

Impotent Numbers: Korean Confucian Reactions to Jesuit Mathematics*

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Two recent publications in Korea have driven more nails into the coffin of an assumption long academically discredited, though it unfortunately is still widely accepted among the general population in Korea. It is not unusual to read or hear in Korea that most Confucians during the latter half of the Joseon dynasty were so narrow-minded and hidebound that they were both unwilling and unable to entertain ideas and practices that were not sanctioned by centuries of Chinese Confucian tradition. Jang Hyewon and Koo Mhan-ock have shown conclusively, particularly in the case of mathematics, that that was not true.¹ Books by European missionaries that appeared in China after 1600 and introduced Western mathematical techniques were eagerly read by a wide range of Korean Confucian scholars, and most of their Confucian readers recognized the superiority of the techniques suggested in those books. Moreover, another Korean scholar has recently confirmed what has long been known by historians of science in Korea, that the official calendar for the last two centuries of the Joseon dynasty was based on European methods of calendrical calculation, and, moreover, that Koreans knew that those methods were European in origin.² There is therefore no justification for the assertion that Korean Confucians rejected “Western Learning” (*Seohak*) in its entirety because of its non-Confucian European origins.

But, when we look at the long list of names of Joseon dynasty Koreans who studied Western mathematics, we find very little overlap with a list of names of Joseon dynasty Koreans who were attracted to another side of “Western Learning,” the Catholicism that those who wrote those mathematics texts came to China to preach. None of the famous mathematicians discussed by Jang Hyewon, such as

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¹ Jang Hyewon, *Sanhakseoro poneun Joseon suhak* [Mathematics in Joseon Korea, as seen in mathematical publications] (Seoul: Gyeongmunsa, 2006); Koo Mhan-ock, “Mat’aeo Lich’i ihu Seoyang suhak-e daehan Joseon jisigin ui paneung” [The response of the educated class to the Western mathematics of Matteo Ricci], *Han’guk sirhak yeon’gu* 20 (2010), 301–55.

² Gang Yeongsim, “17-seigi Seoyang Cheonmun yeokbeop seojeok ui suip gwa cheonmun yeokbeop insik ui byeonhwa: Seoyang yeokbeobin siheollyeok suyongeu jungsimeuro” [The introduction of Western books on astronomy and calendrical calculation in the seventeenth century, and changes in the understanding of astronomy and calendrical calculation: focusing on the acceptance of the *Shixian li* calendar, which was based on Western methods of calendrical calculation], in Hong Seonpyo et al., *17.18 seigi Joseon ui waeguk seojeok suyong gwa dokseo munhwa* [The acceptance of Western-authored books in Korea in the seventeenth and eighteenth centuries, and the culture of reading] (Seoul: Hyeon Publishing, 2006), 221–63.

Hong Jeongha (1684–?), Choe Seokjeong (1646–1725), and Hwang Yunseok (1719–1791), played any role in the emergence of a Catholic community on the Korean peninsula. Koo Mhan-ock discusses a broader group, including those who were not primarily mathematicians but included mathematics among the many subjects they deemed worthy of scholarly attention. A few of those whom Koo discusses, such as Yi Byeok (1754–1786), Jeong Yakjeon (1758–1816), Jeong Yangyong (1762–1836), Yi Seunghun (1756–1801), and Yi Gahwan (1742–1801), are associated with the founding of a Korean Catholic Church. However, most of those Koo discusses, such as Hong Daeyong (1731–1783), Pak Jiwon (1737–1805), Seo Hosu (1736–1799) and Hong Yanghae (?–1778), focused on mathematics only and were not the least bit interested in the religious beliefs of the Jesuit mathematicians in China.³

At first glance, this is somewhat puzzling, since recent scholarship published on the other side of the Pacific Ocean, in North America, has confirmed what both academics and the general public have long known, that the Jesuit missionaries who traveled to China in the seventeenth and eighteenth centuries and wrote books introducing Western science, technology, and philosophy to the Confucian world did so for one reason only—to convert Confucians to Christianity. Both Florence Hsia and Liam Brockey,⁴ drawing solely on European-language sources, have little to say about how people in China, Korea, and Japan responded to the Jesuit missionary drive. They both make clear, however, from their reading of what the Jesuits themselves were saying about their reasons for traveling to East Asia, that mathematics, science, and technology were nothing more than tools to be utilized in their proselytizing project.

Hsia highlights the Jesuit subordination of mathematics to religion in some of the subheadings in her chapters. Phrases such as “the missionary mathematician” (p. 21), “the mathematician as saint” (p. 26), “the mathematician as martyr” (p. 30), and “mathematical magic” (p. 45) are used to draw her readers’ attention to the relationship the Jesuits themselves saw between their mathematical skills and their proselytizing goals. She also points out, however, that the vast majority of Jesuit missionaries in late Ming and Qing China focused almost exclusively on either converting Chinese to Catholicism or ministering to those already converted. “As for the more than four hundred individuals who bore the burden of the old Society’s evangelical efforts in the Middle Kingdom ... only a bare handful—perhaps fifteen in all—ever held positions in the imperial Astronomical Bureau.” She notes that a few more may have spent some of the time “casting astronomical instruments, surveying landscapes, or rendering texts in natural philosophy, pure and mixed mathematics, and medicine,” but they still didn’t amount to more than 20% of the total number of those who toiled in the Jesuits’ China mission.⁵

³ Koo Mhan-ock, op. cit.

⁴ Florence C. Hsia, *Sojourners in a Strange Land: Jesuits and their Scientific Missions in Late Imperial China* (Chicago: University of Chicago Press, 2009); Liam Matthew Brockey, *Journey to the East: The Jesuit Mission to China, 1579–1724* (Cambridge, MA: Harvard University Press, 2007).

⁵ Hsia, op. cit., 5.

Brockey provides an even more persuasive depiction of the Jesuit missionaries as more concerned with matters of faith than of mathematics or science. He shows in his survey of the Jesuits' activities in China in the seventeenth and eighteenth centuries that most of those missionaries were more interested in the ritual life of their flock than in the mathematics they used. He also points out that most Chinese Christians shared their priests' emphasis on religion over secular knowledge. "The vast majority of Chinese Christians had little interest in the Western science and technology that the missionaries used to win friendships among the educated elite."⁶ Moreover, according to Brockey, the elite of China were able to separate Jesuit mathematics and science, which were acceptable, from Jesuit religious beliefs and practices, which were not. That became especially clear in the persecutions that broke out occasionally over the course of the eighteenth century, when the Jesuits working as astronomers and mathematicians for the court in Beijing were allowed to stay in China even though their fellow Jesuits were expelled from the country.⁷

Koreans found it just as easy as the Chinese had to separate Jesuit religion and Jesuit mathematics and science. Very few of the small number of Koreans who were Roman Catholics from 1784, the year the Korean Catholic Church was born, to the end of the nineteenth century were particularly interested in Jesuit writings on mathematics and natural philosophy. Moreover, as we have already noted, government officials in Korea were also able to distinguish Jesuit approaches to the natural world from Jesuit approaches to the supernatural realm, though in their case they showed a much more positive reaction to Western mathematics and technology than they did to Catholic doctrines and ritual. Not only were they willing to use Western mathematical techniques for calendrical calculation, in the late eighteenth century they also made use of some Western technology, such as pulleys and cranes, when they constructed the walls for the fortress in a new city being built in Hwaseong, present-day Suwon, which was to serve as a counterweight to the power of the capital of Seoul. But, at the same time, they persecuted Catholics who insisted on following Catholic rather than Confucian ritual practices.⁸

⁶ Brockey, op. cit., 216.

⁷ Ibid., 198–200.

⁸ Peter H. Lee, ed., *Sourcebook of Korean Civilization* (New York: Columbia University Press, 1996), 104–06, 109–59. The pulleys and cranes used in the construction of that fortress were based on designs and explanations contained in the *Qiqi tushuo* [Illustrated explanations of marvelous machines], written by the Jesuit missionary to China Johann Terrenz Schreck (1576–1630) to introduce Western mechanical ingenuity to the Confucian world. On Korean use of that book, see Jeon Sang-woon, *Science and Technology in Korea: Traditional Instruments and Techniques* (Cambridge, MA: MIT Press, 1974), 158–60. On Hwaseong as an intended site of military, commercial, and political power to counter the power of the powerful entrenched families in the government in Seoul, and on Jeong Yagyong's use of the *Qiqi tushuo* to construct the pulleys and cranes he used to build the fortress walls, see Yu Bonghak, Kim Donguk, and Jo Seongeul, *Jeongjo sidae Hwaseong sindosiui geonseol* [The construction of the new city of Hwaseong during the reign of King Jeongjo] (Seoul: Baeksan seodang, 2001).

Jesuit Mathematics and the Origins of the Korean Catholic Church

The Jesuits' use of mathematics to entice Confucians into the Catholic Church was not a complete failure in Korea. Some of the founders of the Korean Catholic community were originally drawn to Jesuit publications because of their curiosity about the mathematics and science they taught. But those who became and remained devout Catholics generally lost interest in mathematics, and instead focused their attention on devotional and doctrinal writings, whereas those who remained interested in Western mathematics and science tended to distance themselves from Catholicism, especially when it became an object of severe government persecution.

For example, Yi Seunghun, the first baptized Catholic in Korea that we know of, was able to travel to Beijing in 1773 when his father was appointed to a diplomatic mission to that imperial capital. Before he left Korea, his friend Yi Byeok suggested that he stop by a Catholic Church in Beijing. "The Western missionaries will certainly be pleased to see you, and will treat you well. Then you will be able to get a lot of interesting and enjoyable things from them. You must not come back empty-handed."⁹ Yi followed his friend's suggestion and sought out the European priests in Beijing.¹⁰ He confessed later that he had originally approached them out of a desire to learn more about Western mathematics.¹¹ But, he said, he came to realize, from reading the books those priests gave him, that Catholicism was a "sacred teaching." Yi was baptized, taking the Catholic name Peter, and after he returned to Korea, in early 1784, became the primary organizer of Korea's first Catholic community.¹² For the rest of his life, until he was executed in 1801 for his Catholic activities, he oscillated between acting the ardent Catholic and hiding his faith to avoid persecution. But he never became known for any particular expertise, or even interest, in Western mathematics, science, or technology. He is known only for his involvement with the Catholic religion in Korea.

When Peter Yi Seunghun was baptized in Beijing, the priests there gave him copies of Ricci's catechism, the *Tianzhu shiyi* [The True Significance of the Lord of Heaven], along with two works on Western mathematics. One was the *Jihe yu-*

⁹ Hwang Sayeong, *Hwang Sayeong baekseo* [The silk letter of Hwang Sayeong], edited and translated by Yun Jaeyeong (Seoul: Jeongeumsa, 1975), 54–55 (lines 43–44).

¹⁰ Yi was not the first Korean visitor to Beijing to take advantage of his time there to check out the exotic Western churches in that city, but he was the first to return home a baptized Catholic. See Shin Ik-Cheol, "The Experiences of Visiting Catholic Churches in Beijing and the Recognition of Western Learning Reflected in the Journals of Travel to Beijing," *Review of Korean Studies*, 9:4 (December, 2006), 11–31.

¹¹ See Yi's letter to the Catholic priests in Beijing, written in 1789. "Yi Seunghun gwangye woegugeo seohan jaryo" [Letters in a foreign language about Yi Seunghun], *Gyohoesa yeon'gu*, 8 (1992), 206. Also see Yun Min'gu, tr., *Han'guk chogi gyohoe-e gwanhan gyohwangcheong jaryo munjip* [Collection of Vatican documents related to the early Korean Church] (Seoul: Gatollik chulpansa, 2000), 164–65.

¹² Choe Seogu, "Han'guk gyohoe ui changseol gwa chochanggi Yi Seunghun ui gyohoe hwalldong" [The founding of the Korean Catholic Church, and the Catholic activities of Yi Seunghun in the early stages], *Gyohoesa yeon'gu* 8 (1992), 10–12.

anben [Elements of Geometry]. The other was the *Yuzhi shuli jingyun* [Imperial Commissioned Collection of Basic Principles of Mathematics].¹³ Shortly after he returned from Beijing, Yi Seunghun shared with Yi Byeok some of the books he acquired there. Yi Byeok, in turn, shared these books with a couple of his closest friends, the brothers Jeong Yakjeon and Jeong Yagyong. According to Jeong Yagyong, Yakjeon was very happy to learn about such books and to acquire the knowledge they contained, but Yagyong reported that those books failed to convince Yakjeon to actually become a Catholic.¹⁴

For Peter Yi Seunghun and Yi Byeok, it was *Tianzhu shiyi*, an introduction to Catholic doctrine, which captured their attention. Both men became fervent Catholics, and appear to have quickly lost interest in mathematics. But, according to Yagyong, though he and his brother Yakjeon found the catechism interesting at first, they soon recognized flaws in it and turned their attention to Western writings on more secular subjects. The Jesuit missionary dream of convincing Confucians that Western science and mathematics were inseparable from Western philosophy and theology was thus not realized in Korea. Korean Confucians, just like most Chinese Confucians, were able to render asunder what the missionaries had tried to keep together. We find further evidence for that in the life of Yi Gahwan.

Yi Gahwan was another prominent Confucian who took an interest in Western mathematics and became associated with the group of scholars who founded the Korean Catholic church. According to one Catholic source, Yi Gahwan “was well-versed in the study of astronomy and geometry. He used to sigh and say, ‘When this old man dies, that will be the end of geometry in this Eastern Country.’”¹⁵ Yi was accused several times of being a Catholic himself and died from wounds suffered under interrogation during the anti-Catholic persecution of 1801. But the

¹³ Cha Gijin, “Mancheon Yi Seunghun ui gyohoe hwaldong gwa jeongchijeok ipji” [Mancheon Yi Seunghun’s political stance and his activities for the church], *Gyohoesa yeon’gu*, 8 (1992), 39.

¹⁴ “Seonjungssi myojimyeong” [An epitaph for my brother Jeong Yakjeon], Jeong Yagyong, *Yeoyudang jeonseo* [The complete works of Jeong Yagyong], I, vol. 15, 39b. (Seoul: Sin Joseonsa, 1934). Later in his life, Yagyong added an appendix to the epitaph for his brother in which he admitted that the books that most excited him and his brother at that time dealt with such subjects as creation, life and death, and the difference between material and spiritual beings. He also admitted that at first they were both quite attracted to Catholicism, but says that the attraction ended when they learned of the Catholic prohibition of Confucian-style ancestor memorial services (*ibid.*, 42a).

¹⁵ Hwang Sayeong, *Silk Letter*, line 46, pp. 56–57. For more on Yi Gahwan and Western mathematics and calendrical science, see Choe Sangcheon, “Yi Gahwan gwa Seohak” [Yi Gahwan and Western Learning], Han’guk Cheonjugyohoe changseol ibaekjuneom ginyeom Han’guk gyohoesa nonmunjip ganhaeng wiwonhoe, ed., *Han’guk gyohoesa nonmunjip: Han’guk Cheonjugyohoe ch’angseol ibaekjuneom ginyeom*, II [A collection of articles on the history of the Catholic Church in Korea in commemoration of the 200th anniversary of the founding of the Korean Catholic Church, vol. II] (Seoul: Han’guk Cheonju gyohoesa yeon’guso, 1985), 41–67; Ha Seongnae, “Yi Gahwan gwa Seohak gwau gwan’gye” [Yi Gahwan and his relationship with Western Learning], *Hanyang University han’gukhak nonjip* 35 (2001), 5–44. Both Choe and Ha argue that Yi Gahwan was an active member of the small Catholic community in the 1780s, but distanced himself from that community after 1791, when the Korean government began executing Catholics.

charge that he was a Catholic appears unfounded. In fact, Yi Gahwan appears to have drawn a clear distinction between Western mathematics and Western religion, even though he realized that others had blurred the distinction between them.¹⁶

According to Jeong Yagyong's epitaph for Yi Gahwan, Yi once declined a request from the king that he read some Jesuit books and write up a summary of the main points they make related to mathematics and calendrical calculation. Yi justified his refusal by explaining that there were a lot of ignorant people who could not distinguish the secular material in those books from religious material and he was afraid he would be face criticism for promoting Catholicism if he did as the king asked. The king accepted his excuse.¹⁷

Jeong Yagyong himself confessed to his king that he had been attracted to "Western Learning" when he was a naïve youth but had soon learned that Catholicism was an evil religion. Here is what he told his king in 1797, when he resigned a post in the capital in order to escape the line of fire of an anti-Catholic group:

When I read Catholic writings, I was still a young man, barely out of my teens. Reading books by Europeans was the popular thing to do at that time. Those books contained a lot of interesting information about astronomy and calendrical science, and about agricultural and irrigation technology. They also included some mathematical techniques useful for surveying land and calculating how large a harvest might be. We all read those books back then and talked about them among ourselves in order to gain a reputation for being well informed and well read.

As I was still young, all I really cared about was having others think that I was as bright as the best of them. That is why I joined the crowd that was reading such books and talking about them. Unfortunately, I am impatient and careless by nature, so I just skimmed through those books without taking the time to understand their fine points and difficult passages. That is why I didn't recognize the flaws in those writings back then. On the contrary, I was entranced by their promises of life after death and was impressed by their calls for rigorous self-discipline. The twists and turns of their fancy rhetoric

¹⁶ For a survey of what we know of Yi Gahwan's approach to Western astronomy, and how his openness to Western astronomy and calendrical science does not suggest that he felt that Western civilization in general was superior to Confucian civilization, see Mun Jungyang, "18 segi-mal cheonmun yeoksan: cheonmun'ga ui gwahak hwaldong gwa damnon ui yeoksajeok seong-gyeok: Seo Hosu wa Yi Gahwaneul jungsimeuro" [The historical characteristics of the scientific activities and discourses of experts on astronomy and calendrical science in the eighteenth century, focusing on Seo Hosu and Yi Gahwan], *Dongbang hakji* 121 (2003), 51–84.

¹⁷ "Jeongheon myojimyeong" [An epitaph for Yi Gahwan], Jeong Yagong, *Yeoyudang jeonso*, I, vol. 15, 23a. For more on how thoroughly Confucian Yi Gahwan was in his approach to calendrical science and the mathematics it involved, see Koo Mhan-ock, "Joseon hugi cheonmun yeoksanhak ui gaehyeok bangan: Jeongjo ui cheonmunchaek-e daehan daechaegul jungsimeuro" [Measures to reform astronomy and calendrical science in the second half of the Joseon dynasty, focusing on King Jeongjo's proposals with respect to astronomy], *Han'guk gwahaksa hakhoeji* 28: 2 (2006), 189–225.

fooled me into thinking that what they were offering was just another form of Confucianism.¹⁸

This is the same Jeong Yagyong who, a few years earlier, had, on the advice of that same king, used a Jesuit-authored work, the *Qiqi tushuo* [Illustrated Explanations of Marvelous Machines], to build the pulleys and cranes needed to construct the Hwaseong fortress. Unlike Yi Gahwan, Jeong Yagyong didn't appear to feel a need to distance himself from Western science and technology so as to protect himself against the charge of being a secret Catholic.

The Confucian Encounter with Western Mathematics

Though mathematics may have enticed a few Koreans to look more closely at a wider range of Western publications, which had led a few of them to become believers in Catholicism, it failed to display the broad persuasive power the Jesuit missionaries had expected it to have. As already noted, most of those who saw utility in Western mathematics failed to extend their positive opinion of European mathematical skill to European philosophy and theology. The ability of Korean Confucians to extract what they found valuable in Western mathematics and discard the rest, an ability they shared with the Chinese, frustrated the Jesuit strategy for presenting "Western Learning" as an integrated whole, to be accepted in its entirety or not at all. The question therefore arises, "Why did the missionary attempt to use math to draw Confucians to Catholicism fail, with only a few exceptions that proved the rule?" What was it about the way Confucians, both in Korea and in China, conceived of and approached mathematics that allowed them to frustrate the Jesuit attempt to take them from an acceptance of European mathematical propositions to an embracing of European theological assertions?

Koreans, just like the Chinese, had a number of reasons for studying Western mathematics. Some were interested in gaining greater facility in what was seen as one of the minor arts, along with archery and calligraphy, that a gentleman was supposed to be familiar with. Some looked to Western mathematical techniques for tools useful for practical administrative work, including calendrical calculation and tax calculation. And there were some who saw numbers as key components of the fundamental patterns that generated and shaped the cosmos, and therefore were worthy of study in their own right.¹⁹ Few, however, saw the study of numbers and their manipulation as part and parcel of the cultivation of a moral character, which was the ultimate goal of Confucianism.

Moreover, the Jesuits had not expected those Confucians in China and Korea who took their mathematical writings seriously to be able to deconstruct mathematics into its three distinct features, weakening even further the link between Jesuit

¹⁸ "Byeonbang sa Dongbuseungji so" [A memorial from the Sixth Royal Secretary in Response to Slandorous Accusations], Jeong Yagyong, *Yeoyudang jeonseo* I, vol. 9, 43b.

¹⁹ Koo Mhan-ock, "Mat'aeo Lich'i ihu Seoyang suhak-e daehan . . .", 348.

mathematics and Jesuit theology. Those three separable components are, first of all, the formulae, especially geometric formulae; second, the method of calculating on paper with symbols for numbers instead of representations of counting rods or abacus beads; and, third, the notion of deductive proofs.

The Jesuits introduced quite a few new formulae and mathematical and calendrical concepts, and those the Confucians had little trouble accepting. “New algebraic notions (of Hindu-Arabic origins), Tychonic cosmology, Euclidean geometry, spherical trigonometry, and arithmetic and trigonometric logarithms”²⁰ did not challenge the fundamental ethical and metaphysical assumptions of their Neo-Confucian worldview. Nor were the Confucians particularly bothered by the different methods Westerners used to work out math problems on paper. It was the notion of deductive proofs, however, the most important component of Western mathematics for Jesuit proselytizing purposes, that presented the greatest difficulty in winning their acceptance. When they read the Chinese translation of the first books of Euclid’s *Elements*, Chinese and Koreans alike tended to ignore the proofs they contained, and to treat that book as primarily a collection of “computational rules and theorems.”²¹

It is this ability of Confucians to accept Western mathematics without accepting along with it the logic that provided its foundation that cries out for explanation. The Jesuits who used mathematics as a proselytizing strategy did not expect that sort of response, since, in the assumptions that governed their own worldview, such a dismantling of the entire mathematical enterprise into its constituent elements was irrational. To Koreans, however, it was insisting on proofs in the Western manner that was irrational. These differences in an understanding of the rational, especially in relation to mathematics, are the focus of this article.

Koreans first learned about both Western astronomy and the mathematics beneath it from an early collection of Jesuit writings entitled *Tianxue chuhan* [An Introduction to Heavenly Learning] that had been compiled by the Chinese Catholic convert Leo Li Zhizao (1565–1630) in 1628.²² Li’s title was a deliberate play on the fruitful ambiguity of the term *Tian*. In Jesuit writings on astronomy and calendrical calculations, “Tian” meant the heavens above, where the sun and the stars shined. When Jesuits wrote about their religion, however, “Tian” meant Heaven, the God above whose existence and characteristics were the primary focus of Jesuit proselytizing writings. Leo Li had thus presented Western civilization to the Confucian world as the Jesuit missionaries wanted it presented: European science, technology, and mathematics linked inseparably with Roman Catholic philosophy and religion under the rubric “Tianxue.”

²⁰ Benjamin Elman, *On Their Own Terms: Science in China, 1550–1900* (Cambridge, MA: Harvard University Press, 2005), xxxi.

²¹Ibid., 115. Elman is, of course, referring in particular to two prominent Chinese scholars, but since there was very little difference between the basic approaches of mathematicians in China and those in Korea, his statement applies as well to how Jesuit mathematics was viewed in Korea.

²²A photocopy edition of *Tianxue chuhan* was published by the Student Bookstore in Taipei, Taiwan, in 1965.

Though the Jesuit mission in China was less than five decades old in 1628, Li Zhizao found enough of its material to fill 52 volumes. The twenty titles of the *Tianxue chuhan* were divided into two major sections, one on principle (*li*), consisting of ten religious works such as Ricci's *Tianzhu shiyi*, the other on "tools and instruments" (*gi, qi* in Chinese), consisting of ten works on mathematics, astronomy, and technology, such as Ricci's translation of the first six books of Euclid's geometry (*Jihe yuanben*).

The books in the "tools and instruments" section of *Tianxue chuhan* were written to convince Confucians not only that the Jesuits were superior mathematicians and astronomers but also that they had earned that superiority by following a specific mode of accurate reasoning, a logical method they also employed in their moral reasoning, and in their arguments for the existence of God. The missionaries hoped that if Confucians could be convinced to adopt Western techniques for calculating movement in the heavens, they could also be convinced to adopt the Christianity that underlay the civilization that had produced those techniques. Their hope was that Confucians who respected Western knowledge of heaven would also respect Western claims about Heaven.

To some degree, the strategy was effective. The Jesuits won an audience. Moreover, they earned Chinese recognition of the superiority of Western mathematics over traditional Chinese mathematics in certain areas. And there were some who took the bait of Western technological expertise and were drawn into belief in Western religion. Li Zhizao and Xu Guangqi (1562–1633) were two such converts in China.²³ But they were exceptions. Moreover, they appear to have been converted more by the admirable moral character of Matteo Ricci than by those scientific accomplishments of Ricci's that had first brought him to their attention.

In Korea, as already noted, men such as Yi Gahwan and Jeong Yakjeon were also initially attracted to "Western Learning" by the mathematical and astronomical skills on display in Jesuit publications. But Koreans who were caught in the Jesuits' net of geometrical precision and calendrical accuracy usually lacked the religious fervor and fidelity of Li and Xu. Yi and Jeong, for example, remained more interested in Western approaches to nature and numbers than in Christian attitudes toward God and morality.²⁴ Most Koreans who encountered "Tianxue" were able to separate the technology and science they found useful from the theology and Christian worldview that the Jesuits linked to them. Koreans incorporated Western mathematics into a Neo-Confucian framework, in the process eviscerating the Western strategy of using Western superiority in certain technical fields to thwart East Asian confidence in the superiority of the Confucian tradition.

²³ Willard J. Peterson, "Why Did They Become Christians? Yang T'ing-yün, Li Chih-tsao, and Hsu Kuang-ch'i," *East Meets West: The Jesuits in China, 1582–1773*, edited by Charles E. Ronan and Bonnie B. C. Oh (Chicago: Loyola University Press, 1988), 129–52.

²⁴ Jeong Yagyong, *Yeoyudang Jeonseo* I, vol. 15, 15a–28b, "Jeongheon myojimyeong" [An epitaph for Yi Gahwan], and I, vol. 15, 38b–42b, "Seonjungssi myojimyeong" [An epitaph for my brother Jeong Yakjeon].

Mathematics as a Model of Reasoning

The Jesuit missionaries had brought with them to East Asia a European mathematics reborn, the mathematics of the Renaissance. In China they encountered a totally different mathematical tradition, one that in numerical notation, organization, and theoretical orientation was as unlike the Grecian mathematics of the Jesuits as Christianity was unlike Neo-Confucianism. Undaunted by this cross-cultural challenge, Matteo Ricci and other pioneers in the mission to China proceeded to prepare Chinese language introductions to the basics of Western mathematics. Such books as *Jihe yuanben*, *Gougu yi* [On the Right Triangle], and *Tongwen suanzhi* [The Epitome of Arithmetic], all by Matteo Ricci and all included in the “tools and instruments” section of the *Tianzue chuhan*, had succeeded in winning the attention of Neo-Confucian scholar-officials in China.

Those books also penetrated Korea and were read and discussed by a number of Korean Confucian scholars, including Jeong Yagyong (better known as Dasan) and his friends. In Dasan’s world, before the arrival of those Jesuit publications, mathematics meant Sino-Korean Neo-Confucian mathematics, just as medicine by and large meant Sino-Korean Neo-Confucian medicine and as astronomy generally meant Sino-Korean Neo-Confucian astronomy. The pre-modern civilizations of both Confucianism and Christianity were unified in a way that modern civilizations are not. At least in literate elite circles, ideally all fields of human interest and endeavor were under the domain of one hegemonic Weltanschauung. In Europe that meant that everything from art and astronomy to metaphysics and mathematics was supposed to be infused with Christian assumptions and values.

Likewise, in China and Korea between 1500 and 1900, the artist, the astronomer, the philosopher, and the mathematician were all expected to operate within the confines of Neo-Confucian presuppositions and moral principles. The Confucian scholar elite in China and the Confucian scholar elite in Korea shared the basic assumptions, and the same fundamental beliefs and values. They were both participants in Confucian civilization, and both operated within its broad philosophical and scientific parameters.

Ricci and the other early Jesuit missionaries realized that they could not launch a frontal assault on such an all-embracing approach to the world, an approach so different from their own. Instead, they attempted to penetrate the ramparts of Neo-Confucianism by disguising the products of Christian civilization in Confucian clothing, presenting them as augmenting and supplementing Neo-Confucian accomplishments, rather than denying those prior accomplishments outright, or posing radical alternatives to them.

Burrowing thus from within, the Jesuits made limited inroads into Confucianism, but the camouflage that made those inroads possible ensured also that those inroads would remain limited. For example, they presented European mathematics, particularly Euclidean geometry, as a model of the type of logical reasoning that guaranteed not only accurate results to mathematical problems but also unassailable conclusions to such questions which arise in other areas of

human concern, from science to ethics. But their strategy forced them to present that mathematics within a Confucian mathematical framework, one that assumed a different function for mathematics, a different approach to the framing of problems, a lesser degree of certainty for its conclusions, and a narrower range of applicability for its techniques.

The Western mathematics that Jesuit books from China had introduced to Koreans contained arithmetic and geometry, nothing more. The coordinate geometry of René Descartes (1596–1650) and the calculus of Issac Newton (1642–1727) and Gottfried Leibniz (1646–1716) had not yet been invented at the time the mathematical works in the *Tianxue chuhan* were composed. The notation system the missionaries employed in their Chinese translations of European mathematical writings was Hindu-Arabic notation, which had only reached the standardized form we use today in fifteenth-century Europe. The symbols so common in stating algebraic problems today did not begin to play a powerful role in the stating and solving of mathematical problems until the end of the seventeenth century, and were not yet available to the first Jesuits writing in Chinese.²⁵ Moreover, the mathematical method that was the centerpiece of this prong of the Jesuit proselytizing strategy had only relatively recently been revived in Europe, with the recovery of Euclid from the Arabs. The first usable Latin translation of that geometry classic from ancient Greece was not completed until 1482.²⁶

Consequently, the mathematics the Jesuits brought to China and Korea was not modern mathematics. Nor was it markedly superior, in the types of problems it could handle or the accuracy of the solutions it could offer, to Confucian mathematics at its best.²⁷ But it did differ from the mathematics that Chinese and Koreans had been accustomed to. It was abstract, deductive, axiomatic, and precise.²⁸ That was what, the Jesuits believed, gave it persuasive, and proselytizing, power.

Jesuit mathematics was abstract both because of the way it conceptualized its fundamental components and because of the way it framed its problems. In the perennial oscillation in the Western world between Platonism and Aristotelianism, the latter was temporarily ascendant in the universities that trained the Jesuits and afforded them the version of Western civilization they brought to China. That meant that the Jesuits did not view numbers, for example, as Platonic universals, essentially separate from, superior to, and ultimately more real than the material

²⁵ George Ifrah, *From One to Zero*, translated by Lowell Bair (New York: Viking Penguin, 1985), 428–497; Joseph Needham, *Science and Civilization in China*, vol. 3 (London: Cambridge University Press, 1959), 155; Morris Kline, *Mathematical Thought from Ancient to Modern Times* (New York: Oxford University Press, 1972), vol. 1, 262.

²⁶ “Introduction” by Sir Thomas L. Heath, in Euclid, *The Thirteen Books of the Elements* (New York: Dover, 1956), 97–105.

²⁷ Regarding the achievements of Chinese mathematics, particularly in the Song and Yuan, see Needham, *op. cit.*, 1–168, particularly 150–51, and Li Yan and Du Shiran, *Chinese Mathematics: A Concise History*, translated by John N. Crossley and Anthony W. C. Lun (Oxford: Clarendon Press, 1987).

²⁸ Morris Kline, *Mathematics in Western Culture* (New York: Oxford University Press, 1953), 5–8.

world of individual entities. Contrary to what Platonists sometimes seemed to teach, numbers, in the Aristotelian universe, reflected the multiplicity of the world rather than creating it.

Aristotelian numbers were not totally apart from the world of mundane reality, but neither were they totally a part of it. They existed as abstractions from the concrete world of actual objects, stripped of all particular characteristics such as color, shape, or mass. With all its sensual particularities removed, a number such as five, for example, could be used to count five dogs, five shades of blue, or even five ways to write the number five, without in any way compromising its meaning and identity. A number derived its reality from the physical realm, but it was not subject to the limitations of that realm and consequently was not confined to any particular configuration of physical characteristics.²⁹ In the philosophical tradition to which the Jesuits adhered, a number was defined abstractly as nothing more than a “multitude composed of units,” with a unit understood merely as “that by virtue of which each of the things that exist is called one.”³⁰

Similarly, a line was defined as no line that ever existed in visible reality. “A line is that which has length but no breadth,” distinguishing it from “a surface, which has length and breadth” (but no depth).³¹ Such abstractions from concrete reality were necessary, the Jesuits assumed, in order for numbers and other mathematical concepts to have as wide an applicability as possible.

Reliability was as important to the Jesuits as broad applicability was. It was not enough that the Jesuits offered Confucians usable mathematics. That mathematics also had to be trustworthy. For their mathematics to have the persuasive power it needed if it were to play its assigned role in the Jesuit campaign to convert Confucians to Christianity, the missionaries had to convince Confucians that Western mathematics offered a degree of certainty unavailable in Confucian mathematics.

That certainty derived from the axiom-driven deductive reasoning found in *Euclid's Elements*, introduced by Ricci and Xu in *Jihe yuanben*. In his introduction to that work, Ricci described the steps by which such certainty was obtained. You begin, he said, with explicit definitions of the key concepts to be used in the proposed mathematical arguments. Next, you list the axioms that will provide the basis for the proofs of those arguments. Only then do you state the specific problems to be addressed. After that, you go through the steps necessary to solve each problem, one by one, and, finally, you conclude with theorems that are the only possible logical deductions from the application of those axioms to those problems. More complex problems build upon the foundations established by the axioms, definitions, and theorems of earlier, simpler problems, so that the process can take you step by step from the obvious to the surprising without losing any

²⁹ John H. Randall, *The Career of Philosophy* (New York: Columbia University Press, 1962), vol. 1, 303–4.

³⁰ Euclid, *The Thirteen Books of the Elements*. Translated with introduction and commentary by Sir Thomas L. Heath (New York: Dover, 1956), vol. 2 (book VII), 277.

³¹ Euclid, op. cit., vol. 1, book I, 153; Matteo Ricci (with Xu Guangqi), *Jihe yuanben* [Elements of geometry], in Li Zhizao, ed., *Tianxue chuhan*, vol. IV, pp. 1950–51.

degree of certitude.³²

The definitions for such geometrical figures as a line, a plane surface, an acute angle, a circle, and an equilateral triangle, and the axioms that accompany those definitions, are abstract enough that the Jesuits could apply the theorems they produced to all possible physical representations of those mathematical entities, providing the applicability so important as a selling point. Moreover, the axioms, the Jesuits believed, are self-evident when understood and logically undeniable. After all, who could deny that, for example, things equal to the same thing are also equal to one another, or that two lines at right angles to one another can only meet in one point on a flat surface?³³ Since those axioms are indisputable, the conclusions one can draw from them are equally logically unassailable, providing the reliability the Jesuits needed.

Precision was also important, since reliability would be irrelevant and applicability impossible unless mathematics provided answers both clear and specific enough, for example, to allow astronomers to pinpoint the exact movements of heavenly bodies, and military leaders to pinpoint the exact positions of their earthly targets.³⁴ An unspoken assumption behind this Jesuit argument was that such precision was made possible only by the rigorous definitions, unforgiving logic, and specialized language of Western mathematics.

The epitome of this mathematical certainty, precision, reliability, and applicability was, in Ricci's view, *Euclid's Elements*. Ricci and Xu's *Jihe yuanben* translated only the first six books of the thirteen books of *Euclid's Elements*, covering plane geometry, geometrical algebra, circles, angles, figures inscribed around circles, and ratios. But for Xu that was sufficient to prove that, with the tools and techniques that Western geometry, and only Western geometry, made available, there was no longer any reason to rely on rough estimates in solving problems, no need to doubt the conclusions one can reach with those tools and techniques, and no reason to test those conclusions empirically.³⁵ In Xu's view, the geometrical tools Ricci provided were reliable, practical, and specific enough for immediate and unquestioning acceptance by his Confucian audience.

Western arithmetic, though also impressive, did not have quite the unchallengeable authority of Euclid's geometry. Nevertheless, Li Zhizao and Matteo Ricci thought it worth their while to join forces to introduce the Confucian world to Western arithmetical techniques. Their *Tongwen suanzhi*, a translation of the *Epitome of Practical Arithmetic* by Ricci's mathematics teacher in Italy, Christopher Clavius (1537–1612), introduced Western methods of adding, subtracting, multiplying, and dividing with pen and paper.³⁶

Those methods in themselves were not noticeably superior in either speed or

³² *Jihe yuanben*, 1935–36.

³³ *Jihe yuanben*, 1970–77.

³⁴ In his introduction, Ricci wrote at length on the many practical benefits of knowledge of Euclidean geometry.

³⁵ *Jihe yuanben*, 1942.

³⁶ Matteo Ricci (with Li Zhizao), *Tongwen suanzhi* [The epitome of arithmetic], in Li Zhizao, ed, *Tianxue chuhan*, vol. V, 2771–3032.

accuracy to calculating with the abacus, which had been in wide use in China since at least the fifteenth century.³⁷ Nor were these methods noticeably superior to calculating with counting rods, still the preferred practice in Korea.³⁸ But a problem worked out with pen and paper could be checked for accuracy in a way that a problem solved with an abacus or even counting rods could not. Pen-and-paper calculations left a paper trail that made it not only possible but easy to go back over the steps leading to the final result, to subtract backwards to verify a product of addition, for example, whereas the beads of the abacus or the counting rods did not always leave precise traces of their previous positions and movements.³⁹ This verifiability gave Western arithmetic the greater reliability it needed to win acceptance and to enhance the credibility of Western civilization in all other respects.

Western mathematics was supposed to shatter confidence in Neo-Confucianism, rendering it less trustworthy than Christianity, rather than the other way around. The Jesuit hope was that the study of Western mathematics would teach Confucians how to “reason properly.” Of course, those missionaries assumed that reasoning properly meant thinking like a late sixteenth-century Roman Catholic. If that did not work, if Euclidean logic proved too difficult for Confucians to imitate, the priests from Europe hoped that at least the respect for the products of such logic would extend beyond mathematics, to philosophy and theology as well. As Ricci stated of his *Jihe yuanben*,

At the beginning it speaks of veritable principles which are very easy and clear. Gradually accumulating [propositions], in the last sections it brings out subtle, obscure ideas. If one cursorily glances at a couple of the later points, then what is said is difficult to comprehend as well as difficult to believe. If, taking the earlier propositions as proofs, one accumulates evidence and develops [the proof] step by step, then, the ideas being in sequence, frequently on comprehending one laughs [at how easy the later proposition is].⁴⁰

Ricci clearly believed that if slow and steady progress could be made from such simple axioms as, for example, that if equals are added to equals, the results are

³⁷ Li and Du, *Chinese Mathematics: A Concise History*, 184; Needham, *Science and Civilization in China*, vol. 3, 74–80.

³⁸ Kim Yongun and Kim Yongguk, *Han'guk suhaksa* [The history of mathematics in Korea] (Seoul: Yeolhwadang, 1982), 281–85.

³⁹ See, for example, *Tongwen suanzhi*, 2796–97; Li and Du, 198–200. Also see Oh Young Sook, “Ways of Calculation in Late Joseon: A Case Study of Choe Seok-Jeong’s *Kusuryak*,” unpublished paper presented at the First Templeton Conference on Science and Religion in East Asia: Science and Christianity in the Encounter of Confucian East Asia with the West, 1600–1800, held at the Kyujanggak Institute for Korean Studies at Seoul National University, Dec. 15–17, 2011.

⁴⁰ *Jihe yuanben*, 1936. I have borrowed the translation of Willard J. Peterson in his “Western Natural Philosophy Published in late Ming China,” *Proceedings of the American Philosophical Society*, 117 (1973), 311.

also equal,⁴¹ to such complex propositions as that, in equal circles, angles have the same ratio as the circumferences on which they stand, whether they stand at the centers or at the circumferences,⁴² then it would not be that difficult to convince Confucians to go one step further, and accept the at first “difficult to comprehend as well as to believe” proposition that there is but one God in Heaven and that God had sent His only Son to be born as a man among men in a small village in a far away land over 1,600 years earlier. Ricci, as well as his fellow Catholic missionaries in China who shared his strategy of using mathematics to open Confucian minds to Catholic doctrines, assumed that the deductive reasoning displayed in their mathematics primers was identical to, and as valid as, the deductive logic displayed in their theological writings. In their view, Catholic doctrine was just as logical as Western geometry.

The efficacy of Ricci, Xu, and Li’s mathematical proselytizing depended, of course, on their Confucian audience sharing their assumption that deductive reasoning and the analytical manipulation of numbers and geometrical figures were the only way to build a practical, precise, and reliable mathematics. Only if Western mathematical formulae were seen to be only as good as the logic behind them would these Christians be able to convincingly present Euclidean geometry as a model of mathematical reasoning. In other words, if those in China and Korea who had read *Jihe yuanben* and *Tongwen suanzhi* would come to believe that the usefulness and reliability of the mathematical tools they contained was a direct reflection of the usefulness and reliability of the techniques used to build them, then acceptance of Euclidean theorems could lead to acceptance of Euclidean reasoning, preparing Neo-Confucians for arguments for Christianity formulated in the same manner. But if most Confucians found it relatively easy to adopt the products of Western mathematics while ignoring the process that produced them, then the Jesuit use of mathematics to convert Confucians to Christianity would not be nearly as effective as Ricci, Xu, and Li expected it to be. Unfortunately for the missionaries, the latter proved to be the case. Mathematics in the Neo-Confucian world was structured and conceptualized differently from Western mathematics, and such differences severely weakened the impact of Jesuit mathematical writings on Neo-Confucian thinking.

The Confucian Mathematical Vision

The Confucians in China and Korea who encountered Jesuit arithmetic and geometry were not mathematical primitives. Their tradition had long provided ways to add, subtract, multiply, and divide. Centuries before Ricci introduced them to *Euclid’s Elements*, they had had their own ways of calculating the area of a square, a rectangle, a triangle, or a circle, as well as the volume of solids such as spheres. They were comfortable with both fractions and decimals and had worked

⁴¹ *Jihe yuanben*, 1970; Euclid, vol. 1 (book I), 155.

⁴² *Jihe yuanben*, 2475–76; Euclid, vol. 2 (book VI, proposition 33), 273.

out an approximation for the ratio of the diameter of a circle to its circumference (π) that was comparable in accuracy to the value used in the West. They had learned to use negative numbers long before Europeans felt comfortable using them.⁴³

But much of the advanced mathematics of the Song (960–1279) and Yuan (1279–1368) dynasties in China had been lost or forgotten by the seventeenth century. For example, Confucian scholars in the latter half of the Ming dynasty (1368–1644) no longer were familiar with an algebraic technique developed in the thirteenth century for dealing with numerical equations of any degree. It was only in the eighteenth century, when Chinese mathematicians had mastered the algebra imported by the Jesuits in the seventeenth century, that later Confucians were able to understand what their predecessors had achieved.⁴⁴

Nevertheless, despite such setbacks, even in the late Ming the Chinese maintained superiority over the West in some areas. To ensure that the *Tongwen suanzhi* that he and Ricci had written would have maximum utility and gain wide readership, Li Zhizao had to supplement its European arithmetic with several Chinese algebraic calculating techniques that Europeans had not yet discovered.⁴⁵ Li, Xu, and Ricci hoped that those contributions by Chinese mathematics, incorporated into a Western mathematical framework, would further bolster their argument that Confucianism and Catholicism were compatible, with the tacit understanding, of course, that Confucianism was to play the supporting rather than the dominant role.

In the philosophy that the Jesuits brought with them to China, abstract concepts underlie the comprehension and manipulation of concrete particulars. For example, individual numbers such as 2, 55, or 3233 were understood and utilized only inasmuch as they shared in the collective qualities of numbers in general. In other words, 2 had to be treated in any mathematical operation as any other number with its characteristics would be treated. There may of course be a group of overlapping general categories governing how a particular number will behave and perform (it may be a whole number, a positive number, a rational number, a prime number, etc.), but nonetheless that number will be subject to those rules that govern all numbers whose properties it shares.

Confucian mathematicians understood, of course, that numbers shared many common properties. Otherwise, mathematics would not be possible. But they neither emphasized nor explicitly stated what those common properties were, nor what universal rules governed them. Their mathematics tended to be a very practical and inductive mathematics, seeking concrete solutions to specific problems first, before moving on to general rules governing a class of problems. A

⁴³ Joseph Needham, *Science and Civilisation in China*, vol. 3 (London: Cambridge University Press, 1959), 81–102. For more on how sophisticated medieval Chinese mathematics was, see Roger Hart, *The Chinese Roots of Linear Algebra* (Baltimore, MD: Johns Hopkins University Press, 2011).

⁴⁴ Ho Peng Yoke. *Li, Qi, and Shu: An Introduction to Science and Civilization in China* (Hong Kong: Hong Kong University Press, 1985), 92; Li and Du, op. cit., 135–140; Needham, op. cit., 129–133.

⁴⁵ Li and Du, op. cit., 201.

method that produced a correct solution to a problem would be applied to a number of similar problems, rather than abstracted into the form of a rule framed in symbolic universal terms. If that method turned out to have wide applicability, then that applicability would be shown, not by restating it in the form of a theoretical principle, but by providing several examples of that method in operation. This is inductive reasoning, unlike the deductive reasoning that shaped *Euclid's Elements*.

A good example would be the Confucian version of the Pythagorean theorem, found in one of the oldest Chinese mathematical classics, the *Zhoubi suanjing*. In Euclidean geometry, that theorem states that in any right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides. The *Zhoubi suanjing* version is, of course, more specific, stating that in a triangle 3 units wide and 4 units high the diagonal joining the two corners will be 5 units long. In the Euclidean geometry the Jesuits brought to China, a general theorem could not be limited to a geometric figure of any one specific size. It did not make any difference how long each of the three sides was for the Pythagorean theorem to be applicable. All that was necessary was that they were the three sides of a right-angled triangle. For Confucians, however, those three sides had to be given specific numerical values. By analogy, the same theorem could then be applied to other right-angled triangles with sides of different specific numerical values.⁴⁶

The contrast between Euclidean abstractness and Confucian concreteness emerges even in the way basic geometric figures are defined. The Confucians chose to define a rectangle, for example, by saying that it originated from the multiplication table that makes 9 times 9 equal 81.⁴⁷ *Euclid's Elements*, by contrast, defined it as a figure “contained by the two straight lines containing the right angle.”⁴⁸ Confucians preferred to visualize a particular rectangle when talking of rectangles in general, but Europeans preferred to talk of rectangles in general before addressing the properties of a particular rectangle. Such differences are deeper than mere differences of language. They reflect different ways of approaching reality.

It is of course possible to write as abstractly in the terse Chinese of these mathematical classics as it is to write concretely in European languages. Centuries earlier, Mozi (a Chinese philosopher active in the fifth century BCE) and his disciples had argued for what some interpret as almost Euclidean concepts.⁴⁹ Moreover, Ricci, with help from Xu and Li, was able to translate Euclid into understandable literary Chinese, but his awkward renditions of Western abstractions into Chinese lacked the rhetorical power necessary to persuade Confucian readers to adopt the same approach.

In his translation of the proof of the Pythagorean theorem, for example, rather than base his argument on a specific right triangle with sides 3, 4, and 5 units long,

⁴⁶ Needham, op. cit., 22.

⁴⁷ Ibid.

⁴⁸ Euclid.1. 370 (Book II, definition 1); *Jihe yuanben*, 1963.

⁴⁹ Needham, op.cit., 91–94. Needham makes Mozi sound more like a mathematical thinker than does a recent translation of Mozi by Ian Johnson, “Canons and Explanations,” *The Mozi: A Complete Translation* (New York: Columbia University Press, 2010), 375–577.

as Confucian mathematicians had done, Ricci instead talked about right triangles in general, with sides abstractly labeled *gap* 甲-eul 乙 (AB), *eul* 乙-byeong 丙 (BC) and *byeong* 丙-gap 甲 (CA), from its angles *gap*, *eul* and *byeong*. The resulting sentences, such as “Let there be a triangle *gap-eul-byeong*, with a right angle of *eul-gap-byeong*” were neither aesthetically pleasing nor visually compelling to their intended audience.⁵⁰

Confucians preferred working with abstractions expressed in concrete terms, with specific numbers rather than nebulous substitutes. Whether in mathematical or in other modes of discourse, they tended to favor abstractions created by assigning a wider range to already existing words drawn from everyday life over abstractions created by neologisms lacking a history of tangible reference. An example outside of mathematics is *li*, the term Neo-Confucianism used for the dynamic patterns that generate and define the appropriate interactions of everything in the universe. *Li* originally referred to the natural patterns in a piece of jade that an artist had to follow when carving a piece of jade into an identifiable object. Neo-Confucians extended the meaning of that term to cover the patterns that human beings were supposed to align with in order to interact properly with their fellow human beings.

Just as they did with *li*, Neo-Confucians tended to focus on interactions when they identified a thread that linked everything that an abstract umbrella term was supposed to encompass. They found commonality not in what things were but in how they behaved. They were not particularly interested in static entities per se. Their focus was on how those entities related to other entities. As a result, Confucian mathematicians were more inclined to algebraic than to geometric formulations. They were more interested in the relations between particular numbers than in the properties of generic lines, planes, and solids.⁵¹

This all has significant implications for the persuasiveness, or lack thereof, of Western logic. The Confucian approach to abstraction, which entailed a different understanding of logical implication, rendered the deductive proofs of Euclidean geometry irrelevant to mainstream Confucian thinkers. One scholar has noted that, “Whereas Euclid’s work is organized into the form of propositions, derived via deductive chains from ‘first principles,’ the basic concern of Chinese mathematics was the algorithm.”⁵² Another scholar explains what an algorithm means in a Chinese context. It means a “procedure, i.e., a sequence of operations that brings into play the data provided by the outline of a problem in order to determine the unknowns for it.”⁵³ In other words, it deals with how the data should work together, how they should interact. Moreover, these algorithms are derived, not from abstract principles, but from what works in particular types of mathematical situations. In

⁵⁰ *Jihe yuanben*, 2059–66.

⁵¹ Needham, op. cit., 23–24.

⁵² Peter M. Engelfriet, *Euclid in China: The Genesis of the First Chinese Translation of Euclid’s Elements, Book I–VI (Jihe yuanben, Beijing, 1607), and Its Reception up to 1723* (Leiden: Brill, 1998), 106–7.

⁵³ Karine Chemla, “Mathematics, Nature, and Cosmological Inquiry in Traditional China,” in Hans Ulrich Vogel, Günter Dux, and Mark Elvin, eds., *Concepts of Nature: A Chinese-European Cross-Cultural Perspective* (Leiden: Brill, 2010), 255.

other words, they are derived from appropriate interactions within specific contexts.

The Confucian lack of interest in Euclidean axioms and propositions was not because they shied away from mathematical abstractions. As already noted, Confucian thinkers were comfortable with abstractions. But, as pointed out above, they preferred their abstractions to be defined differently from the way abstractions were defined in the European tradition. The abstractions of Neo-Confucian mathematics and philosophy were constructed by embracing a large number of specific particulars rather than by subtracting from those particulars. For example, the most important abstraction in the Neo-Confucian philosophical universe is *li*, often misleadingly translated as “principle.” Though *li* is frequently described in Neo-Confucian writings as “above the realm of material forms” (*xing er shang* 形以上), that merely means that it is not confined to any particular form. As pointed out earlier, *li* is nothing more than the umbrella term for the sum total of all the specific patterns of appropriate interactions that generate and direct the cosmos, including the various material forms within it. The “principles” of Sino-Korean mathematics are subsets of this all-embracing cosmic *li*. Therefore, rather than abstract propositions emptied of all specific content, Confucians preferred instructions for addressing a variety of related specific problems and situations. They want their abstract instructions to be grounded in concrete examples, and thus to embrace a multitude of specific applications.

A second reason that Confucians preferred algorithms over propositions is that Euclidian propositions appeared to them to be too closely linked to static entities. The Neo-Confucian vision of the universe was one in which change, and the patterns that direct it, is fundamental. In fact, it can be argued that all that was really real to a Neo-Confucian was changes, the patterns (*li*) that direct those changes, and the interactions that result from those changes. Neo-Confucians saw the universe through the lens provided by the ancient classic the *Book of Changes*, which identifies 64 basic dynamic patterns underlying all change, and therefore all existence, in the universe.

The Western approach to abstraction, and to constructing propositions, was quite different. Two of the universal properties that Western abstractions tend to extract from specific things are change and interactions. In other words, traditional Western abstractions tended to take extract the properties of objects out of their particular context and freeze them, rendering them more amenable to non-algebraic mathematical analysis. An example often given is a dog. The Western abstract concept of a dog ignores the size and color of a dog, as well as whether a dog is eating, sniffing, or sleeping, to create a conceptual dog that is no particular color and no particular size and is engaged in no particular activity. In other words, it creates a dog unlike any dog that ever actually existed. The right triangle was treated similarly in the West.

Rather than focusing on a number of different right triangles of different sizes but having the same relationship among its constituent parts, Western mathematics instead created a right triangle composed of lines of no specific length. In other words, it creates a right triangle extracted from the realm of right triangles that, in the real world, have lines with specific lengths. For this abstract right triangle,

changes in its size, or in the lengths of the lines, are irrelevant as long as the right angle remains. Moreover, the fact that a change in the length of one line in that right triangle interacts with the other lines to cause changes in their lengths as well is considered of secondary importance to the fact that the equation defining the relationship between the square of the hypotenuse and the sum of the squares of the lengths of the other two sides doesn't change.

This lack of attention to change and interactions was particularly true of Western mathematics before calculus emerged. Geometry, for example, appeared in Confucian eyes to be the study of static triangles and rectangles. Rather than focusing on how one object might change into one of a different size, it focused instead on the invariable relationships between the various parts of fixed forms. This runs counter to the Confucian preference for focusing on patterns of change and interactions in constructing abstractions. Rather than focusing on what something is at a specific point in time, they have preferred to examine what something was and did and what it might be and do in the future, and on the underlying patterns behind such changes. *The Book of Changes* served as both a manifestation of this preference and a stimulus of it.

Consequently, an argument couched in Euclidean geometric generalities was unlikely to be adopted by Confucian scholars. Those Koreans and Chinese who accepted the conclusions presented in Western mathematical works, and borrowed the techniques contained in them, by and large ignored the deductive process by which Westerners had reached those conclusions and produced those techniques. Pre-modern Koreans and Chinese tended to ignore the logical arguments used to produce equations in Western mathematics books, and instead simply extracted the equations for application in specific contexts.

The Jesuit missionaries in China had intended mathematics to serve as a proselytizing tool, convincing Confucians that the Western mode of reasoning was superior and deserving of adoption. Instead, the Confucian understanding of abstraction, as rooted in, rather than rising above, change and multiplicity, undercut the theoretical force of the Jesuit argument, severing the intended link between the accuracy of the results the Jesuits' mathematical formulae produced from the validity of the deductive reasoning by which those formulae had been discovered.

A cursory comparison of a Chinese mathematical classic with a Jesuit translation of Western geometry or arithmetic is enough to confirm the differences between Euclidean and Chinese approaches to mathematics. A Han dynasty work which in effect defined mathematics in Confucianism, the *Jiuzhang suanshu* [Nine Chapters on the Mathematical Art], had as its chapter headings such references to specific applications of mathematical operations as "measuring fields," "cereals," and "making taxes fair."⁵⁴ Ricci's *Jihe yuanben*, on the other hand, has no specific chapter titles, but if it did they would be named for mathematical operations rather than for the ways in which those operations could be used. *Jihe yuanben* is organized along theoretical lines, starting with the basics of plane geometry in chapter one and going on to circles, figures inscribed around circles, and ratios in

⁵⁴ Li and Du, op. cit., 33–37; Kim Yongun and Kim Yongguk, op. cit., 53–60.

later chapters. The *Tongwen suanzhi* is similar. It does have chapter headings, and those headings, such as “the laws of addition” and “the rules for turning remainders into fractions,” show again that the prime focus in Jesuit publications is mathematics as a discipline, rather than mathematics as a tool.

The chapters in Western and Confucian mathematical texts are also structured differently. In *Jihe yuanben*, for example, each chapter opens with definitions of the key terms and operations in the problems that the chapter will attack. Each problem, in turn, opens with the general proposition that it is intended to prove. Next, the geometric figure that exemplifies that proposition is described, with all its *gap*, *eul*, and *byeong* lines and angles. Finally, the proposition is proved, step by step, using *gap*, *eul*, *byeong*, etc., for the numerical values being manipulated instead of real numbers. This contrasts with such Confucian works as the *Jiuzhang suanshu*, which begins each section by solving three to five specific examples of the same general type of problem, and then suggests a common element in all those solutions. In other words, Euclidean geometry begins with general statements and deduces from them methods for solving particular problems, but Confucian mathematics begins with particular problems and induces from them methods for solving such problems in general.⁵⁵

Preferring induction to deduction, Confucian mathematicians never developed the concept of rigorous proof so central both to Euclidean geometry and to the Jesuit use of that geometry for proselytizing purposes.⁵⁶ Instead, when they wanted to prove that an algorithm would provide accurate results, they would do two things. They would apply similar procedures to similar problems. Repeated accurate results provided confirmation that the basic procedure was correct, and would also reveal the basic patterns of numeral transformation underlying the accuracy of that procedure. In addition, influenced by the *yin-yang* notion that opposites are complementary rather than contradictory, they would sometimes reverse the process that gave them their initial result, for example using division to check on a result achieved through multiplication. This is how algorithms were proven in traditional Sino-Korean mathematics, not through deduction from abstract proposition but from induction from specific applications.⁵⁷

Scholastic Christian theology encouraged the Jesuits' deductive approach. In a universe believed to be created by a God who was both logical and consistent, it made sense to look first for the rational rules with which God had designed all of his creations, including the rules behind numbers and other mathematical entities. Just as God had done, man too should go from principles to particulars, or so the Jesuits assumed.

Neo-Confucians, on the other hand, adopted a different stance toward the

⁵⁵ Li and Du, op.cit., 194.

⁵⁶ Ulrich Libbrecht, *Chinese Mathematics in the Thirteenth Century: The Shu-shu chiu-chang of Ch'in Chiu-shao* (Cambridge: M.I.T. Press, 1973), 10.

⁵⁷ Karine Chemla, “Generality above Abstraction: The General Expressed in Terms of the Paradigmatic in Mathematics in Ancient China,” *Science in China* 16:3 (2003), 413–58; Chemla, “Mathematics, Nature, and Cosmological Inquiry in Traditional China,” in Vogel, Dux, and Elvin, eds., *Concepts of Nature*, 255–84.

cosmos, a stance that prompted their predilection for induction. Their universe was not created by a deity who used abstract rational principles as building blocks. Such a universe was too static for the Neo-Confucian worldview. As they conceived it, the cosmos was a dynamic network of appropriate interrelationships. Such a cosmos was best understood within, by probing that network (*gungni* 窮理) in order to observe it in operation. Once a particular pattern of interaction within the overall network had been identified, Confucians would then extend that specific mode of relational functioning to other, similar interrelationships. This “pushing of the pattern” (*churi* 推理) to encompass a larger range of phenomena allowed Confucian mathematicians to construct general rules from a few concrete examples.⁵⁸ Thus, in the Confucian mathematical world, induction was supposed to precede deduction, grounding generalizations in specific mathematical phenomena, the opposite of the Western reliance on universals and logical abstractions to analyze and manipulate mathematical particulars.

Korean Neo-Confucians shared that pragmatic, inductive, algebraic Confucian mathematical universe with the Chinese, and were no more willing or able than the Chinese were to bridge the conceptual gap between European and East Asian models of mathematical reasoning. Just as their fellow Neo-Confucians in China did, Korean scholars were able to appreciate the rigor and accuracy that the Jesuits brought to mathematical calculations without, however, unduly appreciating, admiring, or adopting the Western way of conceptualizing mathematical problems. In other words, Koreans shared the Chinese preference for induction rather than deduction.

One example of a Korean scholar who admired the mathematical accomplishments of the Jesuits but declined to adopt their mode of reasoning is Seongho Yi Ik (1681–1763). Seongho had read *Jihe yuanben*, along with a number of other Jesuit publications, and by and large was impressed by the scholarship it contained.⁵⁹ He cited with approval Xu Guangqi’s prefatory statement that the study of mathematics in general, and geometry in particular, would help those who study *li* to settle down and strengthen their powers of concentration: “Those who follow this established method will develop the ability to reason skillfully so that they will become careful and precise in their thinking.”⁶⁰ Seongho recalled that when young boys first began studying, their attention would wander. But once they were introduced to mathematics, they would become more focused and thus able to penetrate deeply into the meaning of the Classics. Such are the benefits to be gained from studying mathematics and, therefore, Seongho argues, “mathematics should not be dismissed as beneath the dignity of a gentleman.”⁶¹

Despite the high regard in which he seemed to hold the mathematics in Ricci’s

⁵⁸ Needham, 163–65.

⁵⁹ Han Ugeun, *Seongho yeon’gu* [A study of Yi Ik] (Seoul: Seoul National University Press, 1980), 49.

⁶⁰ Yi Ik, *Seongho saseol yuseon* [Selections from the *Seongho saseol*], edited by An Jeongbok (Seoul: Myeongmundang, 1982), “Sanhak” [mathematics], 443. Yi is citing *Tianxue chuhan*, 1941.

⁶¹ Yi Ik, *ibid.*

translation of *Euclid's Elements*, Seongho did not imitate the suggested methods for attacking mathematical problems. When he discussed such mathematical topics as the relationship between the diameter of a circle and that circle's circumference or the relationship between the base and the altitude of a right triangle to that triangle's hypotenuse, Seongho followed the same logical path Confucian scholars had followed for centuries when they dealt with numbers and geometric figures. He did not deduce general computational formulae from abstract premises. Instead, he examined collections of similar problems with similar solutions, and only then did he make general statements of wider applicability. For example, he points out that a right triangle with a base three units long and an altitude four units high would have a hypotenuse exactly five units long. But a right triangle with a base five units long and an altitude five units high would have a hypotenuse seven and a fraction units long. His conclusion is that only the specific right triangle that has a base and an altitude 3 and 4 units long respectively could have a hypotenuse whose length can be given in whole numbers.⁶² Even when discussing the Pythagorean theorem, Seongho remained a traditional Neo-Confucian more comfortable with induction from concrete examples than with deduction from transcendental forms.

Seongho was not the only Korean in the eighteenth century to overlook or minimize the differences between European and Sino-Korean mathematics. Even Confucian scholars and professional mathematicians who studied mathematical texts, including Jesuit-authored works, at great length and wrote volumes, rather than pages, on what they had learned from those books tended to absorb the Jesuit contributions into the larger framework of Confucian mathematics. Koreans exploited Jesuit mathematics, treating it as a mine from which they could extract interesting examples of mathematical operations as well as useful calculating techniques. But they used those operations and techniques within a thoroughly Confucian context. They ignored the philosophy and logic behind them, particularly the confidence placed in abstract axioms and theoretical proofs.

Many of those who wrote mathematical treaties in seventeenth- and eighteenth-century Korea showed some familiarity with Jesuit publications. Choe Seokjeong, for example, included *Tianxue chuhan* among the many works he had utilized in preparing his survey of mathematical thought and achievements. Yet he remained an orthodox Korean Neo-Confucian, faithful to the spirit and approach of the *Jiuzhang suanshu* of China's Han dynasty (206 BCE–220 CE).⁶³ The same is true of Hwang Yunseok (1729–1791), another *yangban* (a member of the Korean Confucian scholar-official elite) who wrote extensively on mathematics.

Hwang's two books on fundamental mathematics show that he was aware of Western accomplishments, particularly those found in Ricci's *Tongwen suanzhi* and in the Qing mathematical encyclopedia, the *Shuli jingyun*, but was little influenced by them.⁶⁴ For example, Hwang borrowed a lengthy list of the practical

⁶² Yi Ik, "Gyeongil bang o" [On right triangles, fractions, and π], 444.

⁶³ Kim Yongun and Kim Yungguk, op. cit., 233–40.

⁶⁴ Ibid., 253–56; Kim Yongun ed., *Han'guk gwahak gisulsa jaryo daegyae: suhak pyeon* [A collection of materials for the history of science and technology in Korea: Mathematics] (Seoul: Yeogang, 1985), vol. 3, 1–360.

applications of the Pythagorean theorem from *Tongwen suanzhi*. But the Pythagorean theorem per se was only described, not proven, unlike its treatment in *Jihe yuanben*. Instead of diagrams of triangles with angles and lines labeled with *gap*, *eul*, and *byeong*, showing that the essential properties of right triangles ensured that the suggested procedures would be valid for all possible right triangles, this selection ended instead by reassuring the readers that if they extended these techniques to a variety of situations with right triangles of differing sizes, they would grow accustomed to them and become comfortable trusting in their results.⁶⁵

Hwang, in his *Sanhak immun* [Introduction to Mathematics], next provided several concrete verbal illustrations of how the Pythagorean theorem could be used to find the length of the base once the hypotenuse and the altitude of a right triangle were known, or how it could be employed to calculate the size of a circle inscribed inside a right triangle. He called this section *Gugo ui* [*Gougu yi*, in Chinese, On the Right Triangle], but unlike the Jesuit work by the same name, Hwang's abbreviated discussion left out all the diagrams Ricci and Xu had used to turn their illustrations of specific mathematical problems into assertions of universal mathematical laws.⁶⁶

Nor did Hwang pause to demonstrate how those particular applications of the Pythagorean theorem were discovered or justified theoretically. He merely reminded his readers that these operations were nothing more than extensions of techniques developed for calculations with a specific right triangle with sides 3, 4, and 5 units long respectively.⁶⁷ Practice was his proof. Like others before him, Hwang accepted the results but ignored the logic of Jesuit mathematics. As long as the mathematical equations laid out on the pages of Jesuit-authored texts produced the accurate results he needed, he found no need for deductive logic to convince himself that those equations were reliable.

Hwang's better-known contemporary, Hong Daeyong (1737–1783), felt the same. Hong is applauded today as being almost modern in his interest in mathematics, science, and technology.⁶⁸ He is unusual among Koreans interested in mathematics for having not only read Jesuit publications but also having met and talked with Jesuit missionaries in Beijing.⁶⁹ But there is little in Hong's three-volume *Juhae suyong* [Essential Calculating Techniques] that reflects a new paradigmatic approach to mathematics. His mathematics remains Confucian mathematics, focusing on how calculating techniques are applied rather than on

⁶⁵ *Han'guk gwahak gisulsa jaryo daegyae: suhak pyeon*, vol. 3, Hwang Yunseok, *Sanhak immun*, 180–82; *Tongwen suanzhi*, 3270–72.

⁶⁶ Matteo Ricci (with Xu Guangqi), *Gougu yi* [On the right triangle], in Li Zhizao, ed., *Tianxue chuhan*, vol. VI, 3547–87.

⁶⁷ Hwang Yunseok, *ibid.*, 180–89, esp. 186.

⁶⁸ See, for example, Kim Taejun, *Hong Daeyong gwa geuui shidae* [Hong Daeyong and his times] (Seoul: Iljisa, 1982). Kim summarized his interpretation of Hong in English in “The Thought and Literary Achievement of Hong Tae-yong,” *Korea Journal*, vol. 28, no. 5 (May, 1988), 37–54.

⁶⁹ Gari Ledyard, “Hong Taeyong and His Peking Memoir,” *Korean Studies*, vol. 6, 63–104; Hong Daeyong, *Damheonseo, woejip*, vol. 7, “Yupo mundap” (Seoul: Minjok munhwa chujinhoe, 1974), 9a–15a.

how they are derived and justified a priori.⁷⁰

Hong writes that he had tried to use the new calculation method of pen and paper introduced in the Western mathematics books he read. He does not actually show how his calculations would look on paper, though that is what Ricci and Xu had done in *Tongwen suanzhi*. Instead, for example, he describes it by writing, “place the number you are going to multiply directly above the number you are going to multiply it by” without actually writing it that way himself. Nor does he show how he utilized the main advantage that pen-and-paper calculations offer over calculations with an abacus or counting rods: ease in rechecking calculations.⁷¹ Despite this slight change in how he wrote out his mathematical problems, Hong shows no other noteworthy innovations in his methods. His mathematics remains Confucian mathematics, focusing on how calculating techniques are applied rather than on how they are derived and justified.

His discussion of calculations involving right triangles for example, shows no traces of Euclidean logic. Hong borrows Western terminology, just as Hwang and many others had done. But he draws no diagrams and provides no deductive proofs. As far as he is concerned, Western techniques may look different from those found in the *Jiuzhang suanshu*, but their general principles, particularly their shared reliance on ratios, are the same.⁷² One reason Hong may have overlooked the fundamental differences between Western and Confucian geometry is that he did not have a copy of Ricci’s *Jihe yuanben* at hand to refer to. What he knew of Western geometry he learned from the *Essentials of Geometry* in the *Shuli jingyun*, which was also called *Jihe yuanben* but was a different text, one that left out all the proofs Euclid and Ricci had provided.⁷³

Clearly, Hong was aware that the Catholic priests who wrote those mathematical texts were trying to use their mathematical prowess to lure Confucians to Catholicism. He noted that, “These Westerners came to China to use mathematics in order to proselytize their Way. They are really skilled in technology and have some marvelous devices. Their ability to measure and calculate is like that of a god. No one in China since the Han and Tang dynasties has been able to draw up calendars as accurate as theirs are.... A lot of people have been really impressed by them and have used their techniques and technology.”⁷⁴ Despite how impressed he was with Western mathematics, like the vast majority of Confucians who explored the techniques introduced from the West, Hong was not equally impressed with

⁷⁰ Han Yeongho, “Seoyang gihahak-ui Joseon jollae wa Hong Daeyong-ui *Juhae suyong* [A study of the introduction of Western geometry into Korea and Hong Daeyong’s *Juhae suyong*], *Yeoksa hakbo*, no. 170 (2001), 53–89.

⁷¹ Kim Yongun and Kim Yongguk, op. cit. 256–60; Hong Daeyong, *Damheonseo*, *woejip*, IV–VI, “*Juhae suyong*.” Note that Hong usually calculates from left to right, in the traditional Sino-Korean manner, though Ricci calculated from right to left when he introduced pen-and-paper calculation. See Li and Du, op. cit., 201.

⁷² Hong, *ibid.*, V: 13a–18a.

⁷³ Hong, IV: 5; Koo Mhan-ock, op. cit., 312. Mikami Yoshio, *The Development of Mathematics in China and Japan* (New York: Chelsea Publishing Co., 1974), reprint of 1913 edition), 117.

⁷⁴ *Tamheonseo*, *waejip*, VII: 9a.

Western religion. The failure of Euclidean logic to strike a cord in mainstream Confucian thinking may have been one reason the missionaries failed to achieve the most important goal of their mission to China.

Another Korean Confucian who delved deeply into Western mathematics, but refrained from becoming a Catholic, was a disciple of Dasan Jeong Yagyong. We don't know his name, since the lengthy text (530 pages) he wrote, the *Gugo wollyu* [A Comprehensive Account of Calculations with Right Triangles], is included among Dasan's collected works as if Dasan himself wrote it.⁷⁵ Whoever he was, he had access to Ricci's version of *Euclid's Elements*. But apparently he agreed with most of his fellow Confucians that Western mathematicians did not depart significantly from the way mathematics traditionally had been conceived and practiced in China and Korea. Though Dasan was much more flexible and open to new ideas than the vast majority of his contemporaries, his student, and probably Dasan as well (since he left no written indicators of a positive impression of Western mathematics), failed to recognize the novelty or grasp the significance of the Western approach to mathematical reasoning.

Probably based heavily on an unidentified Chinese source, the *Gugo wollyu*, a collection of examples of mathematical problems, reveals nothing more than the usual tendency of Dasan and his disciples to examine in exhausting detail whatever subject is being addressed. It includes no deductive axioms, no diagrams, and no deductive proofs, only example after example of the types of calculations that are available to those who understand the ratios governing the relationships within a right triangle. Whoever wrote this text responded to Jesuit mathematics in the same way that other Koreans had responded. He read Jesuit books to learn how to perform certain calculations, frustrating the Jesuit missionary plan to have readers ask not only how but also why.

A why question was supposed to lead to a two-part answer. The Jesuits assumed that Confucians impressed with the mathematical wizardry of Catholic priests from the West would wonder why these strange men from a faraway land were able to surpass the achievements of the sages of China. The explanation they were supposed to come up with was that European civilization was at least the equal of Confucian civilization, with traditions and practices as trustworthy and as respectable as the traditions and practices of Confucian civilization, and, moreover that Catholic missionaries understood the world of numbers and geometric shapes so well because they had superior insight into the rational design of the cosmos through their superior knowledge of the mind and the will of the Divine Designer.

Ironically, the effectiveness of Jesuit mathematics as a proselytizing tool seemed to be in inverse proportion to the amount of attention an intended target dedicated to understanding and utilizing it. It was most effective on those who were either little interested in mathematics or incapable of mastering the new calculating tools

⁷⁵ Jeong Yagyong, *Yeoyudang jeonseo boyu* [An addendum to the *Yeoyudang jeonseo*] (Seoul: Gyeongin munhwasa, 1974), vol. 4, pp. 1–530; Kim Eonjong, “Yeoyudang jeonseo boyu ui jeojakbyeol jinwi munje-e daehayeo (ha)” [A look at the various items in the Addendum to the *Yeoyudang jeonseo* in regard to whether they are genuine or not, part II], *Dasanhak*, 11 (Dec. 2007), 323–28.

the Jesuit offered. None of the Koreans who wrote about Western mathematics, with the possible exception of Dasan, were favorably impressed with Christian theology.⁷⁶ Hwang Yunseok, for example, stated quite clearly that Western superiority in mathematics and calendrical science did not mean that what they had to say about more important subjects, such as human nature and *li*, was equally credible.⁷⁷ And even Dasan, though he may have become somewhat of a monotheist, remained for most of his life more Confucian than Catholic.⁷⁸

Western mathematics could not lead many lead Neo-Confucians to God because it could not even lead many Koreans to accept the Western way of conceiving and manipulating mathematical entities as the only way to do mathematics. Historically, it was not yet time for Western mathematics to claim overwhelming superiority over Confucian mathematics. The Renaissance mathematics the Jesuits had brought to China was not as powerful as the mathematics of modern times. The range and types of problems that Sino-Korean mathematics could not solve was not that much greater than the range and types of problems the Jesuits could not solve with their mathematics. There was thus little practical imperative to abandon one for the other.

That was not the only reason that Western mathematics did not have the proselytizing impact on Korea that the missionaries had hoped it would have. Sociologically, though mathematics was held in high esteem, mathematicians in Korea were not. Pre-modern Korean society was structured differently from pre-modern Chinese society. In China, there was no rigid hereditary class structure that separated Confucian scholars and officials from government clerks with technical skills. Korea, however, treated professional mathematicians as separate and distinct from the Confucian scholars, known as *yangban*, who monopolized the top rungs of the political and social hierarchy. Professional mathematicians ranked above peasant commoners but they were painfully aware that they ranked below the *yangban*. They were not allowed to intermarry into *yangban* families, and they were not allowed to have any formal say in determining government policies. Nor could they even sit for the higher-level civil service examinations that were used to

⁷⁶ How impressed Dasan was by Christian theology is still a matter of heated debate in Korea. That he was a member of the first Catholic community in Korea, in the 1780s, is undeniable. But the claim by some that he remained a secret Catholic after the anti-Catholic persecution began in 1791 is controversial, primarily because Dasan himself says that he left Catholicism over the issue of ancestor memorial rites. Nevertheless, he continued to believe in a Lord Above (*Sangje*), though he argued for the existence of such a God, not through deduction from the design in the universe to a Supreme Designer but because of the practical implications for moral behavior of belief in *Sangje*. Don Baker, "Practical Ethics and Practical Learning: Dasan's Approach to Moral Cultivation," *Acta Koreana*, 13: 2 (December, 2010), 47–61.

⁷⁷ Ha Seongnae. "Ijae Hwang Yunseok ui seoyang gwahak sasang suyong" [Hwang Yunseok's acceptance of Western scientific thought], *Jeontong munhwa yeon'gu*, 1 (Dec., 1983), 51–52.

⁷⁸ Kim Yung Sik, "Science and the Confucian Tradition in the Work of Jeong Yagyong," *Dasanhak* 5 (June, 2004), 127–168; Don Baker, "Koreanizing Confucianism: Dasan Cheong Yagyong and His Commentaries on *Mencius* and *the Doctrine of the Mean*," in *East Asian Confucianism: Interaction and Innovations* (New Brunswick, New Jersey: Confucius Institute at Rutgers University, 2010), 106–20.

select central government officials.

Professional mathematicians were Korea's quintessential *jungin*, a social class composed of technical specialists. Professional mathematicians formed a closely knit group in Seoul who intermarried among themselves and passed on to their descendants the knowledge of mathematics necessary to pass the government examinations which certified that they had the technical expertise their government needed.⁷⁹ It was in their vested interest to preserve the supremacy of the Sino-Korean mathematical tradition that they had mastered and which gave them their livelihood, and it was in the best interest of the *yangban* to avoid identification with those lower status professional mathematicians.

Both factors worked against anyone, *yangban* or *jungin*, intent on arguing for the abandonment of Sino-Korean mathematics and its replacement by the imported Western approach. *Yangban* did not want to advocate too loudly for a new approach to mathematics for fear that they would appear too concerned with matters of technical expertise best left to the *jungin*. And *jungin* did not want to challenge the Confucian underpinnings of their mathematical techniques for fear that they would be seen as distancing themselves ever further from their Confucian scholar betters.

But the most telling reason for the failure of the Jesuits' use of mathematics to convert many Confucians to Catholicism, whether in China or in Korea, was that, conceptually, the analytical and abstract character of Western mathematics conflicted with the Neo-Confucian preference for a concrete and contextualized approach. Renaissance mathematics, with its insistence on breaking the universe up into discrete points and lines, and on a basis of linear deductive logic, threatened to tear apart the cosmic unity so important to orthodox Neo-Confucian thinkers. Confucians preferred their abstractions closer to the ground, and more tightly integrated with the different entities and processes that constitute the world of everyday experience. Moreover, the Western focus on static geometric shapes ran counter to the Confucian concentration on the underlying patterns behind change and transformations. Simply said, the Western approach to both numbers and nature reflected in Jesuit publications represented a noun-based orientation toward the world. It viewed the world as composed of substances, in which what something was, how it could be distinguished from other things (a triangle from a rectangle, for example), was primary. Neo-Confucianism, by contrast, could be described as based more on verbs than on nouns. It was more concerned with functions than with substances. It emphasized what things do more than what they are, how things interact with one another more than how they differed in substance from each other.⁸⁰ This distinction divided not only Western from Sino-Korean mathematics but also the Jesuits' Scholastic philosophy and values in general from

⁷⁹ Kim Yong Woon, "Pan-paradigm and Korean Mathematics in the Chosŏn Dynasty," *Korea Journal*, 26, no. 3 (March, 1986), 25–46; *Han'guk suhaksa*, 192–199.

⁸⁰ See Karine Chemla, "What is at stake in Mathematical Proofs from Third Century China," *Science in Context* 10: 2 (1997), 227–251, for an argument that traditional Chinese math, through its reliance on a multitude of examples or applications of related algorithms, had sought to uncover the "fundamental patterns of transformation underlying the procedures."

Neo-Confucian philosophy and values. As a result, the mathematics the Jesuit missionaries presented to the Confucian world lacked the persuasive power to overthrow a methodological stance toward the world of numbers that had reigned in China and Korea for centuries.

Abstract

In the eighteenth century, Korean Confucian scholars began reading and discussing books from China explaining the European approach to mathematics. Those books, written by Jesuit missionaries in China and their Chinese disciples, were intended to shatter confidence in Neo-Confucianism and lead those to read them to accept Western reasoning as superior in mathematical as well as ethical and theological reasoning. However, because the analytical and abstract character of Western mathematics conflicted with the Neo-Confucian preference for a concrete and contextualized approach, the use of mathematics to convert Confucians to Christianity was, with a few exceptions, ineffective. Koreans were usually able to extract useful formulae from those Western books while ignoring the logic behind them.

Keywords: abstractions, Catholicism, Euclid, geometry, Matteo Ricci, Neo-Confucianism, *Tianxue chuhan*