A couple of decades ago, at the beginning of my academic career, I published an article on “Jesuit Science through Korean Eyes.”[2] Looking back at that article now, I notice at least a couple of things I would change about what I said back then. First of all, I used the term ‘science’ uncritically and failed to distinguish between modern science and pre-modern natural philosophy. Partially because of that lack of precision in terminology but also because at that time I was more interested in why Koreans in the 17th and 18th centuries rejected Western ideas than I was in determining how those ideas influenced them, I made a second mistake. I failed to point out how the encounter with the West, in the form of Jesuit-authored Chinese-language texts on the natural world, stimulated changes in the thinking of a few Koreans who, though small in number, were influential enough to sow the seeds of changes in Korean intellectual life that helped Korea prepare for the full-scale encounter with the West that began in the late 19th century.

A more accurate depiction of the impact of Jesuit writings on Korean intellectual history requires, first of all, a clarification of the difference between natural philosophy and science. It also requires a clear and accurate account of the similarities and differences between Korean concepts of the natural world in the 17th and 18th centuries and the European concepts introduced in the Jesuit publications Koreans were reading at that time. I will therefore begin by taking those two preliminary steps before I move on to describing how Koreans reacted to the challenge the Jesuit view of the natural world posed to their traditional worldview.

Natural Philosophy before Science

Before the 19th century bookshelves on the Korean peninsula did not hold any scientific publications in the sense in which we use the term ‘scientific’ today. Neither the books written by Koreans and Chinese within their own traditions nor books written by Jesuit missionaries in China and their Chinese colleagues on European astronomy, mathematics, and medicine could be described as ‘science’ as we use the term today. However, they could qualify as ‘scientia’.

The term ‘scientia’ is the Latin term from which we derive our modern term ‘science’, but ‘scientia’ had a much broader scope than the term ‘science’ currently has. ‘Scientia’ referred to all types of systematic attempts at accumulating knowledge. Biology and astronomy were examples of ‘scientia’ but so were philosophy and theology.[3] Today, however, few would call a philosopher or a theologian a scientist. In the 21st century science is normally limited to the exploration of the natural world using the tools of mathematics, precise observation, and experimentation. Scientists are those who labor in laboratories or in other technologically sophisticated facilities such as astronomical observatories. They tend to view the natural world as quantifiable. For them, if something cannot be measured or described mathematically, it is not a proper subject for scientific research. Moreover, science today requires confirmation through replication. Statements about material objects or physical states or processes, in order to be accepted as scientific statements, must be verified through either the observations or mathematical calculations of others or through others repeating the experiment that generated the scientific claim then achieving the same result.

The traditional Korean approach to the exploration of the modern world was not modern science. It was not experimental (there were no
those who worked on it, was widened by the constraints the Korean social order placed on who could do what. Neither as empirical, as experimental, or as mathematically oriented as modern science, the ‘Western Learning’ Koreans encountered in the 17th and 18th centuries was conceptually dominated by the late medieval, early Renaissance version of Aristotelian natural philosophy. It was Thomistic scintia rather than modern science. That pre-modern Western view of the universe was not markedly superior overall in explanatory, manipulative, or predictive power to what Koreans already had available. The astronomy the Jesuit offered the Koreans was pre-Copernican astronomy. Their mathematics was pre-Newtonian mathematics. And their medicine was pre-Harveyian medicine.

Nor should the picture of the natural world Jesuit missionaries painted for East Asians in the 17th and 18th centuries be called ‘modern science’. The Western ‘scientia’ those Roman Catholic missionaries brought to China in the 17th century was not modern science. Neither as empirical, as experimental, or as mathematically oriented as modern science, the ‘Western Learning’ Koreans encountered in the 17th and 18th centuries was conceptually dominated by the late medieval, early Renaissance version of Aristotelian natural philosophy. It was Thomistic scintia rather than modern science. That pre-modern Western view of the universe was not markedly superior overall in explanatory, manipulative, or predictive power to what Koreans already had available. The astronomy the Jesuit offered the Koreans was pre-Copernican astronomy. Their mathematics was pre-Newtonian mathematics. And their medicine was pre-Harveyian medicine.

Both traditional Korean natural philosophy and the Jesuit natural philosophy Koreans encountered employed a qualitative rather than a quantitative approach to understanding the basic building blocks and dynamic forces in the universe and therefore cannot be described as modern science. This does not mean, however, that the books written in Chinese by Jesuit missionaries in China that Koreans were reading in the 17th and 18th centuries had nothing to teach Koreans.

First of all, the Jesuits brought from Europe superior mathematical formulae for calculating astronomical movement. Court astronomers in China and Korea could make more accurate predictions of such celestial events as solar and lunar eclipses when they used imported Western formulae than when they used traditional methods. Those same Jesuits also provided Euclidean geometry, which provided tools for calculating area and volume that were better than the techniques traditional Sino-Korean mathematics provided. Koreans recognized the superiority of those elements of what they called ‘Western Learning’ (Sohak) and began using them in the 17th and 18th centuries.

Second, the natural philosophy the Jesuits taught was already moving in the direction of modern science. One astute scholar of early Jesuit science has argued that science “may be best characterized as ‘ratio-empirical’.” He pointed out that Jesuit science displayed both strong respect for and adherence to the rule of reasoning, which we find in the classical authorities (especially Aristotle and Euclid) that we associate with traditional natural philosophy, as well as the vigorous interest in experiment, observation, measurement, and collection that we associate with modern science. He went on to note that “The Jesuit missionaries still lived in an Aristotelian intellectual world but at the same time they accepted mathematical and empirical contributions of early modern science that allowed them to impress Confucians with their superior techniques.” Their modern tendencies were particularly visible in the astronomy, geometrical mathematics, and cartography they taught and practiced. Those were precisely the areas of Jesuit claims to expertise that most impressed Koreans.

Third, the Jesuits challenged the traditional separation of technology from science. In both traditional East Asia and pre-modern Europe, science and technology were not as closely associated as they are today. Natural philosophers and technicians did not rely on each other. Technological advances normally were not inspired by the writings of professors, clerics, or others involved with ‘scientia’. And natural philosophers generally did not rely on advances in technology to improve the accuracy of their knowledge of the natural world (though that had begun to change in Europe with the invention of the telescope at the beginning of the seventeenth century). However, many of the Jesuit missionaries in China both promoted their philosophical approach to the natural world in their writings and constructed scientific instruments. Besides publishing books on Thomistic philosophy and psychology, they also produced a Chinese-language description of the telescope as well as other books on various other examples of Western technology, from hydraulic devices to the “marvelous devices” such as pulleys and cranes described in Yuanxi qiqi tushuo luzui (Diagrams and Explanations of the Marvelous Devices of the Far West) by Johann Schreck Terrenz (1576-1630), which appeared in 1627. This joining of natural philosophers and technicians in the persons of Jesuit missionaries is significant, since it is the close cooperation between science and technology that has made so much of the scientific progress of the last four centuries possible. Moreover, Jesuit missionaries made the link between technology and natural philosophy explicit, arguing that Chinese should infer from the superior technical skill of Europeans that behind that technical expertise lay a more accurate picture of the nature and structure of the natural world.

The Jesuit challenge to the traditional separation of natural philosophy from technological expertise was even more of a challenge to Korean tradition than it was to Chinese tradition. In Choson Korea (1392-1910), the gap between the world of those who thought about nature and of those who worked on it, was widened by the constraints the Korean social order placed on who could do what. Yangban, the hereditary Confucian literati ruling class, could and did engage in thinking and writing about the natural world in ways that could be characterized as pre-modern scientific thinking or natural philosophy. However, actually manipulating or measuring nature was the job of the chungin, who constituted an entirely separate hereditary social class, one lower than the yangban on the social ladder. Because of their status as the scholar-generalist ruling class of the Choson dynasty, yangban did not and could not serve as professional mathematicians, physicians, astronomers, or geographers. Mathematicians, physicians, astronomers, and geographers, on the other hand, because of their status as technical specialists did not wax theoretical on the implications of their work or on the philosophical assumptions that underlay it. Their task was to do what they were told to do by their Confucian scholarly superiors, not to discuss or debate philosophical approaches to conceptualizing the world they were manipulating or measuring.

Jesuit missionaries, however, appeared to Korean eyes to act as both yangban and chungin, articulating a clear philosophy of the natural world
The encounter with ‘Western Learning’ not only stimulated interest in Western technology among some yangban in Korea, it also stimulated changes in the way they conceived of the basic building blocks of the cosmos. Though the Thomistic philosophy promoted by the Jesuit missionaries in China relied as much on qualitative concepts as the Neo-Confucianism hegemonic in Korea did, there was a significant difference. The fundamental components of the Thomistic universe, though they were qualitatively defined, could nonetheless be conceived as things, as separate and distinct objects. The Neo-Confucian worldview relied more on amorphous patterns and processes than on things. However, under the influence of Jesuit-authored Chinese-language philosophical texts, some Koreans began to give their nebulous abstract qualitative concepts more clearly-defined characteristics. Though the Koreans who were reading Jesuit books in the 17th and 18th centuries were not yet prepared to subject all natural objects to mathematical description and analysis (a modern approach those pre-modern Jesuit publications did not promote), by moving toward greater clarity and specificity in the terms used to name the basic components and forces of the natural world, they were transforming the cosmos into a form that was more amenable to quantitative treatment and therefore more amenable to eventual examination with the tools of modern science.

The Neo-Confucian worldview can best be summarized with its account of the emergence of the universe. In his “Explanation of the Diagram of the Supreme Polarity,” China’s Zhou Dunyi (1017-1073) writes: 
“Non-polar (wuji) and yet Supreme Polarity (taiji); The Supreme Polarity in activity generates yang; yet at the limit of activity it is still. In stillness it generates yin; yet at the limit of stillness it is also active. Activity and stillness alternate: each is the basis of the other. In distinguishing yin and yang, the Two Modes are thereby established.

The alternation and combination of yin and yang generate water, fire, wood, metal, and earth. …The Five Phases are simply yin and yang; yin and yang are simply the Supreme Polarity; the Supreme Polarity is fundamentally Non-Polar.”[10]

Zhou goes on to say that the myriad things in the universe are produced from the interaction of yin and yang and the intermingling of the Five Phases (water, fire, wood, metal, and earth). However, he is not trying to provide a chronological account of how the universe came into being. Instead, he is trying to describe the various levels of existence that he believes exist simultaneously.

The Non-Polar represents the Neo-Confucian borrowing of the Buddhist assumption that ultimate reality is unchanging and unchangeable as well as undifferentiated. The Supreme Polarity is a statement of the Neo-Confucian belief that, nevertheless, change and differentiation is real. Yin and Yang represent the Neo-Confucian assumption that, within constantly changing differentiation, all reality is relational and that, in all relationships, at any one time one party is more active (yang) than the other (yin). Moreover, yin-yang relationships are not stable. Instead, they constantly change, with that which is yin sometimes gaining at the expense of that which is yang, and the yang sometimes gaining at the expense of the yin. Moreover, when that which was yin grows strong enough to dominate a particular relationship, it then begins changing into yang, and the yang that it displaced begins changing into yin. This is a cosmogony of unending creative interaction rather than of creation at one point in time.

The Five Phases appear at first glance to be similar to the basic substances out of which the universe is constructed but that would be a misinterpretation of how they were conceived by mainstream Neo-Confucians. Those five terms are used metaphorically to represent five basic types of processes. Fire represents rapid movement upward. Wood represents slow growth upward. Earth represents balance in preparation for growth or decline. Water represents movement downward. Metal represents change toward solidity. Moreover, those processes interact and supplant one another. The traditional order of controlling interactions has wood overcoming earth, metal overcoming wood, fire overcoming metal, water overcoming fire, and earth overcoming water. In other words, wood breaks up the earth by growing out of it, metal chops wood, fire melts metal, water quenches fire, and earth damns water. Notice the circularity of this set of relationships. The Chinese view of change in nature was circular, not linear. We also see that in the way the Five Phases are linked in productive as well as controlling relationships. Wood produces fire, fire produces earth (ashes), earth produces metal (mined out of the ground), metal produces water (through condensation), and water produces wood (by stimulating the growth of plants and trees), starting the whole process all over again.[11]

It is important to notice a couple of distinctive features of this neo-Confucian view of the ultimate nature of the physical world. First of all, the various things that fill the universe are seen less as separate and distinct objects than as intertwined processes or events. In other words, they are not substances. It would be more accurate to call them nodes in a cosmic network. Seeing the various components of the cosmos as nodes in a network helps us comprehend a second distinctive characteristic of the Neo-Confucian worldview. Nothing in the Neo-Confucian universe exists in static isolation. Rather, every thing, or rather every process or function, exists only in relationships with other such processes and functions. The universe and its components are an organic whole in which everything is related to everything else, and those relationships are in a constant state of change (with the changes characterized in terms of yin, yang, and the Five Phases).

This leads us to a third distinctive feature of the Neo-Confucian cosmos. There was no concept of cosmic ‘creation’ in Neo-Confucianism, at least not in the sense of something external reaching out and creating something outside of itself. Instead, the universe, though its constantly changing interactions, creates and re-creates itself. The modern word used for nature in Korea and China is chayon (Chinese: ziran), which
means literally “that which is the way it is in and of itself,” in other words, self-caused. Another term sometimes translated as ‘creation’ (Korean: chohwā, Chinese: zaohua) actually means ‘creative transformations’. [12]

Despite its constant self-generation the Neo-Confucian universe was not chaotic. Yin, yang, and the Five Phases engaged in unending self-creation that could best be described as harmonious fecundity. There was order in the way the various processes related to, and generated one another. One expression of this order can be seen in the list of correlations Chinese relied in on a multitude of fields, from interpreting the implications for worldly affairs of celestial events to determining the proper treatment of an illness. The Five Phases were correlated with five seasons, five major senses, the five major bodily organs, the five visible planets, five types of weather, etc. [13]

There was also a single term for all the relationships in the cosmos: li. Li in the singular was the pattern forming the entire network of relationships that constituted the cosmos. Li in the plural (Classical Chinese does not require grammatical markers distinguishing singular nouns from plural nouns) referred to all the various specific relationships, such as that between a ruler and a subject and between a mountain and the streams which formed on its slopes. Li both defined what something was, or rather did, and what it should be (or should do). One way to explain li into English would be to call it the dynamic patterns that determined the way the various components of the universe related to each other in such a way as to define themselves, as well as the patterns of what would be appropriate interactions between and among the various components of the universe. (We will see shortly that this linking of the “is” and the “ought,” of what was and what should be, had implications for the way Koreans reacted to Jesuit natural philosophy.)

Li was the thread that wove the Neo-Confucian moral universe, in which the natural world provided models of selfless harmonious interaction that human beings were supposed to emulate and operate in harmony with, both in their interactions with their fellow human beings as well as in their interactions with nature. In Neo-Confucianism, understanding yin, yang, the Five Phases, and li was essential not only for understanding how the universe operated, it was also essential for understanding how human beings should behave.

Li could not produce the universe on its own. It had to work with ki (Chinese: qi), the dynamic (moving under its own power) primal matter-and-energy that filled the entire universe but also separated out and congealed to form the various things that interacted in patterns defined by li. Li and ki therefore were the formative forces in the cosmos, but so where yin, yang and the Five Phases. Neo-Confucians did not feel any need to have one, and only one, explanation for why the universe was the way it was.

Neither li nor ki, nor yin, yang, or the Five Phases could be measured and given specific weights, densities, or even proportions. They were qualitative concepts, not quantitative, and therefore were not susceptible to examination by the mathematical and experimental tools of modern science. The same is true of the fundamental concepts in the natural philosophy Jesuits promoted in the books they published in China, books that reached Korea and were read by Korean Confucian scholars in the 17th and 18th centuries.

In contrast to the Chinese preference for sets of five, Jesuit natural philosophy suggests a preference for sets of four. For example, Jesuits publications talked of four elements in nature, four humors in the human body, four causes, etc. The four elements were fire, air, water, and earth. Superficially, they appear similar to the Five Phases of Confucianism, since they even overlap, with fire, water, and earth appearing as some of the Five Phases. However, the four elements were substances, not functions. That is quite clear in the many books the Jesuits published in China explaining their worldview.

For example, in his The True Meaning of the Lord of Heaven, (Tianzhu shiyi), the pioneer Jesuit missionary to China Matteo Ricci (1552-1610) wrote, “Everything in the world comes into existence through the combination of the four elements: fire, air, water, and earth.”[14] Later in that same work Ricci presents a chart of the various types of beings. The four elements are clearly under the category of material things. [15]

Moreover, on another page, he explains that “there are two categories of things: substance and accident. Things which do not depend on other things for their existence, such as heaven and earth, ghosts and spirits, men, birds and beasts, vegetation, metals, stones, the four elements, and the like, are all classed as substance.”[16]

Notice the emphasis on separate and distinct things and substances. This is quite different from the Neo-Confucian emphasis on process and function, and on identity as determined through relationships and interactions rather than on an independent identify defined in terms of not depending on anything else. The Jesuits, because of their Thomistic philosophy, stressed being and individual existence, while Neo-Confucians stressed doing and interconnections instead.

The Jesuit stress on separate and distinct substances reveals itself again in the Aristotelian-Thomistic account of the four causes of a thing being what it is. Nothing is said about a thing being created through interaction with other things and forces around it. Instead, the four causes are the active cause (that which makes an object what it is), the formal cause (the defining characteristics that place that object in one category of objects instead of another), the material cause (the material out of which the object is made), and the final cause (the reason that thing exists). [17] Though a cause may be external to an object, as in the case Ricci cites of a carriage maker who builds a carriage, the emphasis is what the cause does to make that object, not how a cause like a carriage maker and a product like a carriage construct each other through their interaction, which is how Neo-Confucians would tend to describe such a relationship. Substances in the Jesuit worldview are somewhat passive objects, at least to the extent that they have things done to them. The basic components of the Neo-Confucian universe are much more active, in that they participate in their own creation.

We also see this emphasis on substances rather than processes even in the Jesuit description of human physiology. However, another Jesuit who arrived in China a few years after Ricci did so in great detail. In 1629, Johann Adam Schall von Bell (1592-1666) published Zhuzhi qunzheng (A host of arguments that God rules the world.). Among the arguments for God’s existence Schall presented was the argument from the intricate design of the human body.[18]
Schall published *Zhuzhi qunzheng* one year after William Harvey (1578-1657) had demonstrated the circulation of the blood, and over a full century since Theophrastus Philippus Aureolus Bombastus von Hohenheim (1493-1541), more commonly known as Paracelsus, began denouncing the medieval humoral explanation of illness.[19] Yet Schall ignored the revolutionary contributions of those two men and relied instead on the writings of Galen (130-201), a Roman citizen whose description of what human internal organs are and what functions they perform had shaped European understanding of the human body for more than a millennium. The Galenic tradition Schall relayed to China and Korea taught that the human body was formed from the four basic elements of air, fire, water, and earth. Those four elements were said to be the material manifestations of the four basic qualities of heat, cold, dampness, and dryness and were reflected in the four basic humors (blood, black bile, yellow bile, and phlegm) whose harmonious cooperation and proper balance were essential to a healthy human body.[20]

On those Grecian foundations Galen built a complex and comprehensive framework that provided a paradigm for understanding anatomy and physiology, and for practicing medicine, radically different from that which prevailed in Choson Korea. In Galenic biology, anatomy was primary. To understand how the various parts of the human body should function, Galenic theory argued, it was necessary to understand the actual physical structure of the body’s organs, since those organs were designed to perform certain functions.[21] Anatomy defined physiology. This is the reverse of the approach adopted by the traditional Sino–Korean medicine of Choson Korean, in which function determined structure, physiology determined anatomy, and the body’s organs were only the physical manifestation of a more fundamental underlying physiological process. The Galenic physiology promoted by Schall was a substance-based physiology, with blood, black bile, yellow bile, and phlegm conceived more as separate and distinct substances than as labels applied to physiological functions and modes of interaction.

These sharp differences between the substance-oriented worldview promoted by the Jesuits in China and the function- and relationship-oriented worldview of their Korean Confucian counterparts meant that, though they both emphasized qualities rather than quantities in discussions of the essential components of the natural world, Jesuits and Koreans were miles apart in what they considered the most fundamental types of qualities. Jesuit publications focused on the qualities of individual beings, while Neo-Confucian natural philosophy focused on the interactions between individual objects more than on those objects themselves. The Neo-Confucian worldview can be characterized as a pattern perspective. Neo-Confucian philosophers sought to uncover patterns of interaction within the natural world, such as those between heaven and earth,[22] between the human body and the rest of the material world, and between energy within the earth and energy and fortune above it, that Choson Koreans believed men needed to know in order to interact appropriately with and within their physical environment. Often these patterns manifest themselves in the form of specific correlational correspondences, such as the field-allocation system that paired specific regions of heaven with corresponding regions on earth, and the Five Phases that linked the human body with seasonal changes. Such patterns of interaction attracted more attention, and were studied, discussed and analyzed more intensively, than were the physical objects that were actually interacting.

This pattern perspective had dominated thinking in East Asia for over a millennium before the arrival of the Jesuits. It earned its staying power with its flexibility and comprehensiveness. The pattern perspective could provide explanations for most natural phenomena Koreans were likely to encounter. That was both its strength and its weakness. Because it could explain most natural phenomena with broad generalizations about the interaction of yin, yang, and the Five Phases, it kept most Korean natural philosophers from turning into scientists who sought more precise explanations by focusing on specific and distinct characteristics of individual material objects. Moreover, the broad generalizations generated by the pattern perspective were so broad, general, and vague that they were not amenable to experimental confirmation or refinement.

It would not be inaccurate to say that both Neo-Confucian natural philosophy and the Jesuit natural philosophy Korean Confucians encountered were based more on deductive than inductive reasoning. In the 17th and 18th century, Koreans and the Jesuits they were reading tended to start with general principles from which they drew particular examples instead of working their way up from particular facts to broad generalizations. However, because Jesuit attempts to understand nature focused on separate and distinct individual objects while Korean Neo-Confucians were more interested in the network of connections linking every individual object to every other individual object, it was easier for Jesuits and other Westerners who shared their world view to make the conceptual shift away from deduction, from generalizations to particulars, toward induction, from particulars to generalizations. That is one reason modern science arose in the West first.

That is also one reason Jesuit publications planted seeds of modernity in Choson Korea. Most Koreans who were aware of what the Jesuits were doing and writing in China were willing to adopt elements of Jesuit technology that did not challenge their pattern perspective on the universe. Western formulae for calculating calendars were acceptable imports. Western assertions that the universe was filled with separate and distinct substances that depended on an external force (i.e., God) for their existence and their predictable behavior were not. Western maps of the globe and of the heavens that included more information and were more accurate than maps that had been previously available to Koreans were acceptable. However, Jesuit attempts to uncouple the links between places and events on earth and places and events in the sky above were not. However, a few bold Korean scholars were stimulated by what they read in Jesuit books to begin questioning the Neo-Confucian pattern perspective and its emphasis on interaction and connections rather than individual material objects examined in isolation. It is in those scholars that we first see the seeds of modernity sown by Jesuit books begin to sprout.

Korean readers of Jesuit books were particularly interested in what those missionaries had to say about geography, astronomy, mathematics, and medicine. Three of those fields (medicine being a conspicuous exception) were more advanced than their counterparts were in East Asia, at least in terms of certain practical techniques for making important calculations. Medicine also interested Korean readers, although most felt that Galenic medical theory had little to offer them. It is therefore to those four fields that we turn now in this brief exploration of the Jesuit impact on Korean views of the natural world.
Both Hong and his friend Pak Chiwon (1737-1805) confessed the abstract impracticality of his rotating earth theory, admitting that it was nature or of mathematical calculations based on actual astronomical data. Moreover, his cosmological speculations had no practical impact. Astronomy and cosmology were products of imagination and speculation, not the result of the adoption of a new paradigm for understanding 33

Hong was a philosopher, not a practicing astronomer. Though he kept a set of astronomical instruments at his home, those instruments appear without drawing the inescapable conclusion that such a spherical globe cannot be still since it is the nature of round things to rotate. 32

However, there were a few Korean philosophers to decide. 26 However, Koreans were more interested in learning the locations and place names of distant places than they were in adopting the Jesuit approach to depicting the geography of East Asia. Long after their first exposure to Jesuit maps of the world, Korean cartographers continued to draw the earth as though it were flat, with China at the center. And, well into the 19th century, maps of Korea continued to depict mountain ranges in the traditional style highlighting their role as geomantic reservoirs of life-enhancing terrestrial energy. (Koreans, like the Chinese, were practitioners of feng-shui (Korean: P’ungsu), the belief that by locating their residential buildings as well as the graves of their ancestors on sites where terrestrial energy was strongest, they would enhance both their health and their financial situation.) 27 Moreover, the traditional ch’onhado format for world maps remained popular, with Western influence detectable primarily in the names of some of the nations on the periphery.

Ch’onhado maps (‘maps of all under heaven’) are often called ‘wheel maps’ because they are round with a continental island dominated by China in the center. Such maps were intended to represent cultural reality (Sino-Korean culture as the cultural center of the world) rather than actual physical reality and therefore their basic orientation did not change despite the undeniable superior geographical accuracy of the maps Jesuit drew. Similarly, geomantic maps of the Korean peninsula were intended to represent the value of the terrain depicted (identifying sites valuable in terms of feng-shui) rather than the actual lay of the land and therefore did not have to be modified to take into account Jesuit cartographical techniques. In both cases, Koreans protected their traditional cartography by separating Jesuit maps depicting physical facts from their own maps depicting the cultural meaning of the geography of East Asia. Though the Korean refusal to adopt modern cartographical techniques for every map they drew might seem a reflection of a hide-bound dedication to tradition and therefore an anti-modern reaction, by separting the realm of physical fact from the realm of geographical value, Koreans were actually taking a small step toward the modern world in which the realms of fact and value are clearly delineated.

Western Astronomy

We see that same tendency away from the traditional Neo-Confucian fusion of fact and value (remember that li meant both what things were and what they should be) in the Korean response to Jesuit astronomy. Jesuit superiority in some fields of astronomy had the same limited impact it had on Korean geography. European missionaries learned soon after their arrival in China that they could predict solar and lunar eclipses as well as other celestial phenomena more accurately than the Chinese could predict. They assumed that their calendrical calculations were more exact because they were based on a more accurate map of the universe, reflecting the actual constitution of physical reality. 28 Their practical success in applied astronomy would convince China’s Neo-Confucian scholars to change the way they envisioned the universe, or so those Christian missionaries expected.

They were unprepared for a China that had, at least since Tang times, divorced cosmology from astronomy. 29 When the Jesuit missionaries first arrived on Chinese soil, they found professional astronomers who limited themselves to providing maps of the skies and precise predictions of the movements of the sun, the moon, the planets, and the stars so that accurate ephemerides could be compiled. It was not the astronomers’ job to concoct theories which explained why the heavenly bodies moved the way they did. Consequently, Chinese astronomers traditionally displayed little interest in the mechanistic models characteristic of Western astronomy. What shape the cosmos took was left for philosophers to decide. 30

The same, of course, was true of Korea. Koreans adopted the same Western formulæ for calendrical calculation that both the Ming and the Qing had adopted. Yet, like the Ming and the Qing, Koreans did not find the cosmology which the Jesuits attached to those calculations particularly persuasive. The 18th century polymath Yi Ik (1681-1763), for example, was a staunch Neo-Confucian who recognized the superior technical skill and knowledge of Western astronomers. He did so, however, within his Neo-Confucian paradigms rather than outside them. He wrote that the Western calendar was so accurate that even the ancient Confucian sages would follow it if they were still alive. But he added that it was a mere calendar of phenomena and did not plumb the hidden meaning behind celestial events. It was, in his words, “a calendar for men, not a calendar of heaven,” lacking any astrological, cosmological, or metaphysical significance. 31 However, there were a few Korean Confucian scholars in the18th century willing to challenge some major concepts of traditional astronomy. One such man was Hong Tae-yong (1731-1783), though he arrived at his belief that the earth was not only round but also made one complete rotation every day despite, not because of, Western influence. In fact, Hong criticized the Western missionaries he had met in Peking for recognizing that the world was round without drawing the inescapable conclusion that such a spherical globe cannot be still since it is the nature of round things to rotate. 32 (The Jesuits in Peking were still bound by papal decree to the medieval cosmological concept of a stationary earth at the center of the universe.)

Hong was a philosopher, not a practicing astronomer. Though he kept a set of astronomical instruments at his home, those instruments appear to have been only for amusement, as Hong left no records of ever having used them for systematic observation of the heavens. 33 Hong’s astronomy and cosmology were products of imagination and speculation, not the result of the adoption of a new paradigm for understanding nature or of mathematical calculations based on actual astronomical data. Moreover, his cosmological speculations had no practical impact. Both Hong and his friend Pak Chiwon (1737-1805) confessed the abstract impracticality of his rotating earth theory, admitting that it was

Korean Reactions to Jesuit Geography

Not long after their arrival in China at the end of the 16th century, the first Jesuit missionaries in China, Frs. Matteo Ricci and Michael Ruggieri, announced that “the earth is round and has inhabitants living all around it.” 23 The Chinese, who believed that they lived in the center of the world, were at first surprised by this challenge to the popular East Asian belief that heaven is round but the earth was square. 24 Koreans, who received a copy of a Jesuit map of the earth as early as 1603, were just as surprised as the Chinese were. 25 However, by the end of the seventeenth century most knowledgeable Chinese and Korean scholars accepted the notion that the world was indeed round. That reevaluation of one of their core traditional beliefs did not lead to the transformation of the traditional approach to geography that the Jesuit missionaries had hoped it would bring.

Korean geographers incorporated insights and information acquired from Jesuit maps into their own geographical tradition without radically altering that tradition in the process. 26 However, Koreans were more interested in learning the locations and place names of distant places than they were in adopting the Jesuit approach to depicting the geography of East Asia. Long after their first exposure to Jesuit maps of the world, Korean cartographers continued to draw the earth as though it were flat, with China at the center. And, well into the 19th century, maps of Korea continued to depict mountain ranges in the traditional style highlighting their role as geomantic reservoirs of life-enhancing terrestrial energy. (Koreans, like the Chinese, were practitioners of feng-shui (Korean: P’ungsu), the belief that by locating their residential buildings as well as the graves of their ancestors on sites where terrestrial energy was strongest, they would enhance both their health and their financial situation.) 27 Moreover, the traditional ch’onhado format for world maps remained popular, with Western influence detectable primarily in the names of some of the nations on the periphery.

Western Astronomy

We see that same tendency away from the traditional Neo-Confucian fusion of fact and value (remember that li meant both what things were and what they should be) in the Korean response to Jesuit astronomy. Jesuit superiority in some fields of astronomy had the same limited impact it had on Korean geography. European missionaries learned soon after their arrival in China that they could predict solar and lunar eclipses as well as other celestial phenomena more accurately than the Chinese could predict. They assumed that their calendrical calculations were more exact because they were based on a more accurate map of the universe, reflecting the actual constitution of physical reality. 28 Their practical success in applied astronomy would convince China’s Neo-Confucian scholars to change the way they envisioned the universe, or so those Christian missionaries expected.

They were unprepared for a China that had, at least since Tang times, divorced cosmology from astronomy. 29 When the Jesuit missionaries first arrived on Chinese soil, they found professional astronomers who limited themselves to providing maps of the skies and precise predictions of the movements of the sun, the moon, the planets, and the stars so that accurate ephemerides could be compiled. It was not the astronomers’ job to concoct theories which explained why the heavenly bodies moved the way they did. Consequently, Chinese astronomers traditionally displayed little interest in the mechanistic models characteristic of Western astronomy. What shape the cosmos took was left for philosophers to decide. 30

The same, of course, was true of Korea. Koreans adopted the same Western formulæ for calendrical calculation that both the Ming and the Qing had adopted. Yet, like the Ming and the Qing, Koreans did not find the cosmology which the Jesuits attached to those calculations particularly persuasive. The 18th century polymath Yi Ik (1681-1763), for example, was a staunch Neo-Confucian who recognized the superior technical skill and knowledge of Western astronomers. He did so, however, within his Neo-Confucian paradigms rather than outside them. He wrote that the Western calendar was so accurate that even the ancient Confucian sages would follow it if they were still alive. But he added that it was a mere calendar of phenomena and did not plumb the hidden meaning behind celestial events. It was, in his words, “a calendar for men, not a calendar of heaven,” lacking any astrological, cosmological, or metaphysical significance. 31 However, there were a few Korean Confucian scholars in the18th century willing to challenge some major concepts of traditional astronomy. One such man was Hong Tae-yong (1731-1783), though he arrived at his belief that the earth was not only round but also made one complete rotation every day despite, not because of, Western influence. In fact, Hong criticized the Western missionaries he had met in Peking for recognizing that the world was round without drawing the inescapable conclusion that such a spherical globe cannot be still since it is the nature of round things to rotate. 32 (The Jesuits in Peking were still bound by papal decree to the medieval cosmological concept of a stationary earth at the center of the universe.)

Hong was a philosopher, not a practicing astronomer. Though he kept a set of astronomical instruments at his home, those instruments appear to have been only for amusement, as Hong left no records of ever having used them for systematic observation of the heavens. 33 Hong’s astronomy and cosmology were products of imagination and speculation, not the result of the adoption of a new paradigm for understanding nature or of mathematical calculations based on actual astronomical data. Moreover, his cosmological speculations had no practical impact. Both Hong and his friend Pak Chiwon (1737-1805) confessed the abstract impracticality of his rotating earth theory, admitting that it was
more convenient for calendrical calculation and astronomical observation to assume that the earth was stationary and heaven alone was moving than that the earth rotated on its axis once a day.\[34\]

The reaction in Korea to Hong’s suggestion that humanity lived on a revolving sphere was a collective yawn of indifference. Whether the earth under man’s feet was static or in constant motion, and whether that earth was round or flat, was of little import in a culture which was more concerned about the patterns in the heavens than about the shape or motion of the earth. Neither Hong nor the Jesuits seriously threatened the fundamental assumptions underlying traditional Korean science because their cosmological assertions challenged what were, in Choson dynasty Korea, merely peripheral concerns. The core of the Korean approach to science and nature, the pattern perspective, remained unaffected by such debates over the physical properties of specific material objects.

The failure of Jesuit astronomy to convince Korean Confucians of the superiority of the cosmological perspective the missionaries promoted meant that Koreans separated Jesuit philosophical and theological claims from Jesuit technical expertise. This becomes clear when we notice that not only were Jesuit calendrical formulae and star maps adopted by the Confucian court, a star map incorporating information Jesuit astronomers introduced to China ended up as a proud possession of a Korean Buddhist temple!\[35\] Clearly the Buddhist monks who kept a copy of that star map did not feel that what the Jesuit astronomers said about the stars in the heavens threatened their own religious beliefs in any way. Korean Neo-Confucians reacted to same way. Challenged by the greater accuracy of both Jesuit geometry and Jesuit astronomy, Koreans defended their traditional value system by separating the claims Jesuit missionaries made about the physical layout of heaven and earth from their own traditional beliefs about the proper relationship between heaven and earth, on the one hand, and human affairs and behavior on the other. In other words, they separated fact (claims about physical reality ) from value (claims about what is and what is not proper human behavior).

**Western Mathematics**

For Korean Neo-Confucians, mathematics did not have the behavioral implications traditional geography and astronomy had. They did not feel they needed to align their actions with numbers the way they believed they should align their actions with the cultural beliefs and values they derived from natural philosophy. However, the traditional pattern perspective approach to mathematics, reinforcing the pattern perspective of Confucian natural philosophy, was as unaffected by the Jesuit challenge as geography and astronomy were. Koreans had learned from the Chinese a preference in mathematics for algebra over geometry, for relationships rather than shapes, and for the particular over the abstract. That traditional mathematical orientation remained strong despite the introduction of *Euclid’s Elements* in Chinese translation early in the 17th century.\[36\]

Just as was the case with astronomy, the mathematics which Jesuit books from China introduced to Koreans was not the latest in mathematics. The Jesuits brought from Europe arithmetic and Euclidian geometry, nothing more. The coordinate geometry of René Descartes and the calculus of Issac Newton and Gottfried Leibniz were not yet invented at the time the Jesuits wrote their early 17th century introductions to Western mathematical principles and techniques. The missionaries were not even able to introduce modern methods of mathematical notation, since 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 17th century.\[37\]

Consequently, the mathematics the Jesuits brought to China and Korea was not 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.\[38\] However, it was different from the mathematics to which Koreans were accustomed. It was abstract and deductive rather than concrete and inductive.\[39\]

Though Koreans shared the Jesuit preference for deduction in philosophical reasoning, like the Chinese, they preferred induction when it came to deriving formulae for calculations. This not only made traditional Korean mathematics quite different in approach from Western mathematics, it also eviscerated the Jesuit hope of using mathematics to teach the Western approach to philosophical and ethical reasoning.

The difference between Jesuit and Confucian mathematics becomes evident when the canonical works of Western and Korean mathematics are compared. In the Chinese language translation of *Euclid’s Elements*, for example, each chapter opens with definitions of the key terms and operations in the problems that chapter will attack. Each problem, in turn, opens with the general proposition that it is intended to prove. Next the geometric figure which exemplifies that proposition is described, with all its lines and angles labeled, *Kap*, *Ul*, and *Pyong* (A, B, and C). Finally, that proposition is proved, step by step, using *Kap*, *Ul*, *Pyong*, etc. for the numerical values being manipulated instead of real numbers. This contrasts with such Confucian mathematical classics as the *Nine Chapters on the Mathematical Art*, 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. Euclidean geometry begins with general statements and deduces from them methods for solving particular problems but Sino-Korean mathematics begins with particular problems and induces from them methods for solving such problems in general.\[40\]

Preferring induction to deduction when devising formulate useful for calculations, neither Chinese nor Korean mathematicians ever developed the concept of rigorous proof so central to Euclidean geometry.\[41\] Remember, they thought of the cosmos as primarily a dynamic network of appropriate interrelationships. Such a cosmos was best understood within, by probing that network (Korean: *kangni*, literally, “plumbing principle”) in order to observe it in operation. Once a particular pattern of interaction within the overall network had been identified, Koreans would then extend that specific mode of relational functioning to other, similar interrelationships. This ‘pushing of the pattern’ (Korean: *ch’uli*) to encompass a larger range of phenomena allowed Choson dynasty mathematicians to construct general rules from a few concrete examples.\[42\]

Thus in the Korean 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. Even when Koreans recognized the utility of some of the mathematical formulae introduced in Jesuit writings on mathematics, they tended to incorporate those formulae into their concrete and deductive tradition rather than adopt that tradition to have it more closely resemble the Western approach. Both Hong Taeyong and Chong Yagyoung (1762–1836), another famous Choson dynasty philosopher, wrote lengthy treatises on mathematics that showed that they both were familiar with Jesuit writings on the subject. However, both Hong’s three-volume *Essential Calculating Techniques* (*Chuhae suyong* and Chong’s 530-page manuscript entitled *A Comprehensive Account of Calculations with Right Triangles* (*Kugo wollyu*)) remain firmly within the Korean tradition of focusing more on how calculating formulae are applied than on how they are derived and justified. They include no deductive axioms, no diagrams, and no proofs, only example after example of the types of calculations that are useful in calculating the area covered by a right triangle, for example.[43] Jesuit mathematics failed to change the way Koreans thought about numbers and mathematics, just as Jesuit geography failed to significantly change the way Koreans thought about the earth and cartography and Jesuit astronomy failed to significantly change the way Koreans thought about the stars and cosmology.

Mathematical calculations in Korean tradition were value-neutral so, although they assumed the pattern perspective, they were in a totally different category from reasoning about geography, astronomy, or even the human body. Deductive reasoning, with its emphasis on universals and generalizations, was reserved for natural philosophy, which had moral implications. The Jesuit argument that the standards used in mathematical reasoning should be applied to thinking about the nature of the universe and the place of human beings within it failed to persuade Koreans to abandon their traditional approach to mathematics.[44] Jesuit texts on geometry failed to nudge Koreans onto the road toward modernity.

**Western Medical Theory**

Medicine, the fourth science the Jesuit missionaries in China hoped would prove the superiority of European civilization, had even less impact. There are a couple of reasons for that. First of all, Jesuit missionaries in China could, and did, serve as court astronomers and cartographers, displaying their European mathematical skills and astronomical and geographical expertise. However, there were no physicians among the Jesuit priests sent to China during this period. Chinese and Koreans learned about Western medicine primarily from the books the Jesuits wrote, some of which discussed Western medical ideas. Second, unlike Western approaches to mathematics, astronomy, or geography, Western medical theory, particularly Western notions of anatomy and the functions of such organs as the brain, challenged certain philosophical components of the Neo-Confucian ethical perspective.

Schall’s *Zhuzhi qunzheng* (*A Host of Evidence That God Rules the World*) was the most influential introduction to Western concepts of the body available to Koreans in the 17th and 18th centuries. In that book, as part of an argument for the existence of God the Creator from the order that exists in creation, Schall described the complexity of the human body and the marvelous intricacy of its internal mechanisms, as envisioned by Europeans. As noted earlier, that vision was based on the vision of the influential second century Hellenic physician Galen in which anatomy, the physical structure of the organs of the human body, was a primary concern.

At least one Choson scholar, Yi Ik, was impressed with the intricate Galenic picture of the anatomical basis of human life Schall eloquently presented. He was also puzzled by it. “Schall offers much more detail than Chinese doctors can provide, so what he says cannot be ignored. However, the language and the framework Europeans use are both quite strange. There are some points I do not understand.”[45]

It is no wonder that Yi had trouble understanding Schall, for Yi was accustomed to the entirely different medical tradition of China, in which physiology was more important than anatomy. For example, Schall listed three primary organs (the liver, the heart, and the brain), but Chinese and Korean physicians recognized five (the heart, the liver, the kidney, the lungs, and the spleen), none of which was the brain and all of which were more names of physiological functions than of actual physical organs. Moreover, the two essential innate qualities Schall proposed, warmth and dampness, corresponded to only two of the five phases familiar to practitioners of Chinese medicine, the heat of fire and the dampness of earth.[46]

Nevertheless, Yi accepted much of what Schall had to say. He agreed with that Jesuit missionary that all living things have innate heat and moisture. After all, he noted, if you prick someone’s skin with a needle, warm blood will flow out, confirming this assertion. Yi could agree with Schall on that point because East Asian medicine also recognized the existence of warmth and fluids in the human body. As for the role of the liver in manufacturing blood, though that was the function of the spleen in Confucian physiology, Yi was willing to concede that responsibility to the liver. He also had no objections to Schall’s attribution of life-sustaining heat to the heart, since his tradition also made the heart the source of vitality.

Yi balked, however, at Schall’s claim that the brain was the organ of perception. Schall had written “the brain is the site of the pneuma of movement and sensation, which functions through the nerves,” carrying sensation back to the brain and carrying orders for movement out from the brain.[47] But the brain was a minor organ in traditional East Asian physiology, serving as a passive storage facility and as an accessory to the kidney, rather than as an active force receiving sensory impressions and commanding bodily responses.[48] Moreover, perception was usually linked with cognition. In fact, the Sino-Korean character *kak* (Chinese: *jue*), which Schall used to mean sensation, normally referred to more than just the transmission and reception of external sensory stimulation. *Kak* also included conscious awareness of such reception.

To use the word perception in talking about the brain is not the way we Confucians talk about it. Flesh is moved by muscles. Those muscles are just dense clusters of tissue. When some external object touches the flesh, the flesh immediately moves. If a muscle is not making it move, what is? But those muscles have no self-awareness. The brain receives the sensory impressions and, without stopping for a moment to think about what it is doing, immediately orders the muscles to respond. That is the way the brain operates. But it is the heart, not the brain, which knows that there has been sensory stimulation. So if we say that sensation is based in the brain, we had better add the knowledge is centered in
Yi maintained an open mind toward European challenges to traditional East Asian conceptions of the physiological functioning of the liver and the brain but he felt compelled to correct language that seemed to deny the heart control of cognition. Yi allowed mere sensation to fall under the domain of the brain but he would not permit Schall to place knowledge in the brain as well, separating knowledge from will-power, originating in the heart, which alone could translate knowledge into ethically significant action. The body’s instinctive response to external physical stimuli was one thing; the mind’s awareness and evaluation of such stimuli was another. It did not make much difference to Yi which organ was responsible for the former, but the latter was central to the Confucian vision of the human being as an ethical being who knew what was right and choose to act accordingly. The moral concern at the heart of the Neo-Confucian worldview would not permit knowledge to be severed from the primary human ethical faculty, the heart.

By thus separating Jesuit anatomical and physiological claims that had no moral or philosophical import from claims that challenged key assumptions of Neo-Confucian moral philosophy, Yi Ik showed that he was learning to distinguish the realm of neutral fact from the realm of ethical value. Ironically, his encounter with ‘Western Learning’ strengthened his ability to make such distinctions, an ability which he then used to counter the Jesuit attempt to move their readers from acceptance of Jesuit statements about the heavens, the earth, and the human body to acceptance of Jesuit statements about God and the proper relationship human beings should maintain with Him.

Dismantling the Building Blocks of Confucian Natural Philosophy

The next generation of Korean Confucian scholars produced a few original thinkers who went farther than Yi Ik did in distinguishing between fact and value, between statements about the natural world that were morally neutral and statements that had moral import. They then turned this sharpened analytical tool against Neo-Confucianism and began dismantling the buildings block Neo-Confucians used to contruct their vision of the universe.

This uncoupling of natural philosophy from the moral metaphysics of Neo-Confucianism made it possible to explore nature on its own terms rather than examining it only through lens formed from pre-existing moral assumptions. It also made it possible to move away from the function-oriented perspective of mainstream Neo-Confucianism, with its emphasis on action and interactions, and instead treat things as things, as objects which can be investigated in their own right.

There were not many Koreans in the 18th century who were bold enough to make such a break with the hegemonic philosophical outlook of their time. Those who did so were from the small group that read Jesuit books imported from China in addition to the usual library of Confucian texts all Korean yangban were expected to read. Three that stand out are Hong Taey-ong, Pak Chiwon, and Chong Yagyong, better known by his pen name of Tasan.

Hong and Pak did not stray very far from mainstream Neo-Confucianism. However, they did begin to question the traditional understanding of yin, yang, and the Five Phases as essentially forms of activity and interactivity. They don’t refer to Jesuit books or Western ideas when they state their objections to the way those terms have been used in Neo-Confucianism. However, we know that they read some Jesuit books. Hong even met with a couple of missionaries in Beijing to see what he could learn from them about the latest in astronomical technology.[50] Pak, who traveled to Beijing 15 years after Hong’s trip, was not able to engage any missionaries in conversation, but he was able to visit one Catholic church there as well as the tomb of Matteo Ricci.[51] Since the criticisms by Hong and Park resemble similar criticisms made in Jesuit publications, it would not be unreasonable to assume that reading Jesuit publications stimulated their challenge to these key elements of traditional Confucian natural philosophy.

Hong and his friend Pak both insisted that yin, yang, and the Five Phases had acquired such a broad range of meanings that they had were too vague to hold any real explanatory power. On his way home from Korea in 1766, Hong wrote an imaginary dialogue between a “Master Vacuous” and “Master Substantial” in which he had Master Vacuous spout the traditional Neo-Confucian take on the natural world and then had Master Substantial set him straight. For example, he has Master Vacuous say that the heavens begin to produce yang on the winter solstice and begin to produce yin on the summer solstice. It is therefore the changes in the relative strength of yin and yang that creates the four seasons. Master Substantial countered that there is not such thing as yin and yang. Those are just terms used for things that are warm and things that are cool. There are so many things that can be labeled yang and so many things that can be labeled yin that those two terms have no substantial explanatory power and therefore it is meaningless to say that yin and yang create the myriad things in the universe. Hong went on to dismiss the Five Phases in a similar fashion. He has Master Substantial say that fire, wood, metal, earth, and water are nothing more than names of things that are needed in an agricultural society, and you cannot rely on the standard correlations that identify specific things with one and only one of the Five Phases, since most things on this earth are a mixture of various types of matter and energy.[52]

Pak made similar comments dismissing the purported creative powers of yin, yang, and the Five Phases. He said the the ancients did not talk about yin and yang when they drew up their calendars. Yin and yang were added to those calendars latter by fortune-tellers. And, as for the relations of mutual production and control of the Five Phases, he asked how can we say, for example, that metal is the only thing that the earth produces, since a lot of other things such as plants grow out of the earth?[53]

Tasan Chong Yagyong never visited China or talked to missionaries. Nor was he friends with Hong or Pak. He was a member of a different political faction, so he wouldn’t have learned from them about Western natural philosophy and the Jesuit criticisms of Neo-Confucian natural philosophy. His contact with Western Learning, however, was much deeper than theirs. Tasan was one of the founders of the Korean Catholic Church in the 1780s, before there were any missionaries preaching Christianity to Koreans on Korean soil.
In the late 1770s and early 1780s, a small group of young yangban became interested in the religious teachings they found in Jesuit publications imported from China. One of them, Yi Sung-hun (1756-1801), who happened to be the brother-in-law of one of Tasan’s older brothers, accompanied a diplomatic mission to Beijing in 1784 and, while in Beijing, was baptized by a European missionary there. Yi then returned to Korea and began preaching his new faith to his close friends and relatives, Tasan among them. As Tasan himself admitted later in a letter to his king,

“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 a bright as the best of them. That is why I joined the crowd that was reading such books and talking about them. Unfortunately, by nature I am impatient and careless, 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 fooled me into thinking that what they were offering was just another form of Confucianism.....

I was infected with Catholic ideas when I was young, delighting with them as a child would with a toy. However, now that I have matured, I recognize that Catholicism is my enemy and I attach Catholic ideas much more harshly than someone who had never known them would.”[54]

Tasan wrote this letter to his king in 1797, six years after his cousin Yun Chich’ung (1759-1791) had been executed for obeying the papal directive to East Asian Catholics to refrain from participating in the standard Confucian mourning ritual that required bowing before a tablet on which the name of the deceased was inscribed and then offering food to the spirit thus enshrined. Tasan claimed that he had left that small Catholic community as soon as he learned of the conflict between Confucian ritual obligations and Catholic commandments. Historians debate today whether or not Tasan remained a secret Catholic for the rest of his long life (he lived to be 74 years old), pretending to a staunch Confucian and anti-Catholic in order to avoid his cousin’s fate. (Yun’s execution was just the first of hundreds of government executions of Korean Catholics during Tasan’s lifetime.) Whether or not he remained faithful to the church he joined when he was in his 20s, it is clear that he continued to be influenced by Catholic ideas for the rest of the life. [55] He was not as completely anti-Catholic as his letter to his king implies.

We can see that influence in his criticism of the Confucian concepts of yin and yang and the Five Phases and also in his adoption of the Thomistic notion of substance. Tasan was stimulated by his reading of Jesuit books to look at the world through new eyes, eyes that focused more on things than on actions and interactions. He was exiled in 1801 during a major anti-Catholic persecution in which one of his brothers was executed. He ended up spending 18 years in an isolated coastal village far from his family. Though he was not able to take his family with him into exile, he was able to bring his books. During those 18 years, he referred to his personal library to write hundreds of pages of comments and commentaries on the Confucian Classics in which he reinterpreted them according to his Jesuit-influenced perspective.

For example, Tasan states explicitly that yin and yang cannot play the creative role Neo-Confucian cosmology assigns them. He points out that yin and yang are simply labels for things that are dark or light and are not concrete entities in themselves that we can point to. Since they are not material objects themselves, they cannot create any material objects. Instead, he says heaven combines with heat to generate wind, fire with yin and yang are simply labels for things that are dark or light and are not concrete entities in themselves that we can point to. Since they are not material objects themselves, they cannot create any material objects. Instead, he says heaven combines with heat to generate wind, fire

not only does Tasan do as Hong Taeyong and Pak Chiwon did and deny yin, yang, and the Five Phases the cosmological significance they had in mainstream Neo-Confucianism in order to focus instead on actual material objects, Tasan goes even farther and denies independent existence even to li, the dynamic network of interrelationships that constitutes the Neo-Confucian universe. Borrowing terminology he could only have learned from Jesuit publications, Tasan writes that li can not play the directive and creative role Neo-Confucianism assigns it because it cannot exist by itself and is always dependent on something else for its very existence. In other words, Tasan says the li is but an accident, in the Thomistic sense, and contrasts it with ki, which he says is a substance, something that can exist on its own. [60] Tasan states explicitly that li exists only by adhering to a substance made of ki, a radical demotion for a concept that was essential to the Neo-Confucian metaphysics of function and processes rather than substance.

Tasan shows many other signs of Jesuit influence, such as a belief in a God who rules the universe (whom he calls Sangje, pronounced Shangdi in Chinese) as well as a denial of the Neo-Confucian insistence that human beings are born virtuous, replacing it with his argument that virtue must be earned by exercising our free will (a novel concept in the Confucian tradition) to choose to do what is right. However, I do
not have the time in a paper of this size to delve any deeper into the Jesuit-influenced Confucian philosophy of Tasan.[61]

Conclusion

Though neither Hong Daeyong, Pak Chiwon, nor Tasan Chong Yagyong could be classified as ‘scientists’ in the modern science of the word, they helped Korea begin moving toward a world view that made the natural world more amenable to scientific investigation and thus helped Korea prepare for its encounter with the modern world, including modern science, at the end of the nineteenth century. By shifting attention from nebulous concepts of cosmic processes to specific material objects, they took the first steps in Korea toward conceiving the universe in quantitative rather than qualitative terms. In addition, by treating yin, yang, the Five Phases, and, in Tasan’s case, even li, as natural objects of limited scope, they began the process of separating cosmology from axiology. Their shift in perspective paved the way for a science that could study nature on its own terms instead of imposing moral assumptions onto unconscious natural objects and giving them a moral role. They extracted the ‘is’ from the ‘ought’, a prerequisite for objective scientific observation of the natural world. For their time and place, these were bold steps, steps they probably would not have taken if they have not been stimulated by reading Jesuit publications imported from China that showed them a different way to look at the world. Those Jesuit works explaining the Thomistic natural philosophy of Renaissance Europe, therefore, served as seeds of modernity in Korean history. Any narrative of Korean intellectual or even scientific history that did not take into account Jesuit influence on Korea’s first sprouts of modernity would therefore be incomplete.

EndNotes

1. I want to thank Barbara Bundy, the executive director the the Center for the Pacific Rim at the University of San Francisco, who offered me the Kiriyama Research Fellowship that allowed me to spend a month in spring 2006 in the library of the USF Center’s Ricci Institute for Chinese-Western Cultural History. It was the time I spent in that library that made it possible for me to write this paper. I also want to thank Mark Mir, the archivist at the Ricci Institute, who went out of his way to supply me with normally hard-to-find materials. [Return to Text]
5. Elman, p. 69 [Return to Text]
6. Yi Yongbom, Chungsej soyang kwahakui choson chollae [The spread of the science of the medieval West to Korea] (Seoul: Dongguk University Press, 1988). By ‘science’ Yi means primarily technology and cosmological philosophy. [Return to Text]
7. Harris, p. 23. [Return to Text]
8. Harris, p. 282 [Return to Text]
11. Ho Peng Yoke, Li, Qi and Shu: An Introduction to Science and Civilization in China (Hong Kong: Hong Kong University Press, 1985), p. 11-24. [Return to Text]
15. True Meaning, p. 192 [Return to Text]
16. True Meaning, p. 109. [Return to Text]
17. True Meaning, p. 85. [Return to Text]
18. Adrian Dudink, “The Religious Works Composed by Johann Adam Schall von Bell, Especially His Zhuzhi Quanzheng and His Efforts to Convert the Last Ming Emperor” in Malek, Western Learning and Christianity in China, pp. 805-898. [Return to Text]
19. I. Bernard Cohen, in “Vesalius, Paracelsus, and Harvey: A Revolution in the Life Sciences,” Revolution in Science (Cambridge: Harvard University Press, 1985), pp. 176-194, points out that as revolutionary as the Harveyan revolution may have been in biology, it was a long time before it had any practical impact on the practice of medicine. [Return to Text]
24. See, for example, the note in the Siku quanshu zongmm tiyao (Notes on the works listed General Catalogue of the Siku quanshu catalogue, with descriptive notes), 106:67, on Sebastiano de Ursis, Biao du Shuo (The Gnomon): “Talk that the earth was a small sphere shocked a great


28. Jesuit confidence in their Aristotelian cosmology appears misplaced to modern observers. Ricci made the smug comment that the Chinese “never knew, in fact, they had never heard, that the skies are composed of solid substances, that the stars are fixed and not wandering about aimlessly, and that there were ten celestial orbs enveloping one another, and moved by contrary forces. Their primitive science of astronomy knew nothing of eccentric orbits and epicycles.” Louis Gallagner, trans., China in the Sixteenth Century: The Journals of Matthew Ricci, 1583-1610. (New York: Random House, 1953), p. 325.


30. Shigeru Nakayama, A History of Japanese Astronomy: Chinese Background and Western Impact (Cambridge, Harvard University press, 1969), p. 68, points out that “Chinese astronomy showed no concern for projection in space; for all purposes of measurement, heaven was two-dimensional.”


34. Pak Chiwon, 14: 8a; Hong, 4:22a-b.

35. Yi Yongbom, “Popjusa sojang 'sinbop ch'onmundo sol'-e taehayo” [The star map according to new methods” found at Peopji temple ] in his Han'guk kwhakh sacangyo von'gu, pp.109-237.

36. Euclid's Elements were introduced in “Jihe yuanben” [Foundations of Geometry] in Tianzhu shiyi [An Introduction to Heavenly Learning], compiled by the Chinese Catholic convert Li Zhizhou in 1628.


40. Li and Du, p. 194.


44. See “Jihe yuanben,” p. 1936 (available online at www.usfca.edu/ricci/resources/library/tianxue_chuhan_vol4/Jihe_1936_1937.htm in which Ricci describes this introduction to geometry as also an example of deductive logic, in that it moves from self-evident principles step by step to propositions that, arising from propositions proven previously, can be accepted as proven also. See the discussion of Jesuit argumentation in Henderson, woejip 7:9a-15a.

45. Yi Ik, Songho saesol yuson [A selection from Yi Ik's collected writings], pp. 447-448.

46. Ted J. Kaptchuk, The Web That Has No Weaver (New York; Congdon and Weed, 1983) is a readable and reliable introduction to the basic concepts and principles of Confucian medicine.


49. Yi Ik, Songho saesol yuson, pp. 448-449.

50. Hong met with Frs. Augustine von Hallerstein (1703-74) and Anton Goegeisl (1701-71) at the South Church in Beijing when he accompanied a diplomatic mission there in 1765-66. His account of that meeting can be found in Hong, Tamhonso, waejip, 7:9a-15a.


52. Hong, Tamhonso, naeip, 4: 30a-b.

53. Pak, Yonamjip, 1: 6b-8a. For more on how Hong and Pak challenged the traditional natural philosophy of Confucianism, see Han'guk sasangyo von'guhoe (Society for the study of the history of Korean though), Choson yuhakui chayonch'ol hak [Korea's Confucian natural
54. Chong Yagyong, Yoyudang chonso [the complete works of Chong Yagyong] I., 9, (43b-46A). [Return to Text]
56. Chong, Yoyudang chonson, 2: 4, 1b-2a. [Return to Text]
57. Chong, Yoyudang chonson, 2: 4,3a. [Return to Text]
59. Chong, Yoyudang chonson, 2: 25: 30a-31b. [Return to Text]
61. There are literally dozens of books and hundreds of articles on various aspects of Tasan's life and thought. Two articles in English that discuss the influence of Jesuit publications on how he thought about the material world and human nature are Yung Sik Kim, “Science and the Confucian Tradition in the Work of Chong Yagyong,” Tasanhak [Journal of Tasan Studies], vol. 5 (June, 2004), pp.127-166, and Song Young-bae, “A Comparative Study of the Paradigms between Dasan's Philosophy and Matteo Ricci's Tianzhu shiyi,” Korea Journal, 41:3 (Autumn, 2001), pp. 57-99. [Return to Text]
Both traditional Korean natural philosophy and the Jesuit natural philosophy Koreans encountered employed a qualitative rather than a quantitative approach to understanding the basic building blocks and dynamic forces in the universe and therefore cannot be described as modern science. This does not mean, however, that the books written in Chinese by Jesuit missionaries in China that Koreans were reading in the 17th and 18th centuries had nothing to teach Koreans. Seed Coat: In the seed of cereals such as maize, the seed coat is membranous and generally fused with the fruit wall, called Hull. Endosperm: The endosperm is bulky and stores food. Generally, monocotyledonous seeds are endospermic but some as in orchids are non-endospermic. Aleuron layer: The outer covering of endosperm separates the embryo by a proteinous layer called aleurone layer. Embryo: The embryo is small and situated in a groove at one end of the endosperm. Scutellum: This is one large and shield-shaped cotyledon. Embryonal axis: Plumule and radicle are the two ends.