷*Tianyuan shu* is a method to solve an equation of higher degrees with one unknown, in which “*tianyuan yi* 天元一” is established as the unknown number and a solution is obtained in accordance with given conditions. The *Sea Mirror of Circle Measurements* (*Ceyuan haijing* 測圓海鏡) and the *New Steps in Computation* (*Yigu yanduan* 益古演段) written by Li Ye 李冶 (1192–1279) are considered as books that described *tianyuan shu* in a systematic manner. See, Kim Yong-wun and Kim Yong-guk, *Hanguk suhaksa*, 221; Jang Hyewon, “Sanhak ipmun...,” 139.

¹⁰⁸YN, gwon 14, Gyeongin (1770)/04/02, vol. 3, 125. “蓋我東方，自金叅判始振以後，往往始留心算家，而任濬始窺見天元一法大意，近年吾所見，洪量海可謂冠絕，而其餘則中路人文光道，熟於曆家算法，致於天元一法，則僅依數理精蘊所稱借根方比例，草草成樣。若忽出意外新題難法，使以啓蒙天元一本法下手，則茫然不知所爲。今以盛答立天元一者攷之，實出其上，不遑遠矣。”

which corresponds to *thetianyuan shu* in China.¹⁰⁹ Hwang also had commented on the relationship between the two methods in his *Origin of Mathematical Learning* (*Sanhak bonwon* 算學本源), saying “‘*tianyuan yi*’ of the *Introduction to Mathematics* (*Suanxue qimeng*) and the ‘borrowed roots’ (*jiegenfang*) of the *Essence*, though they have different names, are the same in reality.”¹¹⁰

According to his own recollection, Yi Hyeonjik became interested in the *Introduction to Mathematics* only after he turned 18, and analyzed it with great detail to investigate its beginning and end, and finally was able to understand it by using the *Essence* as a reference. In the case of the *tianyuan shu*, he had obtained information from his precursors in the beginning. He said that he had learned from, for instance, Yi Taechang 李泰昌, who was an official of the Royal Bureau of Astronomy, but Yi Hyeonjik opined that even Yi Taechang had limited understanding when it came to the ultimate points.¹¹¹

Hwang recalled that he used to like reading the *Complete Collection* at home from early on, and using it as reference, he could start understanding other books related to “principles and numbers,” and gradually advanced toward the “learning of numbers” (*suhak* 數學). He delved into the *Introduction to Mathematics* at first, concentrating his mind and energy on it without relying on precursors. As for the *tianyuan shu*, he even came down with an illness because of his excessive thinking until he reached a point where he knew everything about it like the back of his hand.¹¹² To Yi Hyeonjik, who considered Hong Yanghae the Matteo Ricci of Joseon, he also explained the genealogy of Western missionaries from Li Madou (利瑪竇, Matteo Ricci), Tang Ruowang (湯若望, Adam Schall von Bell), Xiong Sanba (熊三拔, Sabbathine de Ursis) to Liu Songling (劉松齡, August von Hallerstein).¹¹³

Hwang said that he had made a copy of the *Essentials of the Nine Numbers*

¹⁰⁹ Kim Yongwun and Kim Yongguk, *Jungguk suhaksa* 中國數學史 [A history of mathematics in China] (Seoul: Mineumsa, 1996), 299; Jang Hyewon, *Sanhakseoro boneun Joseon suhak* 算學書로 보는 朝鮮數學 [Mathematics in the Joseon period seen through mathematical texts] (Seoul: Gyeongmunsa, 2006), 159–182.

¹¹⁰“Sanhak bonwon, cheonwon il sul” 算學本源, 天元一術, *Lisu sinpyeon* 理藪新編, gwon 23, 27b-28a: (Photocopy edition) *Yijae jeonso* 頤齋全書 [Complete work of Mr. Yijae (Hwang Yunseok)] (Seoul: Gyeong-in munhwasa, 1976), vol. 2, 528. “算學啓蒙之天元一, 數理精蘊之借根方, 名異而實同也.”; YN, gwon 15, Gyeongin (1770)/05/19, vol. 3, 286. “按數理精蘊[蘊]借根方比例, 卽算學啓蒙立天元一法也.”

¹¹¹YN, gwon 14, Gyeongin (1770)/04/02, vol. 3, 125. “因自言十八歲以後, 始留意於算學啓蒙, 熟觀詳思, 洞究本末, 最後得數理精蘊參之, 自能刃解, 而天元一法, 則初頭猶有得諸先覺者. 蓋觀象官李泰昌, 嘗稱知此者, 頃年試問下手之處, 則爲示初頭一兩段, 因此入手, 至於極處, 更以質之, 則李泰昌所知, 乃其初一兩段而已, 不知其餘. 未知左右, 初亦有傳授者乎.”

¹¹²*Ibid.*, 125. “余笑曰, 少也, 學於家庭, 愛觀性理大全一帙, 因之演繹理數文字, 漸通數學, 而首從事於算學啓蒙, 不待先覺, 大費心力. 以至天元一法, 瀾漫透悟之境, 而思索之過, 疾病生焉. 每念游藝訓釋, 玩物適情之語, 反覺瞿然耳.”

¹¹³*Ibid.*, 125–126.

(*Gusu ryak* 九數略) written by Choe Seokjeong 崔錫鼎 (1646–1715) long before, but that it did not make sense (*muri* 無理) to him when he had revisited the book again more recently. He asked Yi Hyeonjik what he thought of it. Yi answered that it was the same as the mathematical methods of Hong Gye-hui, and added that he owned a copy of the *Essentials of the Six Arts* (*Yugye ryak* 六藝略) edited by Bak Shinwon but it was not comparable to the 20-odd volumes of the *Complementary Compilation of Geometry* (*Kiha bopyeon* 幾何補編) written by Hong Yanghae. He regretted that Hong's writings had disappeared.¹¹⁴

After that meeting, Hwang wrote letters to Yi Hyeonjik on mathematical problems,¹¹⁵ and read the handwritten set of the *Elements of Geometry* that belonged to Mun Gwangdo and Part II of the *Essence* (type-printed) in Kim Hyeongtaek's possession, both of which Yi Hyeonjik brought to him, and discussed questionable items with Yi Hyeonjik. According to Yi Hyeonjik's testimony, Shim Yeomjo 沈念祖 (1734–1783) bought 53 books of the *Essence*, including Parts I, II, and the Tables of Logarithms (*duishu biao* 對數表), from the family of Yi Taechang, an official of the Royal Bureau of Astronomy, at the price of 20 *tael*.¹¹⁶

Yi Hyeonjik and Hwang continued their discussion on mathematics by visiting each other,¹¹⁷ and in the course of this, Hwang heard interesting stories about the country's mathematics from Yi, who had been studying mathematics in earnest for seventeen years. After seeing others' calculations, Yi came to understand the fundamentals and then advanced his learning through such books as the *Introduction to Mathematics* (*Suanxue qimeng*), the *Unified Lineage of Mathematical Learning* (*Sanxue tongzong* 算學統宗), and finally the *Essence*. He also said that, while it was difficult to understand the principles of the *tianyuan shu*, he could finally understand it, thanks to help from Yi Taechang. Yi Hyeonjik suspected that Yi Taechang's mathematics derived from Yi Ik 李穡 (1681–1763). According to Yi Taechang, Gyeong Seonjing 慶善徵 during King Injo's 仁祖 time (1623–1649), and Yu Suseok 劉壽錫 and Hong Jeongha 洪正夏 during King Sukjong's 肅宗 time (1674–1720) were outstanding mathematicians of the country. Among contemporary mathematicians, Yi Hyeonjik thought the most highly of Hong Yanghae, who reportedly could calculate fast using his knowledge of the *Essence*. Park Shinwon's *Essentials of the Six Arts* was considered to be highly precise compared with the methods of his predecessors, but Hong Yanghae reportedly did not

¹¹⁴*Ibid.*, 126. “余曰，曾見崔相錫鼎所輯九數略否。少日當錄一通，攷之，近日漸覺無理。李君笑曰，此與桂山洞洪啓禧算法，魯衛耳。又聞江景朴新源，亦有所輯之[六]藝略一冊，都不如洪量海所著幾何補編二十餘冊，聞其不幸灰燼矣。”

¹¹⁵“Yeo Yi seoksa Hyeonjik seo” 與李碩士顯直書 [A letter to Yi Hyeonjik], YN, gwon 14, Gyeongin (1770)/04/5, vol. 3, 134.

¹¹⁶YN, gwon 14, Gyeongin (1770)/04/06, vol. 3, 137. “是日，子敬出示文光道寫本幾何原本一帙，及金亨澤(和澤兄)活字印本數理精蘊下編一帙，遍問疑義。又言沈念祖，曾買數理精蘊上下二編，及對數表，共全帙五十三冊于觀象官李泰昌家，價本二十兩，當使人購出，未知能辦價否。”

¹¹⁷YN, gwon 14, Gyeongin (1770)/04/11, vol. 3, 142. “李子敬來訪，講論算學，終夕乃罷。”

acknowledge this. After reviewing Hong Yanghae’s answers to Yi Hyeonjik’s questions, Hwang Yunseok also acknowledged that they repeated the *Essence* with some modifications.¹¹⁸

Although Yi Hyeonjik acknowledged that the *Essence* was the most comprehensive book (*jeil dae jeonso* 第一大全書) for mathematicians, he saw some deficiencies in it and had a desire to supplement it and write a new book.¹¹⁹ However, Yi Hyeonjik’s wish never came true. Hwang Yunseok was greatly shocked to hear the news of Yi’s death on the 18th day, 7th month of 1774.¹²⁰ Kim Yonggyeom also held Yi in high esteem, considering him a rare talent, and expressed sadness at his sudden demise.¹²¹ Hwang visited Yi’s house outside Namdaemun 南大門 and was saddened at the sight of the *Essence* that Yi read every day.¹²²

Table: Discussion on mathematics between Hwang Yunseok and Yi Hyeonjik

No. of Gwon in YR	Date	Contents	Volumes and page numbers of the photo-copy edition	Remarks
14	1770/03/17	答李君顯直子敬算學八問	vol.3, 96–97	Refer to vol.3, 797–798
14	1770/04/04	數學問答	vol.3, 133	Refer to vol.3, 800
14	1770/04/14	又附李子敬算法, 數學問答(已見前)	vol.3, 143	
15	1770/06/14	第四數學問答	vol.3, 264	Refer to vol.3, 815
15	1770/06/27	答李子敬算學三問	vol.3, 314	Refer to vol.3, 816

¹¹⁸YN, gwon 14, Gyeongin (1770)/04/13, vol. 3, 142.

¹¹⁹*Ibid.*, 143. “子敬又自言, 精蘊實古算家第一大全書也, 而猶有漏處, 吾欲補之, 近已留意出草, 早晚書成, 當就兄相質, 須要無一遺漏, 使極其變化耳.”

¹²⁰YN, gwon 20, Gabo (1774)/07/18, vol. 4, 141. “又聞李子敬下世, 可愕.” It seems that the last year of Yi Hyeonjik’s life was in fact in the Gyesa癸巳 year (1773).

¹²¹YN, gwon 20, Gabo (1774)/07/26, vol. 4, 154. “又言, 李顯直亦非易得之人, 不幸作故, 其遺孤方移南大門外藍井洞, 似難尋問, 奈何.”

¹²²YN, gwon 24, “轉往南大門外焰硝廳橋, 故友李顯直子敬家, 蓋子敬自三清洞移寓一處, 以癸巳沒... 出示其大人所閱數理精蘊活字鄉本, 追念舊事, 益增歎悵.”

18	1771/05/09	答李子敬算法天元一問	vol.3, 701	Refer to vol.3, 835
47	Miscellaneous writings on the calendars and mathematics (yeoksu japgi 曆數雜記)	三答李顯直子敬, 算學四問, 數學問答第三	vol. 9, 1–4	Refer to vol.9, “appendix,” 1–6

Concluding Remarks

Hwang Yunseok’s style, generally known as “broad learning,” is closely related to his investigation into the *Complete Collection on Nature and Principle*. Committed to studying classics from childhood, Hwang studied Confucian classics including the *Yijing*, and then expanded his interest to “the doctrines of the *Yijing*, the Great Plan, Shao Yong’s *Supreme Rules Governing the World*, harmonics, calendrical astronomy, and mathematics.” It was in this same context that Hwang expressed his interest in the *Complete Collection*. Hwang worked very hard from his late teens to elucidate the *Complete Collection*, and this commitment continued for the rest of his life.

Hwang studied harmonics and calendrical astronomy in conjunction with his investigation into the *Complete Collection*. He had already made an ambitious plan, in his childhood, to examine the connection between heaven and man (*cheonin jije* 天人之際), and focused his attention on harmonics, calendrical astronomy, and mathematics as part of his effort to achieve this goal. The three subjects were closely related to one other in the traditional system of learning. Hwang thought that study of the problems of numbers would naturally lead to solving calendrical problems as well. In other words, his work on mathematics started in the context of harmonics, calendrical astronomy, and mathematics.

Hwang’s interest in mathematics was an extension of his interest in the traditional subject of “images and numbers” (*sangsu hak* 象數學). He became interested in mathematics in the process of studying the *Complete Collection*. He studied the *Introduction to Mathematics*, a representative book of traditional mathematics, and as an extension he became interested in Western mathematical texts including the *Elements of Geometry*. Later, during his life in Seoul, he focused his efforts on studying the *Essence of Numbers and Their Principles* and the *Thorough Investigation of Astronomical Phenomena*, which were considered at the time to be

the best mathematical texts.

In the late eighteenth century in Joseon, Hong Yanghae was widely recognized as the most prominent figure in mathematics. Mun Gwangdo, at the time a renowned expert in the field of calendrical science, had learned Western mathematics from Hong, and Seo Hosu said he had learned mathematics from Mun. If such reports are true, Western mathematics in the late eighteenth century was passed down from Hong Yanghae to Mun Gwangdo and then from Mun to Seo Hosu. At the time, Seo Myeong-eung (and his son Hosu), Yi Byeok, and Jeong Hujo were often mentioned as those who did specialized works on Western mathematics, and it was widely known that Seo Myeong-eung's Dalseong Seo clan and Yi Ik's Yeoju Yi clan had a particular interest in Western learning.

While living in Seoul, Hwang befriended people known as experts of Western mathematics at the time, and discussed various problems of mathematics with them. Hwang's circle of friends included Seo Myeong-eung and his son Hosu, Jeong Dongyu and the Donggi brothers, Jeong Cheoljo and the Hujo brothers, and Yi Gahwan, Hong Daeyong, Bak Jiwon, and other scholars in the "Northern Learning (*bukhak* 北學)" school. One notable figure among them, in terms of mathematics, was Yi Hyeonjik. Yi had his mind set on mathematics from early on and studied traditional mathematical texts including the *Introduction to Mathematics*, and then went on to embrace Western mathematics on that foundation. Hwang frequently met with Yi to discuss a variety of mathematical problems. Yi, while acknowledging that the *Essence* was the most comprehensive book for a mathematician, saw deficiencies in it, and intended to write a book that would improve on it. The goal and the actual course of Yi's study on mathematics had some similarities to those of Hwang Yunseok.

The interest of Hwang, who tried to embrace Western mathematics as an extension of traditional mathematics, can be summarized as the study of harmonics, calendrical astronomy, and mathematics (*ryulyeok sansu ji hak* 律曆算數之學). Hwang believed that while "the science of calendar" was not essential for the studies of a Confucian scholar in nurturing one's mind and body, it was still "the great letters between heaven and earth" and thus was indispensable. Hwang legitimized mathematical learning further by calling it "a field that forms inside and outside of the *Yijing* and the Great Plan (*yeokbeom* 易範), and investigates systematically into heaven and earth," and asserted that not even ancient sages abandoned it. In this manner, Hwang studied the systematic relations between the three fields of harmonics, calendrical astronomy, and mathematics, and through his research on mathematics he attempted to solve questions of harmonics and the calendars and, ultimately, to explain the principles of *yeok* 易, which is the root of human nature and destiny (*xingming* 性命). In short, he endeavored to investigate the *Origins of Pitchpipes and the Calendar*, allegedly the most advanced book in that field at the time, from the perspective of the study of harmonics, calendrical astronomy, and mathematics (*ryulyeok sansu ji hak* 律曆算數之學), and to "make the historical legacy of the Joseon Dynasty [聖朝史典] shine" and "to complement historical records of the Joseon Dynasty" by completing unfinished projects of the previous

scholars through his study. His mathematical work and his acceptance of Western mathematics were byproducts of this endeavor.

Abstract

The *Yijae nango*, a lifetime journal of a Confucian scholar of eighteenth-century Korea named Hwang Yunseok, contains detailed records about Hwang's study on mathematics and on his relationship with other *yangban* literati who had specialized interests in mathematics. Based mainly on this material, this article examines why and how a Confucian scholar in late eighteenth-century Korea studied mathematics, including Western mathematics introduced from China. Hwang's interest in mathematics, as shown in his journal, was an extension of his interest in the traditional learning of "images and numbers (*sangsu* 象數)," an interest that he earned while studying Neo-Confucian texts compiled in the *Complete Collection on Nature and Principle* (*Xingli daquan* 性理大全). He began his mathematical study from texts on Chinese traditional mathematics, notably, the *Introduction to Mathematics* (*Sanxue qimeng* 算學啓蒙), and as an extension of this study, he became interested in Western mathematical texts including the *Elements of Geometry* (*Jihe yuanben* 幾何原本), and the *Essence of Numbers and Their Principles* (*Shuli jingyun* 數理精蘊) and the *Thorough Investigation of Astronomical Phenomena* (*Lixiang kaocheng* 曆象考成). This paper also examines Hwang's records concerning the community of mathematicians in late eighteenth-century Seoul—the main figures in the field, their relations to one another, the circulation of books among them, and the trends of their mathematical studies.

Keywords: Hwang Yunseok, *Yijae nango*, Western mathematics, *Complete Collection on Nature and Principle* (*Xingli daquan* 性理大全), *Essence of Numbers and Their Principles* (*Shuli jingyun* 數理精蘊).