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Through the Eyes of a Painter: Re-visioning Eighteenth-century Traditional Korean Paintings by Jeong Seon in Virtual Environments

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Media Arts and Technology

by

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June 2019

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ABSTRACT

Through the Eyes of a Painter: Re-visioning Eighteenth-century Traditional Korean Paintings by Jeong Seon in Virtual Environments

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Jeong Seon (1676–1759, 鄭歚, 정선), was one of the most prolific and inventive artists in Korean history. More than 300 of his paintings and a great deal of material written about him has enabled Korean art historians to study his work carefully in the past 20 years. His illustrations of nature after the site explorations spawned the so-called “true-view” art movement (jingyeong, 眞景, 진경) that dominated in the late Joseon period (ca. 1700–1850). Jeong’s approach was considered a shift away from traditional painting subjects. His appointment as the mayor of Cheongha in North Gyeongsang province in 1753 gave him opportunities to explore the famous scenic areas around the town. These paintings were collected in *Album of Gyeongsang Province* (yeongnamchup, 嶺南帖, 영남첩).

Jeong’s methods for simulating Korean landscapes have been the subject of much debate, but most of the discussion surrounding his work has been focused on the literature around him. For this reason, Jeong’s unique perspective style has yet to be clearly defined.

Thus, after reading Kay Black's exceptional paper on how to scientifically describe paint styles, I decided to define the true-view style.

This research presents clear answers about Jeong's extraordinary perspective skill based on computer graphical analysis. Jeong's paintings in *Album of Gyeongsang Province* were virtually reconstructed based on photographs and geographic data of the locations. The true-view landscape painting style utilized multiple distances, hemispheric distortion effect, morphological alteration, and constructing a linear narrative in painting. This dissertation explains how Jeong represented natural scenery using these techniques in his paintings. Finally, this research furthered the goal of our program to build bridges between art and science.

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Chapter 1.

Introduction

The origins of Korean landscape painting traces back to the Goguryeo (BC 37–AD 668) tombs complex. However, the first known landscape artist, An Gyeon (安堅, 안견) (?–?). He painted *A Dream Journey to the Land of Peach Blossoms* (mongyudowondo, 夢遊桃源圖, 몽유도원도) as a painter of the early Joseon dynasty (1392–1592) in 1447 (fig. 1.1). The painting originated in a dream of Prince Anpyeong (安平大君, 안평대군) (1418–1453). The subject of the painting is illusory, so An tried to create a fantastic atmosphere rather than a literal depiction of nature. His style is similar to that of a famous Chinese painter, Dai Jin (戴进) (1388–1462), founder of the Zhe School which was known for a richer style than the landscape paintings of the Southern Song period. Most Zhe paintings are accurate and restrained with rich textures, giving a magnificent, clear

impression.[1]

Fig. 1.1. An, Gyeon. *Dream Journey to the Land of Peach Blossoms* (mongyudowondo), 1447. Ink on silk, 38.7 cm × 106.5 cm. Tenri Central Library, Nara.[2] [Korean Open Government License, copy of the original painting]

The peaks and the trees in An's painting are not drawn from a single perspective, but rather overlap and are interwoven from series of scenes from the prince's dream. French Surrealist painters also represented many scenes on a single perspective in early 20th-century Europe. In Surrealist paintings, forms are represented minimally as Surrealist painters varied and transformed them. Like Surrealism, the paintings of the early Joseon dynasty focused on conveying various messages or intentions. Natural backgrounds supported a painting's theme rather than served as a depiction of the real world.

Dramatic political changes in the middle of the Joseon dynasty affected the art world. The Japanese Invasions of Joseon (壬辰倭亂, 임진왜란) (1592–1598) and the Qing

[1] Zhongguo Meishu Jianshi, Park, Eunhwa translated. *Brief Chinese Art History*. Seoul: Sigongsa, 1998. pp.250.

[2] It is presumed that this painting was plundered during Japanese invasions of Korea (1592–1598). The route was unclear so far, it is currently designated as a National Treasure of Japan. This image is a copy of the original painting owned by Seosan city, digitalized by the Academy of Korean Studies. Digital Seosan Cultural Library. http://seosan.grandculture.net/?local=seosan. Detail explanation of the painting was described in "Dream Journey to the Peach Blossom Land: Reappearance of Paradise and Establishment of Classical Landscape Paintings." by Hong, Sun Pyo.

invasion of Joseon (丙子胡亂, 병자호란) (1636–1637) devastated Joseon and its cultural heritage. The collapse of the Ming dynasty turned the world on its head. The Old Doctrine (noron, 老論, 노론) political cadre took the power after the chaos as the successors of the Ming dynasty. Joseon ruled by King Yeongjo (英祖, 영조) (b. 1694–1776, r. 1724–1776) and then his grandson King Jeongjo (正祖, 정조) (b. 1752–1800, r. 1776–1800) fully restored the dynasty after the three major wars[3] and commenced an era of economic growth and political stability unseen since the reign of Sejong the Great (世宗, 세종) (b. 1397–1450, r. 1418–1450). During this revival, aesthetes became more active in literary societies and their demand for paintings increased precipitously. Noron leader, Kim Chang Jeeb (金昌集, 김창집) (1646–1722), who became prime minister, was the patron of many artists but cared a great deal about Jeong Seon (鄭歚, 정선) (1676–1759) in particular. Jeong began painting at the age of 20 in the royal court with Kim's recommendation.

Jeong is one of most renowned artists in Korean art history because he observed and described the landscapes of Korea as they were, not through the lens of traditional Chinese aesthetics which is derived from the cultural follow to the Ming dynasty. His painting style known as "true-view" (jingyeong, 眞景, 진경) and was characterized by a more realistic representation of subjects. It adopted the Western perspective technique to achieve a likeness to nature which differentiated it from conventional painting techniques influenced by Ming aesthetics. However, Jeong's true-view aesthetics were derived in part from the political and economic circumstances of his time. The utmost support from the royal

[3] Japanese invasions of Korea (1592–98), Later Jin invasion of Joseon (1627), and Qing Invasion of Joseon (1636–1637).

auspices enabled him to lead a stable life as a painter and resulted in his assignment to multiple government posts. During this time, he was able to travel to many different landscapes and this allowed him to expose his works to many different audiences.

Jeong's most famous painting, *Clear Skies after the Rain at Mt. Inwang* (*inwangjesaekdo*, 仁王霽色圖, 인왕제색도) illustrates his unique approach to representing nature (fig. 1.2). Mt. Inwang (仁王山, 인왕산) is located to the west of Gyeongbok Palace (景福宮, 경복궁) in Seoul. The peaks and ridgelines in the painting and the image of its subject have remarkably similar positions and shapes, indicating that the painting was not a product of the old tradition or his imagination (figs. 1.2 and 1.3).

Fig. 1.2. Jeong, Seon. *Clear Skies after the Rain at Mt. Inwang* (inwangjesaekdo), 1751. Ink and light colors on paper, 79.2 cm × 138.2 cm. Leeum, Seoul. [Courtesy of Leeum]

Fig. 1.3. Mt. Inwang from Gyeongbok Palace. [Photographed by the author in 2019]

Until the late 1990s, Korean art historians have mainly studied his "true-view" style with a focus on his position in the royal court.[4] This focus was a product of the blurred lines between archaeology and art history and the fact that the Joseon dynasty art history research was not particularly popular in comparison with the Goryeo (918–1392) and the Three Kingdoms of Korea (57 BC– 668 AD). In *Old Paintings of Korea* (1975), Lee Dongjoo mentions Jeong's experience as an official in the royal court:

> On the other hand, it is written that Jeong Seon was known to have given devotions in

[4] Hwang, Intae, Chang, Alenda. "Reinterpreting Korean "True-View" Landscape Painting Using Graphics Analysis Techniques – The Case of Jeong Seon's Dosando." *International Symposium on Electronic Art 2019*, Gwangju (2019).

three places as a magistrate in *Changamjib*, through only one place is known to us: Yangcheon (Yangcheon District, Seoul). Nothing is known about the two other places.[5]

The other two places that previously unknown are Hayang and Cheongha prefecture, meaning that Jeong had not been studied carefully in the 1970s. Choi Wansoo (崔完秀, 최완수) (1942–) devoted his life to the study of Jeong and discovered many texts about the painter. He also defined true-view style as a unique cultural movement during the Joseon dynasty.[6] After Choi's research, art historians have evaluated Jeong from different perspectives. They began to conduct a comparative analysis of the scenes that Jeong painted and their subjects and studied how he was influenced by the Western painting style that he learned through the mostly Baroque paintings brought to the Qing dynasty by Italian missionaries.[7] Analyzing photographs of paintings' locations confirmed that Jeong visited the places that he painted. However, artistry is not simply reproducing natural scenery. Jeong preferred to reconstruct the composition by blending several sketches at the site and others produced from memory later. Therefore, the true-view style is not actually just a reproduction of a natural scene. To better understand it, this study built a three-dimensional model of his subjects and tried to develop an algorithm to replicate his unique composition techniques.

This study selected four paintings which are believed to have been produced while he was in Cheongha (淸河面, 청하면), an area which is now in North Gyeongsang

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[5] Lee, Dongjoo. *Old Paintings of Korea*, 2nd Edition. Seoul: Hakgojae, 1997. pp.231.

[6] Lee, Eunhae. 2006. "Issue: Repetition of the controversy to the true-view landscape paintings." *Kyosusinmun*, June 03, 2006. http://www.kyosu.net/news/articleView.html?idxno=9845

[7] Park, Eunsoon. "Jeong Seon's True-view Landscape Painting and the Western Influences." *Korean Journal of Art History*, No.281, Art History Association of Korea (2014): 58.

Province (慶尙北道, 경상북도) in South Korea. By reconstructing his subjects and determining the vantage point from which he made his paintings, this study found that his paintings were distinguished by four major characteristics:

- three depths of field, a traditional East Asian perspective technique that presents a scene with from multiple perspectives;
- hemispheric distortion effect and panoramic view, a composition method for emphasizing particular aspects of the subject;
- morphological alteration, an exaggeration or deformation of a scene to maximize the impression received from the motif; and
- representing multiple events in a single painting.

Jeong Seon virtual reality project has two different modes. The first mode allows users to navigate through the reconstructed spaces with a head-mounted display. All the objects in the reconstructed space can be displayed as depicted in the painting. The second mode allows users to verify the presence of the above-mentioned four major characteristics. The goal of this application was not to offer an artistic experience but rather to integrate two experiences to create analytical material generated by user behavior to ultimately create a virtual painter.

Chapter 2.

Related Studies

2.1. Interpretation of the True-view Landscape Movement by Art Historians

St Ottilien's Six "True View Landscapes" Chông Sôn (1676–1759)[8] by Kay Black and Eckart Dege, published in 1999, attempted to define Jeong Seon's distinctive perspective technique used in *The Complete View of the Diamond Mountains* (geumgangjeondo, 金剛全圖, 금강전도) (fig. 2.1.1). The analysis of artistic perspectives using modern computational techniques inspired this dissertation.

[8] Black, E Kay. Dege, Eckart. "St. Ottilien's Six "True View Landscapes" Chông Sôn (1676–1759)." *Oriental Art* Vol.XLV, No.4 (1999): 38-51.

Fig. 2.1.1. Jeong Seon. *The Complete View of the Diamond Mountains*, ca. 1750. Color on silk, 33.3 cm × 54.8 cm. Order of St. Benedict Waegwan Abbey. [Courtesy of Order of St. Benedict Waegwan Abbey]

The rich expressions and detailed depictions of the mountains in the painting were caused the Western art historians to doubt whether the painting was the result of actual observation of the mountains or was the product of the artist's imagination. Thus, they went to various places that were hypothesized to be Jeong's vantage point from which he created the painting. Dege[9] traveled to the Diamond Mountains several times and posted many

[9] Black was not possible to visit North Korea because of her citizenship

photographs of them on Google Earth.[10] Digitized topographic data was rarer Black and Dege wrote their article than it is today, so a U.S. military map of the Diamond Mountains published in the 1950s was used to create a three-dimensional virtual representation of the mountains. They assumed that the painting was based on actual observations made at a certain location among the peaks of the mountains. However, images rendered at the hypothesized vantage points were different from actual photographs of the site. Therefore, Black concluded that there was no convincing proof that the painting was the product of Jeong's actual observations.

The assumptions with which Black and Dege conducted their study were anchored in Western painting methodologies. Ever since the Renaissance, artists have attempted to represent their subjects the way that they are seen with the human eyes which led to the development of various perspective techniques. The single point perspective method, which is mainly used in landscape paintings, places the vanishing point near the eye level of the painting's viewer. All the objects in the painting become smaller relative to their proximity to the vanishing point. This effect generates a feeling of distance from the painting's elements, mimicking the way that the human brain understands the world. However, this method assumes that the viewers will observe the painting from a fixed point. Jeong's painting of the Diamond Mountains was not done using a single-point, but rather a multi-point perspective method.

The first rule of Western painting was to depict the subject as realistically as possible until the advent of the camera. It cannot be assumed that Jeong stood in multiple places to

[10] The old version of Google Earth was shutting down in November 2017, many valuable photographs are missing now. Dege's travelogue was one of them.

paint the Diamond Mountains. Instead, it is more likely that the painting was a product of an accumulation of memory and revisions after a great deal of observation of the area, rather than the portrayal of a single scene. The only way to truly see the 530 km^2 from a single perspective is via satellite which was obviously impossible in his time. The second-best option is to stand on the highest peak. Jeong's methods differed from the Western method in which the viewer stands at the center of the painting, so the Western art historians have struggled to understand him.

There are many artistic techniques that painters use to depict nature as they observe it. One technique is to complete the painting on-scene. This technique was popular with Impressionist painters due to the recent invention of the paint tube. Another technique is to make a simple sketch on-scene and then finish the painting on a large scale in a studio. This technique was favored by Dutch landscape painters in the 17th and 18th centuries. A third technique is to simply paint based on memory and impression. Black initially suspected that Jeong had used the first technique, completing his paintings at the mountains. However, given the brevity of his brushwork, Black then hypothesized that Jeong might have used the second technique, making rough sketches and later completing the painting in another location. Finally, she hypothesized that, if the painting did not share many features with its subject, then it was likely created using the third technique in which Jeong would have painted largely from his memories and impressions, a common Chinese practice at the time.

There are many written arguments from his contemporaries of his kaleidoscopic painting style. Lee Byeongyeon (李秉淵, 이병연) (1671–1751), a famous, prolific poet, is related to *Clear Skies after the Rain at Mt. Inwang* (fig. 1.2). Jeong visited his friend Lee while he was sick. Jeong painted Mt. Inwang from Lee's house with the hopes that it would

inspire his quick recovery. They wanted to memorize the travel to the Diamond Mountains by sharing this painting. Lee wrote about this in their journey:

觀鄭元伯霧中畫毗盧峯 - Watching Won Baek (Jeong's pen name) Drawing at Bilobong Peak in the Mist[11]

吾友鄭元伯	My friend Jeong Seon
囊中無畫筆	Has no brush in his pouch
時時畫興發	Sometimes the painting inspiration occurs
就我手中奪	Immediately, he steals the one in my hand
自入金剛来	Since we came to the Diamond Mountains
揮灑太放恣	He arrogantly swings his brush to paint
白玉萬二千	Twelve thousand pieces of white jade
一一遭點毁	Each of them is broken by the dots

Another piece of evidence supports the conclusion that Jeong was in the habit of extemporaneous painting. An Joongkwan (安重觀, 안중관) (1683–1752), Neo-Confucianist and government official, described how Jeong drew the Diamond Mountains:

題九龍瀑帖 - The Nine Dragon Falls Album[12]

庚子初夏	Early in the summer of 1720
余入楓嶽	I went to the Diamond Mountains
觀於水	Awed at the sight of the water
得九龍瀑甚壯之	I arrived at the splendid Nine Dragon Falls
歸與鄭殿中元伯語其槩	I returned to Won Baek and told him of the scenery

[11] Kho, Yeon Hee. *A Study on Travelogue and Real Scenery Painting of the Late Joseon Period–Jung Son and Nong Yeon Group*. Seoul: Iljisa, 2001, pp. 174. The original text is Lee Byeongyeon's one of anthologies *Sachunsicho* (槎川詩抄, 사천시초) vol 1, p40b. (Jangseogak Royal Archives of The Academy of Korean Studies, yoksa.aks.ac.kr)

[12] *Ibid*., 180. The original text is An Joongkwan's *Hoewajip* (悔窩集, 회와집) vol.4, part 2. Media Korean Studies http://db.mkstudy.com.

元伯喜爲水墨戲者	Won Baek likes to draw with brush and ink
聞之聳然	As he listened to my story
從坐上灑筆	He sat and swung his brush
直就之	And finished the painting
便見千尺奇勢	He knows the true shape
宛然本境	And the essence of a place

Lee's poem suggests that Jeong painted the Diamond Mountains as a result of direct observation, the first technique. However, An's piece indicates that he depended upon a description from someone else and his own memory,[13] the third technique.

Lee Taeho (李泰浩, 이태호) (1952–) pointed out the importance of the viewing angle in the comparative analysis of the true-view style. He insisted that, with current technology, only a camera with a focal length of 28 mm or less, such as a digital single-lens reflex camera, would produce a similar perspective as that in Jeong's paintings.[14] The 28mm lens released by Nikon has a viewing angle of 53°[15] which means his paintings were not made by viewing the subject from a single, but rather multiple, directions, reflecting the second technique.[16] Lee also insisted that Jeong's style indicated that he mostly depended on memories and impressions. Therefore, all three techniques must be considered to ensure that Jeong's perspective method is correctly understood.

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13 Jeong traveled the Diamond Mountains in 1711,1712, and 1747.

14 Lee, Taeho. "Painting from Actual Sceneries or from Memory–with Focus Onview Point and Angle of View in True-view Landscape Paintings of the Late Joseon Dynasty." *Korean Journal of Art History*, WN.257 (2008): 146.

15 AF-S NIKKOR 28mm f/1.8G Tech Spec. https://www.nikonusa.com/en/nikon-products/product/camera-lenses/af-s-nikkor-28mm-f%252f1.8g.html#tab-ProductDetail-ProductTabs-TechSpecs.

16 Here is a discussion about how much the painting of Jeong depicts the area on one screen, thus "multiple directions" is appropriate term.

Choi appreciates the bold exaggeration and transformation of Jeong's paintings as they present the subjects in a condensed fashion and convey Jeong's personal views. Park Eunsoon (朴銀順, 박은순) (1958–) suggests that Jeong realized his unique style by combining Western painting methods he learned from the Qing dynasty paintings when he was an adjunct professor in the Bureau of Astronomy (gwansanggam, 觀象監, 관상감) and traditional Korean methods. Park has shown how Jeong used many techniques, such as the use of aero and linear perspectives, in his paintings, all of which enhanced the resemblance between the paintings and their subjects.[17]

The views on what elements were characteristics of the true-view style expressed in five Korean art history and four non-art history journals were analyzed.[18] Researchers' positions were classified as holding that Jeong's paintings were the result of either field expeditions and close observation of their subjects, of his imagination and memory, or of copying Ming dynasty landscape prints (table 1).

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[17] Park, Eunsoon, "Jeong Seon's True-view Landscape Painting and the Western Influences." *Korean Journal of Art History*, No.281, (2014):82.

[18] 1. Korean Journal of Art History (미술사학연구), Art History Association of Korea, ISSN 1225-2565, (http://www.korea-art.or.kr).
2. The Art History Journal (강좌미술사), The Association of Korean Buddhist Art History, ISSN 1226-6604, (http://www.arthistory.co.kr).
3. Korean Bulletin of Art History (미술사학보), The Korean Society of Art History, ISSN 1598-1258, (http://www.karthistory.or.kr).
4. Journal of the Korean Institute of Landscape Architecture (한국조경학회지), Korean Institute of Landscape Architecture, ISSN 1225-1755, (http://www.kila.or.kr).
5. Toegyehag nonjib (퇴계학논집), Yeongnam Toegye Studies Institute, ISSN 2005-3851, (http://www.tege.co.kr).
6. Art History Forum (미술사논단), Center for Art Studies, ISSN 1225-9519, (http://www.cassia.org). The Journal of Art and Culture Studies (동서미술문화학회 미술문화연구), East-West Art and Culture Studies Association, ISSN 2287-8289, (http://www.ewart.co.kr). HACE (한자한문교육), The Korea Association For Han-character and classical written language Education, ISSN 1598-1363, (http://www.studyhanja.net). Yang-Ming Studies (양명학), The Korean Society of Yang-Ming Studies, ISSN 1229-5957, (http://ymhh.or.kr).

Jeong did not leave any writings and his pieces do not have any inscriptions,[19] so true-view theories are relatively wide-ranging. Most of what is known about Jeong is from what was written about him, such as letters from his close friends. However, these writings amount to fragmentary anecdotes, not deep critics or reviews of his works.

Choi declared that over 300 of Jeong's paintings survived today, of which he introduced 206 in his book.[20] The prolific and successful painter exhibited dramatic

Table 1. Researchers' position of Jeong Seon's true-view style.

Group	Journal [21]/Year	Author	Title
Group 1	3/1995	Yu, Jun Yeong	A Study on Jeong Seon's Songanmyoseon.
	4/2002	Kang, Young-Jo and Bae, Mi-Kyung	Prospect Behavior in the Analysis of Kyumjae Chung Sun's One Hundred Scenes from the Real Landscape Painting.
	4/2001	Kang, Myung-Soo	Pattern Classification and Characteristics Concerning Landscape on Mountains and Hills by Using a Landscape Picture.
	1/2014	Park, Eunsoon	Jeong Seon's True-view Landscape Painting and the Western Influences.
	6/2013	Ahn, Ho-Kyun	A Study on Sketching of Buddhist Temple & Sightseeing Place of Sketching Landscape. Appeared in Actual-view Landscape Painting of the Geumgang mountain of Gyeomjae (Jeong Seon).
	6/2013	Kim, Jin-Kyoung	A study on modernity by the art of drawing Kyeom-jae.
Group 2	3/1999	You, Hong June	The Theory of Jingyeong Poet and Jingyeong Landscape Paintings in the Late Joseon Dynasty.
	3/2006	Kang, Kwanshick	A Study on the Gyeomgyosu (兼敎授, Professor extraordinary) Duty in Astronomy of Gyeomje Jeongseon (謙齋 鄭敾, 1676-1759) and the Interpretation of <Geumganjeondo (金剛全圖, General View of Kumgang Mountain)> from the Viewpoint of the Science of Astronomy-Divination (天文易學).
	2/2008	Lee, Taeho	Painting from Actual Sceneries or from Memory.
	1/2008	Hong, Sunpyo	The Complementarity between Antiquity-Imitating Landscape Painting and Real-Scenery Landscape Paintings of the Late Joseon Period.
	1/2006	Yoo, Jaebin	A Study of "Dosando (陶山圖)."
	6/2011	Chang, Chinsung	The Fallacy of Love - How to Interpret and Write about the Life and Work of Chong Son.
	6/2012	Jin, Jae-Kyo	Demonstration about the weakness in the research on the "Real landscape painting (眞景山水)."
Group 3	3/2002	Kho, Youen-Hee	The Paintings by Jeong Son and 'the Other.'
	2/2008	Lee, Soon-Mi	A Study on the Transmission and the Influence of *Haenaegigwan* in the Joseon Dynasty.
	1/1996	Han, Jeong-Hee	Chinese Influence of the Late Choson Painting.

[19] Chang, Chinsung. "The Fallacy of Love - How to Interpret and Write about the Life and Work of Chong Son." *Art History Forum* no.33, Center for Art Studies, (2011): 54.

[20] Choi, Wan Soo. *Kyeomjae Jeong Seon,* Vol.3, Seoul: Hyunamsa, 2009. pp.535.

[21] Number indicates which Journal in the footnote no.18 published the paper.

changes in style over the course of his career. The quality of his painting after he earned his notoriety for his works declined in his late 40s. Chang Chinsung (張辰城, 장진성) (1966–) described Jeong's later years like this:

> In his daily life, he accepted numerous commissions from patrons and clients. High-ranking officials, members of the *yangban* class, merchants, interpreters, and even commoners were his clients. The number of his commissions was so overwhelming that Chŏng was unable to find time to eat and sleep. He used his son and his student as ghost-painters to handle the constant requests for his paintings.[22]

The biggest challenge in the study of Jeong and his work is that the lack of evidence from him. Most surviving evidence about Jeong is descriptions of his life by others. The existing debates in the academy have focused on the artist' life and the background rather than the works. For example, Choi's theory that Jeong's works were the product of Noron's Little Sino-centrism was brought intense debate between art historians while the most important topic, Jeong's paintings, had not received the spotlight. Erwin Panofsky (1892–1968), a German-Jewish art historian, developed a three-step approach for analyzing artwork.[23] The first step is "Pre-iconographical description" which is to identify artistic motifs depicted in the work of art. The second step is "Iconographical analysis." This step is to find out stories or allegories behind the subject of the artwork. The last step is "Iconological interpretation." This stage is inferring the intrinsic meaning that constitutes the symbolical value of the work. In his framework, most of Jeong theories skip the pre-

[22] Chang, *Ibid*, pp. 73.
[23] Panofsky, Erwin. *Meaning in the Visual Arts*. Chicago: Univ. of Chicago Press, 2008.

iconographic analysis because there exist abundant historical sources of Jeong's circle while there is not enough description of the painting in detail written in his time. It was difficult to find research that attempted to analyze and interpret of Jeong's paintings themselves in any kind of sophisticated fashion. Therefore, this study was concentrated both on the details of Jeong's works and materials written about him to a better understanding his art.

2.2. Precedents for a Virtual Reality Project Based on Landscape Paintings

Dreams of Dali, created by the Salvador Dali Museum, is one of the virtual reality projects based on paintings. The museum recreated Dali's *Archaeological Reminiscence of Millet's Angelus* as a three-dimensional environment to allow viewers to appreciate it in a new way. According to the museum's description, Dali thought that the female in Millet's painting was threatening to the man. Mixed with the shape of a mantis, Dali transformed both human figures into the ruins of an archaeological site.

The museum posted a 360-degree version of the project on YouTube. In the video, audiences follow a fixed path through the environment while being able to control the camera with four arrow buttons on the top-left corner of the screen (fig. 2.2.1).[24] In this program, the subjects are more detailed than in the original painting, generating a dreamlike

[24] VR version is currently presenting only in the museum.

Fig. 2.2.1. The Dali Museum. *Dreams of Dali: 360° Video*, 2016, ©Salvador Dali Museum, Inc., St. Petersburg, FL. Worldwide rights ©Salvador Dali, Fundacio Gala-Salvador Dali.

atmosphere. It is significant in that it provides an alternative way of experiencing the imagery of the space in the painting. It also demonstrates the possibilities for the rebirth of other paintings through technology.

Another virtual reality project, *The Night Cafe* produced by Borrowed Light Studios,[25] is based on Vincent van Gogh's oeuvre. The studio used *The Night Cafe* (1888), *Van Gogh's Chair* (1888), *Self-Portrait* (1889), and *Still Life: Vase with Twelve Sunflowers*

[25] Borrowed Light Studios, www.borrowedlightvr.com.

(1888) by van Gogh to create a café scene. According to the production notes,[26] the creators wanted to fabricate a larger space than the cafe depicted in the paintings. Adding extra rooms to the space in the project extended experience duration and stimulated a sense of curiosity in its users. Thus, the multiple layers of the space encouraged users to explore it. This sense of expanded space was an important part of the project. The audience was able to imagine something outside of the canvas by combining what they saw in the painting with their previous experiences, to do some degree this program replaced viewers' imaginations by completing the scenes behind the original paintings. The most distinctive feature of this project is the special textures of the programs' objects which reproduce the unique brush strokes in van Gogh's paintings. To make the scene more picturesque, the objects in the program were exquisitely deformed to exclude straight lines to mimic van Gogh's style.

National Palace Museum developed *Roaming through Fantasy Land*, a virtual reality project based on one of Zhao Mengfu's landscape painting, *Autumn Colors on the Qiao and Hua Mountains*.[27] The museum's intention was to provide an imaginary space of the painting to the audience. The production procedure followed the conventional painting-based VR project. The game object in the virtual space was generated by scanning of the painting. The outcome achieved a stylistic atmosphere at some point, however, it only covered the limited space depicted in the painting.[28]

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[26] Borrowed Light Studios. "Borrowed Light Studios, The Making of Night Cafe (Part 1)." The Making of Night Cafe Part 1 Comments. Accessed May 24, 2019. http://www.borrowedlightvr.com/2015/09/28/the-making-of-night-cafe-part-1/.

[27] The detail explanation of the exhibition is in the official museum website. https://theme.npm.edu.tw/exh107/VRart/en/index.html

[28] The VR application is published through one of sales flat forms of VR applications VIVEPORT. https://www.viveport.com/apps/fcd3d1b7-62ca-46b4-9cde-0b2098f8e66f/Autumn_Colors_on_the_Qiao_and_Hua_Mountains-_NPM_Painting_VR/

Crystal CG[29] exhibited the masterpiece at the 2010 Shanghai Expo, their project was to recreate Zhang Zeduan's painting, *Along the river during the Qingming festival*. The painting is a huge scale handscroll describing the capital city of the Song Dynasty. The size of the original scroll is 525cm long and 25.5cm height. Not only the giant scale of painting, but its detailed descriptions of the people in the city made the painting is a majestic work of art. Not like previous work, the team produced an animation of every subject that had to have movement depicted in the painting. Thus, the audiences are in the illusion that they have gone to back to the street in the city of Bianjing. 70 participated artists with their two years labor reproduced this painting as a live animation.[30] The CG canvas is 6.3-meter-high and 130 meters long. Because of the sizes of the canvas, they had to split it into 12 parts with the same number of projects with a 2048 × 1080 resolution.

These are four examples of technology-based projects using paintings that provide users with unique experiences like paintings on which they are based. In a similar fashion, this research focused on analyzing his unique perspective method. The program presented Jeong's multi-viewpoint and memory-dependent reproduction methods. This study took a different approach to analyze Jeong's paintings than that pursued by Korean art historians. Previous studies compared site photographs and to Jeong's paintings then suggested ambiguous criteria for determining how Jeong achieved his style based on the comparison results. The Jeong virtual reality application takes a different path to answer questions about his true-view style by using computer graphical analysis. Similar to Black, this program compared the scenes generated by virtual cameras placed at multiple spots where Jeong

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29 Cristal CG, Chinese computer graphics company. http://en.crystalcg.com/.

30 Quick, Darren. "Video: Animated Digital Tapestry Wows Visitors at Shanghai Expo 2010." New Atlas - New Technology & Science News. https://newatlas.com/crystal-cg-digital-animated-tapestry/16108/.

might have stood for this painting, and generated scene by combining observations made from multiple vantage points. This program then quantified the similarity between the generated images and Jeong's paintings to determine the vantage points from which he most likely made his paintings.

2.3. Computer Science-based Analytical Approaches to Understanding Painters

Analyzing paintings requires complicated steps. Paintings can only be understood with a knowledge of their historical background and painting techniques. Certain painting elements, such as color, brightness, texture, and shape can be quantified and easily subject to computational analysis, but elements like symbolism are more difficult to specify and so are not as easily analyzed.[31] This difficulty became particularly pronounced with the advent of the abstract style of early 20th-century Europe which separated a painting's superficial appearance from its underlying meaning.

The most common subject of computational analysis is determining which elements constitute an artist's particular style. Shamir et al. (2010)[32] examined the similarities between Expressionism, surrealism, and Impressionism based on 57 paintings. Lior Shamir

[31] Hwang, Intae, Chang, Alenda. "Reinterpreting Korean "True-View" Landscape Painting Using Graphics Analysis Techniques – The Case of Jeong Seon's Dosando." *International Symposium on Electronic Art 2019*, Gwangju (2019).

[32] Shamir, Lior, Tomasz Macura, Nikita Orlov, D. Mark Eckley, and Ilya G. Goldberg. "Impressionism, Expressionism, Surrealism." *ACM Transactions on Applied Perception* 7, No. 2 (2010).

and Jane Tarakhovsky (2012)[33] extended this experiment to include 994 paintings by 34 painters. Chen et al. (2017)[34] proposed a method for determining the era during which Chinese paintings were created depend on paintings from the Mogao Grottoes in Dunhuang by extracting core image features and training a classifier with them.

However, these studies analyzed the correlation between several painters and their broad styles, but this study compared the similarity between a single artist's paintings and those paintings' subjects to determine whether two images from the painting and the virtual space created through research are similar or not. Because this research basically compares images of different domains, Shrivastava et al. (2011)[35]'s experiment which developed a method for determining whether images from different visual domains, such as a photograph, or artistic drawing, are of the same subject were precedent for Jeong's case. Their study removed the unnecessary elements from that algorithm to place more weight on interesting visual structures. The algorithm developed by Shrivastava et al. trains a discriminative classifier that estimated which image features were the most important. They trained their algorithm using a large data set from Flickr.

Bratkova et al. (2009)[36] developed an automatic landscape rendering system based on terrain data. They analyzed the styles of the work of Heinrich Berann and James Niehues in terms of their size, texture contours shadings, and perspective. They then created an

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33 Shamir, Lior, and Jane A. Tarakhovsky. "Computer Analysis of Art." *Journal on Computing and Cultural Heritage*, vol. 5, No. 2 (2012).

34 Chen, Long, Jianda Chen, Qin Zou, Kai Huang, and Qingquan Li. "Multi-View Feature Combination for Ancient Paintings Chronological Classification." *Journal on Computing and Cultural Heritage* 10, No. 2 (2017).

35 Shrivastava, Abhinav, Tomasz Malisiewicz, Abhinav Gupta, and Alexei A. Efros. "Data-driven Visual Similarity for Cross-domain Image Matching." *Proceedings of the 2011 SIGGRAPH Asia Conference on - SA 11* (2011).

36 Bratkova, Margarita, Peter Shirley, and William B. Thompson. "Artistic Rendering of Mountainous Terrain." *ACM Transactions on Graphics* 28, No. 4 (2009).

algorithm that produced rendered images of Yellowstone based on three-dimensional mesh data generated by satellite scans. Their approach was partially adopted to creating Jeong Seon filter which generates paint like scene only based on a three-dimensional object in the virtual environment.

Another similar approach was taken by Russel et al. (2011)[37] who developed a method for matching non-photorealistic images generated from three-dimensional models of archaeological sites with architectural paintings. They generated three-dimensional mesh data from more than 500 photographs of Pompeii in Italy, and then found the locations that were the subjects of the paintings. The initial process compared the view of likely candidates from particular vantage points by accurately aligning the paintings with three-dimensional mesh data. They then extracted contours from the paintings and then ran the matching process again. This two-stage method proved that many paintings of previously unknown sites were actually of large historical sites. Just comparing pixel value of painting and photograph of its subjects made lots of unstable result in Jeong's case. Their method corrected the wrong approach of the early stage of this research.

Jeong made considerable efforts to deliver the sense of the size of entire massive peaks and boulders in small scrolls. His style is even more simplified and symbolic in the shapes and represented strokes he employs and multiple perspectives. For example, *The Complete View of the Diamond Mountains* (fig. 2.1.1) combines more than seven

[37] Russell, Bryan C., Josef Sivic, Jean Ponce, and Helene Dessales. "Automatic Alignment of Paintings and Photographs Depicting a 3D Scene." *2011 IEEE International Conference on Computer Vision Workshops (ICCV Workshops)* (2011).

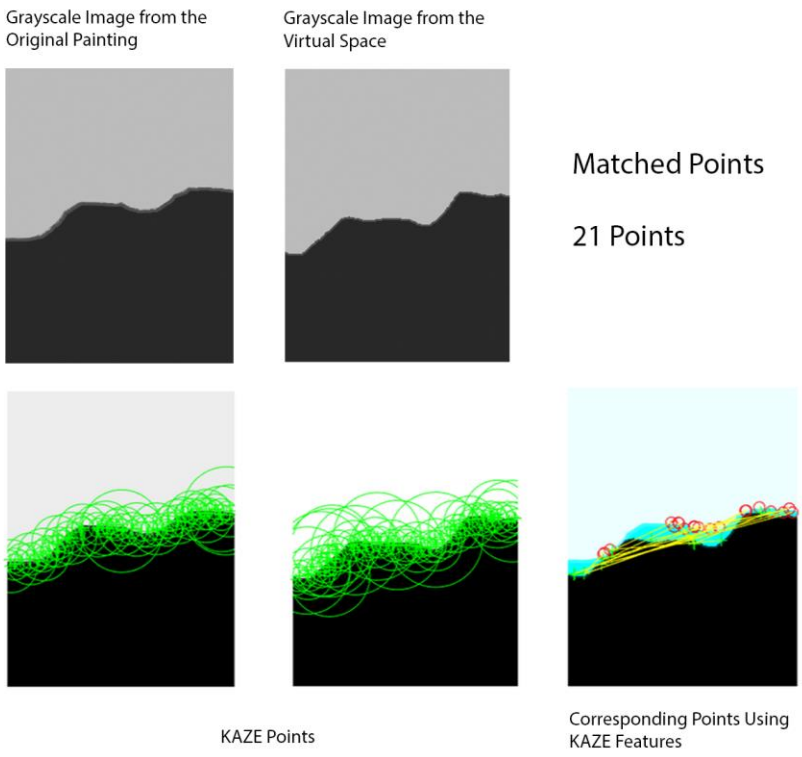

Fig. 2.3.1. The similar KAZE features between an image from Jeong's painting (fig. 3.1.4.2 left) and the virtual reproduction of a candidate subject (fig. 3.1.4.2 right).[38]

perspectives. He did not hesitate to transform the shapes of the subjects according to his inspiration. These alterations make the use of the image-matching systems discussed above, such as the Scale-Invariant Feature Transform algorithm, the Harris Corner Detector, the Speeded-Up Robust Features algorithm, and the Binary Robust Invariant Scalable Keypoints algorithm hindered. Of these systems, only KAZE feature[39] was able to produce meaningful

[38] MATLAB Computer Vision System Toolbox. "Detect KAZE Features - MATLAB." Accessed May 24, 2019. https://www.mathworks.com/help/vision/ref/detectkazefeatures.html.
[39] Alcantarilla, Pablo Fernández, Adrien Bartoli, and Andrew J. Davison. "KAZE Features." *Computer Vision – ECCV 2012 Lecture Notes in Computer Science* (2012): 214-27.

matches between points. The MATLAB R2018a: Computer Vision System Toolbox detectKAZEFeatures function (fig. 2.3.1) produced 21 matching points between the original painting (fig. 3.1.4.3 (left)) and virtually reproduced image (fig. 3.1.4.3 (right)). However, the function's performance was imperfect. The bottom-right image of figure 2.3.1 shows the matching result and the yellow line pairs indicate the similarities between the two images. These long lines reveal that the matching system tells both ends of the yellow line are similar even though the two images are overlapped. This result means that the two images have no significantly similar KAZE features even the system produced many matching points compared to the other methods.

Computer scientists have examined famous Baroque paintings to understand the unique painting techniques used to produce them by reproducing these paintings as three-dimensional models. They placed a virtual camera in the position at which they thought that the painter sat to create an image similar to the original painting. David Stork and Yasuo Furuichi[40] analyzed two Baroque paintings, Diego Velázques's *Las Meninas* (1656) and Parmigianino's *Self-portrait in a Convex Mirror* (1524). They tried to find the actual positions of subjects by reconstructing the tableaux and models. They identified the exact positions of the main subjects whose existence had been obscured and by analyzing light patterns and angle of perspective in the room as depicted in the painting. The analysis of Parmigianino's painting has been done in the past. Giorgio Vasari (1511–1574) tells how Parmigianino's painting was born in *Lives of the Most Eminent Painters, Sculptors, and Architects* (1550). Vasari thought that Parmigianino had looked at himself in a convex

[40] Stork, David G., and Yasuo Furuichi, "Computer Graphics Synthesis for Inferring Artist Studio Practice: An Application to Diego Velázquezs Las Meninas," *The Engineering Reality of Virtual Reality 2009*, 2009. Stork, David G., and Yasuo Furuichi. "Reflections on Parmigianino's Self Portrait in a Convex Mirror: A Computer Graphics Reconstruction of the Artist's Studio," *Computer Vision and Image Analysis of Art*, 2010.

barber's mirror then painted self-portrait on a curved wood surface.[41] The painter's easel and the light's source and direction are defined in Parmigianino's reconstructed studio. The rendered virtual space resembles the original painting. This virtual restoration approach showed has the potentials to answer many questions that have arisen around Jeong and his works.

All the methods described above except for the last two cases basically compared grayscale pixel values. In this study, comparing the pixel value of a site photograph and its painting would not have produced relevant results because the true-view paintings were so different from their subjects from a certain point of view. There are many variables, such as viewpoint location and direction, and light sources that change over time, so it is difficult to the values of those parameters that the painter used. As James Cahill discussed in *The Compelling Image*,[42] Chinese and Korean landscape painting in Jeong's time was only focused on reproducing ideal scenery. Jeong is the first painter who tried to shift away from this tradition by actual observation of nature. Jeong's ideal certainly affected the composition and depiction of his subjects, however, still there existed a past influence, so these formalized elements should be filtered to prove the fact that his paintings were of natural subjects. Jeong's subjects, like shapes of rivers or appearance of buildings, may have changed since he painted them, so they cannot be the main standard for comparing paintings to subject reconstructions to find the painter's observation point. However, subjects such as mountains do not change significantly over time and so are suitable for conducting the similarity analyses. There are many ways to depict mountains in Korean landscape painting,

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[41] Giorgio Vasari, translated by Gaston du C De Vere, *Lives of the Most Eminent Painters, Sculptors, and Architects,* London: P.L. Warmer, 1912-14. pp. 245.
[42] Cahill, James. *The Compelling Image: Nature and Style in Seventeenth-century Chinese Painting*. Cambridge, MA: Belknap Press of Harvard University Press, 1993. pp.5.

but the most prominent method is to draw the line where the mountain and the sky meet. This stroke show similarity to a sound wave in their shape, and the shapes of mountains and the graphs of sound waves enabled the cross-correlation method, which measures displacement in signal processing, could be used to compare Jeong's paintings to their subjects. Thus, topographic data and Jeong's painting could be quantitatively compared.

Chapter 3.

Reinterpretation of the True-View Landscape Painting Style Using Graphics Analysis Techniques through a Study of *Album of Gyeongsang Province*

3.1. *Painting of Cheongha Castle and Town*

Jeong Seon was assigned to Cheongha prefecture (hyeon, 縣, 현) with the position of the magistrate[43] on August 15, 1733, a period of 20 months. During this time, he was able to

[43] Journal of the Royal Secretariat (seungjeongwonilgi) “book 761, 9 June 1733", “鄭敾爲淸河縣監” (Assign Jeong Seon as a magistrate of Cheongha prefecture), “book 763, 15 August 1733”, “下直, 淸河縣監鄭敾.” (Accept the position and depart to Cheongha), “book 805, 24 July 1735”, “下直, 淸河縣監淆”(Lee Sung

explore several famous places around the region.[44] These pieces, namely *Standing Rock between Two Streams* (sanggyeibam, 雙溪立岩, 쌍계입암), *Painting of Dosan Confucian Academy* (dosanseowondo, 陶山書院圖, 도산서원도), *Seongryu Cave* (seongryugul, 聖留窟, 성류굴), *Painting of Cheongha Castle and Town* (cheonghaseongeupdo, 淸河城邑圖, 청하성읍도), *Three Dragon Ponds* (neyeonsamyongchoo, 內延三龍湫, 내연삼용추), and *Haein Buddhist Temple* (haeinsa, 海印寺, 해인사), constitute the *Album of Gyeongsang Province* (yeongnamchup, 嶺南帖, 영남첩). The name of this album originated from "Yeongnam" (嶺南, 영남), the name of the southeastern part of Korea surrounded by the Sobaek Mountains (小白山脈, 소백산맥).[45]

Lee Duksoo (李德壽, 이덕수) (1673–1744), poet and politician, wrote *Colophon of Gyeomjae's*[46] *Goohakchup* (jegyeomjaegoohakchup, 題謙齋丘壑帖, 제겸재구학첩), which tells a story behind the *Album of Gyeongsang Province* and the *Album of Four Counties* (sagoonchup, 四郡帖, 사군첩) that he made for his friend Kim Kwangsoo (金光遂, 김광수) (1699–1770):[47]

題謙齋丘壑帖 題跋　　Colophon of Gyeomjae's Goohakchup

近世號能畫　　One of today's best painters

accept the position and depart to Cheongha), National Institute of Korean History, http://sjw.history.go.kr/main.do.

[44] Hwang, Intae, Chang, Alenda. "Reinterpreting Korean "True-View" Landscape Painting Using Graphics Analysis Techniques – The Case of Jeong Seon's Dosando." *International Symposium on Electronic Art 2019*, Gwangju (2019).

[45] Today, Yeongnam region includes North Gyeongsang Province and South Gyeongsang Province.

[46] Jeong Seon's pen name

[47] Choi, *Ibid*, vol.1, pp.338-340.

…

今河陽使君鄭元伯後出	is Magistrate of Hayang, Jeong Seon
而名掩前人	His name has earned a greater reputation than anyone else
其爲金成仲	For Kim Kwangsoo
寫嶺南及四郡諸勝	Jeong Seon painted scenic spots in Yeongnam and Sagoon

...

余雖足迹未嘗及於嶺外	I have not been to Yeongnam yet
而若四郡則盖嘗遍遊矣	But have visited Sagoon many times and enjoyed my stays
今觀帖中所畫	I carefully reviewed paintings and can say
皆彷彿得其形似	That they are true to life. He has achieved enlightenment in painting
以此而知畫嶺外諸勝	I am sure that Yeongnam looks just like his paintings[48]

Lee was able to see the paintings from both albums because he was a member of Noron.[49] Jeong became the magistrate of Hayang prefecture in January 1721 and served for five years. He then became the Magistrate of Cheongha in 1733. Lee refers to Jeong as the Magistrate of Hayang in his colophon which meant that Lee did not know that Jeong served in Cheongha when he wrote the colophon or that the *Album of Gyeongsang Province* had been produced before Jeong had been appointed to his position in Cheongha. The Joseon government dispatched more than 20 painters around the country every year to produce military maps of major cities.[50] Jeong had probably been involved in this dispatch system while he worked at the Korean Royal Academy of Painting (Dohwaseo, 圖畵署, 도화서)

[48] Original text from Database of Institute for the Translation of Korean Classics, http://www.itkc.or.kr/

[49] Veritable Records of the Joseon Dynasty, "Gyeongjong Sillok," Gyeongjong 2nd year 17th September 2nd record, 1772, http://sillok.history.go.kr/id/kta_10209017_002. "Jibeui Lee Duk-Soo is abrasive, wily. In early days of his reign, he cringes to his superior, his friend Kim Chang Jeeb, to change his coat for profit. He was able to serve three positions in Saheonbu (The board of inspection)."

[50] Lee, Hoon-sang. "Government artists Dispatched to Local Areas, Government artists Dispatched system and their configuration of Local Areas in Late Joseon Dynasty." *The Dong Bang Hak Chi*, No.144 (2008): 309.

before the Hayang period. Thus, Jeong might knew the subjects of the *Album of Gyeongsang province*, before he was appointed to Cheongha town.

The writings left by those who knew Jeong give important insights into his activities. However, they are subjective appraisals and sometimes overzealous in their praise. Thus, it would be inappropriate to treat these sources as the main data for analysis in this study.

3.1.1. Historical Background

Cheongha (currently Cheongha town, Pohang City, North Gyeongsang Province, 淸河面, 청하면) is a small town of 5,000 people. It is a village is located on a coastal plain between high mountains and the East Sea. The history of Cheongha dates back 1,500 years. According to *The Chronicles of the Three States* (samguksagi, 三國史記, 삼국사기), it was known as Ahehyun (阿兮縣, 아혜현) during the Goguryeo (高句麗, 고구려) (BC 37–AD 668) period and became known as Haeahyn (혜아현) during the Silla (新羅, 신라) (BC 57–AD 935) period.[51] King Hyeonjong (顯宗, 현종) (b. 992–1031, r. 1009–1031) built the earthen fortifications first at the center of the town which Sejong the Great (世宗, 세종) (b. 1397–1450, r. 1418–1450) ordered be developed into a stone fortress to defend the town against the invasion of Japanese pirates. In the 1970s, the New Community Movement (saemaulundong, 새마을운동)[52] demolished the existing remaining stone walls. Fortunately,

[51] Kim Busik, *Samhuk sagi*, 1145, Book 37, Geography Section. Korea Creative Content Agency. www.culturecontent.com

[52] The government lead project for residential environment improvement of rural area.

three sides of the fortress remained. The yard has been filled with dirt and is now the site of Cheongha Elementary School. According to the *Municipal Atlas of Cheongha* (cheonghahyeoneupjee, 淸河縣邑誌, 청하현읍지)[53] published in 1899, the fortress was built by soldiers from adjacent towns by order of Sejong the Great in 1427. It is length is 1353 *chuk* long (1968 feet, old measurement standard, 尺, 척) and nine *chuk* (13 feet) high.

The main subject of *Painting of Cheongha Castle and Town* is the castle (fig. 3.1.1.1). There are several other buildings in the painting, the shapes of which indicate their purpose. *Haedong Pictorial Map of Counties* (haedongjeedo, 海東地圖, 해동지도),[54] published in the mid–1750s, describes the layout of the town (figs. 3.1.1.2 and 3.1.1.3) through which it can be guessed that there is a complex government office buildings (舍衙) on the center of the west wall, the Lotus Pavilion (蓮亭) is in the northeast corner, and inn (客舍) and the Moonlight Over the Sea Watch Tower (海月樓) are near the south wall. The map and description of the town's layout indicate what the village looked like in the past and help to identify the buildings. Without such information, it was particularly unclear what the rectangular construction in the painting was (fig. 3.1.1.4), but the small blue circle in the map confirms that had been a pond there, which has since been reclaimed.

Jeong arranged mountains in the background, which take up to half of the painting, and added hills below in the middle ground. He depicted the town and placed two distinctive

53 Anonymous, *Municipal Geographic Document of Cheongha* (cheonghahyeoneupjee, 淸河縣邑誌, 청하현읍지), 1899. Kyujanggak Institute for Korean Studies at Seoul National University. http://kyujanggak.snu.ac.kr

54 Anonymous. *Haedongjeedo*, (haedongjeedo, 海東地圖, 해동지도), ca. 1750, Kyujanggak Institute for Korean Studies at Seoul National University. http://kyujanggak.snu.ac.kr

Fig. 3.1.1.1. Jeong Seon. *Painting of Cheongha Castle and Town*, 1734. Ink and light color on paper, 31.8 cm × 25.9 cm. Gyeomjae Jeong Seon Art Museum, Seoul. [Courtesy of Gyeomjae Jeong Seon Art Museum]

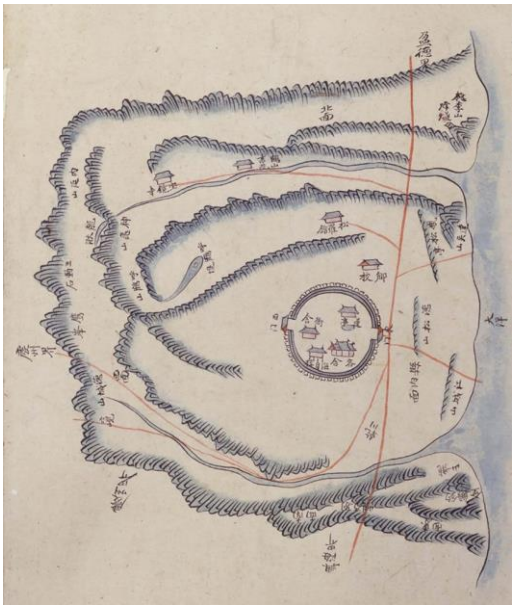

Fig. 3.1.1.2. Anonymous. Cheongha Town in *Haedong Pictorial Map of Counties*, ca. 1750, Kyujanggak Institute for Korean Studies at Seoul National University, Seoul. [Courtesy of Kyujanggak Institute for Korean Studies at Seoul National University]

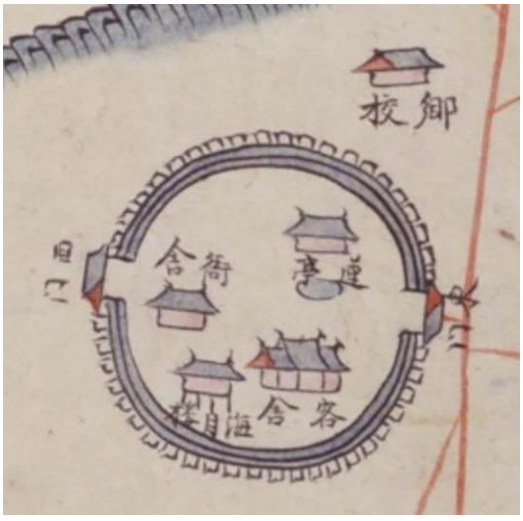

Fig. 3.1.1.3. Detailed close-up of fig. 3.1.1.2.

Fig. 3.1.1.4. Detailed close-up of fig. 3.1.1.1.

pine tree forests in the foreground. The trees are scaled up and depicted with strong, deep touch *mi tree* painting techniques. This *mi tree* technique is accomplished with a brush dripping with ink that is then handled with precision.[55] The *Municipal Atlas of Cheongha* mentions that there are two gates in the castle's east and west walls which are also depicted in the painting (fig 3.1.1.4). Considering the locations of the gates and mountains, it can be concluded that Jeong observed the town from outside of it to its east, the bottom of the painting. The old castle has since been partially demolished and Cheongha Elementary school has been built within the remaining walls (figs. 3.1.1.5 and 3.1.1.6). The types of stones used for the walls indicate that they came from the Joseon dynasty. The street that

[55] Mai-Mai Sze, *The Mustard Seed Garden Manual of Painting, Chieh Tzū Yüan Hua chuan, 1679-1701*, N.J: Princeton University Press, 1978, pp. 93.

Fig. 3.1.1.5. East wall of the former Cheongha Castle. [Photographed by the author in 2018]

Fig. 3.1.1.6. South wall of the former Cheongha Castle. [Photographed by the author in 2018]

leads up to the school's main gate appears to have been constructed after the 1970s and lies in the middle of the castle.

3.1.2. Empirical Observations

The main question that this chapter sought to answer was whether Jeong created the *Painting of Cheongha of Cheong Castle and Town* based on a real place. If he did, finding the vantage point from which he painted is a prerequisite to defining the characteristics of the true-view style. Like most of his contemporaries, Jeong also used an oblique projection

Fig. 3.1.2.1. The view of the town at Mt. Yongsan. [Photographed by the author in 2019]

technique in which the size of an object was not influenced by its distance from the observer for the main subject, causing to be viewed from a particular perspective. He also used a bird's-eye view technique. To properly use these techniques, Jeong would have had to find high points, such as mountaintops, to get an all-encompassing view of his subjects. In the case of this painting, the town has since grown and become surrounded by two- and three-story residential buildings, so it is impossible for a modern viewer to have the same perspective of the castle as Jeong did. There are several hills from which the entire village can be seen two miles east of the town. Mt. Yongsan is tall enough that the whole area can be seen but is too far away to see the details of the town's buildings (fig. 3.1.2.1). The researcher visited several points, but none was suitable (figs. 3.1.2.2 and 3.1.2.3). Several field visits confirmed that the subjects of the painting were drawn based on observations made at different points. The mountains in the background were almost certainly observed from the middle of the rice field a mile to west of the castle. The shapes of mountains in the painting and the photograph taken in the rice field are similar (fig. 3.1.2.4).

Fig. 3.1.2.2. The town as viewed from two miles to the east (left) and south (right). [Photographed by the author in 2018]

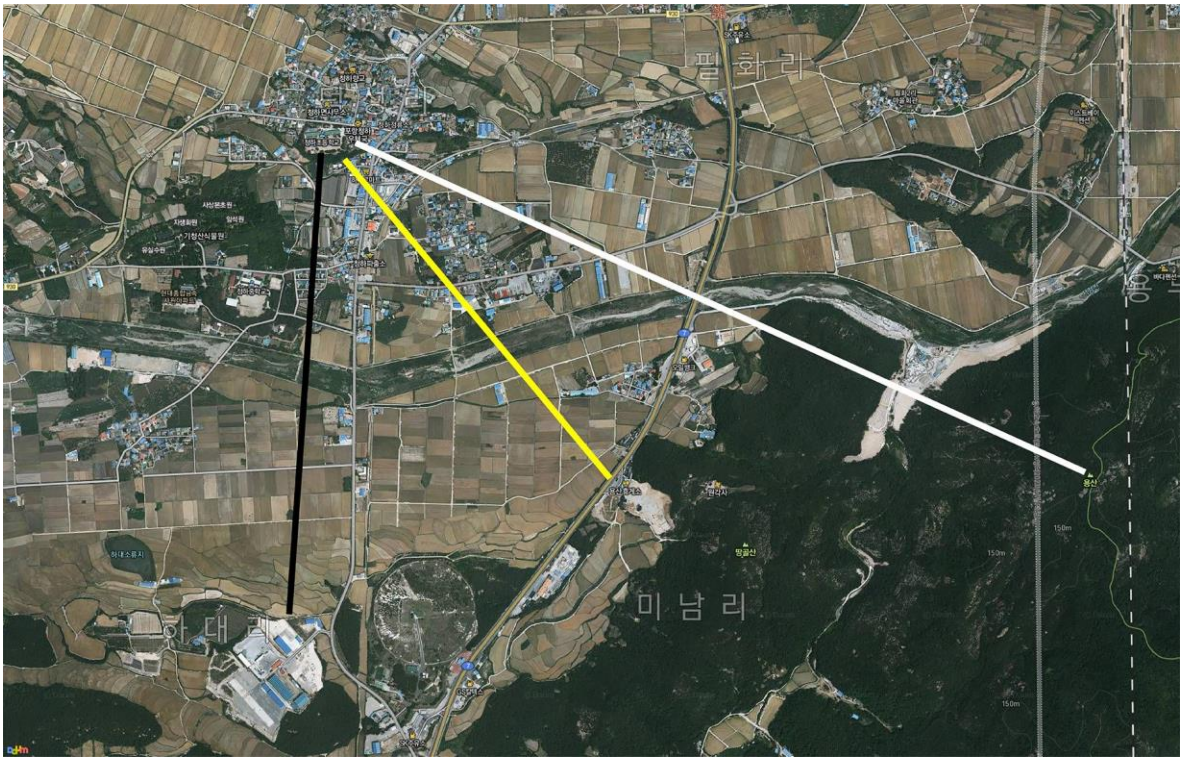

Fig. 3.1.2.3. The location and sightlines of the preceding pictures (black - fig. 3.1.2.2 (right), yellow - fig. 3.1.2.2 (left), white - fig. 3.1.2.1).[56]

[56] Source: kakaomap (https://map.kakao.com)

Fig. 3.1.2.4. View from the rice field a mile west from Cheongha Castle. [Photographed by the author in 2019][57]

[57] This spot is the vantage point for the background of the painting. Photographed using AF-S NIKKOR 35mm f/1.8G ED, 63° lens.

3.1.3. The Tripartite Division of Painting

It is necessary to know how Jeong constructed his subjects to determine where he made his observations. The painting consists of three depths of field. The background, which takes up nearly half of the painting, depicts the mountains from afar. The middle-ground depicts the village and the castle at the center of the painting. The foreground depicts the pine-tree woods at the bottom of the painting. This three-layered composition is typical of traditional landscape painting in China and Korea which originated during the Northern Song dynasty. Guo Xi (郭熙, 곽희) (1020–1090) was a famous court painter who formalized the theory of landscape painting. In *The Lofty Message of Forests and Streams* (Linquan Gaozhi, 林泉高致, 임천고시), Guo defined the three distances in landscape paintings:

> A mountain has three dimensions: looking up to the top from below gives the height called high distance, looking toward the back from the front gives the deep distance; and looking across at a mountain from an opposite height gives the horizontal level distance.[58]

Kevin Hsieh held that three distances are different from the concept of multiple perspectives because they use different techniques to present subjects.[59] The multiple perspectives technique depicts subjects from multiple viewpoints independently, while Guo's three distances technique forced viewers to view the subject in different ways from

[58] Guo, Xi, and Shiho Sakanishi. *An Essay on Landscape Painting (Lin Chüan Kau Chih)*. London: John Murray, 1959. pp. 46.
[59] Hsieh, Kevin. "Contextual Perspectives and the Aesthetics of Guo-Xi's "The Lofty of Ambition of Forests and Streams"." *Journal of the Pingtung University of Education. Humanities and Social Sciences*, Vol.33 (2009): 54

the same viewpoint. But both methods allow viewers being are not limited to appreciating the subject from a single spot. Jeong's approach is also close to Kevin's assertion.

Joseon landscape painters did not frequently use a single perspective which is why Black and Dege were unable to find a single definitive vantage point in their research. *Painting of Cheongha Castle and Town* is the product of four or more perspectives painted using the three depths of field, resulting in ridiculous relative proportions (fig. 3.1.3.1). Jeong painted pine trees in the left-top corner in the background in a relatively significant level of detail, indicating that they were worth viewer attention. However, the vantage point from which all the peaks could be viewed as depicted in the painting would have rendered

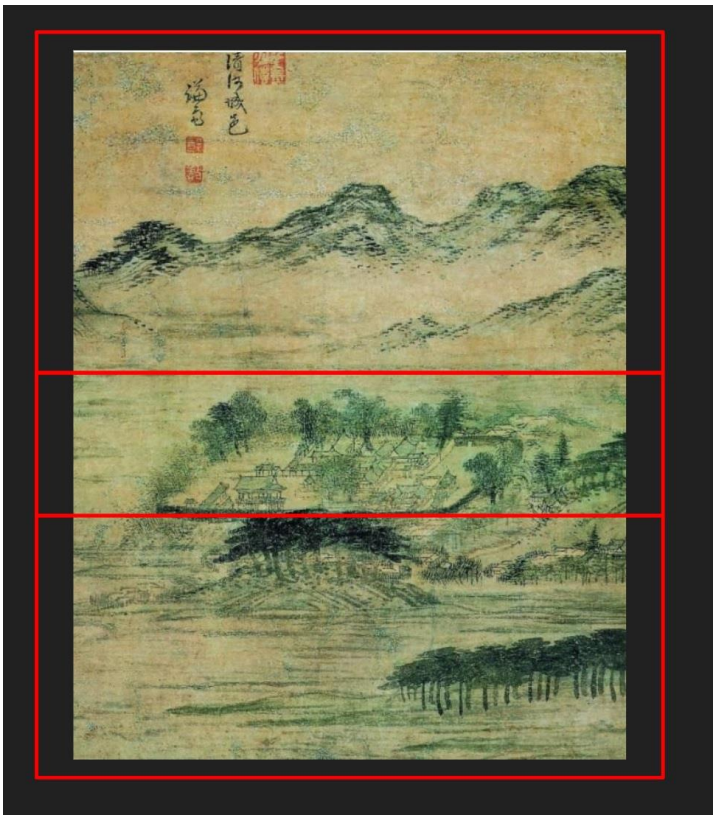

Fig. 3.1.3.1. Tripartite Division of *Painting of Cheongha Castle and Town*.

the pine tree nearly indistinguishable (fig. 3.1.2.4). Additionally, he moved Mt. Woojok (fig. 3.1.4.3 (no.4)) slightly downwards in the right corner to create a sense of depth. The distances depicted in the painting suggest that multiple perspectives would be necessary to properly reconstruct it. The reconstruction of *Painting of Cheongha Castle and Town* (fig. 3.1.4.2 (right)) is the result of observation from a single perspective in the virtual space.

The peaks in fig. 3.1.4.3 (right) is painted as if it were observed from the castle's east wall. The ridges of the mountains around the castle are blurry (fig. 3.1.3.2). However, the similarities between the mountains in the painting and the virtual terrain-based models indicate that Jeong directly observed and depicted his subjects. Lee Taeho found that

Fig. 3.1.3.2. The view from Cheongha Elementary School. [Photographed by the author in 2019]

Jeong's paintings were 30 to 50% similar to their subjects, but there are currently no objective similarity evaluation metrics.[60] This study presents a computer graphics-based method for evaluating the similarity of a painting to its subject and identified the peaks depicted in the painting.

3.1.4. Analyzing the Field of View of *Painting of Cheongha Castle and Town* in a Virtual Environment

Creating a three-dimensional topographic model of Cheongha requires accurate geospatial data. The Shuttle Radar Topography Mission provides[61] high-resolution topographic data through the *OpenTopography Project*.[62] The resolution of this data is 30 m[63] per pixel and is provided in the form of an Arc American Standard Code for Information Interchange grid.[64] For example, ArcGIS is topographic data is an array of numbers and so needs to be converted into a three-dimensional object. Digital Terrain Mesh developed by Florian Frank was used for the transformation[65] in Grasshopper.[66] When data is imported to Rhinoceros,

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60 Lee, Taeho. "Painting from Actual Sceneries or from Memory–with Focus Onview Point and Angle of View in True-view Landscape Paintings of the Late Joseon Dynasty." *Korean Journal of Art History* No.257, Art History Association of Korea, (2008): 148.

61 SRTM is a higher-resolution geospatial data collection project conducted by NASA in 2000, which has been released worldwide since 2015.

62 "About." OpenTopography. Accessed May 24, 2019. http://www.opentopography.org/about.

63 "U.S. Releases Enhanced Shuttle Land Elevation Data." NASA. September 23, 2014. Accessed May 24, 2019. https://www.jpl.nasa.gov/news/news.php?release=2014-321.

64 Developed by Environmental Systems Research Institute (ESRI).

65 Blickfeld7. "DigitalTerrainMesh V0.5." DTM. Accessed April 28, 2019. http://blickfeld7.com/architecture/rhino/grasshopper/DTM/.

66 Grasshopper - Algorithmic Modeling for Rhino. (http://www.grasshopper3d.com/), Rhinoceros - three-dimensional modeling program. (https://www.rhino3d.com/)

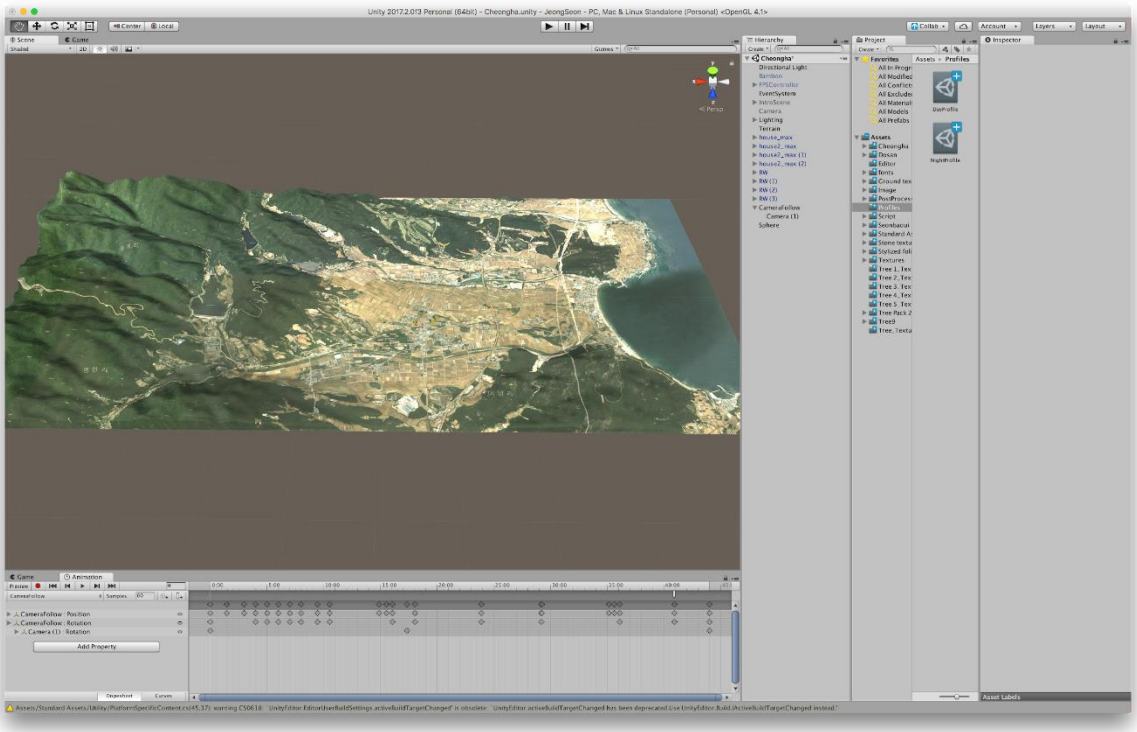


Fig. 3.1.4.1. A satellite image overlaid on a topographic model of Cheongha in Unity3D (scaled up four times on the y-axis).

the terrain is only shapes. An image[67] provided by Kakao Map[68] was applied to the surface of the terrain mesh to properly align the generated terrain. The geospatial model was then exported to the experimental environment (fig. 3.1.4.1).[69]

Painting of Cheongha Castle and Town depicts a castle, government office buildings, two gate posts, annexes, and residential buildings. Jeong used horizontal lines between the foreground and background and did not depict rice paddies around the town to draw attention to the mountains. The density of the horizontal lines is higher in the background to

67 Resolution is 50 cm per pixel.
68 Korea map service. https://map.kakao.com/
69 Unity 3D real-time game engine. https://unity.com/

generate a sense of distant. Jeong frequently used this technique which was not seen in Korean landscape paintings before him which serves as evidence that Jeong learned his approach from the Western landscape paintings.[70]

The rendering of the virtual environment was created by placing the camera in the spot though to have corresponded to Jeong's the vantage point (fig. 3.1.4.2 (right)). The most important factor in choosing the vantage point was the similarity of the mountains' peaks and ridges. Jeong faithfully depicted the mountains which enabled the identification of five peaks in the painting. Mt. Satkatbong (삿갓봉, 2355 feet) is on the right side of the scene, Mt. Jangoojae (장구재, 1929 feet) is in the center of the ridgeline, and Mt. Woojok

Fig. 3.1.4.2. *Painting of Cheongha Castle and Town* and rendered scene of virtual Cheongha town.

[70] Park, Eunsoon. "Jeong Seon's True-view Landscape Painting and the Western Influences," *Korean Journal of Art History*, No.281 (2014): 71.

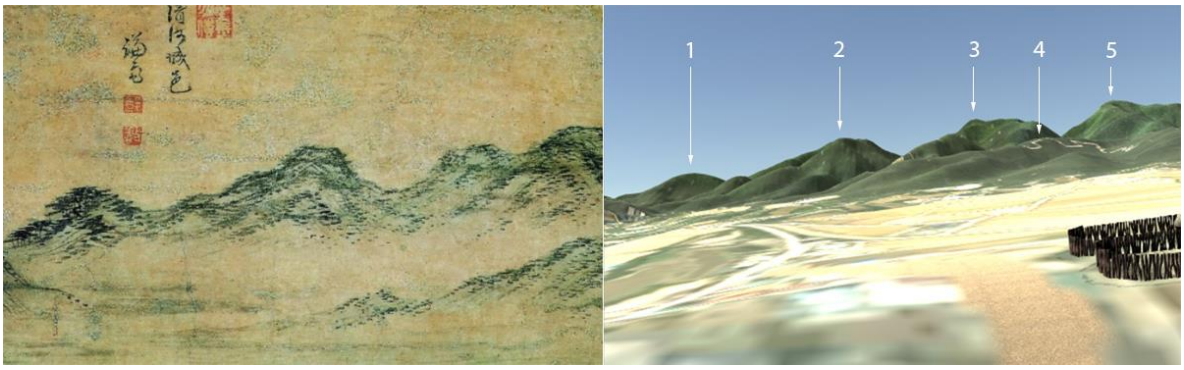


Fig. 3.1.4.3. The high distant view of *Painting of Cheongha Castle and Town* and rendered scene of mountains in virtual Cheongha town.[71]

(우족산, 767 feet)[72] is towards the bottom. The virtual camera was placed on the east wall of the castle (fig. 3.1.4.3).

The virtual camera was located approximately 300 ft above the ground and 1,500 ft from the east wall (fig. 3.1.4.4). It is now possible to produce such an image with a camera attached to a drone, but this was infeasible at Jeong's time. It would have been unattainable for Jeong to describe the buildings inside of the castle, so the main subjects and pine tree

[71] 1. Mt. Bihak (비학산, North Gyeongsang province, Pohang city, Buk-gu, Singwangmyeon, Sangeuplee, San 26-1 경상북도 포항시 북구 신광면 상읍리 산 26-1, Latitude: 36°15'25.38"N, Longitude:129°22'78.75"E)
2. Mt. Jangoojae (장구재, North Gyeongsang province, Pohang city, Buk-gu, Cheonghamyeon, Myeonganlee, San 201 - 경상북도 포항시 북구 청하면 명안리 산 201, Latitude: 36°11'48.26"N, Longitude:129°15'49.15"E)
3. Unknown mount (North Gyeongsang province, Pohang city, Buk-gu, Cheonghamyeon, Yougyegil 111-160 - 경상북도 포항시 북구 청하면 유계길 111-160, Latitude: 36°12'22.01"N, Longitude:129°16'20.83"E)
4. Mt. Woojok (우족산, North Gyeongsang province, Pohang city, Buk-gu, Cheonghamyeon Yougyelee, San 4 - 경상북도 포항시 북구 청하면 유계리 산 4, Latitude: 36°12'15.49"N, Longitude:129°18'32.22"E)
5. Mt. Satkatbong (삿갓봉, North Gyeongsang province, Pohang city, Buk-gu, Songramyeon, Joongsanlee, San 111 - 경상북도 포항시 북구송라면 중산리 산 111, Latitude: 36°12'58.76"N, Longitude:129°15'45.86"E) Latitude, Longitude from Google Earth.

[72] "영일만포항." 포항시 문화관광 (Origin of the name of places in Pohang City). Accessed May 25, 2019. http://phtour.pohang.go.kr/phtour/yeongil_bay/general_information/nomination_north/cheongha/.

woods depicted in this painting were not produced by observation but rather were drawn separately and later combined in the same painting. In the virtual space, the pine trees in the foreground must be enlarged to maintain a similar scale to with respect to the castle as shown in the painting.

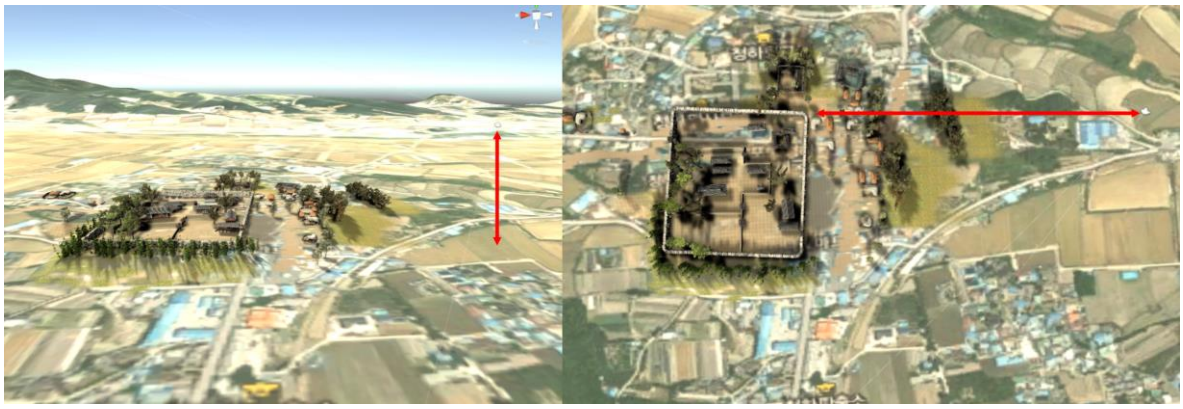


Fig. 3.1.4.4. Camera location for the rendered scene of virtual Cheongha town.

3.1.5. Multi-camera Image Capture Interface for Determining Image Similarity

Jeong observed the Cheongha castle and mountains from different places. He put them together in a single painting instead of trying to paint them as they appeared from a single location. He separated the painting into the foreground, the mid-ground, and the background. The most important subject of the painting, the castle was likely painted from the east given the arrangement of the gates and walls in the painting. The shape of the castle from the sky is close to a square, its walls are parallel to longitude and latitude lines

respectively.[73] This indicates that Jeong had a sense of the cardinal directions and thought that the view from the east would best portray the village. The buildings and walls are arranged parallel to the Taebaek Mountains, the central mountain range that runs along the Korean Peninsula. Jeong used an oblique projection by placing the east wall horizontally and making the sizes of the other walls the same as the east wall regardless of their distance from the viewer. The only two-story building in the castle, the Moonlight over the Sea Watch Tower, was drawn as though it was viewed from the ground. The pine trees in the foreground are the most suitable place to observe these features. There were many difficulties in comparing the painting to its subject given that it was painted from multiple perspectives. The only way to feasibly measure how accurately the true-view technique represents its subjects is to measure how similar the mountains in the painting are to their subjects (figs 3.1.5.1 and 3.1.5.2). Peak Finder AR application[74] and Roman Fedorov[75] had similar problem of identify mountain peaks. Their approaches were extract contour lines from mountains then compared the lines to the data base. This method resolved problems of similarity processing in case of online application by discarding comparison of pixel value of the images of mountains which occurs difficulties.

[73] Slightly tuning clockwise about 8.6 degrees.

[74] PeakFinder – mobile application shows the names of mountains and peaks. www.peakfinder.org.

[75] Fedorov, Roman. *Mountain Peak Detection in Online Social Media*. Master's thesis. Politecnico di Milano, 2012.

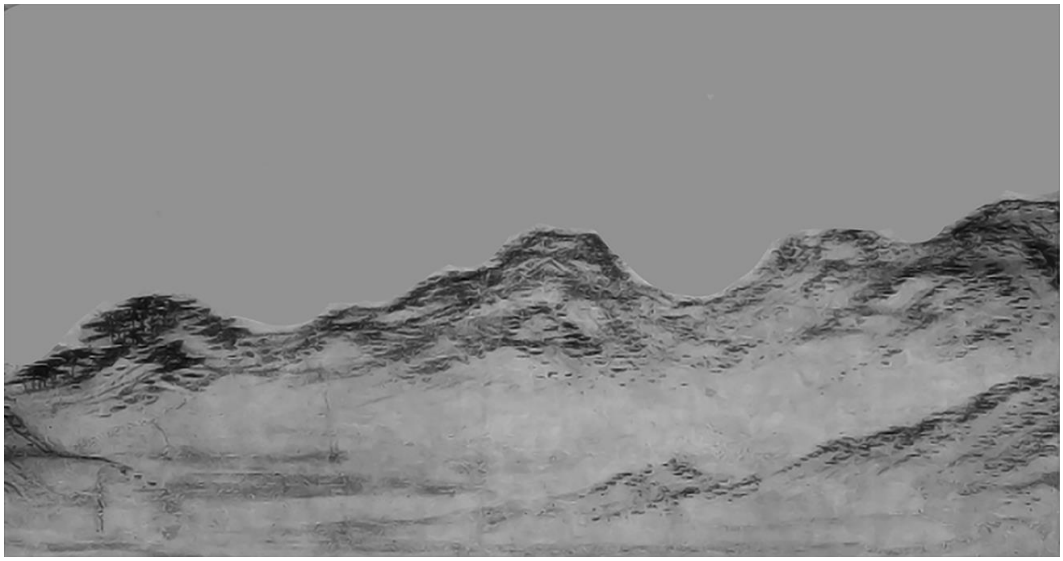


Fig. 3.1.5.1. Grayscale image of the high distance perspective view of *Painting of Cheongha Castle and Town*.

Fig. 3.1.5.2. Grayscale image of the virtual rendering of the mountains near the west wall.

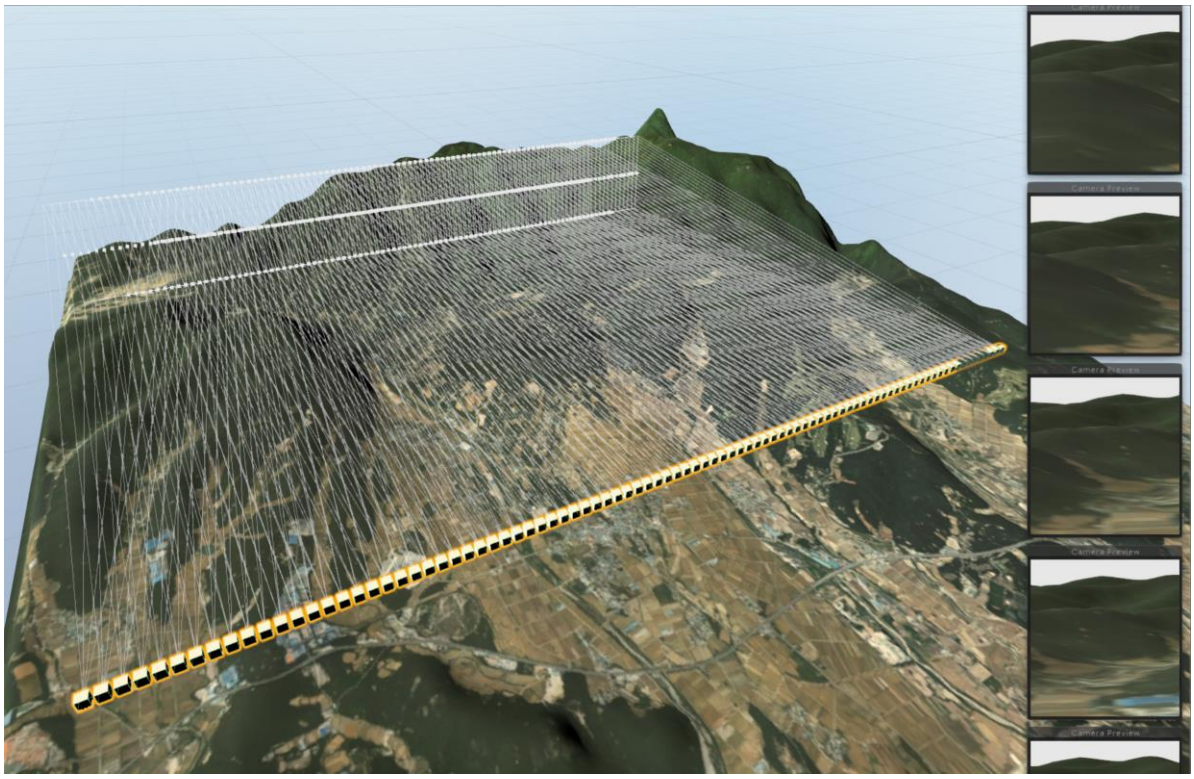


Fig. 3.1.5.3. Mountain image capture system.

The height of terrain in the virtual environment had to be scaled up four times to avoid the shape of the mountains being almost unrecognizably flat. The arrangement of the four peaks and the composition of the low hills in the mid-ground on both sides of the painting roughly indicate the point from which they were painted. Two low hills were visible on each side of view from the vantage point where the background was painted (fig.3.1.2.4). A system for precisely generating the images of mountains was designed to determine where this spot was. A virtual camera was installed to take pictures of the mountains seen from the area of the town in order to determine the assumed point of

observation more accurately. The virtual camera, which had a 15° view angle, moves by 142 yards respectively from 1.24 miles north from the castle to the same distance to the south. It photographed the mountains in such a way that there no more than three peaks per frame resulting in nearly ⅔ of the frames overlapping (fig. 3.1.5.3). Each image was changed to grayscale for a faster analysis (fig. 3.1.5.4).

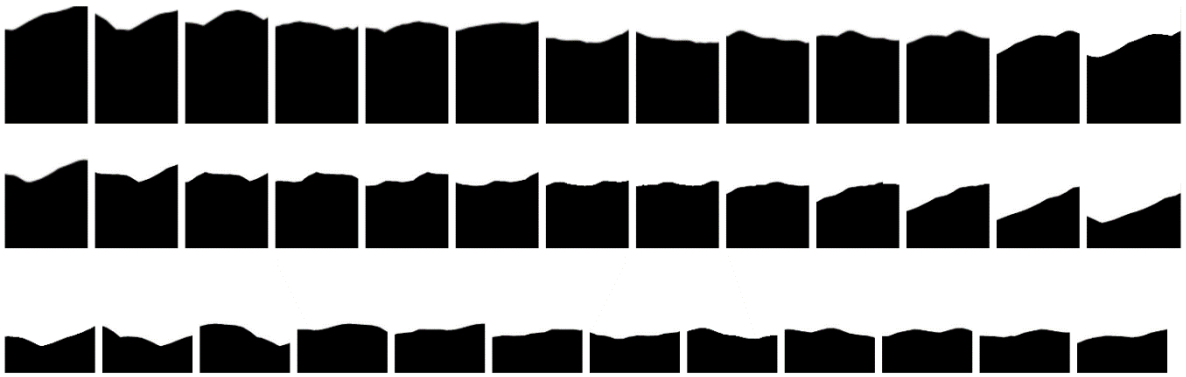


Fig. 3.1.5.4. Simplified images of virtual mountains.

A total of 38 images were generated which were compared with the painting. Cross-correlation analysis was used to measure the similarity between the image and its corresponding portion of the painting.[76] The integrated system extracted contours of the mountain ridges which were treated as sound waveforms. Each waveform was moved along the x-axis while the other wave form the painting was fixed. The y-coordinate of the

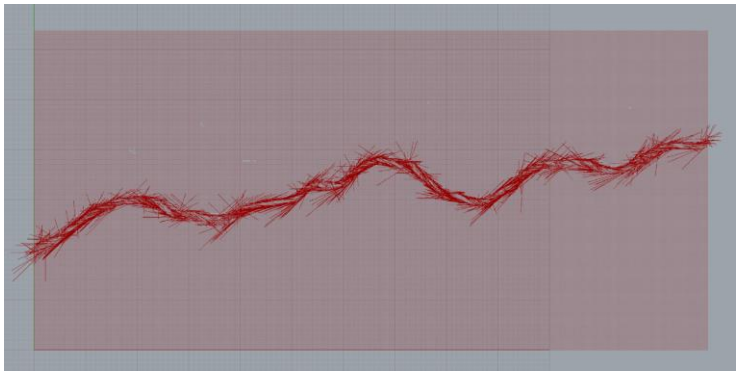
[76] Paul Bourke. *Cross-Correlation - Autocorrelation and 2D pattern Identification*, "Paul Bourke - Personal Pages." Paul Bourke - Personal Pages. Accessed April 22, 2019. http://www.paulbourke.net/.

simplified images was multiplied by the y-coordinate in the painting. The detailed procedure was as follows:

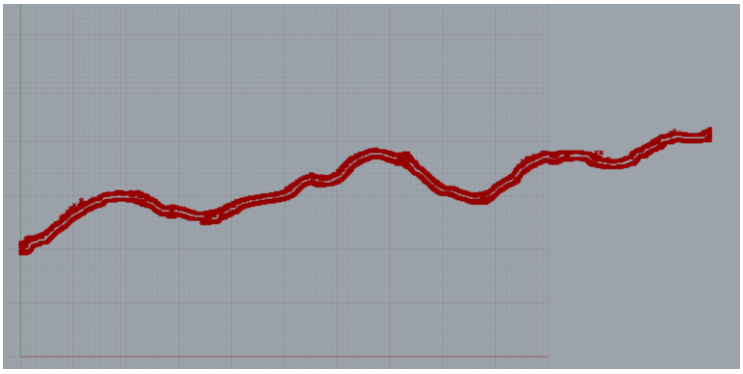
1. An outline of the painting was extracted using Adobe Photoshop using the following series of commands:

(Quick Selection Tool - Create New Layer - Copy - Paste Selected Object - Blending Option - Stroke)

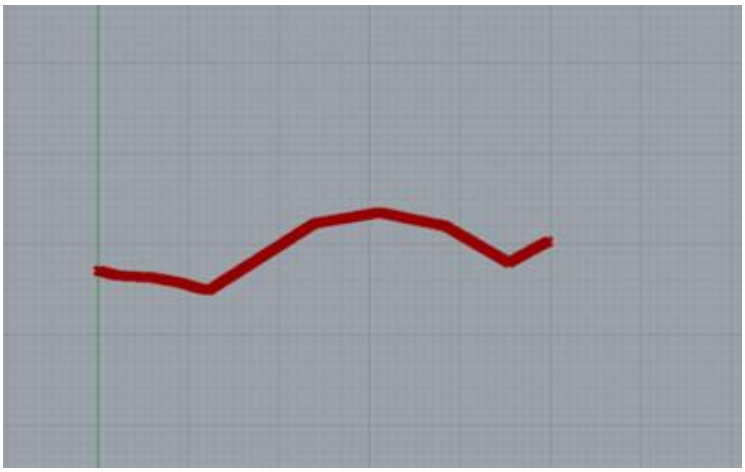
2. The vector lines which constituted the waveform were extracted from the painting using the Grasshopper contour vector function.



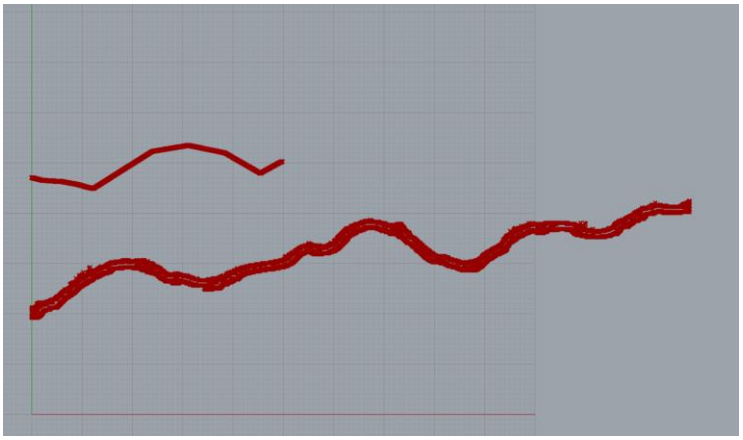
3. The endpoints of the vector lines were extracted.



4. The points from the photographs in fig. 3.1.5.4 were extracted based on the vector lines through the same process above, generating the target image.

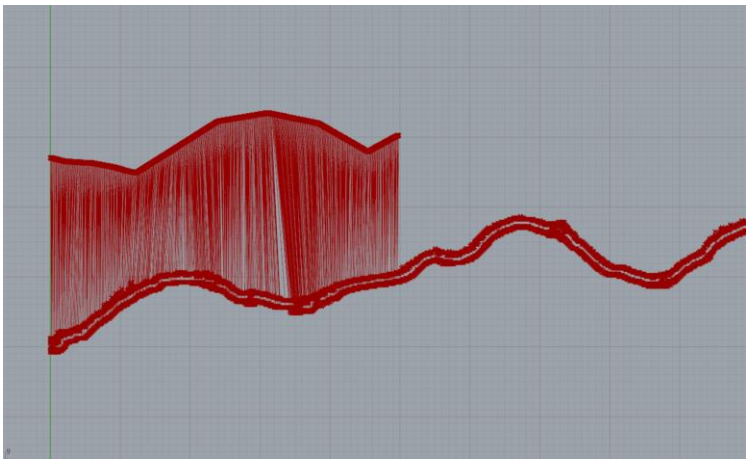


5. Both groups of vector points were plotted on the xy-coordinate plane. The initial points of both graphs were aligned with the y-axis.



6. The target image was moved along the x-axis. The original image, known as the test image contained 2,888 vector points and the target image had 966. The Rhino program showed that the vector points from the test image had a domain of 0 to 86 such that the target image was able to take 86 steps. At each step, each vector point in both groups is matched sequentially and their y-values are multiplied. The products are added together, yielding a cross-correlation efficiency value for each step.

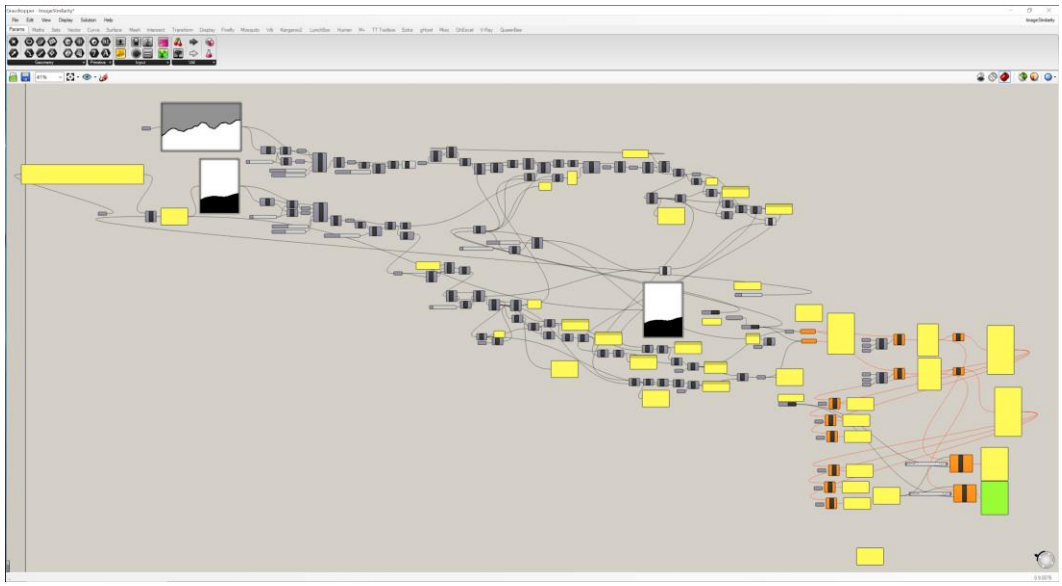
7. A cross-correlation analysis program was created based on the sample code developed by Paul Bourke.[77] The figure below shows which points were matched.



8. The step which has the highest cross-correlation coefficient value indicates that at that step, the test and target images are the most similar. However, the mountains become smaller from north to south causing their y-values to decrease. Therefore, by simply applying Bourke's formula, the test and target images of the northern mountains will appear to match better than those of the southern mountains, regardless of the similarity of their shapes. Thus, in the revised formula, the average distance of each point was subtracted from the raw value to remove the influence of the changing heights.

[77] *Ibid.*

9. The integrals of the product at each step were automatically stored in CVS format by the Grasshopper program. The image below shows the Grasshopper system flow.



10. The CVS files were converted to images through a data visualization program made with Processing. The color of the bar graph indicated the cross-correlation efficiency with a value between 0 and 255. The lower the value and closer to white the color was the higher the cross-correlation efficiency value. The highest values were clearly differentiated from the average values.

11. The data for the mountains from south to north was visually arranged fig. 3.1.5.4. Similar sequential data points during horizontal movement indicate matching peak sections. Pictures number 3, 8, 17, 23, and 33 had high values at the beginning but only pictures 17–27 showed consecutive high-efficiency values.

Identical ⟷ Dissimilar

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

The similar ridgelines begin from here. (Bold)

16

17

18

19

20

21

22

23

24

25

26

27

Period ends.

28

29

30

31

32

33

34

35

36

37

38

These images are the result after applying the compensation value.

1-1

2-1

3-1

4-1

5-1

6-1

7-1

8-1

9-1

10-1

11-1

12-1

13-1

14-1

15-1

16-1

The similar ridgelines begin from here. (Bold)

17-1

18-1

19-1

20-1

21-1

22-1

23-1

24-1

25-1

26-1

27-1

Period ends.

28-1

29-1

30-1

31-1

32-1

33-1

34-1

35-1

36-1

37-1

38-1

Pictures 17–27 and 17-1–27-1 cover approximately 2.4 miles of mountain ridgeline (fig. 3.1.5.5). Four of the peaks above 2,300 ft in this area were identified as the mountains depicted in the painting. The range is 3.3 miles away from the vantage point (fig. 3.1.5.5 (blue square)), which is close enough to distinguish the shape of the peaks. This experiment produced scientific evidence that Jeong's background of *Painting of Cheongha Castle and Town* was based on the real place. However, for the middle ground, several buildings inside the castle and small villages outside have not survived to the present, so it is difficult to say whether the features of Cheongha castle and town depicted based on the real place.

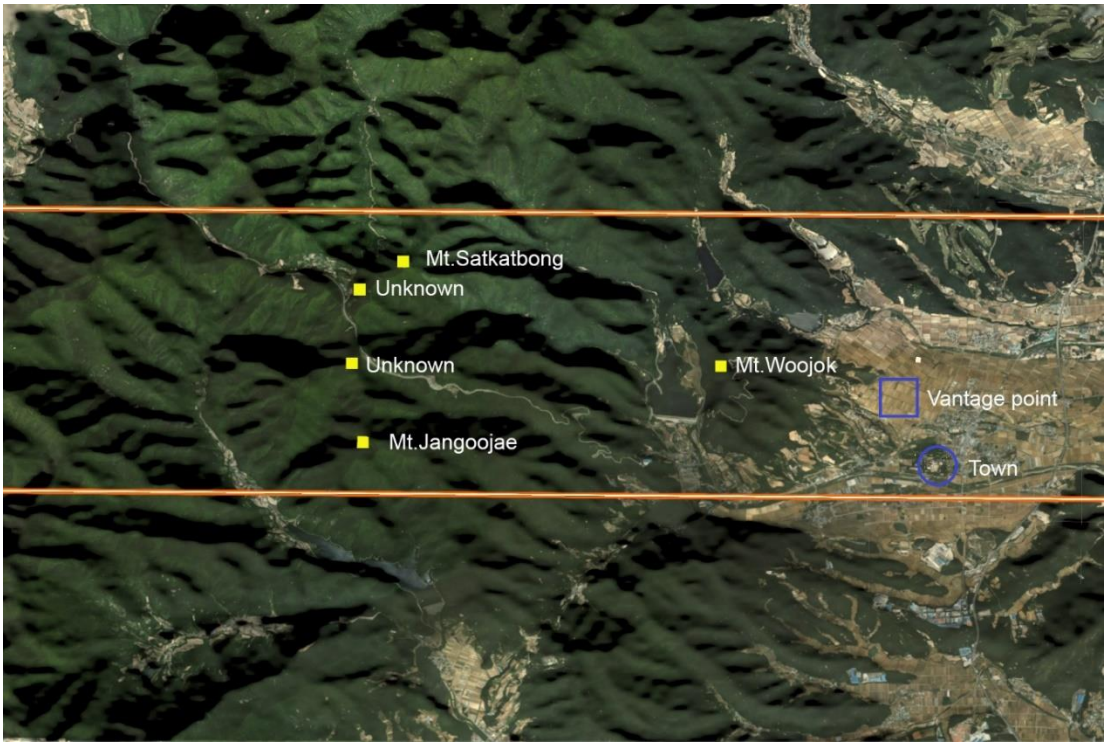


Fig 3.1.5.5. The orange lines indicate the area covered by pictures 17–27. The main peaks in the painting are represented by the yellow squares and the blues square indicates the likely area from which they were painted.[78]

[78] Texture mapping image Source: kakaomap (https://map.kakao.com)

Fortunately, the Cheongha Confucian school 65 yards the north from the castle has been well maintained and so become a reference material for buildings in the production of the virtual reality program.

Thus, this research concluded Jeong's vantage points of Paintings *Painting of Cheongha Castle and Town* like below:

- Background – Based on the actual observation at the rice paddies.
- Middle ground – Depicted based on the close observation but used oblique projection and a bird's eye perspective
- Foreground – Not quite sure, it is scaled up for the harmonious composition.

3.2. *Painting of Dosan Confucian Academy*

3.2.1. Dosan Confucian Academy and its Presence in Literature

Yi Hwang (李滉, 이황) (1502–1571) is a pioneer of Confucianism whose academic achievement had a great influence on the societies of both the Joseon and Edo periods (1603–1868). Yi passed the civil service literary examination and had to leave his hometown with his family in 1534. The power struggle between political parties promoted and purged him several times during his service. He had to travel frequently between the capital (Hanseong, 漢城, 한성) and his hometown Andong (安東, 안동) for twenty-five years. He felt tired of his unstable and insecure life in the capital. Thus, Yi searched for a good place

to reside near his hometown after his retirement. The first place, Gyesang Private Village School (gyesangseodang, 溪上書堂, 계상서당), was too small for his research interests, so he decided to move to a hillside near Nakdong River (nakdonggang, 洛東江, 낙동강) in 1557. This place became Dosan Confucian Academy (dosanseodang, 陶山書堂, 도산서당).[79] Yi was satisfied with the new place and taught students there until his death.

Painting of Cheongha Castle and Town has a clear motivation of production, Jeong Seon wanted to leave a record of the town where he ruled in the form of a map and painting,

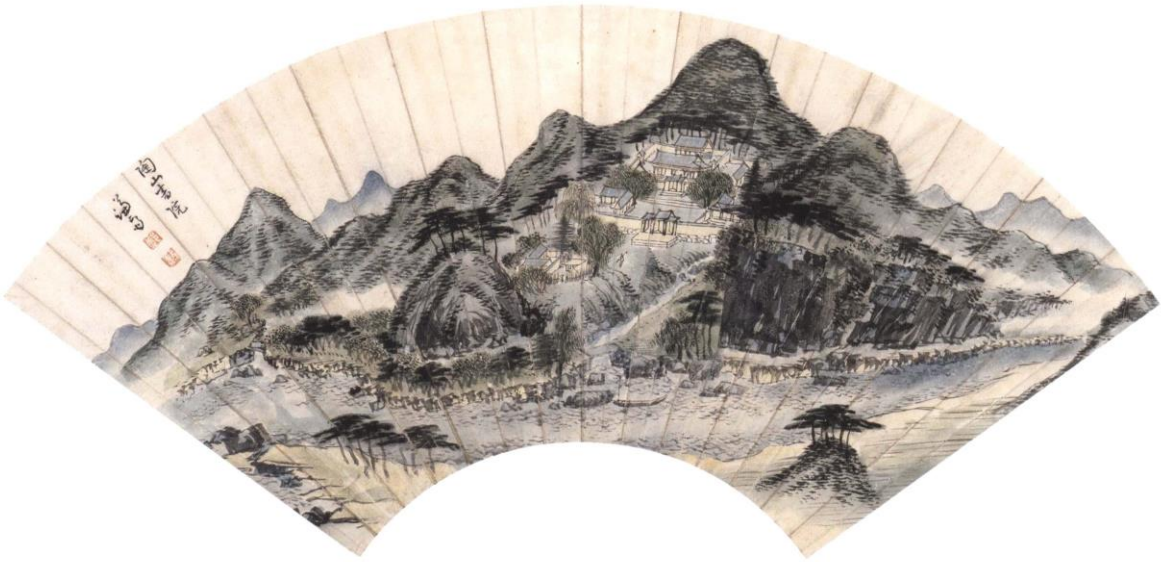


Fig. 3.2.1.1. Jeong Seon. *Painting of Dosan Confucian Academy*, 1734. Ink and light color on paper, 56.3 cm × 21.2 cm. Kansong Art and Culture Foundation, Seoul. [Courtesy of Kansong Art and Culture Foundation]

[79] Yi, Hwang (李滉, 이황). trans. Lee, Kwangho. *Toegyejip* (退溪集, 퇴계집). Seoul: Institute for the Translation of Korean Classics (韓國古典飜譯院, 한국고전번역원), 2017. p.135.

he also wanted to use it for reminiscence after he left. Unlike the painting, there exist different interpretations among the scholars of Korean art history and Confucianism as to the *Painting of Dosan Confucian Academy* (dosanseowondo, 陶山書院圖, 도산서원도) (fig. 3.2.1.1).[80] Currently, there are about ten *Painting of Dosan Confucian Academy* in existence, but most of them had a primary characteristic to succeed in the academic ideology of Yi.[81] Yoo Jaebin classified these paintings into two groups according to their purposes. The first group depicts the whole facility. Southerners (namin, Korean political faction, 南人, 남인) ordered this painting to satisfy their nostalgia for the scholarly background of Yi. The other group considered the facility as a scenic spot, so these paintings highlight a touching place and a remembrance of visiting.[82] Yoo also claimed that Jeong's painting belongs to the second group and is a copy of the original in *Album of Gyeongsang Province*.

Fortunately, there is a poetry book that explains the time when Jeong drew the painting. Cho Yousoo (趙裕壽, 조유수) (1663–1741), a politician and a poet, left a collection, *Hoogyejib* (后溪集, 후계집), that includes six books and 1,007 poems. One of them, *Comment on Jeong Seon's Album of Yeongnam* (ujejeonghwayeongnamchup, 又題鄭畫嶺南帖, 우제정화영남첩), tells the story of Jeong's painting:[83]

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80 Seodang is a private village school has normally one teacher, Seowon is a higher level of institution, there is a ritual shrine for the teacher and it is association of students.

81 Hwang, Intae, Chang, Alenda. "Reinterpreting Korean "True-View" Landscape Painting Using Graphics Analysis Techniques – The Case of Jeong Seon's Dosando." *International Symposium on Electronic Art 2019*, Gwangju (2019).

82 Yoo, Jaebin. "A Study of "Dosando (陶山圖)"." *Korean Journal of Art History*, vol. 250, Art History Association of Korea (2006): 193-194.

83 _____. "Representation of Dosan Confucian Academy in the 18th Century - Paintings of Dosan by Kang Sehwang and Jeong Seon." *The T'oegye Hakbo(The journal of T'oegye Studies)*, Vol.139, The Toegye Studies Institution (2016): 179.

白鹿人歸洞久空	The white deer is back, the valley was empty for a long time
松栢一徑趍靈宮	A spirit flies through the path with pine and thujas trees to the shrine
俎豆之傍一老屋	Utensils used in ancestral rites and bowl for Sanjeok[84]are in the old room
先生几杖琴瑟儼在中	Yi Hwang's staff and harp are in front of them
茅齋僅勝有巢氏	The room is a little better than Uso's[85]
草庭曾行無極翁	The creator seems to be the grass in front of the room
最是朱書點窴痕	There is a mark on the book of Zhou Dunyi
馬肝之硯留墨紅	Red ink remains on Maganseok[86]
河陽花令向過此	Haiyang magistrate arrives here[87]
敬式元與武夷同	His courtesy of Yi Hwang's place compares to Wuyi Mountains[88]
行軒應載畫筆來	He carries brushes on his cart.
盡移山院如愚公	They reach the extreme as the foolish old man removes the mountains[89]
右陶山書院	Dosan Seowon is on the left

This poem suggests that Jeong painted the landscape of the academy on-scene after visiting the place. He also produced another painting of it, *Painting of Gyesang Private Village School* (*gyesangjeonggeodo*, 溪上靜居圖, 계상정거도). One of the sleeves in the *Album with Handwriting of Great Scholar Yi Hwang and Song Siyeol* is now on the back of the Korean 1,000 Won banknotes. This painting also led to controversy about whether the

[84] Korean shish kebab.

[85] Uso is the Chinese legendary adult who learned building house, then taught the skill to the public.

[86] Maganseok means horse's liver stone. It is red color marble, one of the best materials for inkstone. Andong is only place producing this stone in Korea.

[87] The magistrate in here is Jeong Seon.

[88] A mountain in Fujian province, China, listed as a UNESCO World Heritage Site. "The serene beauty of the dramatic gorges of the Nine Bend River, with its numerous temples and monasteries, many now in ruins, provided the setting for the development and spread of neo-Confucianism, which has been influential in the cultures of East Asia since the 11th century." - Advisory Body Evaluation of Mount Wuyi. United Nations Educational, Scientific and Cultural Organization (UNESCO), 2017. pp.1.

[89] The old man indicates well-known Chinese mythology *The Foolish Old Man Removes the Mountains*.

building in the painting is the Dosan academy or the Gyesang school among Korean art historians. The reason why the two paintings caused a dispute related to their subjects is that they did not portray the canonical scenery of the subjects accurately. This research revealed that the exact observation point of the *Painting of Gyesang Private Village School*. It is 1.4 miles to the east from the facility, the confluence of Nakcheon and Toegye. Jeong introduced the feature of the Gyesang Private School, Dongchuibyeong (東翠屛, 동취병), Seochuibyeong (西翠屛, 서취병) of Dosan Academy to the scene. (fig. 3.2.1.2)

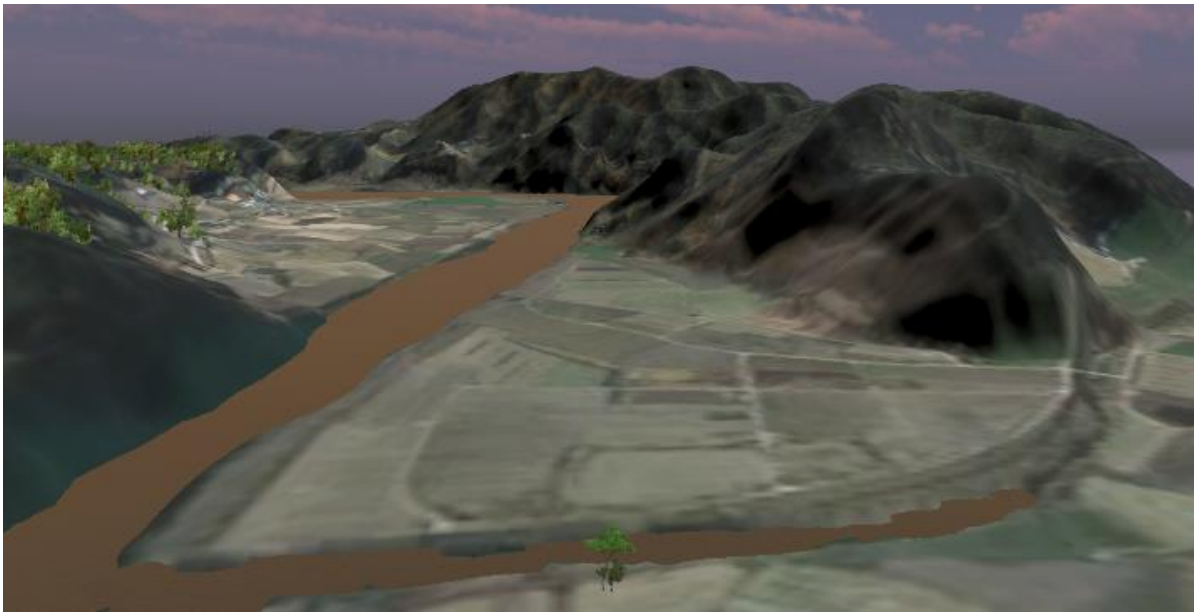

Fig. 3.2.1.2. Rendered scene at the vantage point of *Painting of Gyesang Private Village School*.

Kho Yeon-hee[90] pointed out that both paintings are related to the literary works of his friends whose purpose is to praise the natural scenery. The impression of the works of

[90] Kho, Yeon Hee, *A Study on Travelogue and Real Scenery Painting of the Late Joseon Period - Jung Son and Nong Yeon Group*. Seoul: Iljisa, 2001. pp205 ~265.

literature amplified the appreciation after the visit. As a result, he brought intentionally transformed shapes into the painting. Therefore, it is necessary to consider other elements, such as works of literature or a background philosophy in analyzing Jeong's painting.

3.2.2. Influence of *Anthology of Yi Hwang* on the Composition on the *Painting of Dosan Confucian Academy*

Yi described the detailed construction process of the Academy and his emotional changes in *Anthology of Yi Hwang* (toegyejib, 退溪集, 퇴계집), he also wrote about the exciting moment when he accidentally found the place in volume two:

尋改卜書堂地 得於陶山之南 有感而作 二首　　After finding a place for Dosan Seodang

風雨溪堂不庇牀	I was not able to cover my bed when it rains on Gyesang Seodang
卜遷求勝徧林岡	I explored hills and woods to find a better place
那知百歲藏修地	How didn't I know that the place is for my retirement and cultivation?
只在平生採釣傍	Is the place I usually went to gather firewood and to fish?
花笑向人情不淺	The flower smiling at me is not frivolous anymore
鳥鳴求友意偏長	The bird singing to find his friend is not showing
誓移三徑來棲息	I decided to move
樂處何人共襲芳	Who is going to feel the scent of the joyful reminiscence at the old place?[91]

Jeong created the beautiful scenery of the Confucian academy located along the

[91] Yi, Hwang (李滉, 이황), *Toegyejip* (退溪集, 퇴계집). trans. Lee Kwangho, Seoul: Institute for the Translation of Korean Classics, 2017. pp.135.

Nakdong River on the surface of a fan. He placed the group of buildings at the center of the painting and added surrounding mountains on its sides in decreasing scale. In the same book, Yi explained the conditions of Dosan Confucian Academy based on the idea of Feng Shui:

陶山記 Record of Dosan

靈芝之一支東出。而爲陶山。或曰。以其山之再成。而命之曰陶山也。或云。山中舊有陶竈。故名之以其實也

A branch of Mt. Youngji (youngjisan, 靈芝山, 영지산) went to the east and became Mt. Do (dosan, 陶山, 도산). But some said that "It earned its name because this mountain had risen twice," and other people said, "There had been a kiln in the mountain, so people call it Dosan."[92]

爲山不甚高大。宅曠而勢絶。占方位不偏。故其旁之峯巒溪壑。皆若拱揖環抱於此山然也。

This mountain is not particularly high or large, but its valley is wide, and the shape is auspicious. Its height rises without bias; thus, it seems that all surrounding mountain peaks and valleys take care of each other's hands and bow to Dosan.

山之在左曰東翠屛。在右曰西翠屛。東屛來自淸涼。至山之東。而列岫縹緲。西屛來自靈芝。至山之西。而聳峯巍峨。

The mountain on the left is called Dongchuibyeong (東翠屛, 동취병), and the one on the right is called Seochuibyeong (西翠屛, 서취병). Dongchuibyeong is a detachment of Mt. Cheongnyang (cheongnyangsan, 淸凉山, 청량산, 2,854ft) and came from the east to this mountain and opened it to the east, and Seochuibyeong came out from Mt. Youngji and came to the west of this mountain, and its peaks rose high.

兩屛相望。南行迤邐。盤旋八九里許。則東者西。西者東。而合勢於南野莽蒼之

[92] "tto" means again in Korean, "Do" and "tto" has similar pronunciation. The letter "陶" means pottery, then the mountain has named "陶山" pottery mountain.

外。

Dongchuibyeong and Seochuibyeong are facing each other, they run to the south for five miles, the east one is heading to the west, and vice versa. They joined at the wide field on the south.

To understand the composition of the painting, it is important to carefully read the *Anthology of Yi Hwang*. As Choi pointed out,[93] Jeong read this text several times before visiting the facility. He also claims that Jeong tried to deliver all the elements from the text into the painting. To put a lot of subjects in the fan, Jeong had to compress the scene horizontally. The actual distance between the two subjects at the left and right end of the painting; Mt. Youngji to the confluence of Toegye and Nakcheon is about 12,139 feet. However, the height of Mt. Do (dosan, 陶山, 도산) is 895 feet, thus if Jeong wanted to draw what he saw at the provincial vantage point, the painting's horizontal to vertical proportion should be 13.5:1.[94] Its size is 56.3 cm × 21.2 cm (22.1 in × 8.34 in), so the ratio is 2.6:1.[95] Interestingly, this composition counters a similar fan painting *Painting of Heinsa* which has a normal ratio. From this point of view, Jeong has changed his work method only for this painting with a specific intention to follow the precepts of Feng Shui and including every subject described in the Record of Dosan.

Figure 3.2.2.1 shows all the components described in the painting. Jeong drew Mt. Do (C - green line) at the center. Dosan Confucian Academy is located underneath it (red circle).

93 Choi. pp.284.
94 12139 ÷ 895.
95 Hwang, Intae, Chang, Alenda. "Reinterpreting Korean "True-View" Landscape Painting Using Graphics Analysis Techniques – The Case of Jeong Seon's Dosando." *International Symposium on Electronic Art 2019*, Gwangju (2019).

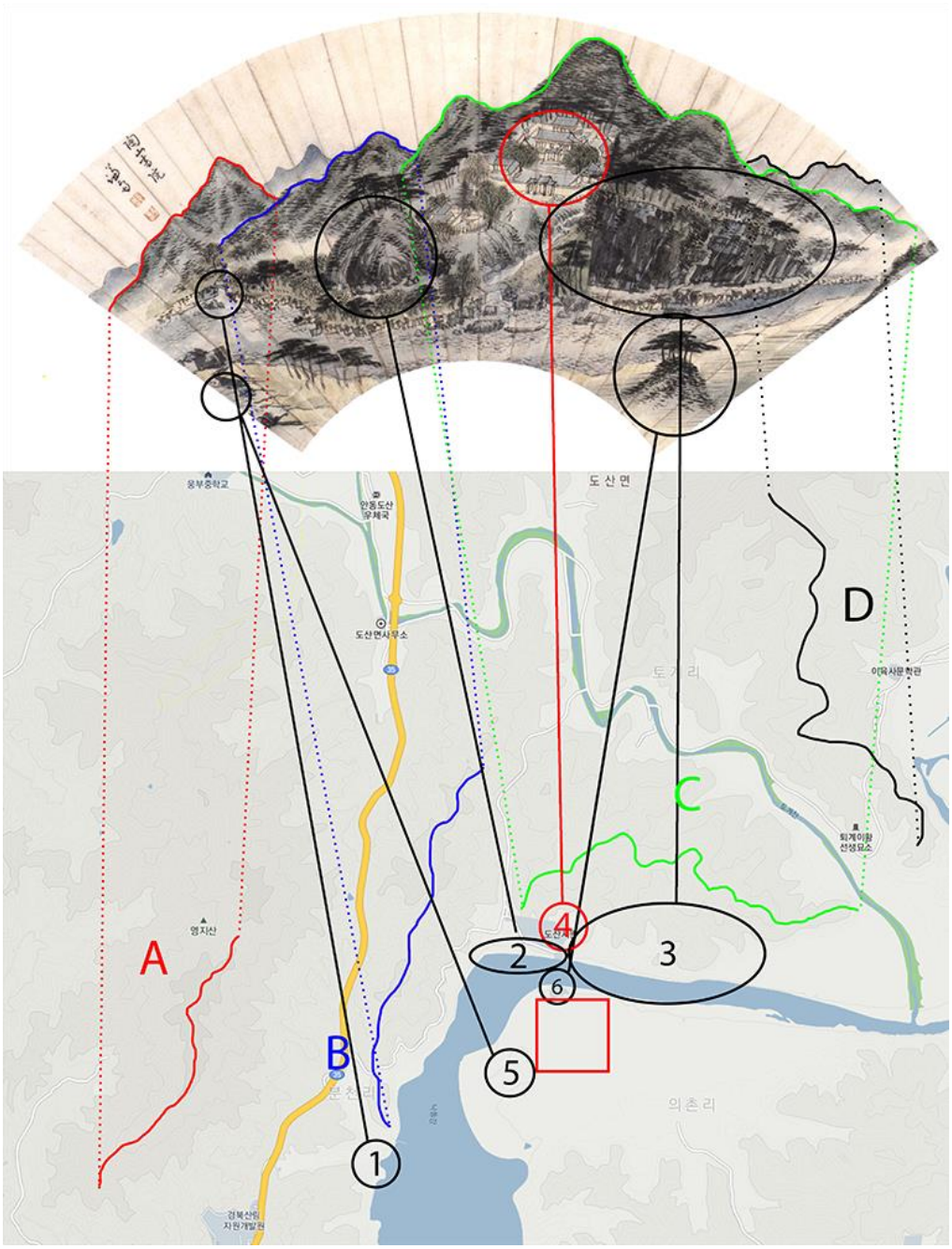

Fig. 3.2.2.1. Matching components on *Painting of Dosan Confucian Academy* and map.[96]

[96] Source: kakaomap (https://map.kakao.com)

On each side of Mt. Do are Seochuibyeong (B - blueline) and Dongchuibyeong (D – black line). However, at the provisional vantage point (red rectangle), Dongchuibyeong is obstructed by Mt. Do.

水在山後曰退溪。在山南曰洛川。溪循山北。而入洛川於山之東。川自東屛而西趨。至山之趾。則演漾泓渟。

The stream behind the mountain is called Toegye, and the one in the south of the mountain is called Nakcheon. Toegye runs from the north to the east, and Nakcheon (洛川, 낙천) comes from Dongchuibyeong when it flows near Mt. Do, it becomes deeper and wider.

沿泝數里間。深可行舟。金沙玉礫。淸瑩紺寒。卽所謂濯纓潭也。

A mile up, the water becomes deep enough to float a boat, gold-like sand, and jade-like pebbles shimmer, shiny and cold. This is the so-called Takyongdam (濯纓潭,탁영담).

Toegye, pen name of Yi, is a river winding behind Mt. Do. Nakcheon is the old name of the Nakdong River flows in front of Mt. Do. Takyongdam is a huge rock in the middle of the Nakdong River.

堂前出入處。掩以柴扉。曰幽貞門。門外小徑緣澗而下。至于洞口。兩麓相對。其東麓之脊。開巖築址。可作小亭。而力不及。只存其處。有似山門者。曰谷口巖。

I blocked the entrance to the house, made a private door and called it Yoo Jung-moon. The trail outside the door follows the stream, and when it reaches the east, both foothills face each other. I destroyed the rock on the eastern shore and wiped the ground, and I built a small pavilion, but because I was weak, I could not finish it, but I left the place. It is like a mount entrance, and its name is Goguuam (谷口巖, 곡구암).

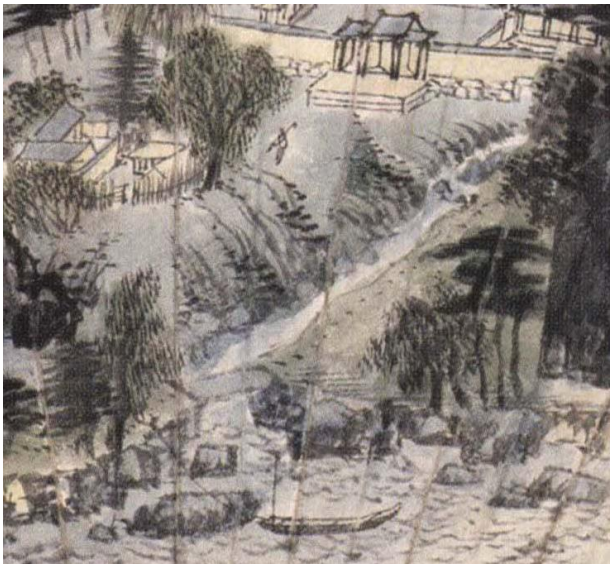

Fig. 3.2.2.2. Detailed close-up of fig. 3.2.1.1.

Fig. 3.2.2.3. Scene from across the Nakcheon (Nakdong River). [Photographed by the author in 2019]

Jeong also depicted the stream and the narrow trail located between the two rocks (fig. 3.2.2.1 (circles 2,3)). He kindly marked this trail as a dotted line (fig. 3.2.2.2) emphasizing that Yi had mentioned it in his writing. The Dosan Confucian Academy redevelopment project[97] carried out in 1970 raises the trail and yard in front of the facility due to the embankment work. The brook depicted in the painting (fig. 3.2.2.2) is now covered by ground. The scene was completely changed after the renovation (fig 3.2.2.4).

> 自此東轉數步。山麓斗斷。正控濯纓。潭上巨石削立。層累可十餘丈。築其上爲臺。松棚翳日。上天下水。羽鱗飛躍。左右翠屛。動影涵碧。江山之勝。一覽盡得。曰天淵臺。
>
> Take a few steps to the east, and you will see the foot of the mountain is cut off before you reach Takyongdam. There is a hundred feet-wide rock on each side of the entrance. I built a pagoda on one of them. Lush pine trees cover the sun. When I go there, I feel the water under the sky, the birds fly, the fishes swim, and the shadows of Dong and Seo Choibyeong mountains sway on the water. Because I can see these there, I named it Cheonyeondae (天淵臺, 천연대).

Cheonyeondae is a rock on the east side of the facility. In the painting, Jeong drew some people who are wearing a coat and traditional hat, this indicates that it was suitable as an observatory in his time.

> 西麓亦擬築臺。而名之曰天光雲影。其勝槩當不減於天淵也。
>
> Resembling the east, I also earthen the western shore and named it Cheonkwangunyoung

97 Bureau of Cultural Properties Protection, *Documentary of Maintenance Work of Dosan Confucian Academy*, Seoul: Ministry of Culture and Public Information, 1970.

(天光雲影, 천광운영), its spectacular scenery is on a part with Cheonyeondae

Fig. 3.2.2.4. Detailed close-up of fig. 3.2.1.1.

盤陀石在濯纓潭中。其狀盤陀。可以繫舟傳觴。每遇潦漲。則與齊俱入。至水落波淸。

Bantaseok (盤陀石, 반타석) is in the middle of Takyongdam. It is enough wide to moor a small boat and we pass the glass of alcohol around. When it faces a big flood, it submerges into the water and then the water dries, and the stone returns.

Construction of Andong Dam in 1971 submerged the towns near Mt. Do and the area twenty-five miles downstream. Only in the drought season does Bantaseok reveals its

appearance. The Andong Dam construction raised the water level of the Nakdong River, so the government had to build a bank along the river to protect the cultural assets.

King Jeongjo held a special civil service literary examination at the sand beach across the river in order to commemorate the accomplishments of Yi. Seesadan (試士壇, 시사단) (1796), a shrine building to memorize the event, did not existed when Jeong visited Mt. Do in 1734. He was able to see the only pine tree woods and brought them into the painting (fig. 3.2.2.7). Figure 3.2.2.5 is a photograph of Seesadan in the 1960s. Comparing it to the current view (fig. 3.2.2.6), the dam construction also changed the view of the other side of the river. The government decided to elevate the shrine 30 feet higher with granite stone. Unfortunately, the pine tree woods and Zelkova trees around the hill probably being the same age as Seesadan were removed.

Fig. 3.2.2.5. Bureau of Public Information, Publicity Department. *The Surrounding scenery of Dosan Seowon 2*, 1969. National Archives of Korea, Seoul. [Korea Open Government License]

Fig. 3.2.2.6. Seesadan in 2018. [Photographed by the author in 2018]

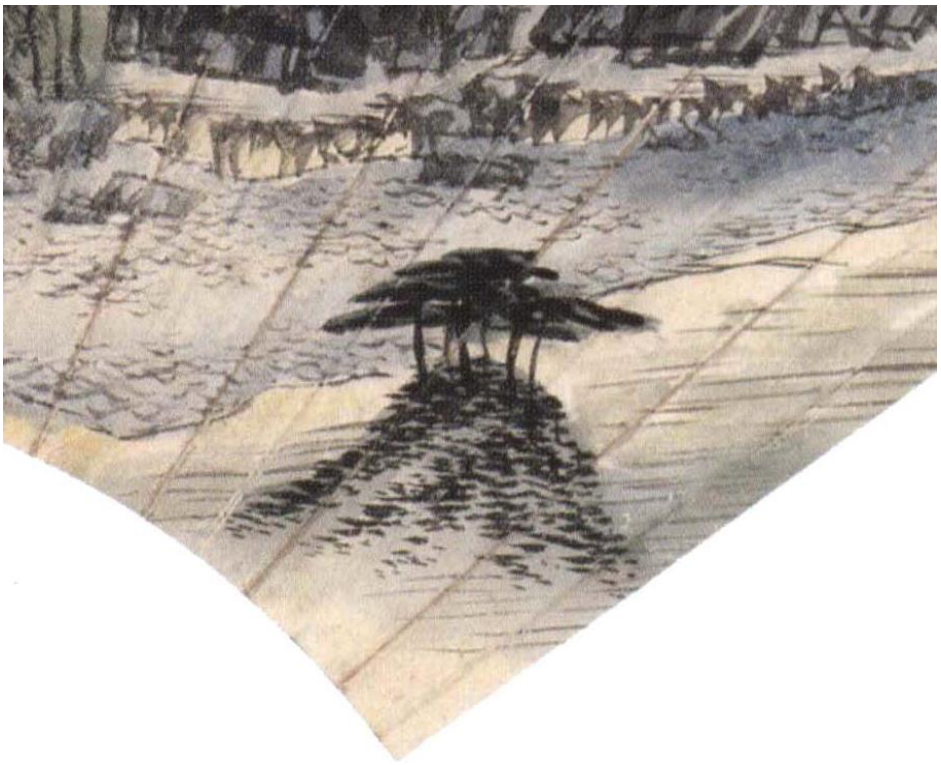

Fig. 3.2.2.7. Detailed close-up of figure 3.2.1.1.

3.2.3. Converting Topographic Data into Terrains for Use in Game Engines

To create virtual Dosan Confucian Academy, the same method used in the case of Cheongha. The texture of the three-dimensional mesh was synthesized with the highest resolution image from the satellite map distributed via Kakao Map.[98] The data distributed by the *OpenTopography Project* comes in ARC format. This file is converted into mesh form by DTM, one of the applications in Grasshopper/Rhino3D.[99] The mesh is sent to in OBJ format to the Unity3D. The file can be used as a game object; however, it needs to be converted into a terrain format to make it configurable. Object2Terrain, one of Unity3D open source programs, converts any kind of object in Unity3D into a "height map."[100] This program allows simple objects to be changed to a slightly higher or lower height, applied in various textures, and plant trees and grass. In addition, the application enables small changes, especially large-scale engineering works, and buildings, and allows the creation of terrain under the water surface.

The terrain mesh was scaled up four times vertically to emphasize the shape of the mountains (fig. 3.2.3.1). To create the virtual Dosan Academy, four village *ri* (an administrative division in Korea); Booncheonri, Dongboori, Toegyeri Woncheonri, and Uichonri (latitude: 36.705 ~ 36.735 / longitude: 128/818 ~ 128.871) were selected (fig. 3.2.3.2). The area of the three-dimensional zone is about 6.0 mi^2.

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98 Texture Mapping Image Source: kakaomap (https://map.kakao.com)
99 Blickfeld7. "DigitalTerrainMesh V0.5." DTM. Accessed April 28, 2019. http://blickfeld7.com/architecture/rhino/grasshopper/DTM/.
100 "Object2Terrain." Object2Terrain - Unify Community Wiki. Accessed April 28, 2019. https://wiki.unity3d.com/index.php/Object2Terrain.

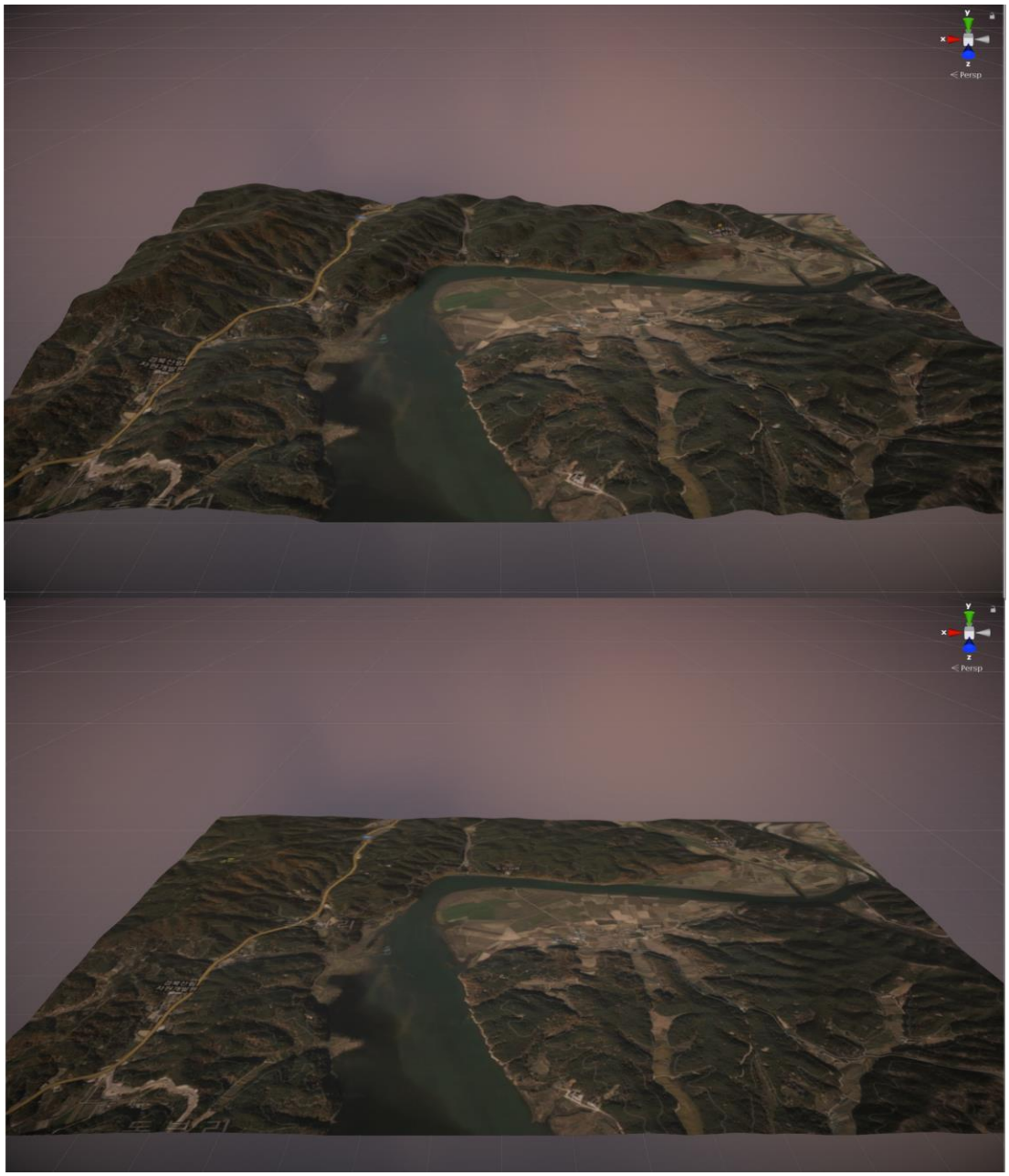

Fig. 3.2.3.1. Virtual topographic model of Dosan Confucian Academy (top: scaled up four times vertically / bottom: original topographic data).[101]

[101] Texture Mapping Image Source: kakaomap (https://map.kakao.com)

Fig. 3.2.3.2. Map of Dosan Confucian Academy and the surrounding neighborhood.[102]

Finding the observation point is an important step in this study because it determines which computer graphics programs should be used to render a similar virtual space. It was not clear if the observation point was a rice field or one of the mountain peaks in the south of Uichonri after the first visit. Depending on whether the painting is a product of synthesized images from multiple places or a panoramic image from a single location, the vantage point of this painting is most likely a small field near Uichonri or one of the hills to

[102] Source: kakaomap (https://map.kakao.com)

the south. The rice field (fig. 3.2.3.2 (green in the center)) is the only spot that provides a detail appearance of the Dosan Confucian academy while the hill provides the entire view from Mt. Youngji to Woncheonri. Jeong might have drawn each subject in different places as in the Cheongha case. Fortunately, Jeong left a clue in his painting to answer this question. He described small creeks starting from the mountains in the south, as the waterways disappear when the monsoon comes (fig. 3.2.3.3). Circle 5 in fig. 3.2.2.1 is one of these inlets. To depict them in his perspective on the left side of the painting, he should stand somewhere around the rice field (fig. 3.2.3.4). Jeong could have represented this small inlet, the outermost part of the painting, so there was not a clear reason for this decision. It is assumed that this painting was originally a larger square, but it might have been tailored to the shape of a fan. The cutoff mountains at the opposite right can also be explained in this way.

Fig. 3.2.3.3. Detailed close-up of fig. 3.2.3.2.

Fig. 3.2.3.4. View to the inlets at Seesadan. [Photographed by the author in 2019]

At the vantage point in the rice paddies, it is impossible to depict nature as it is in the painting from a single perspective, so he must have taken several scenes that appear to be rotating from one place to another direction (fig. 3.2.3.5). The panoramic view combined 9 photographs at the vantage spot to covers all the subjects in the painting. However, it is too far from the main subjects to be easily visible.

Fig. 3.2.3.5. Panoramic view at the vantage point. [Photographed by the author in 2019]

3.2.4. Post Image Processing - Panoramic and Fish Eye View

Jeong Seon made a great effort to reflect his beliefs, in “true view style”: a detailed and informal depiction of the real scenery, within his painting. He tried to capture almost every subject described in Yi’s literature. Jeong used the technique of superimposing multiple

viewpoints in one painting. Jeong's paintings were more appreciated for their rhythmical patterns and characteristics by audiences in his time more than other true view style painters. Yu Jun Yeong advocated for Jeong's paintings and the effects of musical expressions behind the paintings, “Zhangga-style lyrics give delight by delineating the feelings of objects in nature, Jeong listed what he saw and arrange them with musical rhythms in successive time.”[103] In other words, the expressions of natural objects in the literary works are not limited to space, with emphasis and omission boldly applied to the drawings according to the will of the painter while the paintings of the right lines reflect reality at some points.

This study conducted an experiment to obtain the most similar field of view and the vantage point by configuring the camera in the virtual space. The field of view of a person is between 55 to 60°.[104] The virtual camera in this study adopted an almost similar visual field (55°). When the camera was placed at the vantage point beyond the river (bottom - center of the painting), it was not able to catch all subjects at a glance (fig. 3.2.4.1). This means the field of view should be wider than 60°, or the camera should stand a long distance from the main subject. In this case, the objects in the painting should be smaller (fig. 3.2.4.2). To solve this problem, Jeong stood the vantage point near Seesadan and depicted the scene of each direction, then he merged them together. He also intentionally magnified the main subject vertically at the same time. The surrounding mountains and the river around Dosan Confucian Academy are minimized as far as possible from the center (fig. 3.2.4.3).

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[103] Yu, Jun Yeong. “A Study on Jeong Seon’s Songanmyoseon.” *Korean Bulletin of Art History*, Vol.7, The Korean Society of Art History (1995): 184.

[104] Arthur, Kevin Wayne. *Effects of Field of View on Performance with Head-mounted Displays*. Ph.D. diss. University of North Carolina Chapel Hill, 2000, pp.1.

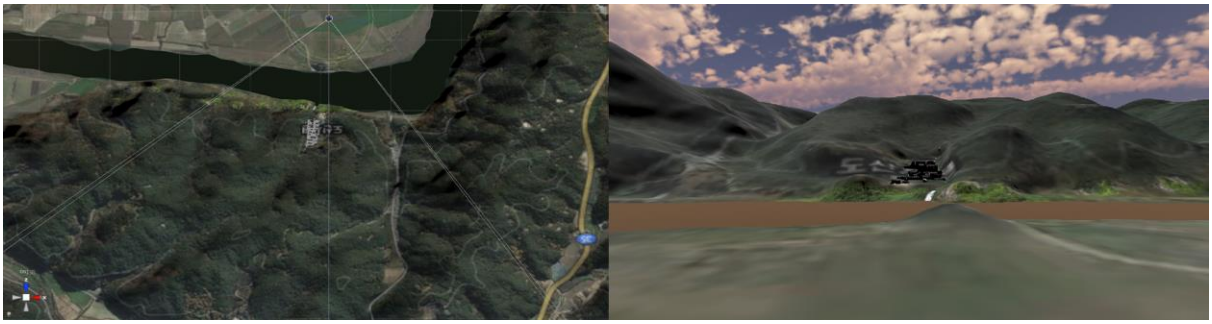

Fig. 3.2.4.1. The angle of perspective and its view from the rice paddies. [105]

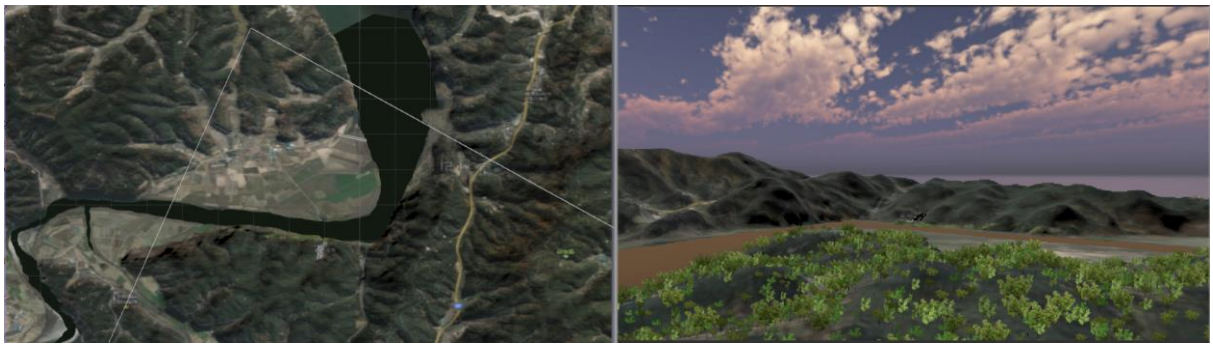

Fig. 3.2.4.2. The angle of perspective and its view from the mountain. [106]

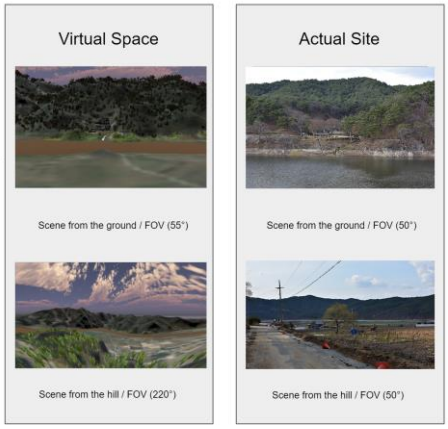

Fig. 3.2.4.3. Views from the two provisional vantage points.[107]

[105] Source: kakaomap https://map.kakao.com

[106] *Ibid.*

[107] Hwang, Intae, Chang, Alenda. "Reinterpreting Korean "True-View" Landscape Painting Using Graphics Analysis Techniques – The Case of Jeong Seon's Dosando." *International Symposium on Electronic Art 2019*, Gwangju (2019).

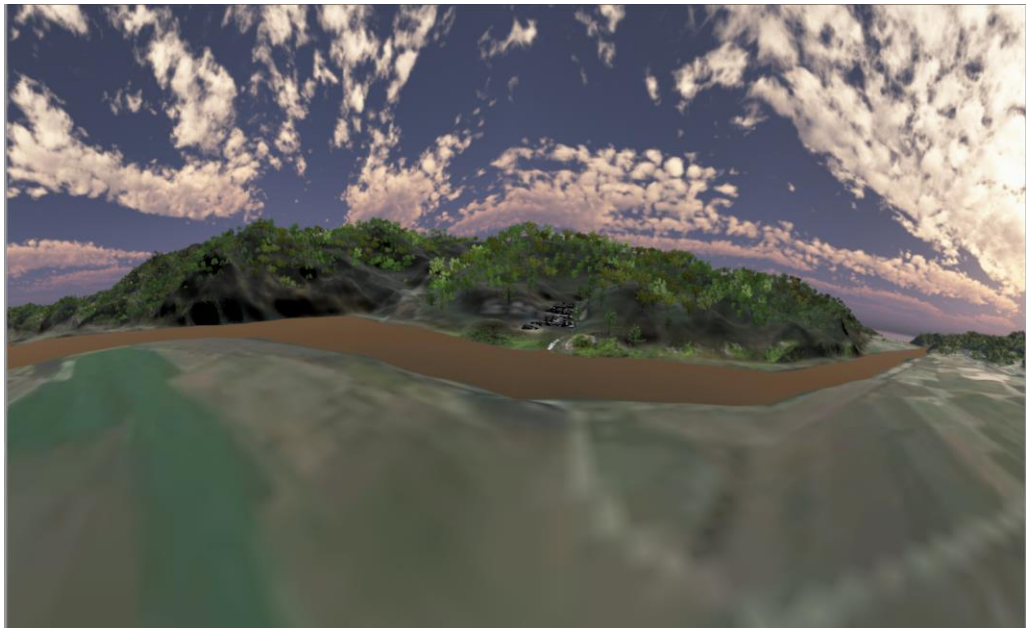

Fig. 3.2.4.4. A combined display of four cameras has a 110-degree angle of perspective.

To catch the scene that includes all the subjects from Mt. Youngji and to Toegye Stream, the cameras use a panoramic composition that combines the images caught from them. Figure 3.2.4.4 shows a screen in which four cameras are arranged side by side and compressed horizontally by ¼ to have a similar ratio as the original painting. Compared to figure 3.2.3.5, a revised panoramic photograph, Nakdong River in the combined display actually turns into a diagonal line. The river runs straight and turns almost 90 degrees when it meets Mt. Youngji, and this feature is pointed out as a major problem in Feng Shui.[108] However, the distortion becomes even worse when the images from the two cameras are

[108] Park, Sungdae, Seong, Donghwang. "Toegye's Feng-Shui (風水) Idea in the Sites Related Toegye." *Han'gughagnonjib*, Academia Koreana (2012): 360.

merged (fig. 3.2.4.5). This phenomenon assumes that the river flows horizontally in front of the observation point. The width of the river becomes narrower and the position becomes higher in the view from the camera. This phenomenon is also apparent in the painting. Jeong depicted the two sides of the river as a V-shape on the lower center of the painting and extended to the left and right, respectively. In other words, Jeong painted the river with extremely realistic observations by introducing modern panoramic techniques.

When the two cameras are combined into a single screen, the angle of the riverside is closer to the original painting; in particular, V-shape lines around the observation point are the most similar arrangement to the painting. However, this panoramic equipment could not explain the centralized screen composition of the painting. The two banks and the bluffs above them are greatly enlarged and took more than two-thirds of the painting. Jeong

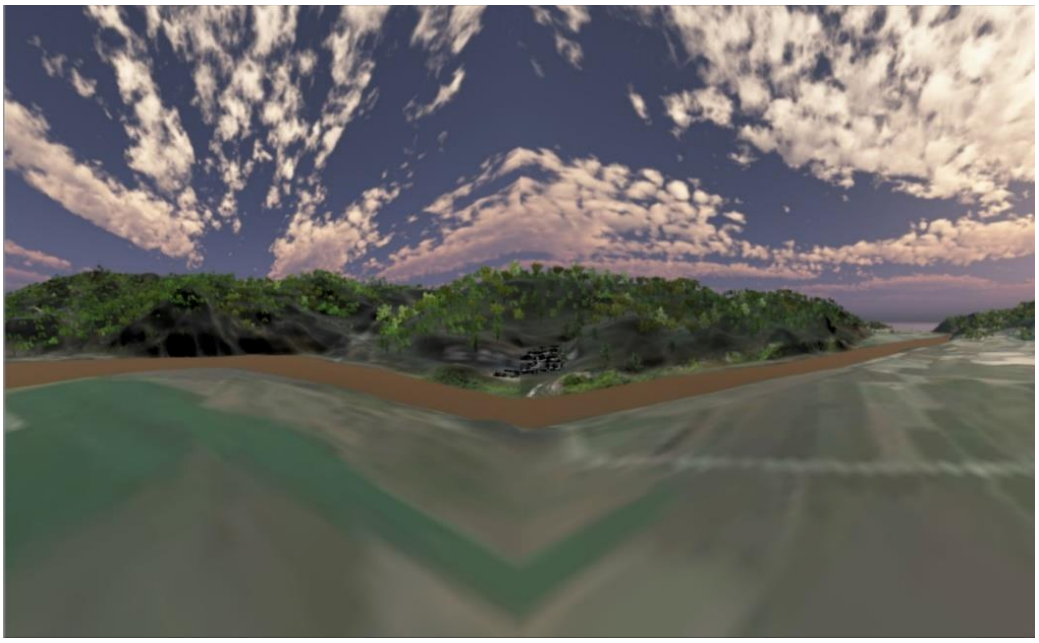

Fig. 3.2.4.5. A combined display of two cameras has a 110-degree angle of perspective.

intentionally enlarged the main subject and surrounding objects by using one of the current camera techniques, the fish-eye lens.

American physicist Robert Williams Wood developed the fish-eye view in 1906 with a curiosity how a fish saw the out from under water. He took photographs with a gadget to show the image of the world from in the water.[109] Because of bend of the light on the surface, the lens gets 180 degrees of view, but the appearance of the target is enlarged at center.[110] Physical lens of camera can change the direction of a light, mapping control in a graphic program can produce same effect. Most game engine offers the "fisheye effect" as one of its image effects.[111] For this study, there were modifications of the shader code and adjustments to the variables which decides where the distortion effect apply to get the most similar image to the original painting. The shader created distortion in the original image as if viewed through a fisheye lens,[112] this effect extended the center images toward all four sides. The modifications made by Jeong in his painting is revealed through this experiment (figs. 3.2.4.6 and 3.2.4.7).

By adjusting the degree of deformation of the x- and y-axis of the image, the program was able to create the image that most closely resembled the original painting. On top of that, the major peaks and ridges were not overlapped as the outlines from the original

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109 Robert W. Wood, *Fish-eye views, and vision under water*, The London, Edinburgh, and Dublin Philosophical Magazine, and Journal of Science Vol.12(68), 1906. p.159-162.

110 Hwang, Intae, Chang, Alenda. "Reinterpreting Korean "True-View" Landscape Painting Using Graphics Analysis Techniques – The Case of Jeong Seon's Dosando." *International Symposium on Electronic Art 2019*, Gwangju (2019).

111 Technologies, Unity. "Image Effect Reference." Unity. Accessed April 28, 2019. https://docs.unity3d.com/540/Documentation/Manual/comp-ImageEffects.html.

112 Technologies, Unity. "Fisheye." Unity. Accessed April 28, 2019. https://docs.unity3d.com/550/Documentation/Manual/script-Fisheye.html.

resource but were similar enough to be drawn based on actual observation.[113] However, it was most difficult to match the shape of the river, and the location of the facility, because he placed the academy building at a higher location in the valley. The scale of this group of buildings was not reduced because he applied the orthodox perspective only, thus it looks bigger in the actual painting.

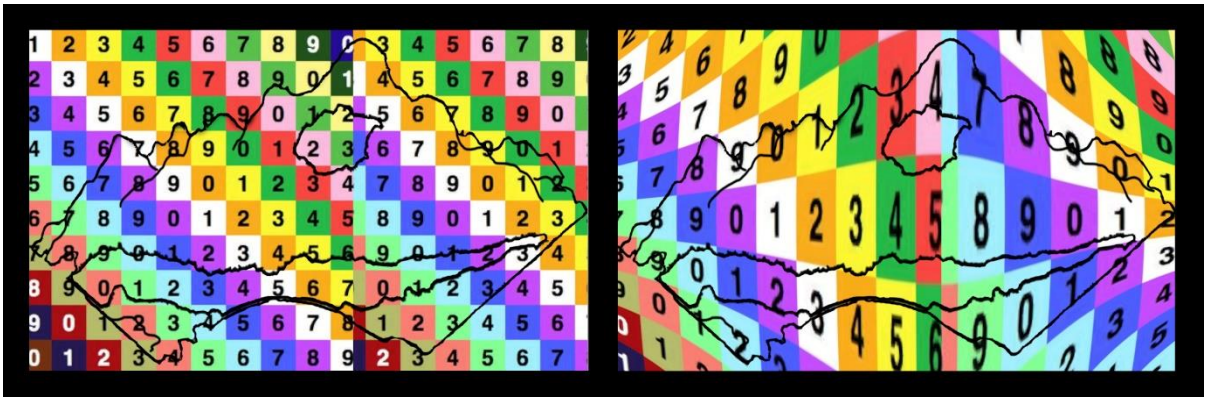

Fig. 3.2.4.6. Application of UV checker map with the fisheye lens effect.

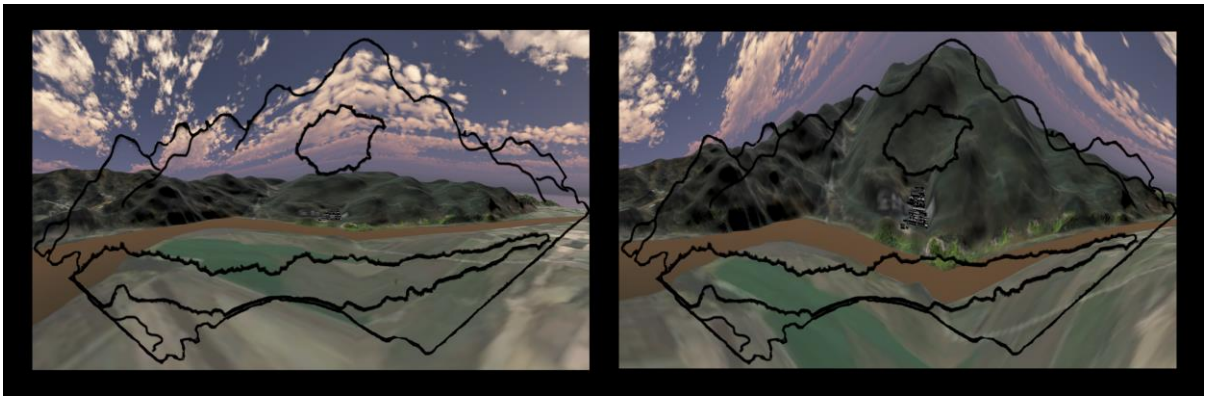

Fig. 3.2.4.7. Application of UV virtual scene with the fisheye lens effect.

[113] Hwang and Chang. (2019)

3.2.5. The Effect of Feng Shui on the Composition

Feng Shui is a practice, passed down for thousands of years in East Asia, which decides good locations for everything from a house to a city. This theory prospered through the evaluation culture for tombs in the early Joseon dynasty and developed into the assessment of towns and cities. The good conditions of location are determined by the shape of the mountain and the flow of water. It should have four mountains inside and two huge mountain ridges outside, and small waterways flow through the center of the before they become a wide river. All mountains the surrounding areas are named after animals: the Tortoise mountain at the behind of the site, and the Green Dragon mountain is on the left White Tiger mountain is on the right. The Red Phoenix is on the bottom.[114]

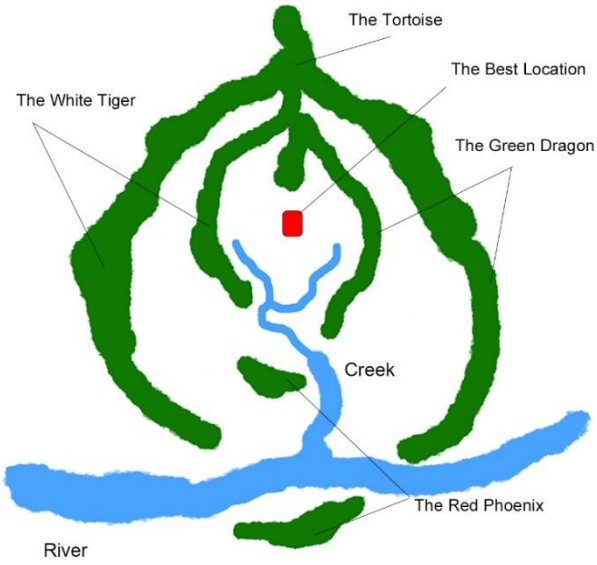

Fig. 3.2.5.1. Map of Feng Shui.

[114] *Ibid.*

Yi talked about the formation of mountains, the amount of sunshine, and the flow of the river, and water in his books. Kim Yeon-Ho[115] claimed that the position of the Dosan Confucian Academy was good for living in accord with the requirements of Feng Shui. However, Park and Sung had a different evaluation of the place because the Nakdong River runs straight in front of Mt. Do and turns south suddenly. The physical feature of this kind of place has an undercut slope. This is considered an inauspicious place for living because the river constantly erodes the cliff over time.[116] However, they also interpreted Yi's intention to move to Dosan Seowon positively and insisted that Yi fully understood the concept of Feng Shui. Yi mentioned two altars at the ends of both mountains' slopes surrounding the facility as White Tiger on the right (Dongchuibyeong) and Blue Dragon on the left (Seochuibyeong) and noted that this intensifies the energy flow of the ground and overcomes the problems presented from the river path.

In the painting, Mt. Do (912ft) is considered the Tortoise in the Feng Shui precepts,[117] and Jeong intentionally expressed it higher than Mt. Yeongji (1,453ft). He placed more space between the Green Dragon and White Tiger mountains. Moreover, the facility's position became higher, and the scale became larger because Jeong applied a bird's-eye view only as usual for the buildings. His other device was that he made Nakcheon is straight and wide, also Cheonyeondae came forward to hide its problematic nature according to Feng Shui precepts. This explains there still existed gap near the river in the images between the outline of the painting and the virtual scene of the place.

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115 Kim, Yeong-Ho. "A study on the site location of Dosan Seodang and the arrangement of Dosan Seowon." *The T'oegye Hakbo (The journal of T'oegye Studies)*, Vol.3, The Toegye Studies Institution (2008): 14.
116 Park, and Seong. (2012): 361.
117 Henry Fong, "Different Sites, Different Results." *Feng Shui Unzip*. September 26, 2017, http://fengshuiunzip.com/different-sites-different-results/.

There is no such a description of his intention applied on this painting. Among most of his fan paintings, only this painting has several devices to emphasize the concept of Feng Shui. The research wondered how much changes had been applied in this case. The virtual image was replaced to a UV checker map (fig. 3.2.4.6) and explained the distortion rate. The research also tried to apply fish-eye and panoramic view functions at the same time head mounted displays (Oculus and Vive), the source code was blocked the change of perspective angle. Thus, we could not get the similar result through them.

3.3. *Painting of Standing Rock between Two Streams*

The previous chapters look for a sign of a faithful depiction of nature in Jeong Seon's painting and explain his method by synthesizing images from several virtual cameras which produced similar image to the original painting. In the case of Dosan Confucian Academy, the analyzed image was deformed by applying a panoramic view and a fisheye lens effect to have multiple subjects within a small painting space. Also, the main subject, Dosan Confucian Academy, was highlighted by the intention of the artist to enhance the concept of a "good place" according to Feng Shui.

This chapter describes how Jeong's paintings differ from reality. The analyzing methodologies used in the previous chapters cannot be applied to the paintings in this chapter. This is primarily because Jeong used a single perspective for the main subject for this case. Second, there exist too many gaps between the subject depicted in the painting and the actual object in the place. Jeong tried to convey the inspiration he felt when he visited

the scenic spot by using an intentional deformation technique. The program used in this chapter reconstructed the actual three-dimensional object with the help of several programs. The programs were developed to transform the three-dimensional object into something similar in the painting. The deformed object in the virtual space was observed by a camera to obtain a similar image to the scrolls. In addition, this algorithm is applied to the photographs of other subjects in his paintings, then compared to see whether the algorithm produced similar a result.

3.3.1. Process of Identification of the Subject

There are two versions of *Painting of Standing Rock between Two Streams* that have been survived to the present, the first one is in Kansong Museum and the other is in the National Museum of Korea (figs. 3.3.1.1 and 3.3.1.2).

屹立風濤百太奇 Rising 492 feet up in the wind and wave is eccentric

堂堂柱石見於斯 Finally watching the majestic rock

今時若有憂天者 When I worry that the sky will fall

早晩扶傾舍爾誰 You are the only thing that supports it right away

An unknown person left a colophon on the top left-top side of in the second painting, the handwriting does not seem to match the painter. There has not been detailed research on these paintings. Since Jeong traveled several times to the Diamond Mountains and visited Sea Geumgang, the words on the first line “濤” considered wave or tide at the Sea Geumgang.

Fig. 3.3.1.1 Jeong Seon. *Standing Rock between Two Streams*, 1733. Ink on silk, 27.4 cm × 23.2 cm. Kansong Art and Culture Foundation, Seoul. [Courtesy of Kansong Art and Culture Foundation]

Fig. 3.3.1.2. Jeong Seon, *Painting of Standing Rock*, year unknown. Ink on paper, 117.5 cm × 57.9 cm. National Museum of Korea, Seoul. [Korea Open Government License]

This caused other insertion of the main subject, one group of people believe that the main subject of these paintings is the rock in the Sea Geumgang. However, the explanation of the National Museum of Korea is that it depicts the same rock as the painting in the Kansong. Most Korean art historians, except for a few, agree that they describe rocks in Yeongyang County in North Gyeongsang province.

Fig. 3.3.1.3. Standing Rock (seonbawi) in Yeongyang County. [Photographed by the author in 2018]

The shape of the rock in Yeongyang County is unlike any other rock. The small rock on the left side and the tall one on the right-side lean against each other, and this standing rock was separated from the main boulder (fig. 3.3.1.4). The total height is 49 ft and the circumference are about 98 ft. Because the rocks are not surrounded by any trees, but the pine forests are depicted behind both sides of the rocks, the two works are considered to depict the rock in Yeongyang. However, it is true that there are some similarities while there is also greater differentiation between the paintings and the subject. Particularly, the part where the shape of the rock is different from the left and right sides is the upper body of the object. The overall shape of the rock narrows as it goes up, and its end is slightly bent from east to west. The way in which a different rock is attached in the middle of the main part (or part of it falls off the rock) reminds us of what looks like an index finger or a penis, its unique figure has enhanced the rock's reputation as a masculine deity. That's why all the old maps in the Joseon dynasty described the existence of the rock.

There was no formal road to the rock until 2000. North Gyeongsang province constructed local highway No.911 in 2003,[118] and this road passes in front of the rock. It had to be raised with the massive concrete bank to make the ground even, thus the entire rock looks smaller than it did in the past because the bedrock was covered by a pile of concrete. Because the height of the rock was reduced since the road construction, the breakpoint is at nearly half of the height the object in the painting, adding further doubt to the subject.

[118] North Gyeongsang province announcement no.4705, 20 February 2003. pp.20 http://www.gb.go.kr/Main/page.do?mnu_uid=2081

To make sure that the subject is the rock in Yeongyang, this study collected and examined well-known rock data in Korea. There are several conditions suggested for candidates in this collection. First, the rock must be a single vertically ascending rock located next to a river. Another condition is that the shape of the left and right sides is different when viewed from a certain point, and the rock in question should be known as Seonbawi (standing rock). The last condition is that there is no tree at the top because the area of the rock is not wide. This is the list of rocks which satisfied the conditions. (table 2 and fig. 3.3.4)

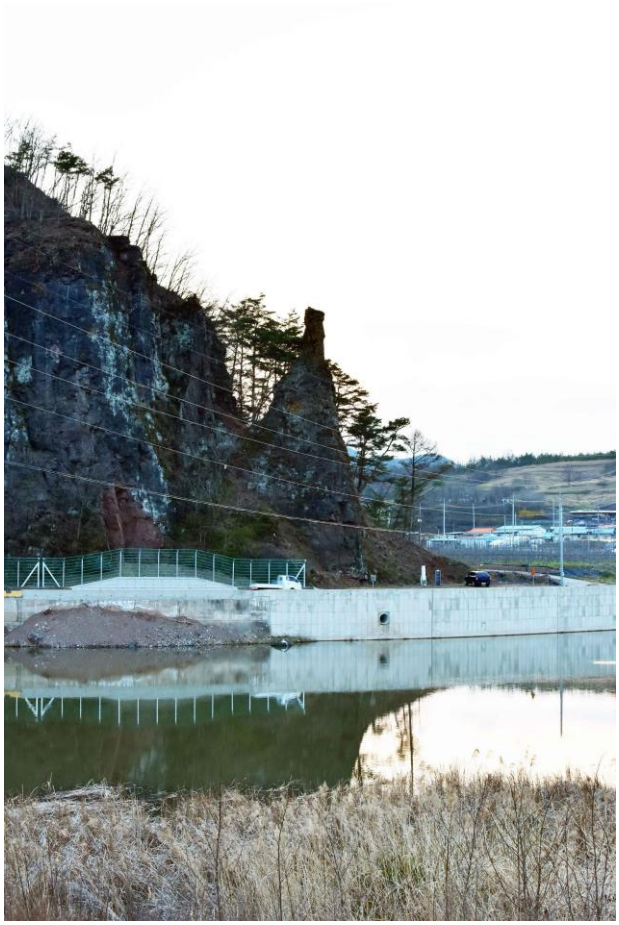


Fig. 3.3.1.4. Standing Rock (seonbawi) from across the river. [Photographed by the author in 2019]

Table 2. List of standing rocks.

No	Name	Location	Feature
1	Seonbawi	Yeongyang County North Gyeongsang Province	Considered the motif of the scrolls
2	Seonbawi	Ulju County Ulsan Metropolitan City	Sit in the middle of a river
3	Seonbawi in Muheulgugog	Seongju County North Gyeongsang Province	Most similar shape
4	Seondol	Yeongwol County Gangwon Province	The tallest one among the candidates (70m/ 230ft)
5	Seonbawi	Jongno District Seoul Metropolitan City	Different shape

The one in Seongju County had a very similar shape to the rock in the scroll, considering the diagonal line at the bottom of the rock, its proportions, and the fact that beautiful pines surround the rock. There is a high probability that Jeong stopped by the one in Seongju when he was going to Haeinsa temple which is one of the paintings in *Album of Gyeongsang Province*. The two places, Haeinsa temple, and the standing rock are about 8 miles apart. However, the Yeongyang one was better known as a scenic spot at the time among people, and this fact has been revealed to some extent through research of the maps made in the past. (see table 3)

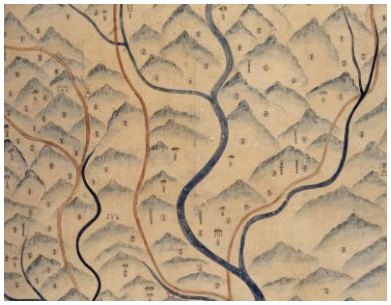
To find a historical record of two rocks, this study selected seven maps published between the 17th and 19th centuries. All the maps show the existence of the rock in Yeongyang, and while their shapes were different, they clearly marked the rock's position. On the other hand, the Seongju one does not appear on any maps, this tells us that it was not well known at the time. More specifically, there is a barrack and mountain fortress (dogyongsanseong, 禿用山城, 독용산성) used by the government during the Japanese

Fig. 3.3.1.5. Pictures of standing rocks.[119]

[119] 2. Image source: kakaomap https://map.kakao.com
3. Image source: Naver Map https://map.naver.com
4. Image source: "영월 선돌" Cultural Heritage Administration, http://www.heritage.go.kr [Korea Open Government License]
5. Image source: "선바위" Cultural Heritage Administration, http://www.heritage.go.kr [Korea Open Government License]

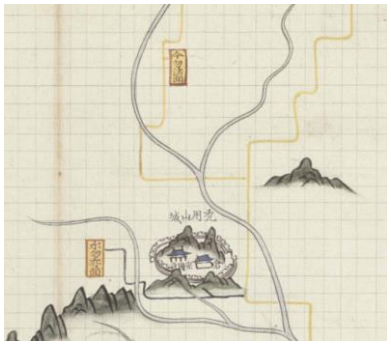
invasions of Korea (1592-98), this mountain fortress was marked on the maps. If the rock was famous, the map maker would have described its location.[120]

Table 3. Old maps of two standing rocks in Yeongyang and Seongju.[121]

Title	Yeongyang	Seongju
Municipal Maps in 1872		
Gwangyeodo in 19c		
Andong Municipal Map 18c		Does not exist

[120] They are only 1.7 miles apart.

[121] Municipal Maps in 1872 (1872 년 지방지도), Gwangyeodo in 19c (광여도), Andong Municipal Map (안동도회[좌통지도]), Bibyeonsainbanganjido (비변사인방안지도), Yeojido (여지도), Jiseung (지승), Haedongjido (해동지도). http://e-kyujanggak.snu.ac.kr. [Courtesy of Kyujanggak Institute for Korean Studies]

Bibyeonsainbanganjido		
Yeojido		
Jiseung		
Haedongjido		

Also, the title of the painting confirms the identity of the rock. The title *雙溪立巖* (ssangyeibam) means standing rock between two streams. It is known as 'Ibam' (立岩, 입암), Sinseonbawi (仙岩, 신선바위), Seonbawoo (선바우), and Seonbawi (선바위). The first two words of the title, "Ibam" became the name of the administrative district (Ibam town, 立岩面, 입암면). Additional research has reaffirmed that the rock depicted in the paintings is one on the Yeongyang.

The geological survey results are interesting because the whole of the Yeongyang county is characterized by the Mesozoic strata. Among them, this the county's geographical feature is divided into two groups: Cheongsan Mountain geographical member and Osip peak member.[122] The surrounding areas of Seonbawi are sedimentary rocks mainly composed of mudstone, sandstone, and conglomerate, while the rocks near the river consist of basalt (fig. 3.3.1.6). Since the rocks and its boulders (the red dot area) are characterized by the different geological formations, it is natural a phenomenon that they were separated by differential erosion, and the two terraces were originally one, but they are believed to be separated by new waterways.

122 Kim, Sang Wook, Park, Bong Soon. *Explanatory Text of the Geologic Map of Yongyang* Sheet. Seoul: Geological Survey of Korea, 1970. pp. 10. Online Achieve: Korea Institute of Geoscience and Mineral Resources (KIGAM). [Korea Open Government License]

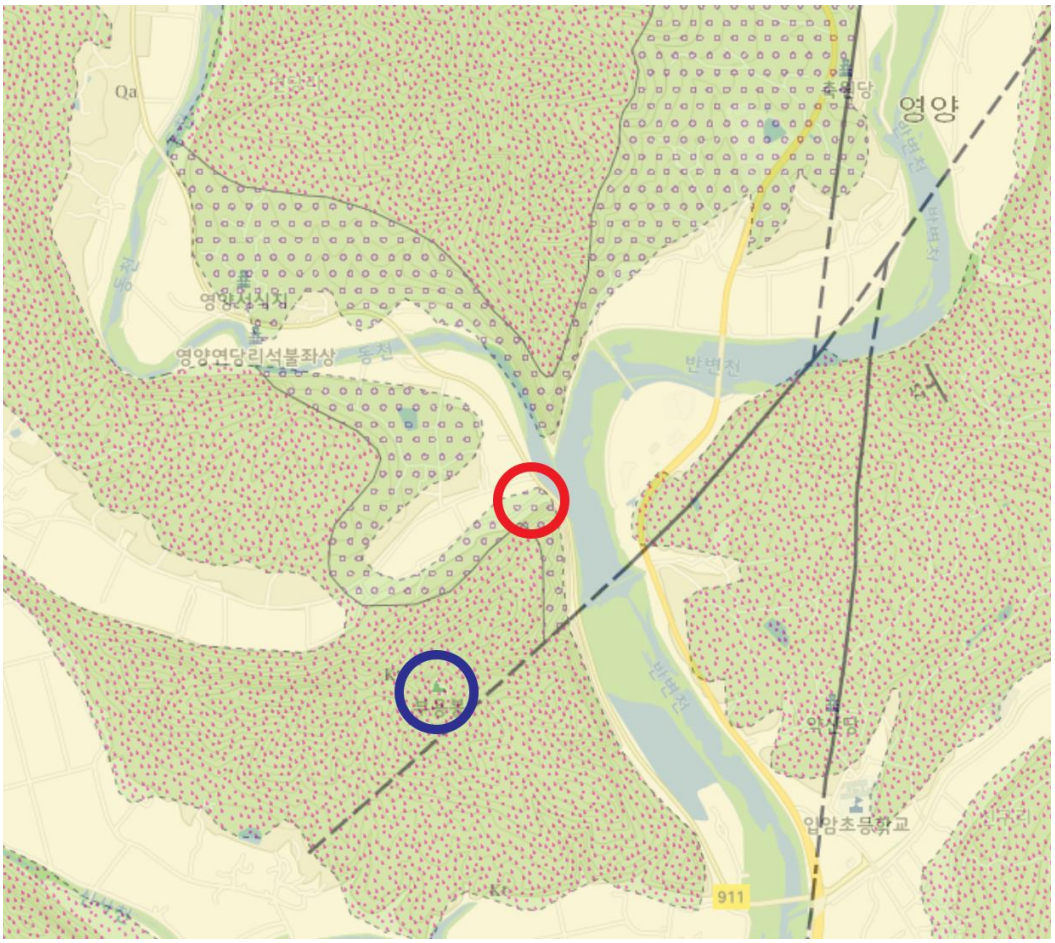


Fig. 3.3.1.6. The Geological Map of Ibam-myeon, (Red Circle - Seonbawi, Blue Circle - Bhuyongbong, Red Dot Area - mudstone, sandstone, and conglomerate, Red Circle Area - Basalt).[123]

[123] Korea Institute of Geoscience and Mineral Resources (KIGAM), Database of Korea Institute of Geoscience and Mineral Resources. https://mgeo.kigam.re.kr. [Korea Open Government License]

3.3.2. Creating a Three-Dimensional Mesh Based on Two-Dimensional Images

The shapes of the standing rock and the actual rocks shown in the scroll are not like the scene at any point. It is true that the painter visited Yeongyang and painted the scene, however, he might have transformed the shape to enhance the impression of the rock. This chapter verified if there are certain rules for this kind of transformation of the subject from nature and whether there are similar variations when these rules are applied. To compare the actual Seonbawi with the rock in the painting, the standing rock was reconstructed as a three-dimensional form through several steps. Autodesk RECAP[124] created the three-

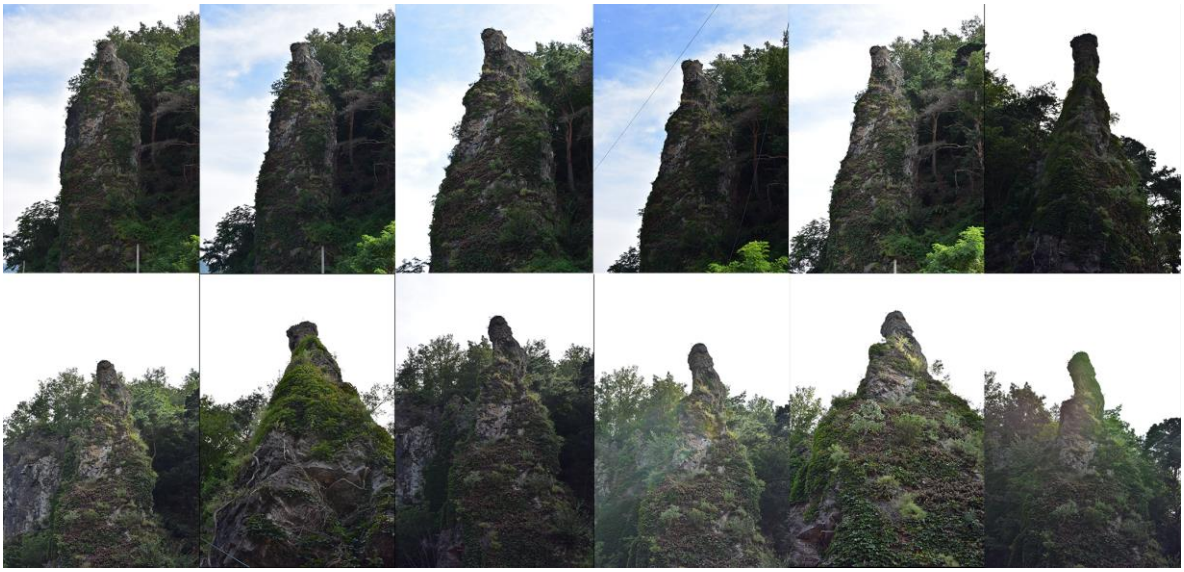


Fig. 3.3.2.1. Photographs used for the three-dimensional mesh of Seonbawi. [Photographed by the author in 2018]

[124] Autodesk RECAP, https://www.autodesk.com/products/recap/overview.

dimensional mesh with dozens of photographs and videos (fig. 3.3.2.1). The program created point cloud data by analyzing the contrast differences in the photographs to create the mesh data (fig 3.3.2.2). This is mainly used for the virtual reconstruction of buildings.

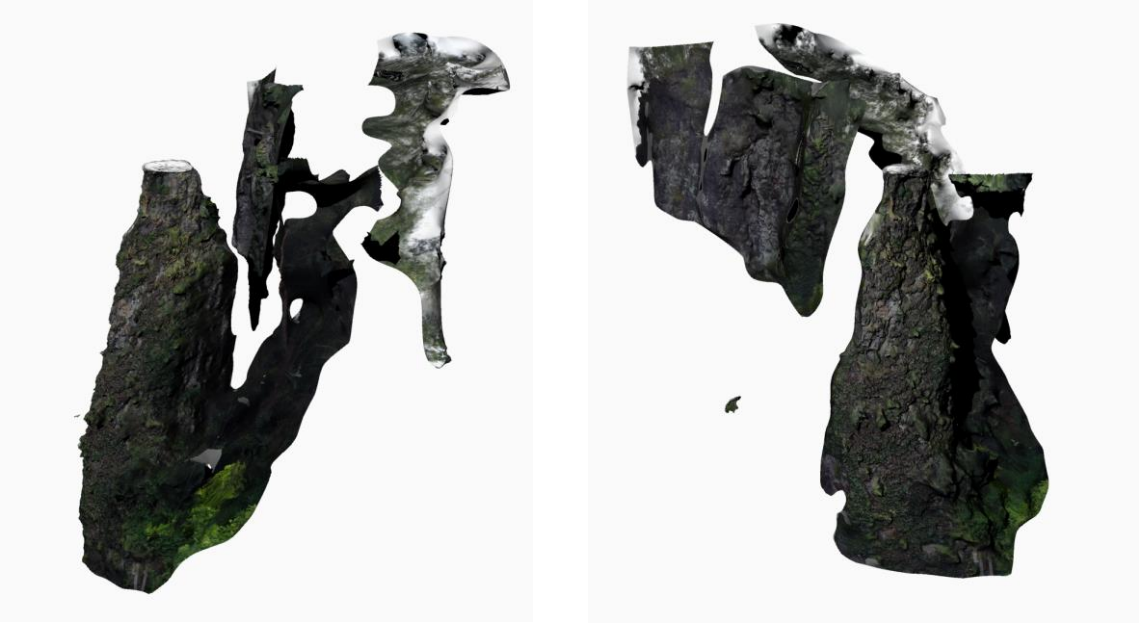


Fig. 3.3.2.2. A three-dimensional mesh model of Seonbawi generated by Autodesk RECAP.

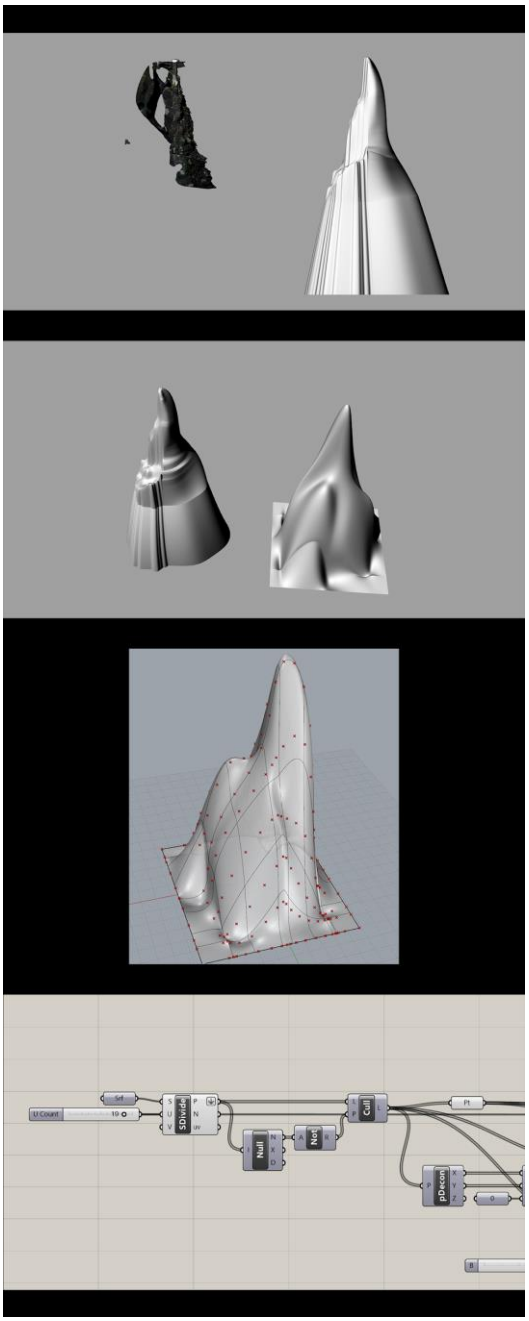
Since the body of the prototype mesh model had about 5,500 naked edges, it had too much information to make additional modifications for the program to transform. So, the mesh created by Autodesk RECAP was simplified and regenerated into a similar three-dimensional model. The program was developed using Grasshopper, a visual programming language for Rhino3D.

These are the detailed steps for the transformation:

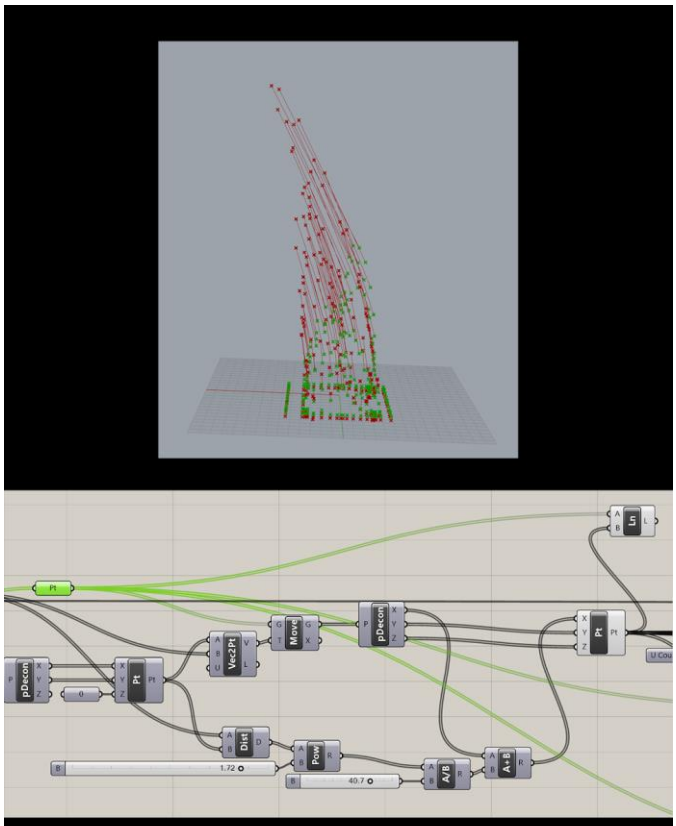
1. The mesh created by Autodesk RECAP contains only about one-third of the total rock, thus the bottom is extended for accurate reproduction.

2. The ‘Drape’ function replicated the simple copy of the shape while maintaining the original proportion of the rock.

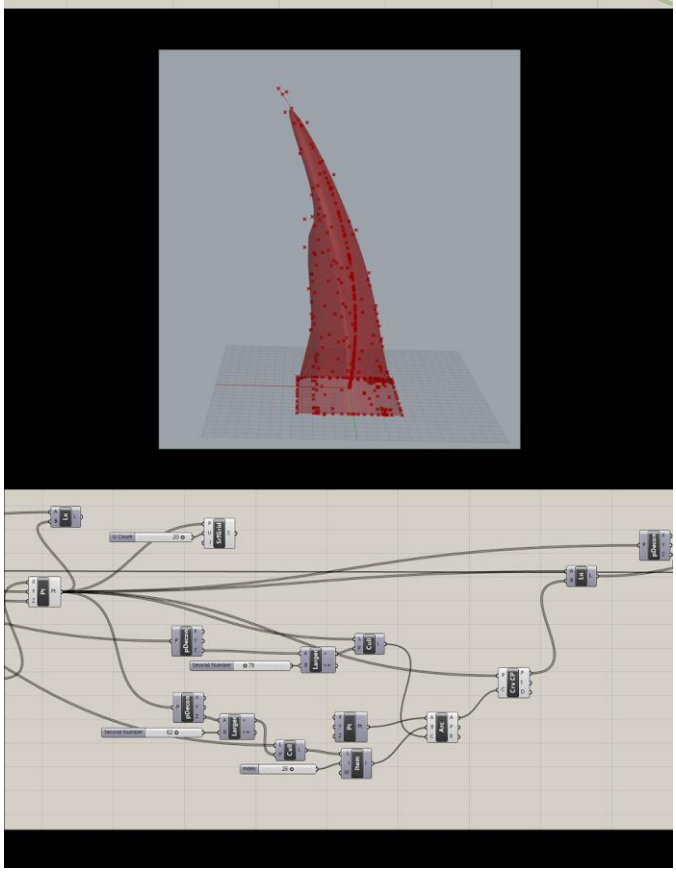
3. The ‘Divide Surface’ function generates UV points on the target surface. Copy the UV points then assign a 0 value on the Z-axis. This function copies and moves all the UV points vertically to the ground to calculate the distance between two points in a group.



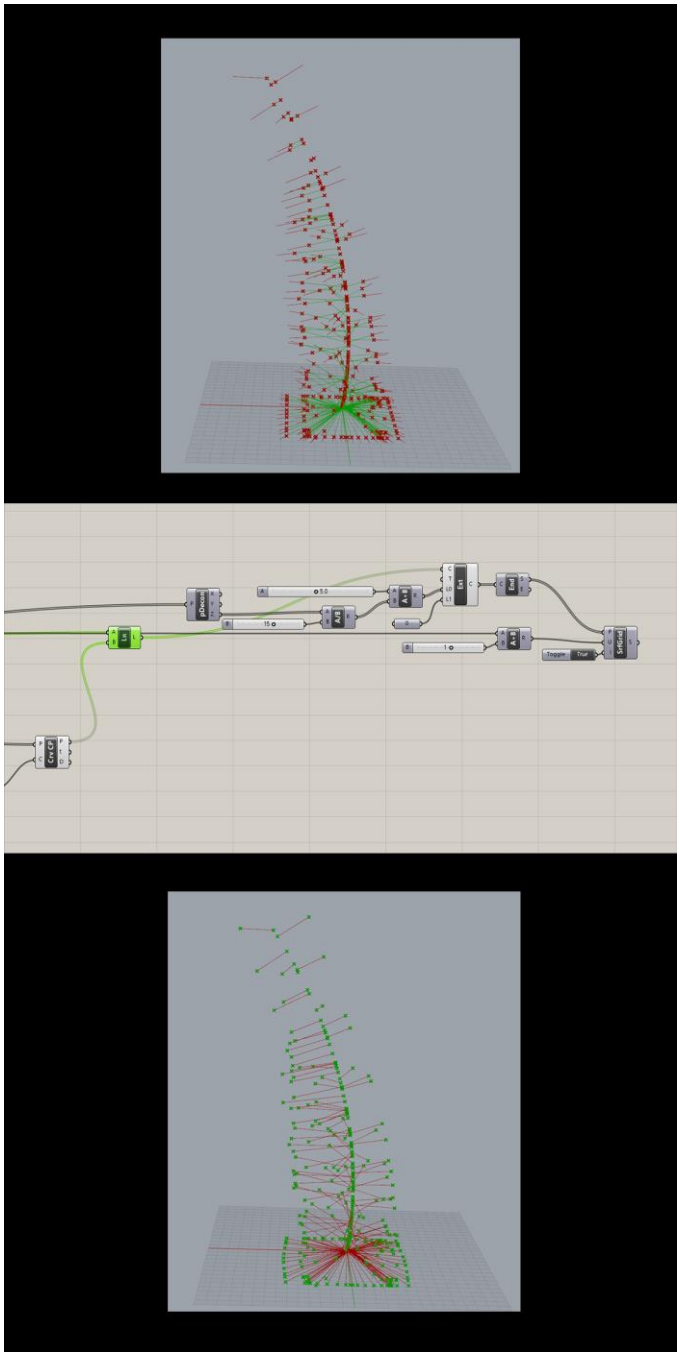
4. Raise the original UV point along with the Y-axis by the distance values found above. This part is the same technique that allows the terrain data to be scaled up 4 times to make the mountains have a similar height from the paintings. Then move all the raised points to the X-axis. This function bends the rock slightly.



5. Generate surface based on the raised points.

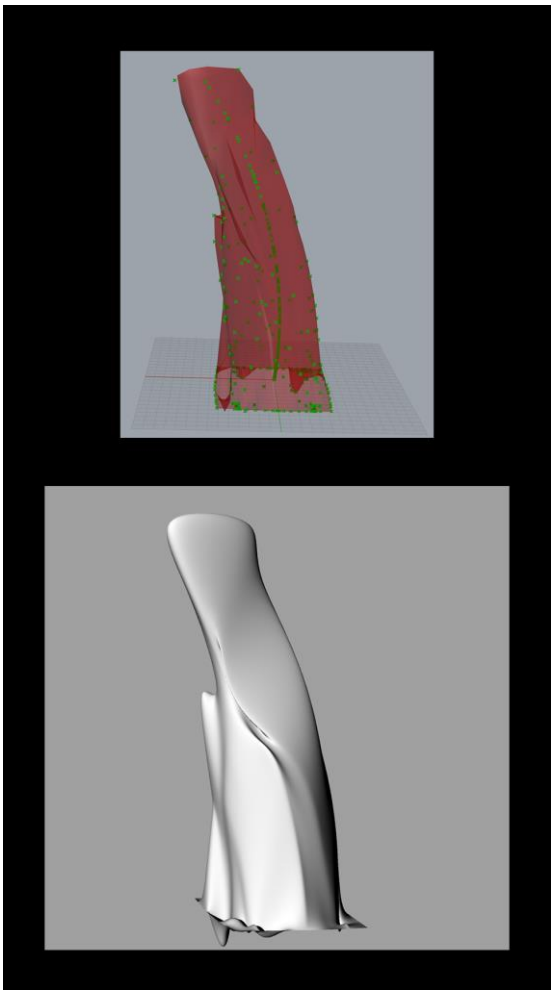


6. Create an arc going through the center of the object.



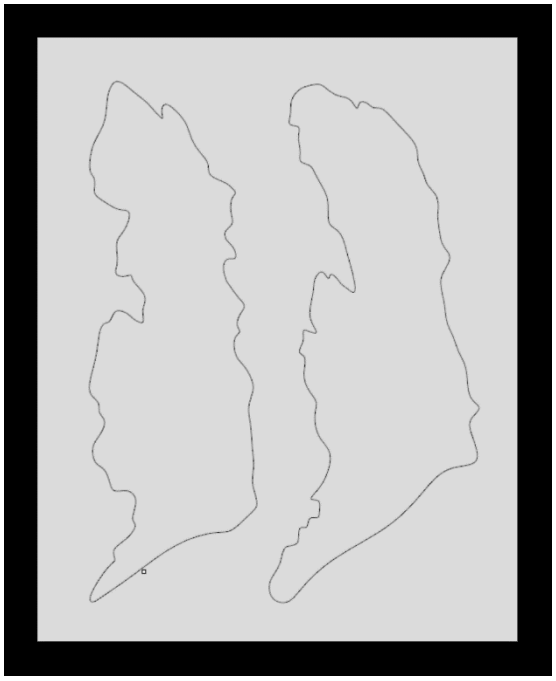
7. Create UV points of the object, then draw lines between UV points and the arc, then extend these lines by the value of UV points' Z-axis, which means higher-located points gets a longer extended line. The rocks depicted in both paintings have an abnormally larger scale as they are.

8. Extract endpoints of these lines, these are the outward points.

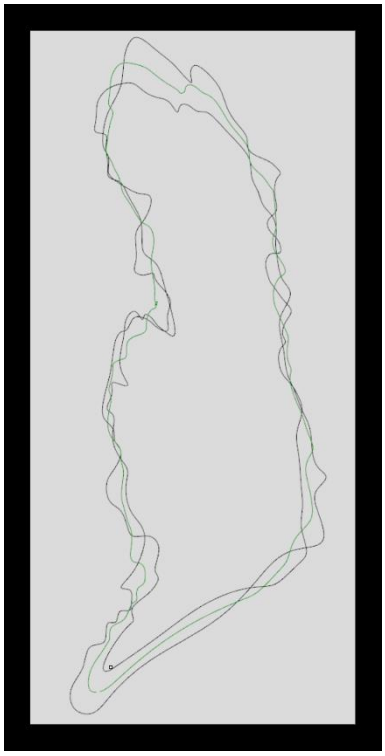


9. Using these points as a UV points reference, generate the surface.

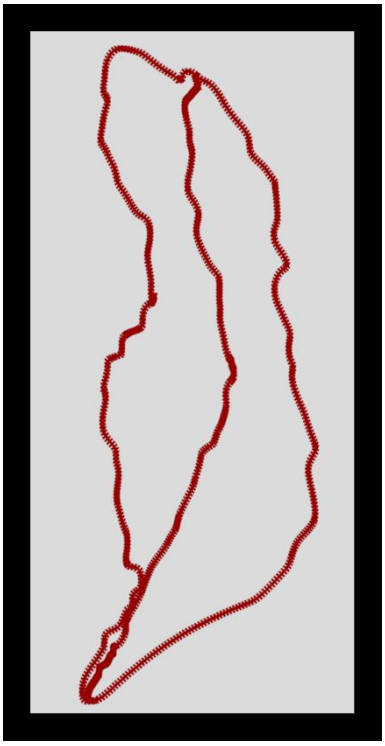
10. Extract contours from the paintings.



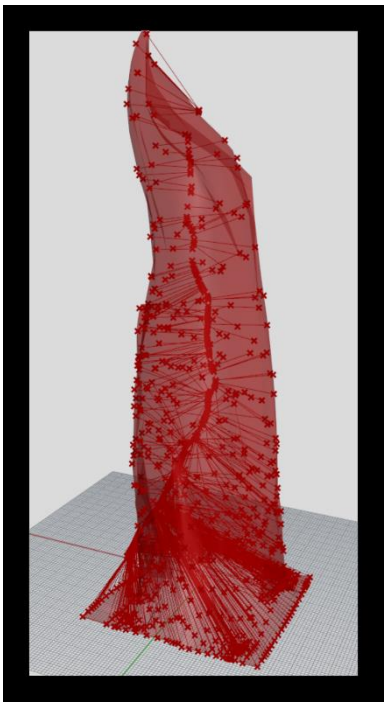
11. Generate one common shape from the two contours.



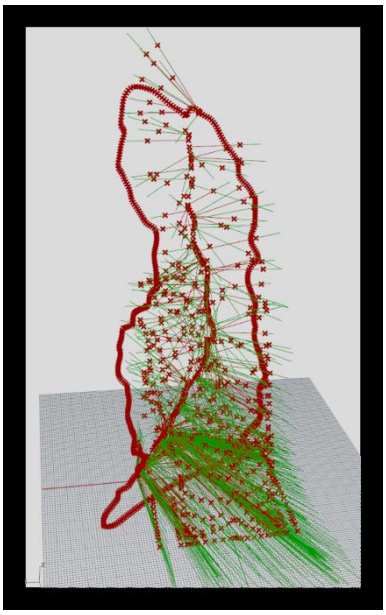
12. Generate a center line of the shape, this is the spine of the rock.



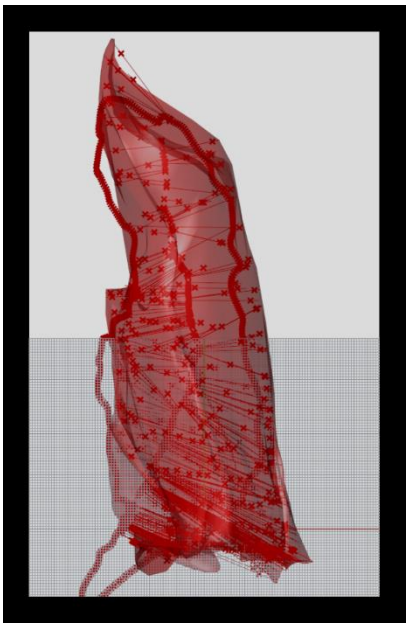
13.Connect points on the spine and points on the surface.



14. Measure the distance between the points on the surface and the closest points on the common contour, extend the line between the spine and the points on the surface as an inverse proportion.



15. Generate surface based on each endpoint of the extended lines.



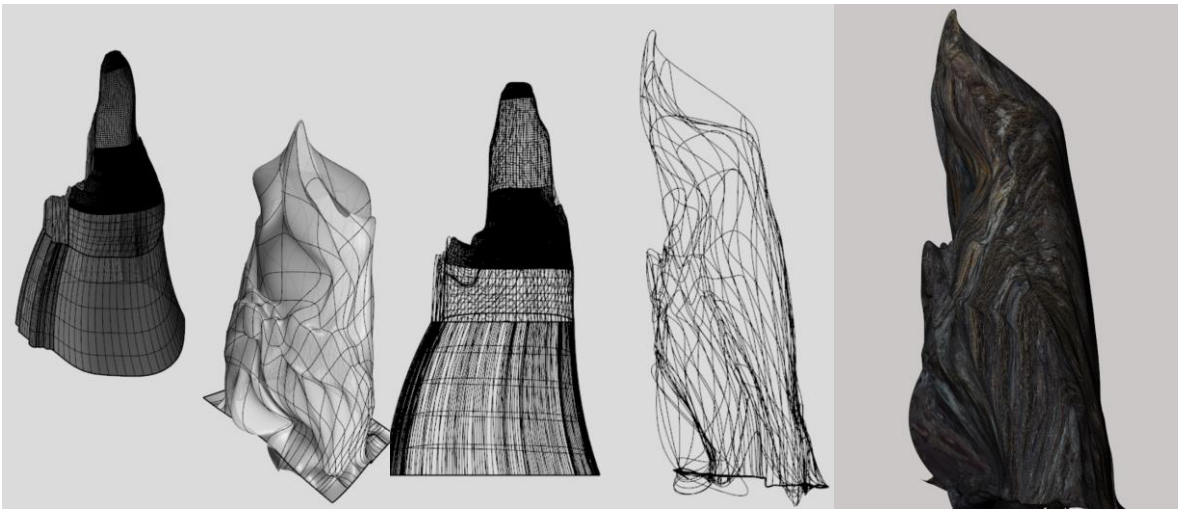


Fig. 3.3.2.3. Result of the modification process.

Compared to the shape of the scanned mesh, the upper part of the rock was abnormally enlarged and tilted to the left. Jeong wanted to create the magnificent effect of the rock stabbing the sky.

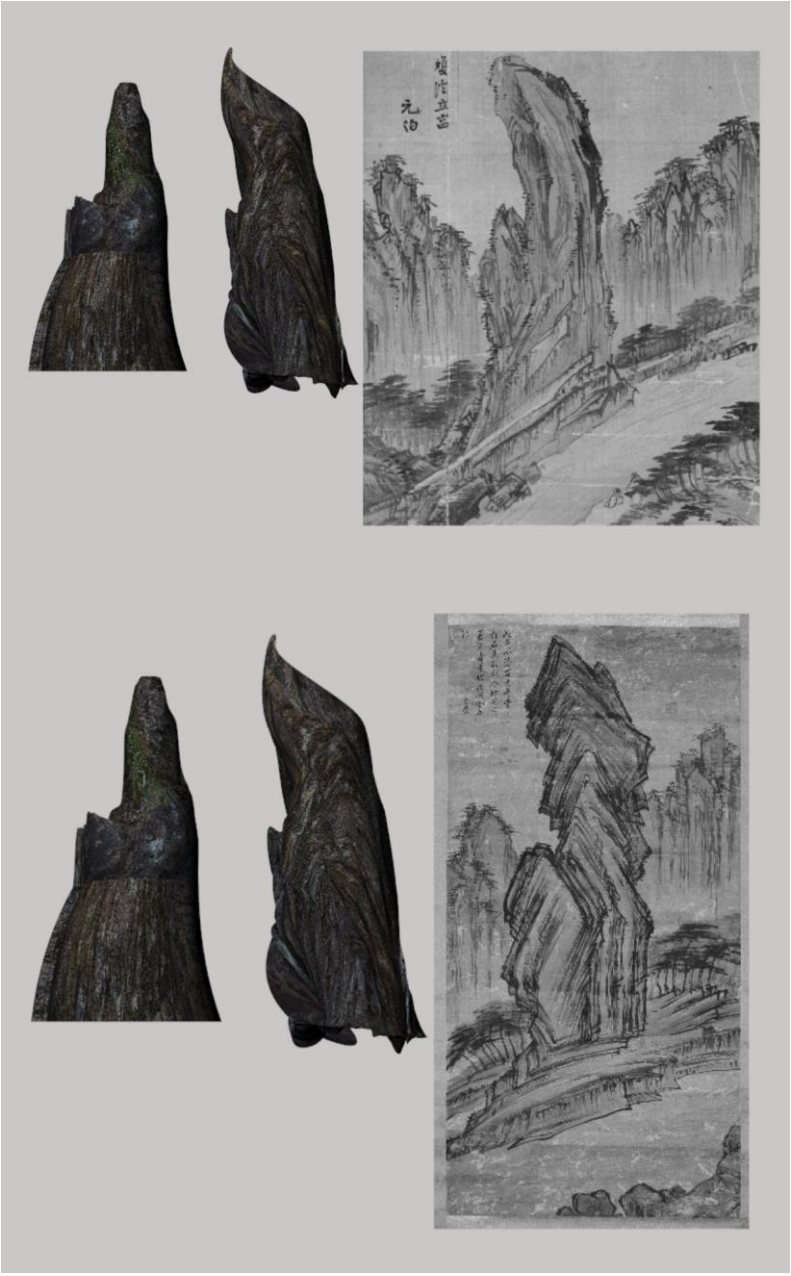


Fig. 3.3.2.4. Comparison image between actual rock, modified rock, and the paintings.

Fig. 3.3.2.5. Comparison images between photographs, rendered scene with scanned objects, and painting: right: photograph of actual rock, middle right: rendered scene of three-dimensionally scanned rock in the virtual space, middle left: *Standing Rock between Two Streams,* right: modified rock in the virtual space.

To make the rock after the modification process close to the scene in the painting, it needed to be scaled up twice. As we can see in the figure 3.3.2.5, the vantage point should be somewhere at the riverbank where two cliffs are insight. The three-dimensional scanned rock based on photographs of the site was properly scaled based on the original photograph. In the modification process, the rock becomes 1.5 times taller, however, after sitting the modified rock at the proper position, the size had to be taller. This exaggeration technique is prominent in other rock paintings. The Seongryu cave in Uljin County is a natural limestone cave about 1,640 feet long (fig. 3.3.2.6).

Fig. 3.3.2.6. Jeong Seon. *Seongryu Cave*, ca.1735. Ink and color on paper, 27.3 cm × 28.5 cm. Kansong Art and Culture Foundation, Seoul. [Courtesy of Kansong Art and Culture Foundation]

Fig. 3.3.2.7. A three-dimensional mesh model of Seongryu Cave generated by Autodesk RECAP.

Fig. 3.3.2.8. Comparison image between the painting and the modified rock.

Figure 3.3.2.8 is the result of applying the same system to the three-dimensional form of Seongryu Cave. The spine that determines the total size of the rock was generated from the original painting, and its size was larger than the original form. However, this system could not produce a vertical shape from the river to the end of the rock as shown in the painting. The spine extracted from the original painting is about three times the height of the three-dimensional model (about 1.5 times higher in the case of Standing Rock). Jeong's general tendency of the rock depiction is to increase the height more than twice as much as the actual one and to draw the upper part of the rock abnormally bigger. By doing this process, this research was expecting to find the standardized pattern of true-view style in a rock case. Jeong produced about 13 paintings of rock as a main subject, and the researcher decided to leave them as a subject of further study.

3.4. *Painting of Three Dragon Ponds*

Mt. Neyeon (3,051ft) is in Songna town (Northern Ward, Pohang City, North Gyeongsang Province, 松羅面, 송라면). It is about 6 miles north of Cheongha town. Jeong Seon must have traveled to this mountain several times during his service and left a travelogue in the form of paintings. The mountain is famous for its wonderful waterfalls and valleys starting from Mt. Mabong until the water flow finally reaches the East Sea. More than twelve huge waterfalls create wonderful sights along the valley. The trip begins at Bogyeongsa temple whose origin is extraordinary. Jeemyong, a bhikkhu in the Silla dynasty came back from Luoyang, one of the cities in the Northern Qi state (550–577) after his twenty years of study

at Baekmasa temple. He pleaded with king Jinpyeong (567?–632, 眞平王, 진평왕) for the patronage required in setting up a Buddhist temple where he could spread the enlightenment of Buddhism. Thus, the king went north following the five-colors clouds, then arrived at Mt. Neyeon, where he built a temple and named it Bogyeong.[125]

3.4.1. Constructing a Linear Narrative of Appreciation in Painting

The pilgrimage guide to the holy land at the entrance of the temple briefly shows the whole valley as an image (fig. 3.4.2). The map adopted a bird's eye view perspective which is overlooking the valley from the air. Like most panorama map paintings, this painting represents the location of the twelve waterfalls and famous rocks in the valley.

Fig. 3.4.1.1. Anonymous. *Panorama Map Painting of Mt. Neyeon,* year unknown. Ink and colors on board, North Gyeongsang province. [Photographed by the author in 2019]

[125] Choi Jeong Hui, *Korean Buddhist Legend 99,* Seoul: Wooribooks. pp. 216.

Fig. 3.4.1.2. Jeong Seon. *Three Dragon Falls at Mt Neyeon*, ca. 1734. Ink and colors on paper, 29.7 cm × 21.1 cm, National Museum of Korea, Seoul. [Korea Open Government License]

Fig. 3.4.1.3. Jeong Seon. *Neyeonsamyongchoo -Three Dragon Falls at Mt. Neyeon*, ca.1734.[126] Ink and colors on paper, 134.7.7 cm × 56.2 cm. Leeum, Seoul. [Courtesy of Leeum]

[126] Kim, Ka-Hee. *Study of Painting Commission between Jeong Seon and Lee Chun-Je Family*, Master's dissertation, Seoul National University, 2002. pp. 65.

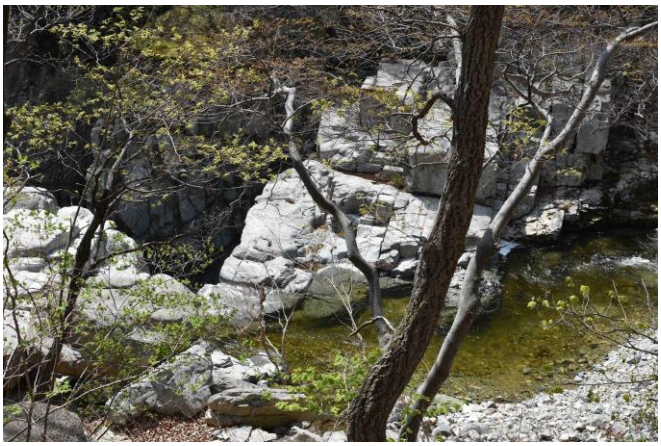
Unlike the panoramic map created for information delivery, the paintings of Jeong seem to be drawn to convey the wonderful atmosphere of the valley after his exploration. The first one is the size of a booklet like *Painting of Cheongha Castle and Town* and is a detailed picture of the cliffs and trails around the waterfalls (fig. 3.4.1.2). The other one was drawn on a scroll and is longer than the first. They are different in proportion, but the section he wanted to depict in the valley was the same (fig. 3.4.1.3).

The following pictures photographed by the author are the twelve falls starting from downstream. Jeong depicted five waterfalls from 4th to 8th. [Photographed by the author in 2019]

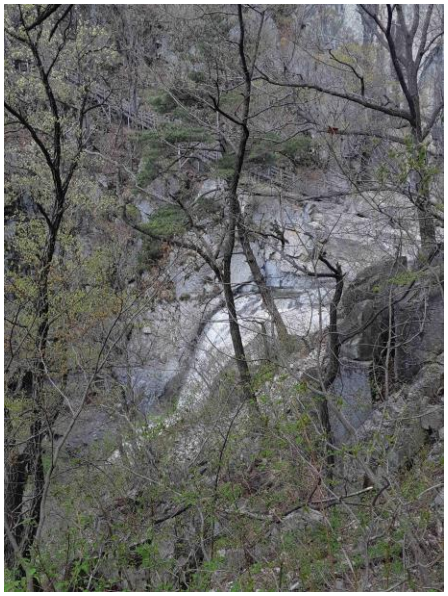
1. Sangsaeng Falls (Twin Falls)

2. Bohyeon Falls

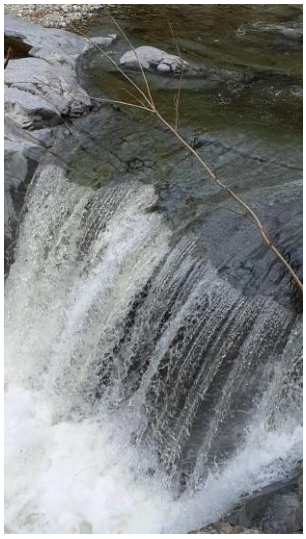
3. Sambo Falls



4. Jamlyong Falls



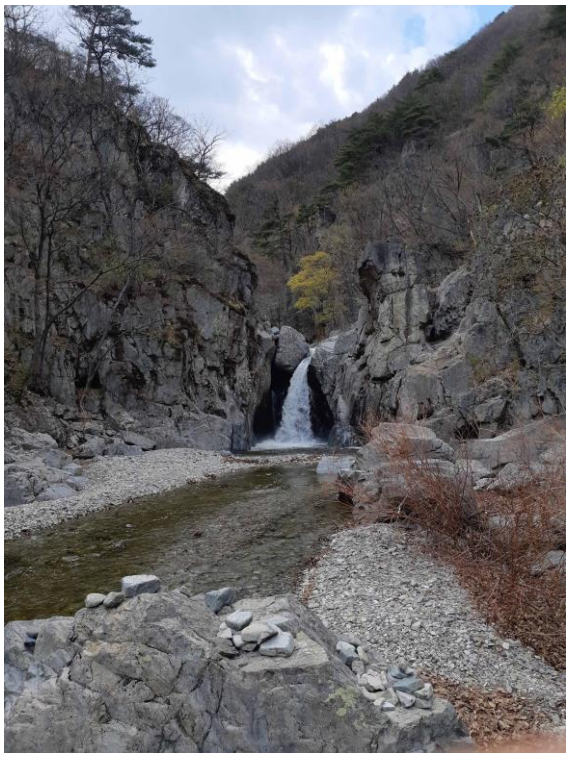
5. Mubong Falls



6. Gwaneum Falls

7. Yeonsan Falls

8. Eun Falls



The area from here to Seemyeong Falls is temporarily closed for preservation.

9. The1st Bogho Falls
10. The 2nd Bogho Falls
11. Sil Falls
12. Seemyeong Falls[127]

The waterfall, which we can clearly identify at the center of the painting, is the sixth waterfall, Gwaneum Falls. The water stream divided into two at the beginning, and poured out between huge rocks, there are three small caves aside. The location is surrounded by

[127] Jongman Byeon, *Reduce the weight of greed, Trekking twelve waterfalls at mount Neyeon*, News, OhmyNews, July 14, 2014, http://www.ohmynews.com/NWS_Web/View/at_pg.aspx?CNTN_CD=A0002015870&CMPT_CD=TAG_PC

rock walls providing a cozy and peaceful atmosphere isolated from the outside world. In the second painting, Jeong drew tourists resting in the front yard of the waterfall, indicating that Gwaneum Falls has the most spectacular scenery among the twelve waterfalls. In reality, the inspiration imparted by the falls keeps most hikers in front of its spectacle. Of course, the subject of the two paintings is Gwaneum Falls, and several waterfalls were depicted in them. The waterfall at the bottom of the paintings is Jamlyong Falls because it has a huge rock on its right. In addition, the water stream after Gwaneum Falls is shifted to the right in the paintings; it seems the painter wanted to briefly depict Mubong Falls whose stream falls in the right corner of the valley. Yeonsan Falls is the most impressive of the 12 waterfalls, it is about 230 ft upstream from Gwaneum Falls, it is the highest and greatest volume of water. The 8th one, Eun Falls, is also a beautiful spot. In the paintings, only the National Museum version has two falls above the main subject, the two waterfalls are thought to be a representation of Yeonsan Falls and Eun Falls. Eun Falls has a rock high on the right, so it is certain that the waterfall at the end of the valley (a starting point) is the 8th one. The 9th to 12th falls are not particularly impressive, thus he thought it unnecessary to have them in the paintings.

Jeong tried to include the five impressive waterfalls that he discovered during the climb into his paintings. From the map above (fig. 3.4.1.4), the 4th to 7th waterfalls are arranged in a straight line; thus, it seems that they might be seen at a glance near the 4th one, however, the sight from the sky and the scene from the ground are quite different. The distance between Jamlyong Falls and Gwaneum Falls is only 230 feet, but the Gwaneum Falls is not visible under the Jamlyong Falls due to the altitude. If true-view methodology is used in those paintings, how would he create a scene whose composition is not visually

Fig. 3.4.1.4. Aerial Map of Mt. Neyeon.[128]

impossible? The first assumption is that he might have found a vantage spot where he could see all four waterfalls (fig. 3.4.1.5).[129] The next assumption is to collect each drawing of waterfalls and then combine them into a single scene, and the last method is that composing a scene from his impressions and imagination after a climb. To find the answer to the questions as to how Mt. Neyeon and the valley were reproduced, this study created a virtual environment used in the previous chapter. In addition, this chapter tried to find effective

[128] Map source: kakaomap (https://map.kakao.com)

[129] Currently, the government has constructed an observatory at point of 1,000 ft, allowing you to see four waterfalls at a glance.

ways to reproduce natural objects such as rocks, trees, and water flow distributed in the virtual space, especially when playing with VR devices.

Fig. 3.4.1.5. A view of the four main falls from the Sky Bridge. [Photographed by the author in 2019]

Jeong brought the same topic into two different paintings, the first one is a book-type album, the other one is a hanging long scroll. The arrangement of each waterfall in those paintings follows the typical Soochow-school type.[130] This kind of vertical scroll has a reading-order, the story starts from the bottom of a painting, the near distance. The typical composition of Soochow-school style has a bridge at the center and several buildings, such as pavilions. Flora constitutes the middle part, mostly pine trees, and bushes. Subjects in this

130 "The composition follows a familiar Shoochow-school type, in that it is arranged around a valley that winds up the center of the tall, vertical scroll." - comment on Chang Hung (or Zhang Hong 1577–after 1652)'s *Mount Shih-hsieh*, Cahill, James. *The Compelling Image: Nature and Style in Seventeenth-century Chinese Painting*. Cambridge, MA: Belknap Press of Harvard University Press, 1993. pp.8.

area become more delicate than the ones in the near distances and simplification with perspectives is rarely achieved. At the top of the painting, a huge peak always presses down on the entire scene. The subjects in the paintings show that their size does not decrease as we move upward from the bottom of the paintings (this does not happen because we are climbing up the valley). This means that a single-perspective technique which describes as objects smaller when they are receding was not used.

Back to the Jeong's paintings, it is visually impossible to arrange four waterfalls in one scene unless there is a place where all waterfalls can be observed at once. Thus, the rule of his composition followed the technique that arranges the scenes that emerge when he climbed the valley from the entrance. He placed the first falls at the bottom of the paintings and subsequently arranged the following ones. And the sights on the way to the next location were omitted. This composition is an important device that overcomes visual limitations and forms a linear narrative in expressing huge natural objects.

Jeong presented a deliberate way to appreciate the paintings. In the National Museum version, he depicted the falls he saw for the first time at the bottom of the painting, then arranged another four sequentially. On top of the painting, there is a small house. Seemyeong was a small village where slash-and-burn farmers lived once. Jeong visited or recognized the existence of the village. Then, he climbed down through the plank road along the cliff on the right side of the painting. This is a spatial structure that combines the geometric representation of the valley and the itinerary of the climbing.[131] His style within the paintings is a breakthrough for achieving both goals, in the form of a panoramic map of the park and the suggestion of a personal appreciation of the important attractions of the

[131] Cohn, Neil. "Visual Narrative Structure." *Cognitive Science*37, no. 3, (2012).

valley.

3.4.2. Handling Massive Amounts of Environmental Data in Games

Modern computer games have increased the amount and quality of objects that can be expressed in the game space with the development of hardware and software. However, since the ability of the hardware to process a lot of data is always fixed, the speed of the game and the quality of the screen are always inversely proportional. Game developers and computer engineers have developed many technologies to increase the number of scenes that can be reproduced per second without degrading the quality of the screen. Most first-person games ensure the camera and the player's eyes are in the same game space, so the scene played on the game screen is the same as the scene when the player enters the game space. Thus, since the distance that human eyes can recognize and the detail of the shape that can be distinguished are predetermined, the resolution of the shape of the object is based on the distance between the object and the player. Gaming has also developed a technique to lower the reproducibility of objects at a long distance depending on the position of the character. This is called the level of detail at a distance.

This study created Mt. Neyeon in the virtual space; thus, this chapter discusses the reproduction of natural objects in one of the three-dimensional game engines, Unity3D. There are many natural objects handled mainly in the game space, but some of them have been studied in the past. In particular, in the case of trees, intensive research by some program development companies has built programs and materials that produce a similar

feeling to reality. SpeedTree[132] is one of the leading companies providing wood data for game engines and other game companies. Unity3D also equipped the tree-making logic defined by SpeedTree and provides a tool for users to make trees themselves. In this program, the tree consists of branches and leaves, and its shape is decided by a combination of many choices. But as with real trees, the program can make unlimited tree branches if the hardware is capable of rendering all of them, so game designers must determine the number of branches and leaves, considering the details and efficiency of the tree (fig. 3.4.2.1).

Fig. 3.4.2.1. Trees in virtual Cheongha town.

SpeedTree provides a tool that can plant tens of thousands of trees on the terrain in

[132] SpeedTree. “SpeedTree.” Accessed May 01, 2019. https://store.speedtree.com/.

Unity3D. Since all the shapes and leaves of the trees cannot be reproduced, simplified images according to the distance levels are created (fig. 3.4.2.2). This is called the LODGroup component[133] which manages the level of detail for an object in the game. A Billboard asset, pre-rendered two-dimensional simple image of an object by distance, is sent to the LODGroup.[134] It is true that these devices reduce the burden on hardware, but in a

Fig. 3.4.2.2. A view from the distance in which the LOD0 group and the LOD1 group of bamboo trees is separated.

[133] Technologies, Unity. "LOD Group." Unity. Accessed May 01, 2019. https://docs.unity3d.com/Manual/class-LODGroup.html.
[134] Technologies, Unity. "Billboard Asset." Unity. Accessed May 01, 2019. https://docs.unity3d.com/Manual/class-BillboardAsset.html.

game environment where the player needs to travel in an expansive natural environment, the system does not need to reproduce all unnecessary natural objects. Thus, programs have been developed that reproduce the terrain of the nearest place in real-time according to the player's location and have been adopted in almost all first-person games.

The program for this chapter introduced users to the journey which Jeong wanted to achieve in his painting. The virtual valley was created in the same way as the previous chapter, vegetation and rock formation were created based on lots of photographs of the location. To show the subject of this chapter, Mt. Neyeon as a virtual environment through one of the commercially-available virtual reality devices (Oculus, HTC Vive), which is about 50 to 60 percent of the speed when compared to playing through a monitor, managing the performance of the game becomes the main goal. The valley was divided into four sections, according to the subjects depicted in the painting: the first is the area from the entrance of the valley to the first waterfall, Sangsaeng Falls, the second section consists of the main subjects of the painting, Jamlyong Falls to Yeonsan Falls. The third zone is the from Yeonsan Falls to Eun Falls. The last and longest section is to the Seemyeong village (fig. 3.4.2.3). Based on the location of users, the program renders the following zones, respectively, and unnecessary game objects remain disabled. Each zone has invisible collision detectors to monitor users' approaches, this collision detector sends a signal to activate each zone. Compared to the method of lowering the resolution of game objects to increase game speed, this method can dramatically boost the rendering speed of the virtual reality devices. A test was performed in with following condition:

GPU: NVIDIA GeForce GTX 1060 [Direct3D11] with 6,062MB VRAM

CPU: Intel® Core™ i7-8750H CPU @ 2.20GHz

RAM: 8,036 MB RAM

OS: Windows 10 (10.0.0) 64bit

Program: Unity 2018.3.13f1

Screen Resolution: 1,920 x 1,080 – 23.7MB

Maximum Vertex Number: 236millions

Minimum Vertex Number: 9.3millions

Result before the function was not active

Unity status checker: Minimum speed: 8.9 FPS

Unity status checker: Maximum speed: 25.0 FPS

Lite FPS Counter: Minimum speed: 6.7 FPS[135]

Lite FPS Counter: Maximum speed: 16.8 FPS

Result after the function was active

Unity status checker: Minimum speed: 9.2 FPS

Unity status checker: Maximum speed: 34.4 FPS

Lite FPS Counter: Minimum speed: 5.1 FPS

Lite FPS Counter: Maximum speed: 21.5 FPS

[135] Used asset: OmniSAR Technologies, Lite FPS Counter, https://www.omnisar.com/

The valley in Mt. Neyeon is curved a lot unlike other places in Korea, so the scene upstream is hidden by rocks and cliffs. This feature makes it unnecessary to reproduce the distant points of the valley in advance so that only game objects are activated around the users' location.

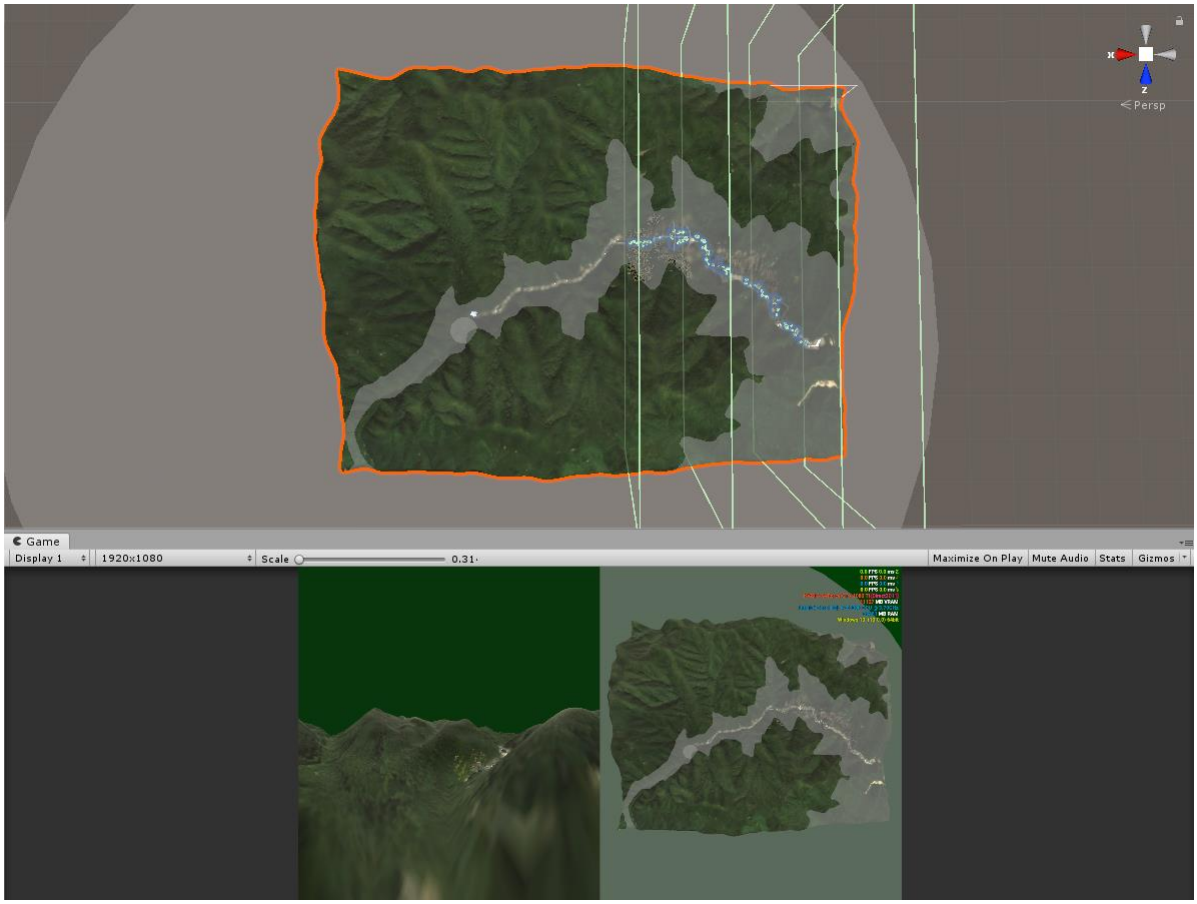


Fig. 3.4.2.3. A map of each section in the valley. Green squares are invisible walls detecting character's approach.

The result gives about 20% improvement in its rendering speed. When the second

zone was inactivated, the rendering speed was increased more than any other areas because the zone has lots of rocks and waterfalls which requires much computational power. This rendering method has helped to improve the efficiency of games exploring large areas, among other things, particularly in the Jeong Seon program, this has helped to solve the problem of the section which as lots of delicate game objects.

Chapter 4

Inquiry into the Composition Method Depending on Selection and Memory in the Production of the Diamond Mountains Paintings

4.1. *The Complete View of the Diamond Mountains*

This chapter analyzed *The Complete View of the Diamond Mountains* using methods other than those used by Black and Dege. Mt. Geumgang, also known as the Diamond Mountains, is the most beautiful place in Korea, and so has long been the subject of painters and poets. The true-view landscape painters, Kang Se-Hwang and Gim Hongdo also visited and

produced many paintings of the Diamond Mountains. Gim produced *Album of the Four Villages of the Diamond Mountains* (geumgangsagunchop, 金剛四君帖, 금강사군첩), which contains 60 paintings of the mountains, under the order of King Jeongjo.

After the Korean War (1950–1953), North Korea possessed the Diamond Mountains and so South Koreans' access to it has been lost for 60 years. North Korea temporarily allowed South Korean tourists to visit the mountains from 1998 to 2008. Most of the photographs and maps used in this study are from this period or before the Korean War.

The Diamond Mountains are located is divided into the inner, the outer, and the sea Geumgang zones. Jeong's *The Complete View of the Diamond Mountains* is of the inner Geumgang zone, which partially opened, making it difficult to precisely investigate the painting's subject. Limited access to the Diamond Mountains made it difficult to get up-to-date information about them.

Jeong produced three different albums of the Diamond Mountains, the second and the third were about 35 years apart. Jeong painted each with a different style. *General View of the Diamond Mountains* (geumgangjeondo, 金剛全圖, 금강전도) depicted the entirely of the Diamond Mountains (fig. 4.1.1). Unlike in his other paintings, in this one Jeong arranged the mountain peaks like a diorama in a geological museum, indicating that his intent was to make a geographically representative product, an ambitious goal for the small size of his paper.

Fig. 4.1.1. Jeong Seon, *General View of the Diamond Mountains*, 1734. Ink and oil on paper, 94.5 cm × 130.8 cm. Leeum, Seoul. [Courtesy of Leeum]

4.2. Multiple Viewpoints of Jeong Seon's Landscape Paintings

Unlike in *Clear Skies after the Rain at Mt. Inwang*, in *General View of the Diamond Mountains* Jeong depicted the thousands of peaks in the area from a bird's-eye view. The mountains' geography as seen from Google Earth shows that Jeong stretched the mountain peaks vertically as he did in many of his paintings (fig. 4.2.1). No single viewpoint was found from which the painting could have been made.

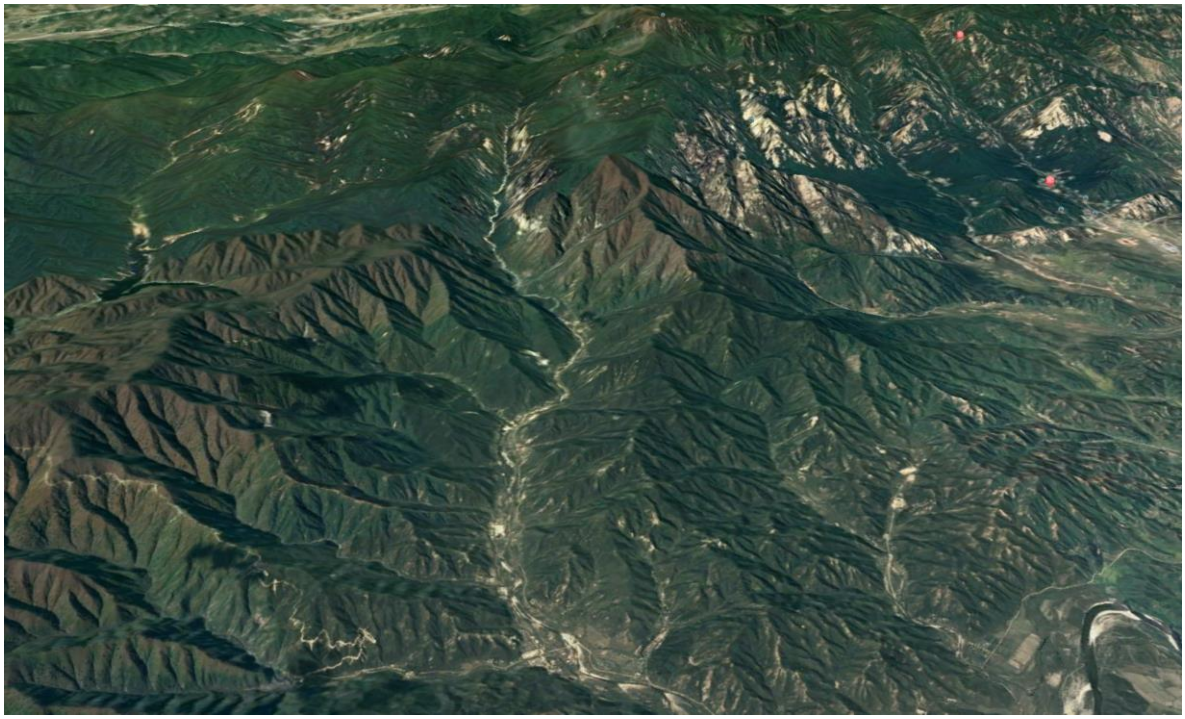


Fig. 4.2.1. View of the Diamond Mountains from a similar vantage point of *General View of the Diamond Mountains* found in Google Earth.[136]

[136] Map data: Google Earth.

Fig. 4.2.2. Jeong Seon. *The Complete View of the Diamond Mountains*, ca.1750. Color on silk, 33.3 cm × 54.8 cm. Order of St. Benedict Waegwan Abbey, Waegwan. [Courtesy of Order of St. Benedict Waegwan Abbey]

Returned Cultural Property Series 1, Album of Jeong Seon, Returned to Waegwan Abbey introduced a detailed study of Jeong's *St. Ottilien Album*. Among them *The Complete View of the Diamond Mountains* was analyzed in detail (fig. 4.2.2). Black and Dege represented two-dimensional map to three-dimensional object to determine the spot from which Jeong could have painted it. They made the mountains in their three-dimensional model 1.5 times higher to make it look more like the painting. A virtual camera was placed at the hypothesized vantage point to determine whether its perspective would resemble the

painting. The resulting scene was compared to the photographs taken by Dege during his visit to the Diamond Mountains. Black and Dege concluded that Jeong had not painted *The Complete View of the Diamond Mountains* from their hypothesized observation point (fig. 4.2.3 (Black's vantage point)). They were ultimately unable to locate Jeong's vantage point because they assumed that he only adopted a single perspective.

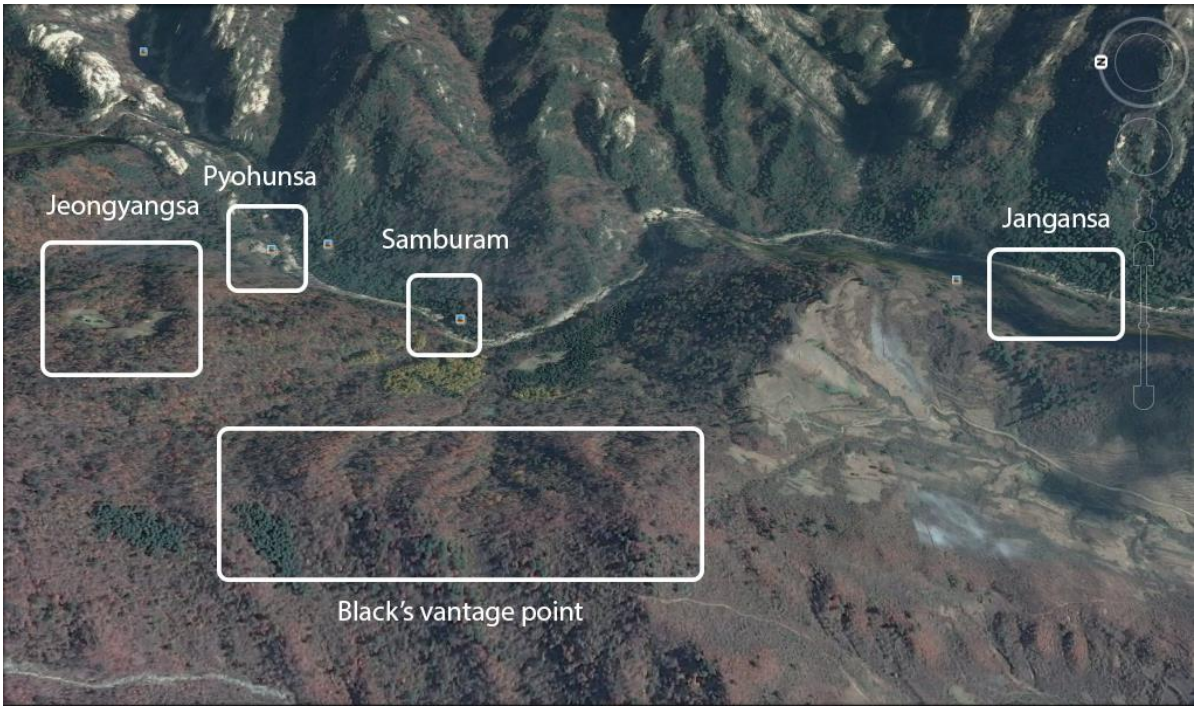


Fig. 4.2.3. The Locations of Jeongyangsa, Pyohunsa, and Jangansa.[137]

Black and Dege's analysis began by identifying the locations of major temples in the painting. There are three major temples and nine Buddhist hermitages in the inner Geumgang zone. Most of the historic sites in the painting were identified based on the map. Black mentioned the existence of Sambulam (fig 4.2.4), a 30 ft tall sculpture of three

[137] Map data: Google Earth.

Buddhas created during the Goryeo dynasty (918–1392). However, there is a 49 ft tall statue of a sitting Buddha (fig. 4.2.5) in the same area which was not mentioned in the writing because it is almost invisible in the painting (fig. 4.2.6). This absence of such a large status indicates that Jeong depicted many things and presented information that is not yet understood. Therefore, this study aimed to extend Black and Dege's research on this painting.

Fig. 4.2.4. Photograph of Sambulam in 1922.[138]

[138] Deogjeon Photostudio (德田寫眞館, 덕전사진관). *A photograph of Sambulam*, Photo album of Mt. Geumgang (金剛山寫眞帖, 금강산사진첩), 1922. Seoul History Archives, Seoul. www.museum.seoul.kr [Korea Open Government License]

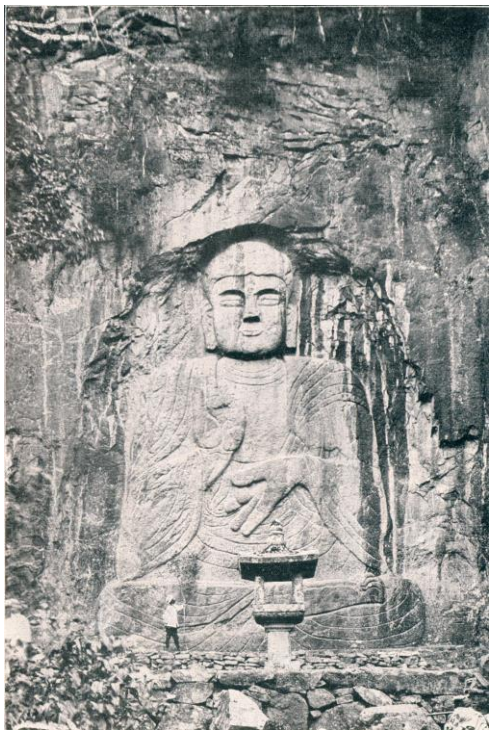


Fig. 4.2.5. Photograph of Myogilsang in 1922.[139]

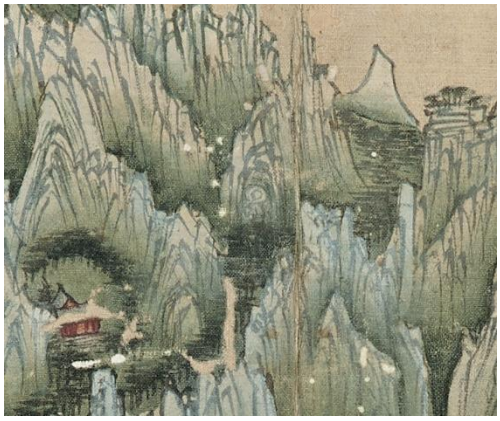


Fig. 4.2.6. Detailed close-up of fig. 4.2.2.

[139] Deogjeon Photostudio (德田寫眞館, 덕전사진관). *A photograph of Sambulam*, Photo album of Mt. Geumgang (金剛山寫眞帖, 금강산사진첩), 1922. Seoul History Archives, Seoul. [Korea Open Government License]

From Western art historians' perspective, having a single viewpoint in a painting is quite normal, so Black assumed that Jeong had painted the Diamond Mountains from a single vantage point:

> A comparison of St. Ottilien's painting of the inner Diamond Mountains with a 1954 US Army Map Service map of the area, indicated that Chông Son might actually have observed what he depicted in his panoramic landscape.[140]

Black identified several hills as the most likely vantage points from which Jeong had painted (fig. 4.2.3). She created a virtual camera with an 86° viewing (fig. 4.2.3 (Black's vantage point)) and concluded that its perspective was not like the painting. The results confirmed that there was a gap between the mountains' appearance in Jeong's painting and their appearance in the topographic map developed and the photographs taken by Dege. In this study, cameras were set at the same point and other places in the virtual environment that Black and Dege set their camera to confirm that it was impossible to have all the painting's subjects contained in a single perspective from that vantage point.

East Asian landscape paintings are conventionally made from multiple viewpoints because they were intended to convey a series of events, unlike Western paintings which aimed to reproduce a painter's perspective. Jeong's paintings can also be considered records of his travels as they may have been the product of several sketches made at different points along his journey through the mountains. For this reason, the peaks' contours resemble those of the actual mountains at some points.

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[140] Black. pp.48

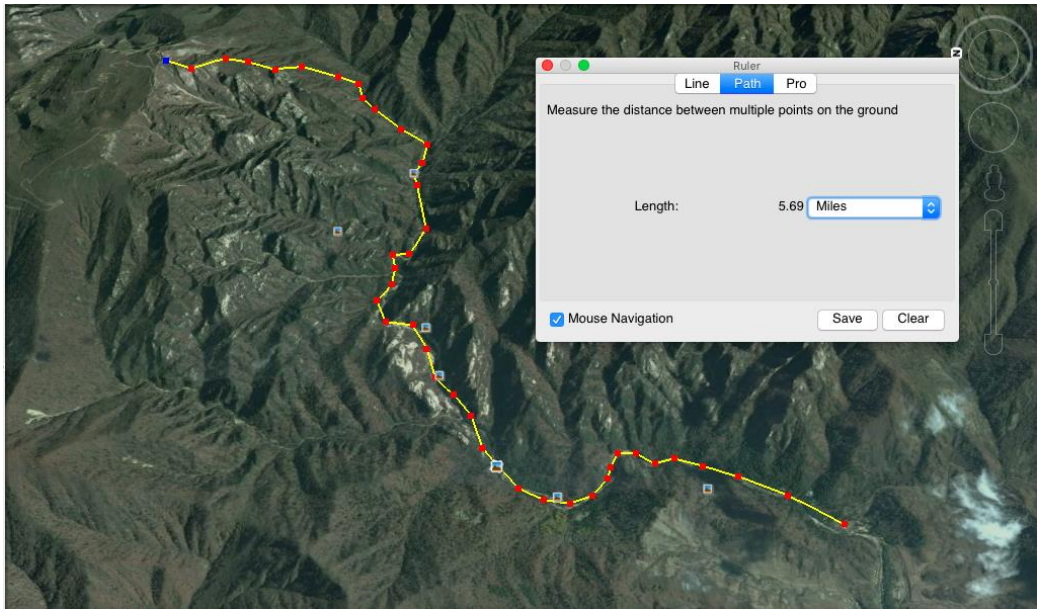


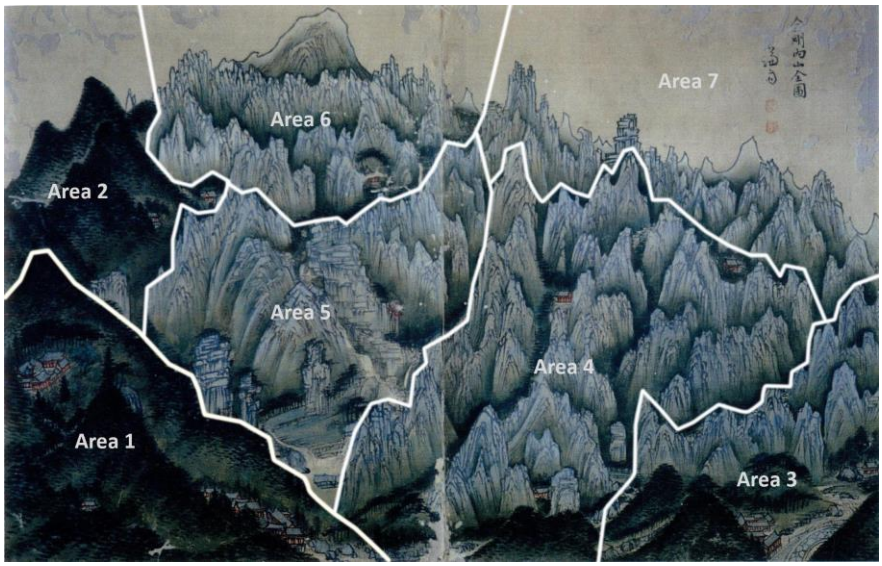
Fig. 4.2.7. Hypothesized travel route to Bilobong Peak.[141]

The journey from the entrance of the inner Geumgang zone to Bilobong Peak is about 5.5 miles (Google Earth) (fig. 4.2.8). Jeong might have stayed in several temples during his exploration of the area and made sketches at interesting spots. His painting indicates that he had enough time to observe his subjects that he was able to realistically represent the peaks' shapes. The weight of the evidence demonstrates that his painting was a combination of perspectives likely recalled from sketches made at different points along his journey. Considering this conclusion, the painting was divided into seven sections to determine where the vantage points were from which part of the painting had been made. The temples and hermitages in the area become reference points in this division.

[141] Map Data: Google Earth

4.3. Representing Selected Areas

The Complete View of the Diamond Mountains was divided into seven zones each of which was hypothesized to have been made from its own observation point (fig. 4.3.1).



Area 1	Jeongyangsa, Pyohunsa
Area 2	Owntongam, Sumiam
Area 3	Jangansa
Area 4	Sambulam
Area 5	Manpokdong
Area 6	Bilobong, Myogilsang, Mahayeon
Area 7	Hyeolmangbong

Fig. 4.3.1. Division of *The Complete View of the Diamond Mountains*.

4.3.1. Area 1: Jeongyangsa and Pyohunsa

There are two temples in the middle of the inner Geumgang zone, both of which are more than 1,500 years old. The arrangements of their buildings provide evidence of their identities when compared with photographs of temples before the Korean War.

Fig. 4.3.1.1. Detailed close-up of fig. 4.2.2.

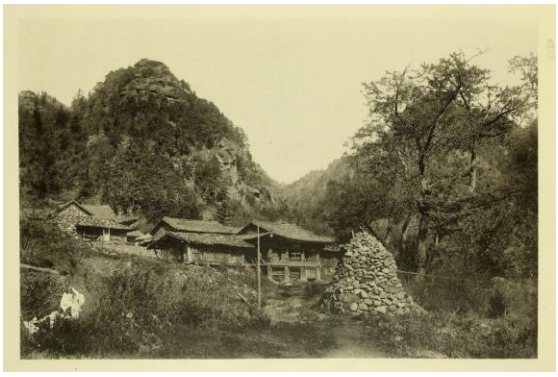


Fig. 4.3.1.2. Pyohunsa in the 1930s.[142]

Part of Pyohunsa was demolished during the Korean War so its current arrangement does not reflect its historical condition. Jeongyangsa was completely demolished, but the layout of its buildings is still known. The distances between Pyohunsa, Jeongyangsa, and Sambulam at the bottom of the painting are accurate relative to the surrounding mountains. The two temples are about 0.28 miles apart, but the painting shows that Sambulam is the same distance from Jangansa as Jeongyangsa is from Pyohunsa despite the fact that the former pair are three times further apart than the latter (fig. 4.3.1.3). Also, Jangansa and Jeongyangsa are located west of the stream that runs from the north to the south while Sambulam is to the east, but in the painting, the river near Jangansa is bent to create a similar image to what he used before. This modification interfered with Black's vantage-point analysis because a singular vantage point would have to have included all four major historic sites.

[142] The Governor-General of Chosen (朝鮮總督府, 조선총독부). *Album of Old Treasures in the Joseon* (joseongojeokdobo) vol. 12. 1934, Gyeongseong: Governor-General of Chosen. National Research Institute of Cultural Heritage. www.nrich.go.kr [Korea Open Government License]

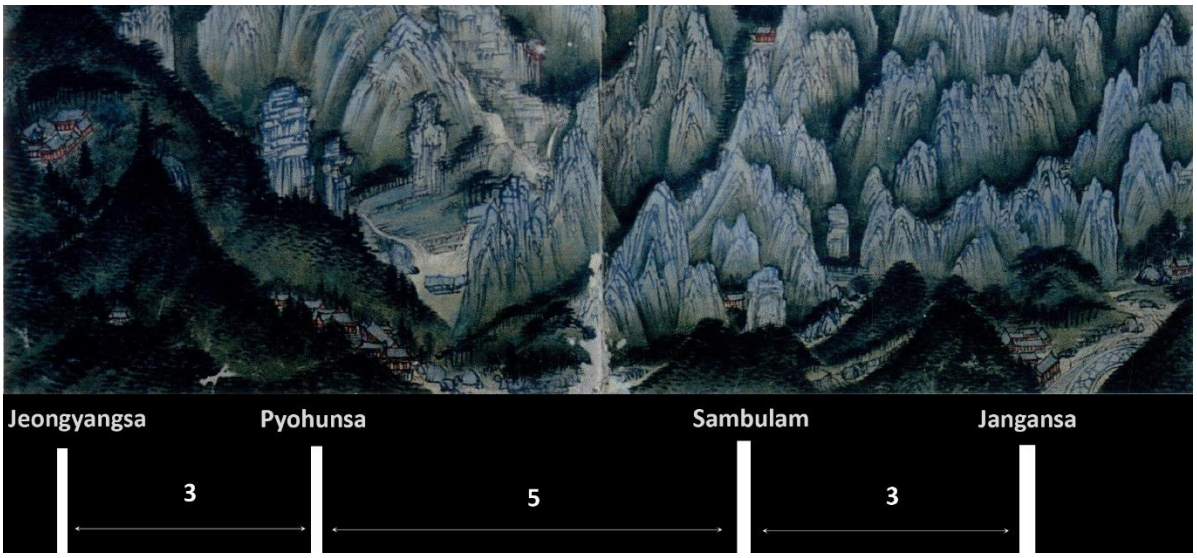


Fig. 4.3.1.3. Distance between the four reference points in the painting.

When Black and Dege performed this research, it was almost impossible to accurately know the geography of the Diamond Mountains because she largely had to rely only on the Dege's photographs. However, Google Earth now allows for the entire area to be viewed in detail. Black's methods were reproduced in this study on three-dimensional geographic data of the Diamond Mountains in Unity3D. The terrain height was scaled up by from 1.5 to 4 times and the screen resolution was set to 1,096 x 666 to mimic the painting's height-to-width ratio at 33.3 cm × 54.8 cm. A translucent version of the painting was overlaid on the screen to visually compare it with the three-dimensional rendering. Hundreds of trials found a likely viewpoint from Jeong had painted the Jeongyangsa and Pyohunsa area was the hill behind Sambulam (fig. 4.3.1.4 (blue circle)). The virtual camera image size was reduced from 100% to 40% to make its scale similar to that of Area 1. The position of

the image moved to bottom-left which corresponded to Area 1 with a fixed field of view of 86° to find the vantage point for Area 1 (fig 4.3.1.5).

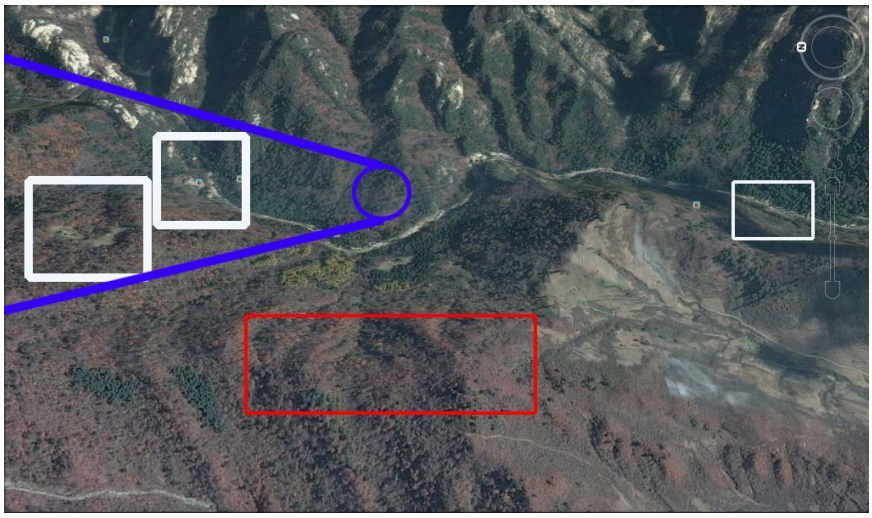


Fig. 4.3.1.4. The vantage point of Area 1 and its angle of perspective.[143]

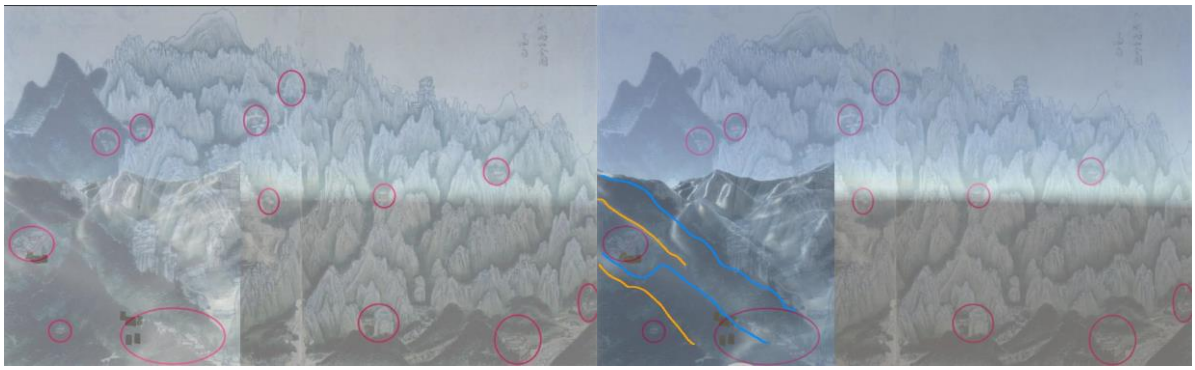
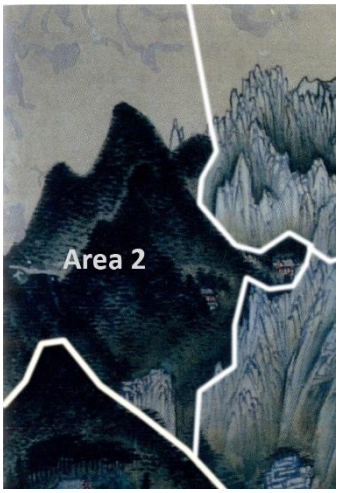


Fig. 4.3.1.5. The translucent painting overlaid on the three-dimensional rendering with an alpha value of 0.7 / 0.5. The blue line highlights the ridgeline in the painting, and the orange line highlights the ridgeline in the virtual terrain.

[143] Map data: Google Earth.

The red circles in the fig. 4.3.1.5 indicate the major historic sites which Jeong depicted in his painting. Dummy objects were placed in the virtual space to determine how precisely the location of the temples in Jeong's painting corresponded to their actual locations. The first trial of the vantage spot was near the Sambulam and Jeongyangsa. The analysis showed that the two ridge lines surrounding Jeongyangsa and Pyohunsa were from Banggwangdae (3,484ft). Although the ridge lines do not overlap precisely in the painting, it is clear that Jeong understood and the realistically depicted the topography around the two temples.

4.3.2. Area 2: Owntongam and Sumiam



In the top left of the painting are mountain peaks with lots of greens, differentiated from the rocky peak. Two historic sites in Area 2, Owntongam and Sumiam, were ruined after the Korean War, such that only sites are visible on Google Earth. The area has never been opened to South Koreans since the Korean War so not much is known about it. Jangansa and Jeongyangsa were relatively large temples, the ruins of which are clearly visible on the Google Earth. The size of the hermitages made them hard to find.

Fig. 4.3.2.1. Sin, Igseong (attributed). *Wontongam,* ca.1620. Ink on paper, 26.7 cm × 43.8 cm. National Museum of Korea, Seoul. [Korea Open Government License]

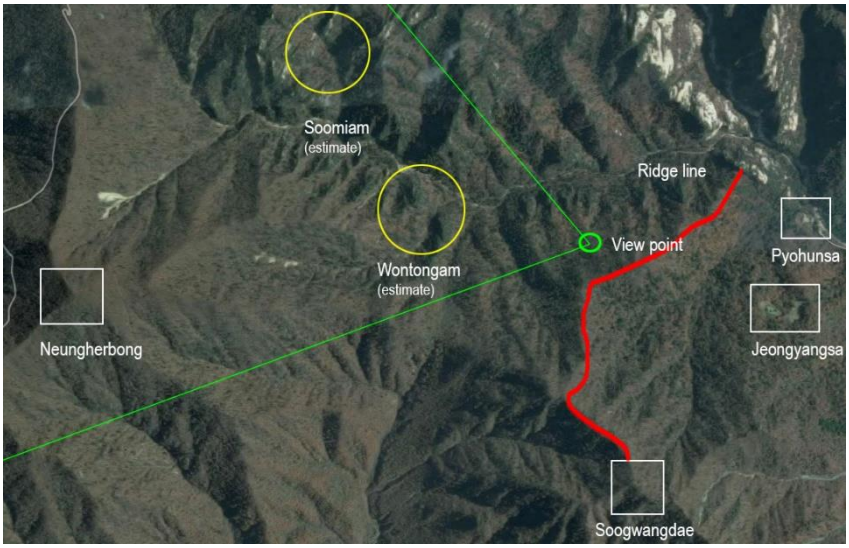


Fig. 4.3.2.2. Hypothesized view from the Area 2 vantage point.[144]

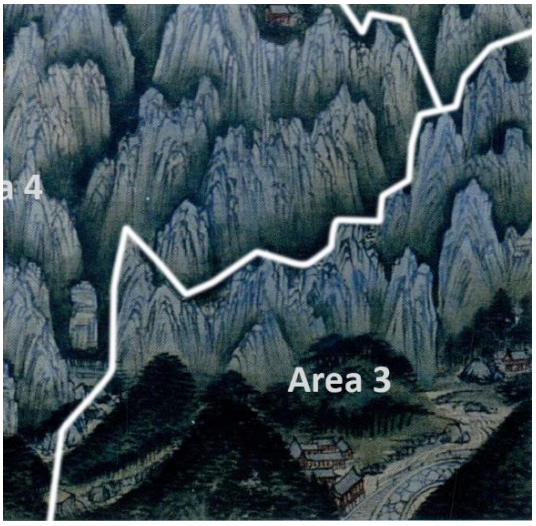
144 Map data: Google Earth.

Fig. 4.3.2.3. Rendered scene as viewed from the hypothesized vantage spot for Area 2 and the overlaid painting.

Fortunately, Sin, Igseong visited and painted Owntongam (fig. 4.3.2.1). The researcher was able to assume its appearance through his painting. But a small stream flowing, and cylindrical rock gave the researcher a clue to track the location of the hermitage. The other hermitage's location was estimated using three reference points, including Neungherbong (4,776ft) in the translucent painting that overlaid the three-dimensional rendering (fig. 4.3.2.3).

However, to match the three reference points (Neungherbong, Sumiam, and Owntongam) in the virtual environment to the historic spots depicted in the painting, the viewing angle had to be narrowed from 86° to 60° and the vertical scale had to be increased from 1.5 to 2.0 times. Narrowing the viewing angle reduced the distance between Neungherbong and Wontongam but caused Sumiam to move further from Wontongam. Thus, the vantage point should be one of the peaks between Jangansa and Wontongam (fig. 4.3.2.2).

4.3.3. Area 3: Jangansa



Jangansa was located at the entrance to the inner Geumgang zone. It was built in the 6th century by the Buddhist monk Haeryang and was one of the four largest temples in the Diamond Mountains (fig. 4.3.3.1).[145] However, it was completely devastated during the Korean War such that none of its structures remain. Jeong painted Jangansa three times. *Jangansa Temple* in 1711 help illustrates differences in his style over time (fig. 4.3.3.2).

Fig. 4.3.3.1. Jangansa in the 1930s.[146]

[145] You Hong June, *My Essay on the Exploration of Cultural Heritages*, vol.5. Seoul: Changbi, 2012.
[146] The Governor-General of Chosen (朝鮮總督府, 조선총독부). *Album of Old Treasures in the Joseon* (joseongojeokdobo), vol. 12. 1933. [Korea Open Government License]

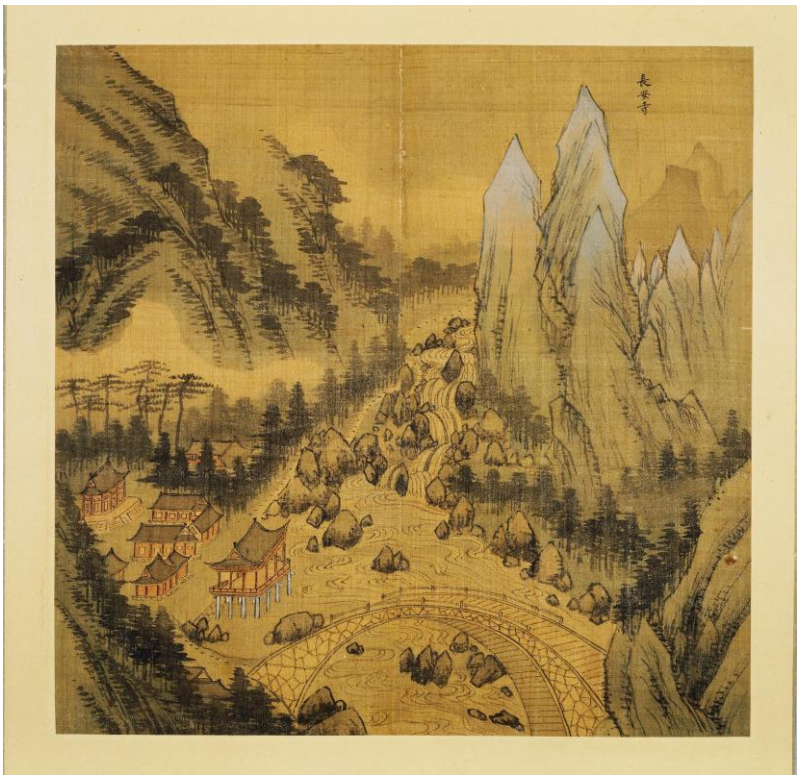


Fig. 4.3.3.2. Jeong Seon, *Jangansa Temple*, 1711. Color on silk, 35.6 cm × 36.0 cm. National Museum of Korea, Seoul. [Korea Open Government License]

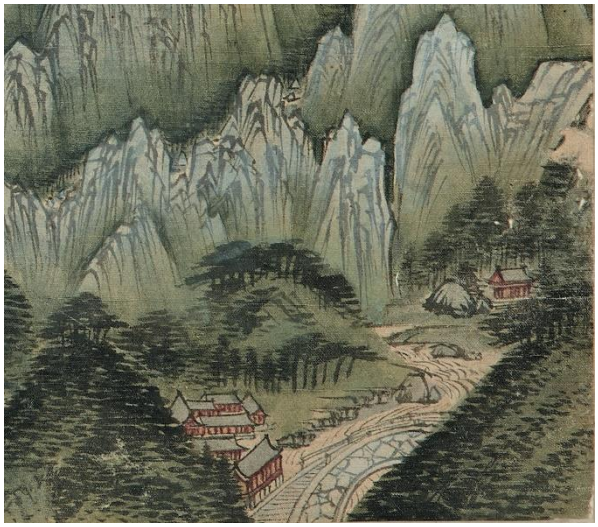


Fig. 4.3.3.3. Detailed close-up of fig. 4.2.2.

Jeong's Jangansa paintings have the same composition. He placed the temple in the bottom-left corner of the painting, drew the Jangandong river flowing from the top of the painting to the bottom, and depicted the Bihonggyo bridge at the bottom because he believed that the bridge was the main gate to the Diamonds Mountains. Bihonggyo manifests the dramatic changes in Jeong's style over his life. Unlike its symbolic meaning as the entrance, the bridge was drawn without accurate representation and from several perspectives (figs. 4.3.3.2 and 4.3.3.3) to the point that both its top and bottom are visible. Park insisted that Jeong had compromised his perspective after being introduced Western perspectives through Japanese engravings.[147] Although he learned about the line perspective, he did not implement it correctly. *Jangansa Temple* (fig. 4.3.3.2) has a vanishing point on the ⅔ of the height of the painting, and the lines of the temple buildings' roofs are parallel, not going to the vanishing point, in contravention of the one-point perspective. This ignores optical principles in the Western paintings.[148] In another painting of Jangansa, he made three years later, he put the vanishing points in the center of the painting (fig. 4.3.3.4). This relocation of the vanishing point stabilized the painting's line perspective, and he did not draw the bottom and up sides of the bridge at the same space.

Jeong precisely painted the shape of the peaks around Jangansa (fig. 4.3.3.3) such that they match the virtual (fig. 4.3.3.5). The observation point for this area is in the middle of the river, putting the bridge in the center of the image. However, *Jangansa, Bihonggyo* was created from a different vantage point on the hill next to the temple and depicts the

147 Park Eunsoon. "Jeong Seon's True-view Landscape Painting and the Western Influences." *Korean Journal of Art History*, No.281, Art History Association of Korea. (2014): 79.
148 Krikke, J. "Axonometry: A Matter of Perspective." *IEEE Computer Graphics and Applications* 20, no. 4 (2000): 7-11.

bridges and buildings from another angle, demonstrating that at least two vantage points for the temple and the bridge were used to make the Area 3.

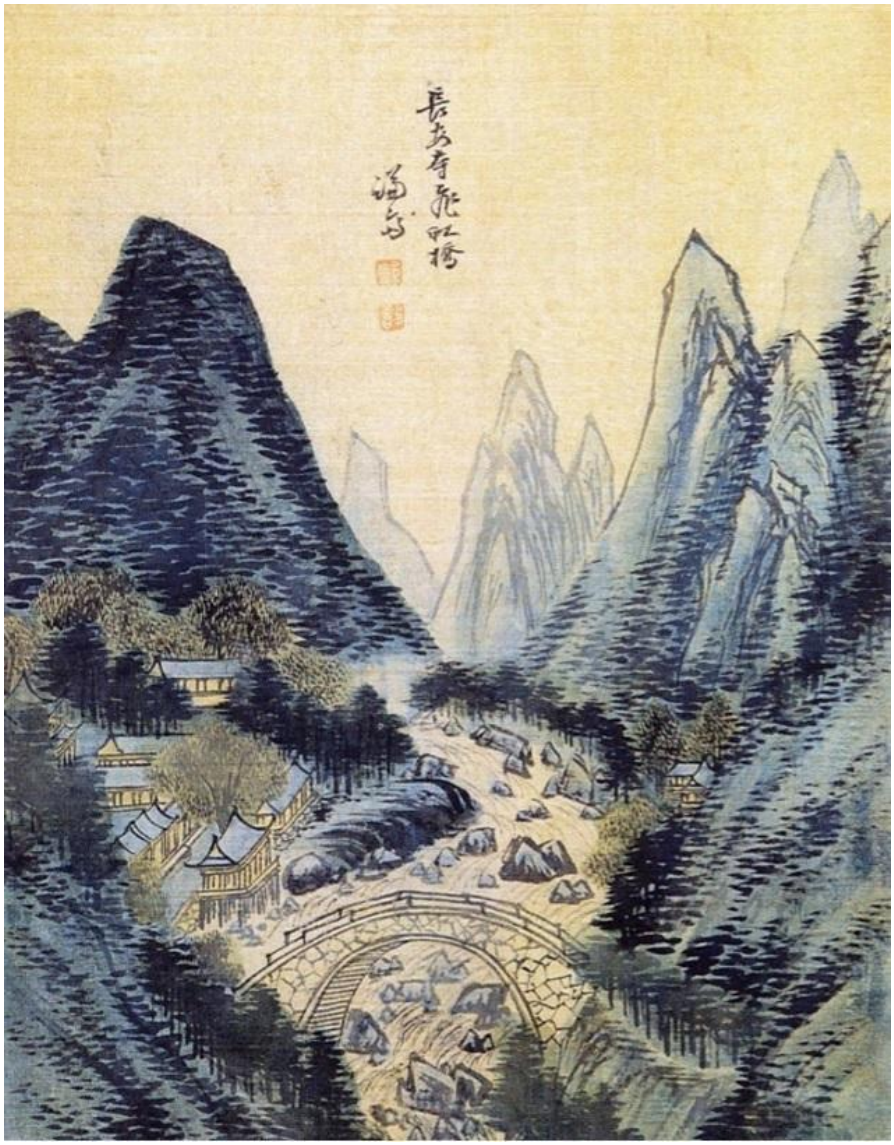
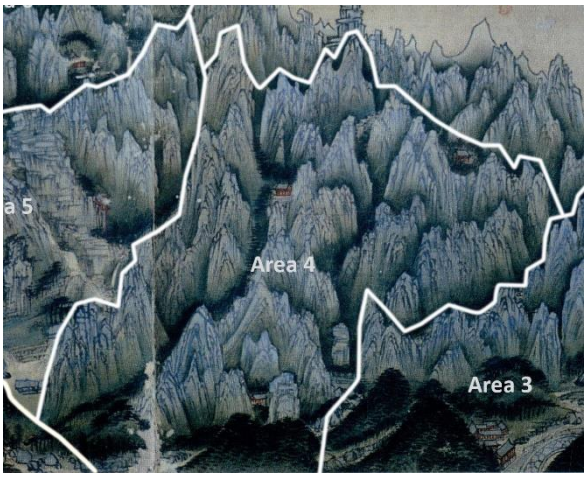


Fig. 4.3.3.4. Jeong Seon. *Jangansa, Bihonggyo,* 1714. Ink and light color on paper, 24.0 cm × 32.1 cm. Kansong Art and Culture Foundation, Seoul. [Courtesy of Kansong Art and Culture Foundation]

Fig. 4.3.3.5. The scene rendered from the perspective of a virtual camera at the Area 3 vantage point and the translucent painting overlaid.

4.3.4. Area 4: Sambulam



The three notable features depicted in Area 4 are Sambulam, 26 ft tall stone sculpture (fig. 4.2.5), Myeonggyeongdae, a huge rock in the middle of the valley (fig. 4.3.4.1), and the Yeongwonam hermitage (fig. 4.3.4.2). There is an interesting story behind Sambulam:

> Naong, head of Jangansa, was looking for his successor. Kimdong was staying at Pyohunsa. Naong suggested that Kimdong take his position but only under the condition that he was victorious in a competition. He had to carve the rock between the two temples. Naong made three huge sculptures of Buddhas, while Kimdong made 60 small sculptures.

The priests of both temples unanimously judged Naong the winner, causing Kimdong to commit suicide by jumping from a waterfall.[149]

This story can be a metaphor for the power struggle between the two temples. Toghon Temür, the last emperor of the Yuan dynasty supported the renovation of Pyohunsa in 1338 while the empress supported the restoration of Jangansa between 1343 and 1345. Myeonggyeongdae is a rectangular, box-shaped rock. Yeongwonam was founded by the Buddhist priest Yeongwon in the Silla and expanded in 1690.

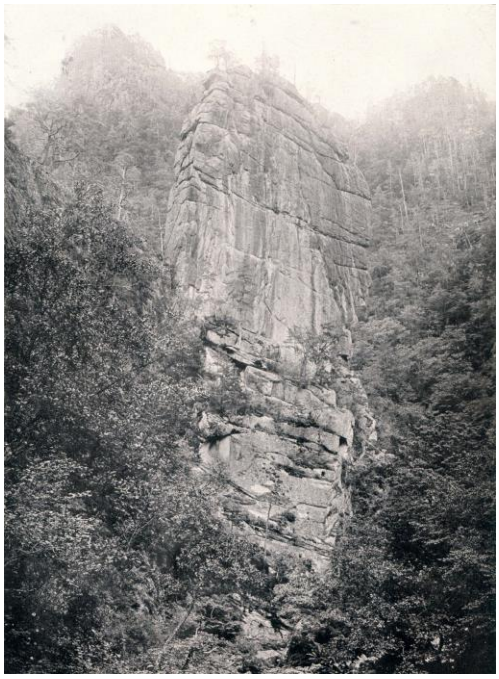


Fig. 4.3.4.1. Photograph of Myeonggyeongdae in 1922.[150]

[149] You Hong June, *My Essay on the Exploration of Cultural Heritages*, vol.5. Seoul: Changbi, 2012.
[150] Deogjeon Photostudio (德田寫眞館, 덕전사진관). *A photograph of Sambulam*, Photo album of Mt. Geumgang (金剛山寫眞帖, 금강산사진첩), 1922. Seoul History Archives, Seoul. www.museum.seoul.kr [Korea Open Government License]

Fig. 4.3.4.2. Photograph of Yeongwonam.[151]

If the three locations were painted accurately according to their locations, Yeongwonam would be the highest place at 3,000 ft near Jijangbong (fig. 4.3.4.3 (3)), Myeonggyeongdae would be 0.7 miles down through the valley (fig. 4.3.4.3 (2)), and Sambulam would have to be down the valley and to the west (fig. 4.3.4.3 (1)). These locations would mean that Area 4's observation was a peak to the west of Sambulam. Thus, it would appear that Black's vantage point (fig. 4.3.1.4) was correct for Area 4.

151 The Governor-General of Chosen (朝鮮總督府, 조선총독부). *Album of Old Treasures in the Joseon* (joseongojeokdobo), vol. 12. 1933. [Korea Open Government License]

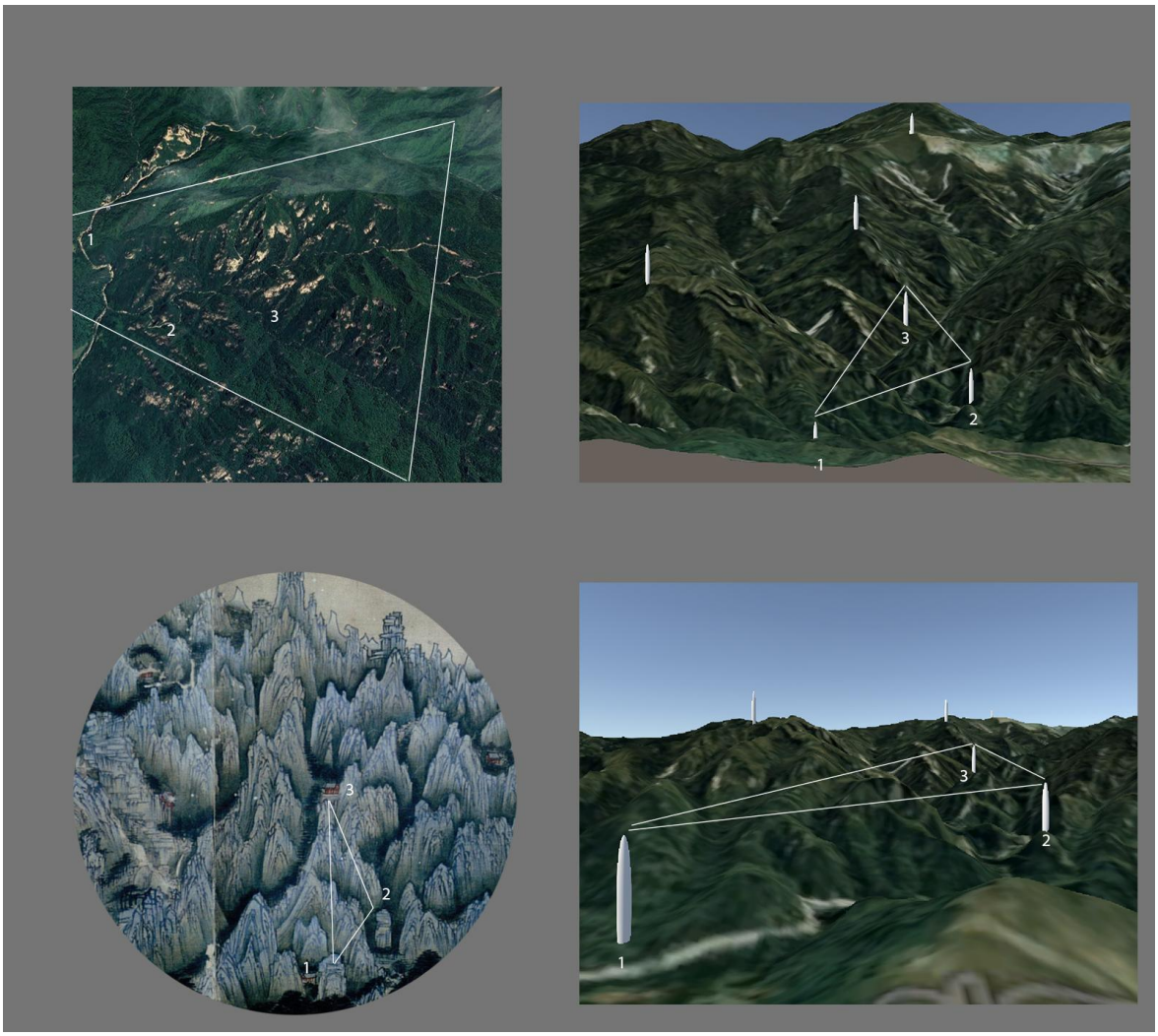
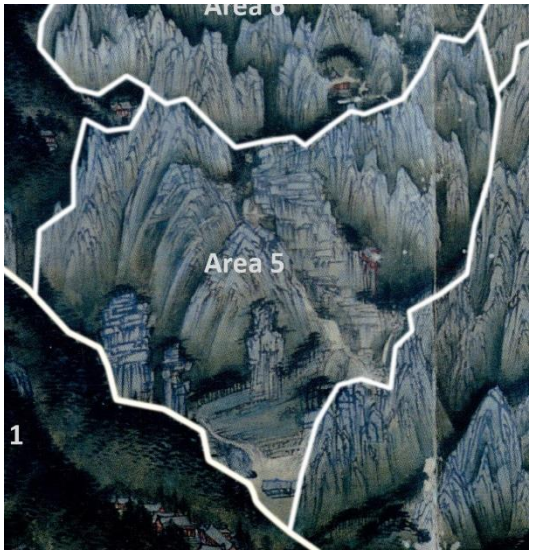


Fig. 4.3.4.3. Comparison of the positions of the three viewpoints from different perspectives of Area 4: top left: Black's vantage point, top right: the orthographic perspective at the vantage point, bottom left: a part of the painting, bottom right: a single perspective at the vantage point. 1: Sambulam, 2: Myeonggyeongdae, 3: Yeongwonam.

4.3.5. Area 5 – Manpokdong



Manpokdong valley is the most beautiful place on the inner Geumgang zone and is home to dozens of waterfalls and pools. It is about two miles long and features large rock at its end where it merges with the Wontongdong valley. The rock is called Geumgangdae and is the subject of many paintings, including two of Jeong's paintings (figs. 4.3.5.1 and 4.3.5.2).

The other notable feature of this area is the Bodeokam hermitage. It was built in 627 inside of a natural cave by the Buddhist monk Bodeok. Hoejoeng later re-established it as a temple. In Jeong's painting, he placed Geumgangdae at the bottom of the painting and illuminated the entire valley until it curved after Bodeokam (fig. 4.3.5.2). The valley is straight between Bodeokam and Geumgangdae, so it appears in both paintings as it does in real nature. Jeong might have stood on a hill south from Geumgangdae as indicated by the small triangle slide he left in the lower-left corner of *Bodeokgul*.

Dege took a picture of the hypothetical observation point from Bodeokam. Dege's hypothesized observation point of *The Complete View of the Diamond Mountains* and the upper part of Geumgangdae can be seen from Bodeokam, but Bodeokam is not visible from Geumgangdae because of the altitude. Thus, Jeong's observation point was one of the peaks

as such a location would have been high enough to see both Geumgangdae and Bodeokam at the same time.

Fig. 4.3.5.1. Jeong Seon. *Manpokdong,* year unknown. Ink and light color on paper, 56.0 cm × 42.8 cm. Kansong Art and Culture Foundation, Seoul. [Courtesy of Kansong Art and Culture Foundation]

Fig. 4.3.5.2. Jeong Seon. *Bodeokgul,* 1711. 36.1 cm × 26.1 cm, Ink and light color on silk. National Museum of Korea, Seoul. [Korea Open Government License]

The two ridges surrounding the Manpokdong valley are well represented in his painting, but the position of the Mahayeon is slightly moved to the right (fig. 4.3.5.3 (red circle)). Jeong's composition of Manpokdong valley was maintained among the several paintings. The observation spot should be in a straight line with the flow direction of the valley to capture the Bodeokam and Geumgangdae the same time. Therefore, the

observation point of Area 5 was the middle hill between the Pyohunsa and the entrance of Manpokdong valley, similar to the vantage point of *Manpokdong*.

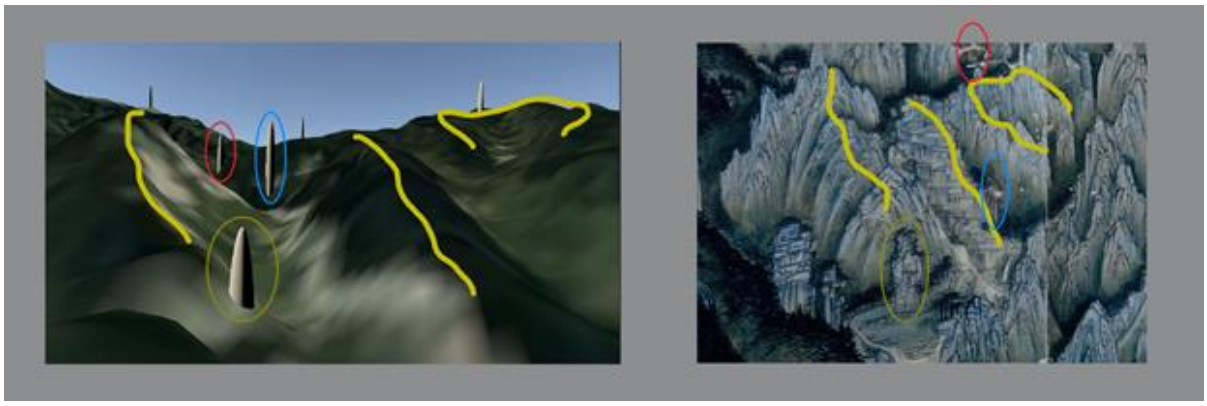


Fig. 4.3.5.3. Comparison of the view at the hypothesized vantage point and Area 4 in the painting: yellow circle Geumgandae, blue circle: Bodeokam, red circle: Mahayeon.

4.3.6. Area 6 – Bilobong

At 5,374 ft, Bilobong is the highest peak in the Diamond Mountains and is the most central peak in the area besides Yeongrangbong, the lesser peak next to Bilobong. Weather permitting, Bilobong is visible from anywhere in the Diamond Mountains and is

even visible from South Korea 20 miles away. Considering its high visibility, it is difficult to determine where Jeong observed Bilobong from based on its appearance in his painting. However, it is highly likely that he depicted the view from the south because the overall shape of the peak is a gentle plateau at the north while it constitutes with complicated rock walls on the south.

Jeong painted Bilobong consistently manner in his paintings, the appearance of the two peaks, and the lack of data about the area, it is impossible to know whether these depictions were based on observations or memories and sketches (fig 4.3.6.1).[152] If his paintings of Bilobong were based on direct observations, there are several vantage points from which he may have done so. Sejonbong is located 0.9 miles northeast of Bilobong and is a famous place for observing Bilobong. North Korea opened this area to tourists, so there are relatively current photos of Bilobong from Sejonbong. From this perspective, Bilobong appears wide with the other two peaks in front of it.[153] Sejibong is located 4 miles to the north of Bilobong and presents a view of Bilobong that is more consistent with its appearance in the painting than the view from Sejonbong. Hyeolmangbong is located 2 miles to the south, and the view from here gives clear rocky castle of Bilobong. Jeong liked to depict the peaks around Bilobong as walls surrounding a castle, a perspective similar to that available from Sejibong. However, nearby peaks are about as tall as Bilobong, but they do not look as tall in the painting because of the distance from which they were observed.

[152] North Korea did not open only Bilobong to tourists during in the opening period of the Diamond Mountains.
[153] Cowboy. "카우보이 자유를날다." 블로그 홈. Accessed May 07, 2019. http://blog.daum.net/_blog/BlogTypeMain.do?blogid=0A5nh.

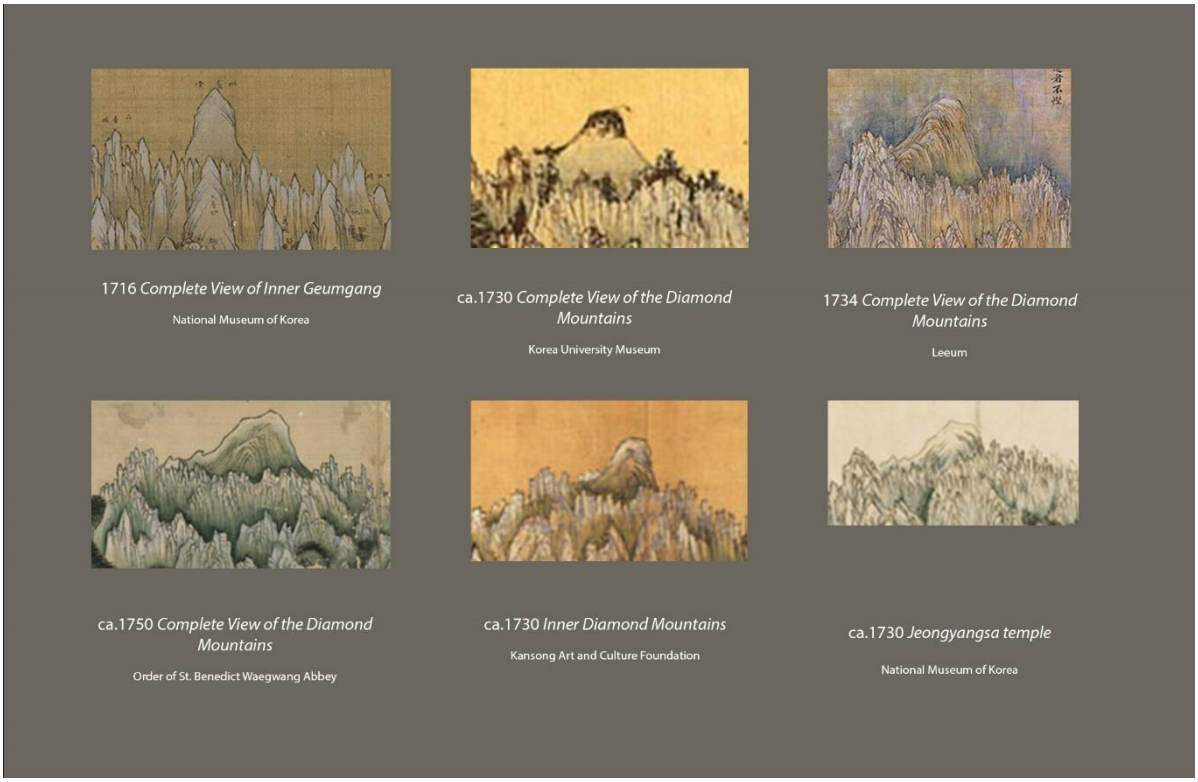


Fig. 4.3.6.1. Bilobong, as depicted in various paintings of Jeong Seon.

Myogilsang is located a mile south from Bilobong It is a 130 ft tall sculpture of Buddha carved into a cliff in the Manpogdong valley during the early Goryeo Dynasty (fig. 4.2.6). It is 50 ft tall and 30 ft wide and has a 10 ft tall face. The sculpture delicately and clearly depicts the shape of Buddha. The painting by Um Chiwook, a student of Gim Hongdo, shows the rough atmosphere of the sculpture (fig. 4.3.6.3).

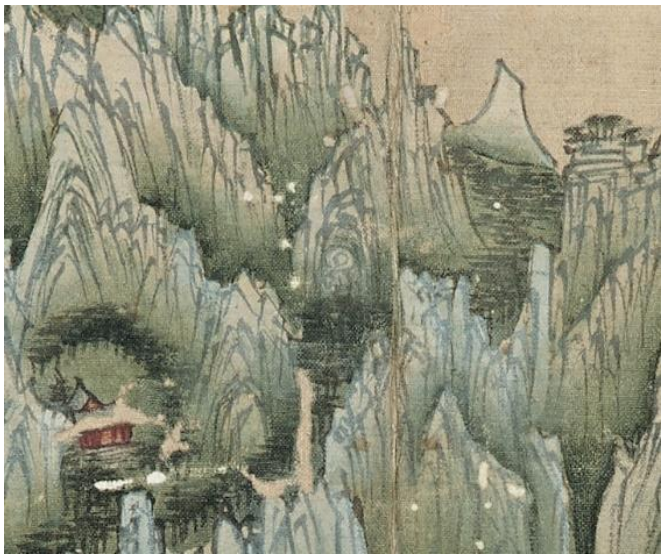


Fig. 4.3.6.2. Detailed close-up of fig. 4.2.2.

Fig. 4.3.6.3. Um, Chiwook, *Myogilsang*, year unknown, Ink on paper, 27.9 cm × 38.8 cm. National Museum of Korea, Seoul. [Korea Open Government License]

Fig. 4.3.6.4. Anonymous. *A photograph of the Mahayeon temple*, The Japanese colonial era. 11.9 cm × 16.4 cm. National Museum of Korea, Seoul. [Korea Open Government License]

The building located just below Myogilsang in the painting is the Mahayeon temple, built in 676 by the great Buddhist monk, Uisang, after the construction of Buseoksa temple (fig. 4.3.6.4).[154] However, it was destroyed during the Korean War. Mahayeon and Myogilsang are located in different valleys, so it is unlikely that there is a place where both places visible at the same time. Thus, it is likely that Jeong visited both places but unlikely that he painted them from direct observation. No likely observation point was found for Area 6 due to a lack of data. However, the observation point only for the Bilobong, it is most likely to be the Hyeolmangbong or Neungherbong from the south (fig. 4.3.6.5).

154 Encyclopedia of Korean Culture (한국민족문화대백과사전), *Mahayeon* (마하연), Accessed May 04, 2019. http://encykorea.aks.ac.kr/.

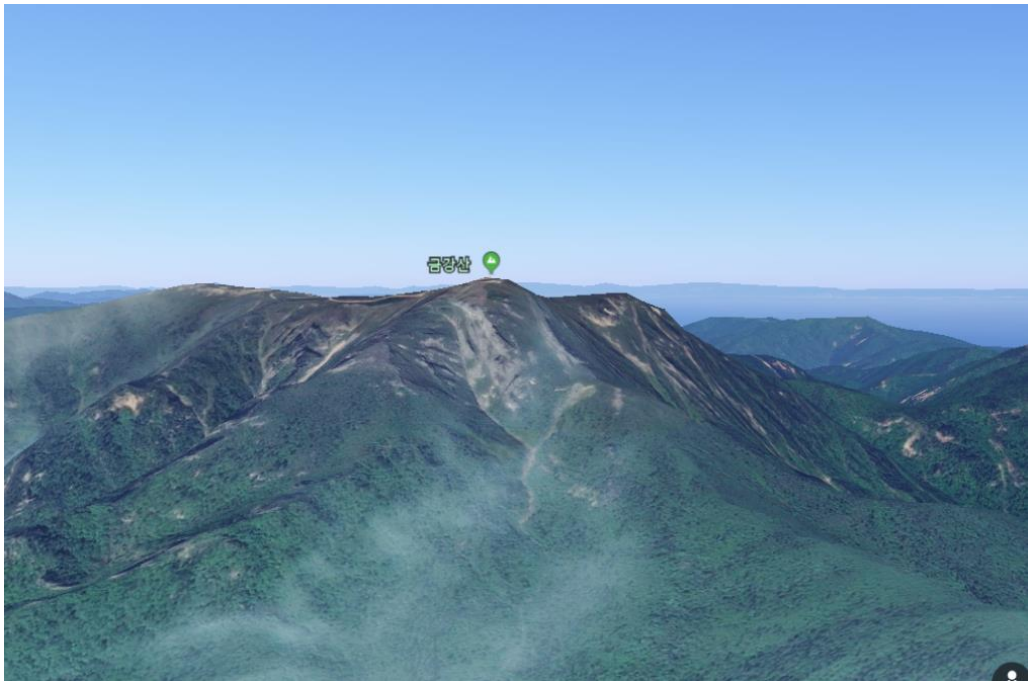
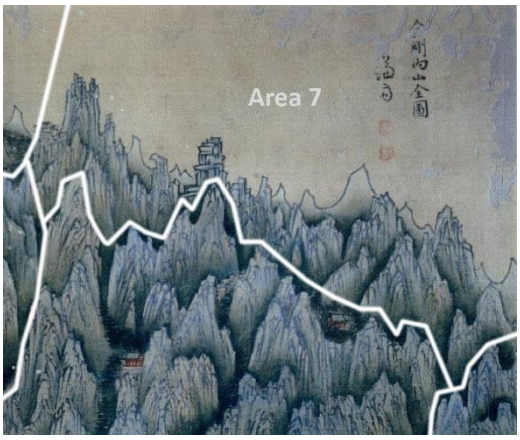


Fig. 4.3.6.5. View of Bilobong from Hyeolmangbong.[155]

4.3.7 Area 7: Hyeolmangbong



Hyeolmangbong, Manggundae, and Cheonhwabong are the three major peaks in this area, located in the inner Geumgang zone. One of Jeong's paintings of Hyeolmangbong still survives today in which he depicted several peaks that rise

[155] Image source: Google Earth. https://earth.google.com/web/@38.65444923,128.10761628,1419.08974542a,2427.07606354d,35y,-35.07191364h,84.99537063t,-0r

sharply in the center, the left-most of which is covered in trees. Considering the similarity of the appearance of Hyeolmangbong in its sole painting and *The Complete View of the Diamond Mountains,* the left one in the fig 4.3.7.1 is Hyeolmangbong.

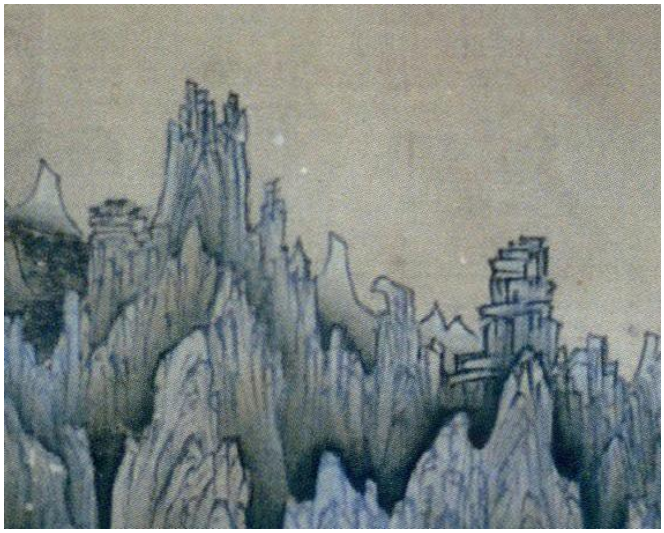


Fig. 4.3.7.1. Detailed close-up of fig. 4.2.2

Hyeolmangbong, Myogilsang, and Yeongwonam get into line, but Hyeolmangbong is shown to be further away from the other two historic sites in the painting. There were no accurate maps at the time that Jeong was painting, so it would have been difficult to accurately paint these three places through empirical experience has given how different they appear in perspective. Given that a peak was included in *Hyeolmangbong*, it was likely painted from Sibwangbong, a peak to the south. He placed the Yeongwonam temple in the bottom-right corner of the painting and the Maebawi peak on the left. There is little data available about these two peaks, so it was impossible to make an accurate judgment.

Therefore, there is no observation point covering this area, and he painted the peaks based on his observation or memories in the approximate position in the painting.

4.4. Jeong Seon's Understanding of the Geographical Characteristics of the Diamond Mountains

In October 2018, the Korean Studies Institute discovered and announced the existence of seven of Jeong's paintings of the Diamond Mountains. The paintings were approximately 30 cm x 40 cm and had "Bilobong," "Bihonggyo," "Mahayeon," "Jeongyangsa," "Bodeokgul," "Guryongpogpo," and "Danbalnyeong" written on them, respectively.[156] There is no other information about these paintings. Each of the places depicted in these paintings is similar to portions of his paintings of the Diamond Mountains, so these paintings are believed to have been based on his larger paintings.

This recent discovery indicates that Jeong's paintings were produced based on several sketches. He climbed to almost every famous spot in the valley and so familiar enough with his subjects to draw. The findings of Black's observation point experiment can be applied to some extent to these paintings. Especially, Areas 4 and 5 contain the most beautiful parts of the inner Geumgang zone, and the vantage points from which Jeong painted the area and Black's hypothesized observation point was identical. Black and Dege could not present conclusive findings for rest of the areas because Dege was only permitted

[156] The Korean Studies Institute (한국국학진흥원), "Discovery of Gyeomjae's the Diamond Mountains paintings." Accessed May 04, 2019. http://www.koreastudy.or.kr/pub/pubMain.do. 2018.

to photograph a limited area. Therefore, there was room for further research on Jeong's vantage points.

Jeong traveled the Diamond Mountains more than three times (1711,1712, and 1747) each trip produced an album of the mountains which has more than ten paintings.[157] Every time he traveled, hundreds of sketches of the memorable locations were produced. These independent paintings, which depict the outstanding scenery in the Diamond Mountains, reveals a deep understanding of the subjects that appeared after his closer observation.

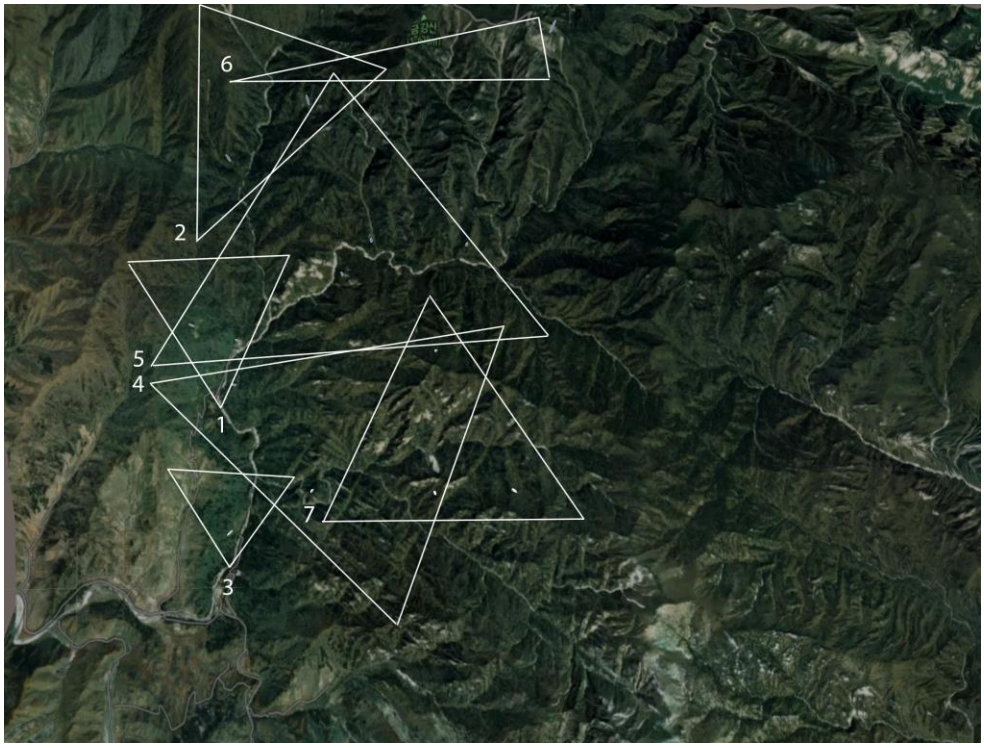


Fig. 4.4.1. Hypothesized vantage points and viewing angles from which *The Complete View of the Diamond Mountains* was painted.[158]

[157] Lee, Soyoung, Ahan Daehoe, Chin-sung Chang, and Lee Soomi. *Diamond Mountains - Travel and Nostalgia in Korean Art.* New York: Metropolitan Museum of Art, 2018. pp.15.
[158] Map data: Google Earth.

However, he did not introduce his true-view technique when he made large scale paintings. Instead, he preferred to produce paintings of the inner Geumgang zone from the perspective of a story teller more than the map maker. Despite the difference of 35 years, the paintings he drew the subject have almost similar compositions (fig. 4.4.2). The beginning of the story starts at the bottom-right of the painting, Jangansa, and the audience is guided through Sambulam and Jeongyangsa, and Manpokdong. It finally reaches Bilobong. This composition was maintained during his life without further changes. This configuration means that Jeong has started true-view movement in his paintings, but he had focused more on an empirical understanding of the space than on scientific analysis. His conservative painting style has not exceeded objectivity to subjects, thus, several steps of modification needed to compare his paintings with the actual scene of terrain. Jeong is too early to complete the realistic scenery within the perspective of Western paintings. Gim Hongdo was born 14 years before his death and continued to Jeong's true-view movement, and his paintings are complete what Jeong was pursuing a more elegant way.

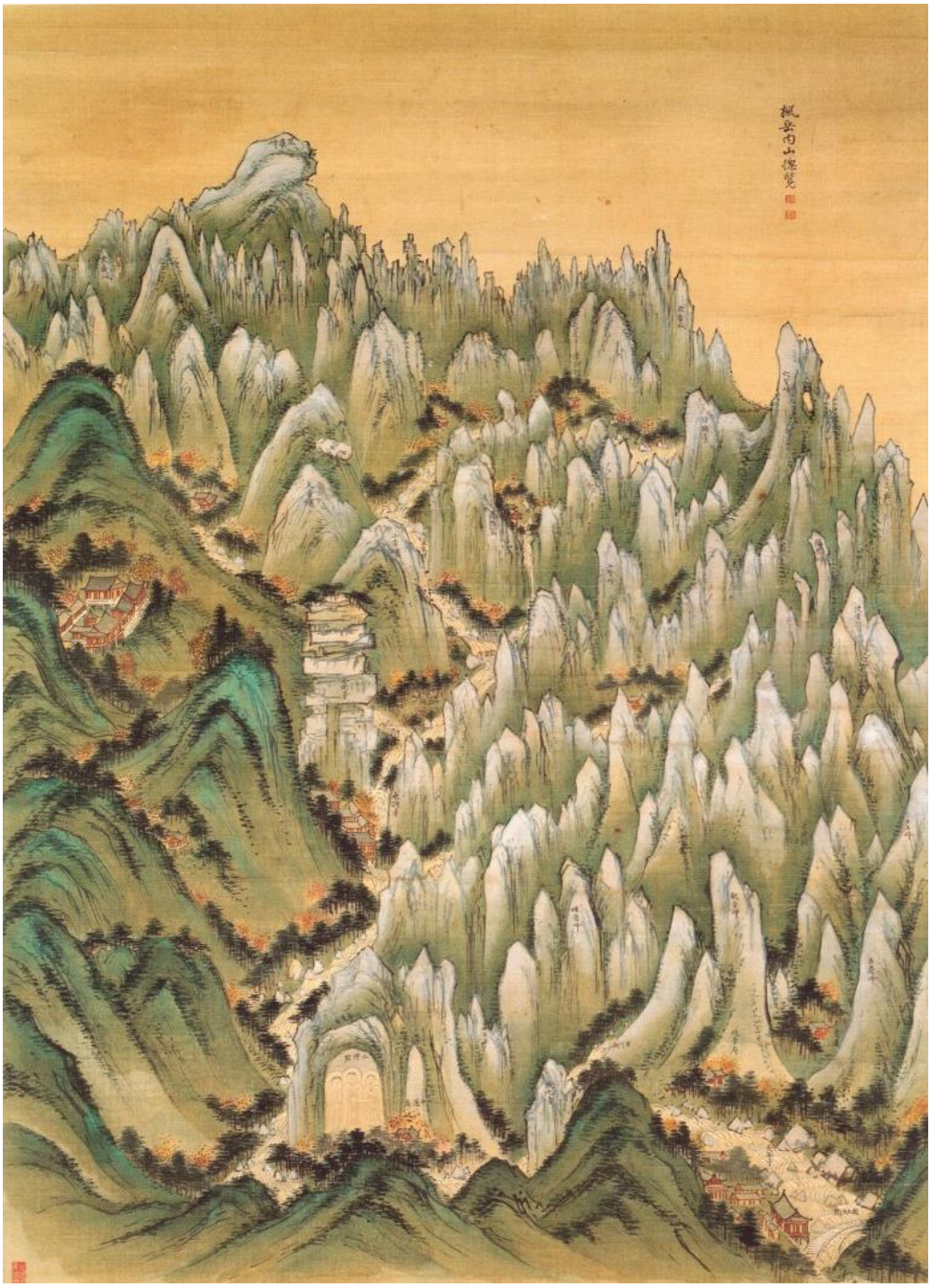


Fig. 4.4.2. Jeong Seon. *General View of Inner Geumgang in Autumn*, ca. 1740. Ink and light color on silk, 100.8 cm × 73.8 cm. Kansong Art and Culture Foundation, Seoul. [Courtesy of Kansong Art and Culture Foundation]

Chapter 5

Future Research

Jeong Seon produced more than 300 paintings during his 78-year life. Choi Wansoo introduced 206 of these paintings through his significant research, but more than this number of paintings remain poorly studied. Thus, the next research project will be focused on these undiscovered albums.

The *St. Ottilien Album*, the beginning of this dissertation research, was discovered in Germany in 1975. In 2018, the Korean Studies Institute discovered Jeong's sketches of the Diamond Mountains. However, his paintings still largely remain an uncovered territory. Considering the amount of Jeong's work that remains today, this research just scratches the surfaces of what remains to be understood about the artist and his legacy.

Jeong produced three albums of paintings of the Diamond Mountains which were produced approximately 35 years intervals, so they can be used to observe his changing style. The natural feature of the Diamond Mountains does not change significantly over the

human scale of time, so relevant data and conclusions about Jeong's true-view style can be generated.

Gim Hongdo was heavily influenced by Jeong and developed Jeong's true-view style into the form that would influence many other artists. His work actively embraced Western perspective styles and was more realistic and detailed than other East Asian styles. *The Diamond Mountains album* includes approximately 60 paintings that show the level of detail in which he painted his subjects. Although this study introduced used Gim's paintings as material against which Jeong's work was compared, the artists' different approaches to portraying the same subjects have aroused scholarly curiosity. Thus, further study of Gim and his works will significantly increase understanding of the development of true-view landscape movement.

Chapter 6

Conclusion

Jeong divided the *Painting of Cheongha Castle and Town* to in three sections. The main subject, the castle and the town, was a product of conventional composition from an oblique projection that arranged buildings parallel to each other without changing their sizes based on their position relative to the viewer. Historical maps show that he arranged the buildings in his painting according to their real-world arrangement. Cross-correlation analysis showed that the background was painted based on actual observations of the subject landscape.

The *Painting of Dosan Confucian Academy* was the product of intentional re-composition. Jeong used a panoramic view and fisheye techniques to emphasize the centrality of the Dosan Confucian Academy in the center of the painting to comply with Feng Shui ideals. This conclusion was supported using data generated by the graphics shader of a game engine.

A program was developed to analyze *Painting of Standing Rock between Two Streams* which converted the subject to more like in the painting. The subject was regenerated as a three-dimensional form by synthesizing photographs. This program

modified the shape taller and thicker the upper part to make the subject more like the appearance in the painting.

Photographs taken during three field expeditions confirmed that *Three Dragon Falls at Mt. Neyeon* depicts five of the 12 major waterfalls in the area. Based on this data, the virtual environment of the valley was created. The program rendered the valley's features from the viewer's location from the nearest area. By inactivating unnecessary areas far from the position, this program increases the efficiency of the virtual reality application.

This study showed that Black and Dege took a relatively reliable approach to determine the vantage points from which Jeong had painted. However, the recent discovery of Jeong's sketches of the Diamond Mountains revealed that he had likely combined multiple drawings of the famous places in one painting in his studio. Over a long period of painting, he had extracted each location's most notable features as symbols of those locations.

This study demonstrated the similarities between Jeong's landscape paintings and his subjects. Analysis of several of his works showed that his true-view style was based on the actual appearance of his subjects but with certain systematic changes to realize his intentions in painting each picture. These variations have caused many art historians to consider the paintings products of his imagination or replicas of paintings in the Chinese tradition. However, this study concluded that his works were based on places that Jeong had personally seen as his painting have certain critical similarities to their subjects that would not likely have been reproduced except through personal observation.

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Appendix

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Map Data

Korea Institute of Geoscience and Mineral Resources (KIGAM)

Kyujanggak Institute for Korean Studies at Seoul National University

OpenTopography Facility, San Diego Supercomputer Center, University of California San Diego

Unity Asset

Post Processing Stack - Unity Technology

Realistic Tree 9 - RAKSHI GAMES

Oculus Integration - Oculus

SteamVR Plugin - Valve Corporation

Grass Flowers Pack Free - ALP8310

Grass and Flowers Pack 1 - Vladislav Pochezhertsev

Rock and Boulders 2 - Manufactura k4

Free Rocks - Triplebrick

Willow Tree Pack vol. 1 - Works for fun

MicroSplat - Jason Booth

Rock 01 - Crazytextures

Rocks FREE pack - Dexsoft-games

ColorSkies - Nightsoundgames

Classic Skybox - Mgsvevo

Photoscanned Mountains PBR - The tale’s factory

R.A.M - River Auto Material – Naturemanufacture

Lite FPS Counters – OMNISAR Technologies

국문초록

화가의 눈, 정선: 가상현실을 통한 18 세기 한국 진경산수화의 재조명

정선(1676-1759)은 한국 미술사에서 가장 혁신적인 인물로 그가 남긴 300 여점의 그림들과 지인들의 방대한 양의 기술(記述)들은 지난 20 년간 한국미술사가들로 하여금 겸재의 세밀한 연구를 가능케하였다. 조선전기(1392-1592)의 전통 회화의 관념에서 벗어나 자연을 직접관찰하여 그림에 옮기려는 시도는 조선 후기(1700-1850) 화단을 지배하는 진경산수 운동으로 태어났다. 그 명칭에도 불구 하고 정선의 화풍은 단지 자연경관의 사실적인 묘사 뿐만아니라 그 당시 조선 회화를 지배해왔던 중국회화의 전통을 희석시키는 과정을 보여주고 있다.

1733 년에 경북 청하현감으로서의 부임은 그에게 영남의 유명한 지역을 직접 답사할 수 있는 기회를 갖게 하였다. 이후 관내에 위치한 명승지를 주제로 여러점의 풍경화들을 그렸는데 이를 영남첩이라 한다.

한국미술사에서 정선의 화풍에 대한 연구는 활발하게 이루어졌으나 대부분은 그를 둘러싼 여러 문헌들에 집중 되어왔기 때문에 그의 독창적인 기법에 대해서는 명확하게 정의되지 못했다. Kay E. Black 의 논문은 처음으로 이 문제에 대해 과학적 접근을 시도 하였으며 본인은 그녀가 제시한 의문점과 당시 실험의 한계를 컴퓨터 그래픽 기술을 이용하여 명확한 답을 제시하고자 하였다.

본 연구는 정선의 독특한 화면 구성 기법을 재현하는 것을 목표로 영남첩에 묘사된 장소들을 사진과 동영상을 바탕으로 재구성하였다. 가상 세계속의 카메라의

위치와 이를 통해 보이는 장면들을 분석하여 정선이 실재로 관찰했을 것이라 생각되는 관측지점을 찾아내고 실재의 사진과 그림을 비교 분석하여 자연풍경을 어떤 방식으로 재구성하여 화폭으로 옮겼는지에 대한 답을 제시하였다. 이를 통해 그의 기법을, 다중 시점, 구심변형, 형태적 전이, 직선적 내러티브 구성으로 정의한다.