A Study of the 1668 *Deungrok*, Records of Celestial Phenomena from the Joseon Dynasty

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This paper will introduce and overview in general the *Seongbyeon Deungrok* issued by the Gwansang-gam, the Astronomical Board in the Joseon Dynasty of Korea. All the Chinese characters in the 1668 *Seongbyeon Deungrok* was deciphered at first and these were translated into Korean and English. With these translations and the word 'white vapor' in particular we discuss the nature of the main object in this *Deungrok*. Lastly, names of observers who engaged in the observations of this 1668 celestial, which are made as a by-product of this research, are introduced.

Keywords: comet, guest star, white vapor, phenomena, *Seongbyeon Deungrok*, *Seungjeong-won Ilgi*, Cheomseong-dae

1. INTRODUCTION

In the course of restoration in 2011 to its original form for the copy of 「the 1668 *Seongbyeon Deungrok* (康熙七年星變膽錄)」, which has been kept by Nha Il-Seong since 1999, we first make an introduction to *Seongbyeon Deungroks* published by the Astronomical Board (Gwansang-gam, 觀象監) of the Joseon Dynasty, 1392-1910, in order to know what kind of record this *Seongbyeon Deungrok* is. Then a summary to known *Seongbyeon Deungroks* and the copy of the 1668 *Deungrok* is presented. The recorded contents in this *Deungrok* has been deciphered, rewritten in Chinese characters, and translated to English in this paper. We point out that the record "white vapor" describes a too strange phenomenon to be a comet. It is interesting to know that an old expression of 'Cheomseong-dae (瞻星臺)' had been used in this *Deungrok* for their observing site in the North Gwangwha-bang (北部光化坊). We also present the titles and names of 12 observing staffs which were recovered by our study.

2. SEONGBYEON CHOOKHOO DANJA (星變測候單子) AND SEONGBYEON DEUNGROK (星變膽錄)

In the Joseon Dynasty, the observing staffs at the Astronomical Board (Gwansang-gam) made a report on unusual celestial and terrestrial event on their day or night duty to the Royal Secretariat (Seungjeong-won) without delay early next morning (Nha 1978). The one-page report in this process was called *Seongbyeon Chookhoo Danja* (星變測候單子, *Danja* in short). The observers on duty at Cheomseong-dae worked in teams of three at normal times, with reinforcements of one or two people to make the team of four or five in a case of celestial event. If the observing staffs on duty observed an astronomical event (*Seongbyeon*, 星變), they wrote down their titles and names at the end of *Danja* before they submitted it to Seungjeong-won in the next morning. This was to make it clear that the report had been made in agreement of the observers. As a daily report, *Danjas* might have been cumulated to an enormous number over ages although it may depend on the duration of each event. Once the event ended, Gwansang-gam kept the original *Danjas* somewhere and made good copies of them

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to build a book. Titles of these books included Chinese reign names and years in those periods, and the terms *Seongbyeon Deungrok* (星變曆錄), *Cheonbyeon Deungrok* (天變曆錄), or *Gaekseong Deungrok* (客星曆錄). *Deungrok* means a book and interestingly ‘Seongbyeon (星變);’ ‘Cheonbyeon (天變);’ or ‘Gaekseong (客星)’ comes before *Deungrok* to specify it. As an example of Chinese reign name and year, 「*The 7th year of Kangxi Seongbyeon Deungrok* (康熙七年星變曆錄)」 means that it is a *Seongbyeon Deungrok* made in the 7th year of the reign of Kangxi in the Qing (清) Dynasty of China. It should be noted that they used a Chinese reign name and year in spite that it is a book written by Gwansang-gam of Joseon for a celestial event in the 9th year of the reign of Hyeonjong (1668), the 18th king in the Joseon Dynasty. There were close interchanges between the Astronomical Board Qintian-jian (欽天監) in China and Gwansang-gam (觀象監) in Joseon, and thus the same reign name was adopted in their convenience since the astronomical data exchanges were set up between the two institutions. It would be difficult to compare observing dates if different year counts are used for solar and lunar eclipses and for global events such as comets or novae (or guest stars). For example, writing the year of the celestial event in 1668 as ‘Seventh year of Kangxi’ in China on one hand but ‘Ninth year of Hyeonjong’ in Joseon on the other would have made it difficult to know that these two indicate the same event. A comparison table would have been necessary in this case. Besides, there are a number of cases that the same name was used by only one king in Korea but by several different kings through the Chinese history. For example, there was only one ‘Sejong (世宗)’ in Korea while four different kings used this name in China; 世宗 of Liao (遼), 世宗 of Jin (金),

世宗 of Ming (明), and 世宗 of Qing (清). Considering these aspects, we may say that it was natural and reflecting an advanced form of international relationship for the two countries to have used the same reign name together. Most countries use A.D. for their dating system these days, but it was only about 110 years ago, in the 33th year of Gojong (高宗), for Joseon to have adopted A.D., a result of the import of the Gregorian calendar.

The method of recording observed comets or guest stars in *Danjas* had already been established by Gwansang-gam (Seong 1818), and it is surprisingly the same as the recording way by modern astronomers. Size of a *Danja* is not clear since there remains no real copy. Only the size of a *Deungrok* is known to be about 20 × 34cm by measuring three *Seongbyeon Deungroks* which are housed in the library of Yonsei University (Nha 1982). It should be noted that the *Deungrok*, which is a collection of *Danja* copies, is smaller than a *Danja* and bears the mark of being trimmed at its top and bottom in the process of bookbinding. Some characters in the top first line are partly or completely missing in some pages. Thus the vertical size of the *Deungrok* in Yonsei University must be larger than 35 cm at least.

3. RECOVERY OF THREE SEONGBYEON DEUNGROK (星變曆錄)

There are 8 books of *Seongbyeon Deungrok* known so far. They were found and reported in Japanese to the society by Wada Yuji (和田雄治) as shown in Table 1 (Wada 1917). The existence of *Danjas* became known from these *Deungroks*. In his article, Wada also introduced a photograph of the

Table 1. List of Seongbyeon Deungroks.

No	Seongbyeon Deungrok	Year and month	Preserver
1	The 18th year of Shunzhi (順治) Seongbyeon Deungrok (The 2nd year of Hyeonjong 顯宗)	February 1661	Nha Il-Seong
2	The 3rd year of Kangxi (康熙) Cheonbyeon Deungrok (The 5th year of Hyeonjong 顯宗)	November 1664	Nha Il-Seong
3	The 7th year of Kangxi (康熙) Seongbyeon Deungrok (The 9th year of Hyeonjong 顯宗)	March 1668	Nha Il-Seong
4	The 34th year of Kangxi (康熙) Seongbyeon Deungrok (The 21st year of Sookjong 肅宗)	November 1695	Unknown
5	The 41st year of Kangxi (康熙) Seongbyeon Deungrok (The 28th year of Sookjong 肅宗)	March 1702	Unknown
6	The 1st year of Yongzheng (雍正) Seongbyeon Deungrok (The 3rd year of Gyeongjong 景宗)	October 1723	Yonsei University Library
7	The 24th year of Qianglong (乾隆) Seongbyeon Deungrok (The 24th year of Youngjo 英祖)	April 1759	Yonsei University Library
8	The 24th year of Qianglong (乾隆) Gaekseong Deungrok (The 24th year of Youngjo 英祖)	February 1760	Yonsei University Library

1664 Kangxi (康熙) *Cheonbyeon Deungrok*, which contains a drawing of the comet and nearby constellations, and this is a copy of the *Danja* of the tenth day of the eleventh month (Wada 1917). *Danjas* as well as *Deungroks* of Joseon were introduced to the world in English by the efforts of W. Carl Rufus. He presented four photographs of the drawings of the 1664 comet to Transactions of the Korea Branch of the Royal Asiatic Society which was published in 1936 (Rufus 1936). Through this paper, European people were impressed by these drawings of the comet, which had been drawn before the photographic technique was invented, and at the same time *Deungrok*, the collections of *Danjas*, became widely known.

Over 40 years after the reports by Wada and Rufus on the eight *Deungroks*, the Korean society had not been aware even of the existence of the *Deungrok*. In the mid-1970s some people in Korea noticed at last that the all of *Deungroks* were missing, but fortunately during their search the last three *Deungroks* (Nos. 6, 7 and 8 in Table 1) were recovered in early 1978 (Nha 1982, 1986). The library of Yonsei University purchased to possess them in no time and these three *Deungroks* have recently been registered as the cultural properties by the City of Seoul. This was such a gratifying event to the Korean society.

This recovery stimulated the society to search the remaining five *Deungroks* (Nos. 1 through 5 in Table 1), but there was no clue to the locations of those. In the meantime, a scholar in Japan sent copies of three *Deungroks* (Nos. 1, 2 and 3) to one of us (Nha) at the end of 1999. It should make it clear that these are not the originals. But, this additional recovery narrowed down the missing *Deungroks* to Nos. 4 and 5.

4. THE CONTENTS OF THE 7TH YEAR OF KANGXI SEONGBYEON DEUNGROK (THE 1668 DEUNGROK)

The title page and contents of the 1668 *Deungrok* are presented in Figs. 1-10. Except for the title page in Fig. 1, this *Deungrok* is a 9-page report on the observations of "white vapor" for four days from March 8, 1668 (the 26th day of the first month in the 9th year of Hyeonjong) to March 11 (the 26th day of the first month of Hyeonjong). Among those 9 pages, two pages have six Chinese characters 星變測候單子, *Seongbyeon Chooohoo Danja* on upper right corner. We present in this paper the English translations from what we deciphered and translated into Korean from the 9-page report (Korea Meteorological Administration 2012). All local times corresponding to the original measurements will be quoted on the 24-hour clock. It should be noted that when

quoting the 60-day cycle, pinyin has been used rather than Hangul.

Fig. 1. Cover of the 1668 Deungrok (from Korea Meteorological Administration 2012).

Fig. 2. Page 1 of the 1668 Deungrok (from Korea Meteorological Administration 2012).

今正月二十七而宮夜一更白氣一道起西方天際渾氣中招天中長可
 數三丈廣八尺其狀如彗四點後隨天而沒而末見其有枝不得作名
 入直左府簿關門外以門簿為書細于波流及傳諸院園建
 大殿差備門及世子亦差備門待開門書 聖領子提調字文如奇告
 入主官前判官臣金都昇 古監官金會同側候
 同日近接都監 啓曰昂古差備 認官亦傳言上副使望見白氣狀
 知有徵應之如何云候待明日招致日友回款之意據詳以卷差候
 傳曰知道夜二更 久下

Fig. 3. Page 2 of the 1668 Deungrok (from Korea Meteorological Administration 2012).

同日夕政院 堅曰伏見觀象臺星記不曉星臺而遠闊闕樹
 木礙碑不能通望有妨於側候云曉星臺舊於設主於四面通
 望之地闊闕樹木茂密當時或所伐而七年則久不所伐枝日友
 常候候於朗善君家牆外觀象臺後視云事甚不當礙障
 樹木使之所去以便測候宜當矣
 田依為之漢城府聖日令也部官 金曉星臺而遠礙障高及
 四面樹木未為所伐

Fig. 5. Page 4 of the 1668 Deungrok (from Korea Meteorological Administration 2012).

二十八日未明領事因方出 聖祥友振黃孝恭眼為招致訪其夜度
 著以早災子國亦信微紫後黃孝恭進表方出使差備認友以早
 徵言于和使和使云知之矣善古監天度秘書不暇使彼人知
 之只據古老人曾證早災之說卷之角
 同日觀象臺官欠以領子提調意 啓曰西方白氣之
 現始於昨日初昏其方似在於日後之雲而古監曉星臺
 西邊闊闕樹木礙障不能通望天際依日月地下食時為望
 之俗今日官登泰山候望以尋其相抵而數盈堂以此分
 付之志故 聖 傳曰知道

Fig. 4. Page 3 of the 1668 Deungrok (from Korea Meteorological Administration 2012).

正月二十八日丁卯夜一更白氣一道起西方天際渾天圍星下費
 天龍指茅二星長可數三丈其狀如彗四點後隨天而沒未
 見其有枝不得作名
 入直左府書友臣金都昇 古監友金會同測候

Fig. 6. Page 5 of the 1668 Deungrok (from Korea Meteorological Administration 2012).

南山看望天慶
學子
今正月二十八日丁卯夕登泰山仰細看候則日沒後星父族也之時而氣具於
西方天際經天而星下雲天狀若二星長較三丈若人休其狀似雙星而其
根抵則入於天際滿中不得而一更四點後隨天而沒
直長且宋選
直長且尹省三
前正且南夢參

Fig. 7. Page 6 of the 1668 Deungrok (from Korea Meteorological Administration 2012).

今正月二十九日戌夜一夜白氣一道起西方天際經天而第二星
指九州珠口星長五丈餘其狀似雙星五點隨天而沒未見其有根抵不
得作名
入至官前判官臣金部鼎 本望海友李同測候

Fig. 9. Page 8 of the 1668 Deungrok (from Korea Meteorological Administration 2012).

二十九日巳時分予 招前定有江華地登高而望天慶測候以數
授黃春恭前判官成厚寬等二丈及本堂下人韓桂同登其
曹給馬乃刻二更 四拜告往而兩經各友在竹亭候候望官

Fig. 8. Page 7 of the 1668 Deungrok (from Korea Meteorological Administration 2012).

南山看望天慶
學子
今正月二十九日戌夜一夜白氣一道起西方天際經天而第二星
指九州珠口星長五丈餘其狀似雙星五點隨天而沒未見其有根抵不
得作名
入至官前判官臣金部鼎 本望海友李同測候

Fig. 10. Page 9 of the 1668 Deungrok (from Korea Meteorological Administration 2012).

4.1 Contents of Fig. 2

戊申正月日

今正月二十六日乙丑初昏白氣一道起自西方天際直指天中狀如彗星之尾長數丈許廣尺餘至夜一更三點後隨天漸沒西方不見入直官即詣闕門外以門隙小紙書入政院侍講院而差備門門未能詳知不為奔告待開門書啓之意奔告領事提調宅定奪後書啓入直官直長尹省三參奉李震善前判官鄭德齊

English translation

On the 26th day, yichou [2], of this first month (of the 9th year of King Hyeonjong) (= 8 March 1668), at the beginning of dusk, one streak of white vapor arose from the western horizon and pointed towards the zenith. Its shape resembled a broom star and its tail was several jang in length and more than a cheek in width. When night came, after the third jeom [= division] of the first gyeong (= night watch), it disappeared in the west following the motion of the sky.

An official on duty deposited an observational report at the gates of the Seungjeong-won and the Sigang-won. When the gates were opened, Hui (a high-ranking official whose full name is currently uncertain) submitted the report to Yeongsa-Jejo (an official of highest rank). Officials on duty were Yoon Seong-sam, Yi Jin-ok and Jeong Deok-je.

4.2 Contents of Fig. 3

今正月二十七日丙寅夜一更白氣一道起自西方天際濁氣中指天中長可數三丈廣尺餘其狀似彗四點後隨天西沒而未見其本故不得作名入直官即詣闕門外以門隙奔告書納于政院及侍講院因達大殿差備門及世子宮差備門待開門書啓領事提調宅更為奔告入直官前判官臣金郜昇本監官員會同側候同日迎接都監啓曰即者差備譯官等傳言上副使望見白氣欲知其微應之如何云故待明日招致日官回報之意措辭以答矣敢啓傳曰知道夜二更允下

English translation

On the 27th day, bingyin [3], of this first month (of the 9th year of King Hyeonjong) (= 9 March 1668), at night, in the first gyeong, one streak of white vapor arose from the turbid air on the western horizon and pointed towards the zenith. Its length was almost three jang and its width more than a cheek. After the fourth jeom it disappeared in the west following the motion of the sky. Since this type of phenomenon has not yet been seen before, it is impossible to give it a name.

An official on duty deposited an observational report at the gates of the Seungjeong-won and the Sigang-won. When the gates were opened, the report was delivered to Yeongsa-Jejo. The official Kim Go-seong made the observations along

with other court observers.

On the same day, Yeongjeob Dogam (an official whose duty was to greet foreign ambassadors), was asked by a high-ranking official of the foreign representatives what kind of portent it could be. Yeongjeob Dogam replied that they should wait until next day and ask the staff of the Court Observatory.

At the second gyeong (20.7-22.9 h), his Royal Highness gave his assent.

4.3 Contents of Fig. 4

二十八日未明領事因都監啓辭教授黃孝恭眼前招致諱 其應變答以旱災事因承傳微稟後黃孝恭進去都監使差備譯官以旱徵言于勅使勅使云知之矣差本監天變秘書不欲使彼人知之只據古老人曾驗旱災之說答之爾同日觀象監官員以領事提調意啓曰西方白氣之現始於再昨初昏其本似在於日沒之處而本監瞻星臺西邊閭閻樹木礙障不能通望天際依日月地下食時看望之例今日官登南山候望以尋其根抵所發宜當以此分付之意敢啓傳曰知道

English translation

On the 28th day (= 10 March 1668), before dawn, a member of the Observatory staff Whang Hyo-gong was called to His Royal Highness and said that this (phenomenon) was a sign of drought. Whang Hyo-gong suggested addressing the foreign representative after the sacrifice. The foreign representative said that he was aware of it already. The Court Observatory staff expressed the wish that celestial portents should not be divulged to foreigners. The interpretation of this sign was based on the experience of an elderly man.

On the same day, Yeongsa-Jejo Hui said that the white vapor in the western direction appeared two nights ago at the beginning of dusk near the sunset point. However, trees of private houses close to the Observatory made celestial observation difficult. Therefore it was proposed to send observers to the top of Mt. Namsan to make their observation.

His Royal Highness gave his assent.

4.4 Contents of Fig. 5

同日夕政院啓曰伏見觀象監草記則瞻星臺西邊閭閻樹木礙障不能通望有妨於側候云瞻星臺當初設立於四面通望之地閭閻樹木茂密處時或斫伐而近年則久不斫伐故日官常常側候於朗善君家牆外觀象監後岷云事甚不當礙障樹木使之斫去以便側候宜當矣上曰依爲之漢城府翌日令北部官員瞻星臺西邊礙障處及四面樹木盡爲斫伐

English translation

In the evening of the same day the Jeongwon (the name of another office) reported to His Royal Highness with reference to a short report which had been received, stating that although the Observatory needed to have a clear view, the nearby trees obscured the view. These trees had not been cut back for several years, so that the observers made their observations at the house of Rangseon-goon (a grandson of King Seonjo). Therefore it was proposed to cut back the trees to facilitate observation.

His Royal Highness gave his approval to the Mayor. Next day, officials of the northern section cut back all the trees surrounding the Observatory.

4.5 Contents of Fig. 6

正月二十八日丁卯夜一更白氣一道起西方天際經天困星下貫天苑指第二星長可數三丈廣尺餘其狀似彗四點後隨天西沒未見其本不何作名
入直官前判官臣金郜昇本監官員令同測候

English translation

On the 28th day, dingmao [4], of the first month (= 10 March 1668), at the first gyeong of the night, a streak of white vapor arose from the western horizon. It passed under (the constellation) Cheon-gun and pointed towards the second star of (the constellation) Cheon-won. Its length was about 3 jang and its width more than a cheek. Its shape resembled a broom. After the fourth jeom, following the motion of the sky it set in the west. Since this type of phenomenon has not yet been seen before, it is impossible to give it a name.

The official Kim Go-seong made this observation, together with other court observers.

4.6 Contents of Fig. 7

南山看望天變單子
今正月二十八日丁卯夕登南山詳細看候則日沒後星文始出時之時白氣見於
西方天際經天困星下貫天苑指第二星長可數三丈廣尺餘其狀似彗而其
根抵則入於天際濁氣中不得看一更四點後隨天西沒
直長臣宋暹
直長臣尹省三
前正臣南夢參

English translation

Cheonbyeon *Danja* at Mt. Namsan.

In the evening of the 28th day, dingmao [4], of this first month (= 10 March 1668), from the top of Mt. Namsan, after sunset and beginning with the first appearance of the stars, a white vapor was seen to arise from the western horizon.

It passed under (the constellation) Cheon-gun and pointed towards the second star of (the constellation) Cheon-won. Its length was about 3 jang and its width more than a cheek. Its shape resembled a broom, but its head was invisible because of its location below the turbid horizon. At the fourth jeom of the first gyeong (20.0 h) it set on the western horizon. Since this type of phenomenon has not yet been seen before, it is impossible to give it a name.

The official Kim Go-seong made this observation, together with other court observers: Song Seom, Yoon Seong-sam, Nam Mong-sam.

4.7 Contents of Fig. 8

二十九日巳時領事榻前定奪江華地登高看望天變測候次以教授黃孝恭前判官成厚寬等二員及本監下人韓檀同竝令兵曹給馬卽刻二員肅拜出往而所經各官支供事牒報監營

English translation

On the morning of the 29th day (= 11 March 1668), at the double hour si (= 9-11 h), the Director of the Observatory ordered two officials, Whang Hyo-gong and Seong Hoo-gwan, to jointly make observations on the mountain at Gangwha Island; they were to be accompanied by a servant, Han Geom. Now the Ministry of Defence offered horses for the two officials. They were also to be provided with necessities at the local stations on their way.

4.8 Contents of Fig. 9

今正月二十九日戊辰夜一更白氣一道起西方天際歷天苑第二星指九州殊口星長五丈餘其狀似彗五點隨天西沒未見其本故不得作名
入直官前判官臣金郜昇本監諸官員會同測候

English translation

On the 29th day, wuchen [5], of this first month (= 11 March 1668), at the first gyeong of the night, a streak of white vapor arose from the western horizon. It passed the second star of (the constellation) Cheon-won, and pointed towards (the constellation) Gujusoogu. Its length was more than 5 jang and its shape resembled a broom. After the fifth jeom it set on the western horizon. Since this type of phenomenon has not yet been seen before, it is impossible to give it a name. The official Kim Go-seong made this observation, together with other court observers.

4.9 Contents of Fig. 10

南山看望天變單子
今正月二十九日戊辰夕再登南山詳細看候則白氣形體與昨無異其根
抵則入於天際濁氣中不得看候而尾長則比前稍長過天苑第

二星直指九州殊口星一更五點後隨天西沒

English translation

Cheonbyeon *Danja* at Mt. Namsan

In the evening of the 29th day, wuchen [5], of this first month (= 11 March 1668), (we) climbed up Mt. Namsan again and made observations. The shape of the white vapor remained the same as on the previous night, but its head was invisible because of its location below the turbid horizon. Its tail became slightly longer and passed the second star of (the constellation) Cheon-won and pointed towards (the constellation) Gujusoogu. After the fifth jeom of the first gyeong it set on the western horizon.

According to the text above, in the first day of observation, the observing staffs of Gwansang-gam named the observed celestial event ‘white vapor (白氣),’ but they called it a ‘comet’ at their report since they were not able to figure it out what the white vapor really was. However, they began to regard the white vapor as a strange phenomenon on the next day and then on. If this white vapor had been a comet, there should have been its head, but it was out of sight under the horizon. In their expression at that time, a head of comet was *geunjeo* (根抵, head). Thus, in search for the head of comet, they made efforts of cutting nearby trees to get better views to the horizon, and climbing up to the Mt. Namsan and even sending observing staffs to Ganghwa Island where the sight to the western horizon is guaranteed. However, they failed to find the head after all and made a conclusion saying “We are not able to name it since there has never been such a phenomenon as this.”

In the case that the head of comet is not seen even though its tail is long above the western horizon, the part of head might be located on the other side of the sun. Then, the head of this comet would be observable at the eastern horizon at dawn, instead of in the western sky in the early evening. However, they were not able to find the head in the east at dawn.

What indeed was this white vapor which they could not determine at that time? We introduce here another record from the Annals of Hyeonjong before continuing to the next section.

Jeong Tae-hwa, the prime minister, said secretly, “I heard that the Chinese envoy (北使) had noticed the extraordinary event of white vapor at night and today he was going to ask a staff of our Board of Astronomy about what this event would be an omen of. I am not sure what sign this extraordinary event is, but I suspect that it might be a portent of a war. As we cannot let the Chinese envoy

(北使) know that as it is, it would be better to tell him that it is an omen of famine.”, but the king said “I don’t think we can hide the fact since they also have astronomers, but it is fine to talk to him based on what you said.”

(Annals of Hyeonjong; the 28th day of the 1st month).

5. WHAT WAS THE WHITE VAPOR IN THE 1668 SEONGBYEON DEUNGROK?

Wada Yuji (和田雄治) is the first one who mentioned briefly the 1668 *Seongbyeon Deungrok*. He introduced the celestial event as follows.

Especially in the record of 「The 7th year of Kangxi,」 “They cut the trees around Cheomseong-dae since the forest was thick and blocked the sight, observed at the summit of Mt. Namsan, and also sent an observing staff to Ganghwa Island for observations.”

(omitted)

They found it in Europe on March 5 in that year, and it was a comet.

Now we examine the article of this *Seongbyeon Deungrok* with 9 pages in total.

First, it cannot be a comet or guest star according to the expression in the record. It is because there repeats several times the sentence “而未見其本故不得作名” which means “Since this type of phenomenon has not yet been seen before, it is impossible to give it a name.” Among the observing staffs on that occasion, more than a few of them must have participated also in the observations of the great comet in 1664 which is a historical comet having appeared just four years before. And such observers confessed that they could not name it comet or guest star.

Second, it is stated that the tail was as long as five jangs (丈), and such a big comet cannot be imagined (Nha 1981). The greatest comet known so far is the one recorded in The 3rd year of Kangxi (康熙) *Cheonbyeon Deungrok* (1664), of which the tail was about two jangs (丈) long and 8 or 9 chons (寸) wide at its maximum size. The comet in The 24th year of Qianlong (乾隆) *Seongbyeong Deungrok* (1759) is the famous Comet Halley, and the maximum length of its tail was only two cheeks (尺) which is less than one-tenth of the former one.

Angular sizes (角度) are used in principle for the length or width of a comet, but length units such as jang (丈), cheek (尺), or chon (寸) were used in the old literature. Converting those length units to angular sizes in degree (度) was done by Sekiguchi Rigichi (關口鯉吉), and he determined one

cheek to be about one degree based on his comparison between comet drawings and records on length of tail (尾長) in several *Seongbyeong Deungroks*. [Annotation: this conversion is in the paper of Sekiguchi reported to *Tenmon Getsubo* (天文月報) of the Astronomical Society of Japan in 1910s, which has not yet been found.] Recently Nha (1981) tried another conversion of cheek for lengths of comet tails to angular sizes. Nha used two samples. First, with four photographs of the comet in *The 1664 Cheonbyeon Deungrok*, he determined about 1.5 degree for one cheek. This is a conversion factor for the 1664 comet in the period of Hyeonjong. With a set of five drawings of the comet in the 24th year of Qianglong (乾隆) *Seongbyeong Deungrok* (乾隆二十四年己卯星變瞻錄) which was recorded after almost 100 years from that point, however, one cheek was appeared to be 7 or 8 degrees. This is for Comet Halley in the 35th year of Youngjo (1759), but the value derived from those drawings is too large and unrealistic for acceptance. Using the factor of 1.5 degree/cheek, the length in question of <over 5 jangs (5丈餘)> in the record on 'the 29th day of the first month, i.e. March 11, 1668,' is converted into larger than 75 degrees. Then it is too long to be a tail of comet since this length is across almost a half of the sky. With the factor of 7-8 degrees/cheek from the period of Youngjo, it would be 350 to 400 degrees. This value is very unlikely and thus drawings in *Deungroks* do not represent the true length of comet tails.

Third, what seems even stranger is that the celestial event was expressed as 'white vapor (白氣)'. There are some cases of writing color of a comet as 'white' but there is no other record of 'white vapor'. This 'white vapor' is certainly not a guest star. Guest star is a word for nova or supernova, but even the greatest supernova could not be seen as wide

spread as in this case. If it is neither a guest star nor a comet, then what is the 'white vapor'?

The position of the 'white vapor' is presented in the *Chookhoo Danja* on the 28th day of the first month (March 10, 1668) as 'It passed under (the constellation) Cheon-gun and pointed towards the second star of (the constellation) Cheon-won' according to the observing records at Cheomseong-dae on Mt. Namsan. We draw the 'white vapor' based on its position with respect to the constellations on a star-map. The star-map used here is the *Eryue Zhongxing-tu* (二月中星圖) in *Tianwen Tushou* (天文圖說) by Yuan Qi (袁啓) (Yuan 1632). This map was published in the period of the Qing dynasty which is close to the occurrence of the present 'white vapor.'

Another star-map, the *Sinbeob Nuju Tongui* (Gwansang-gam 1789), is known as a meridian star-map in Joseon Dynasty. But this map was not used because it has bright stars only and thus the faint constellations 'Cheon-gun' and 'Cheon-won' are missing in this map. On the other hand, the meridian star-map by Yuan lacks accuracies of the relative positions of the constellations whose shapes were even drawn roughly and arbitrarily. Nevertheless, as is shown in Fig. 11, we draw the 'white vapor' on Yuan's star-map according to the positions from the *Deungrok*. This position and shape of the 'white vapor' may not represent the real situation, but would be enough to show the phenomenon appearing very close to the horizon on the sky.

Fourth, it is hardly probable, but could we assume that the 'white vapor' was an aurora borealis? As aurora is an atmospheric phenomenon observable around the poles of the earth magnetic field (地球磁氣), i.e. in high latitude regions near to the north pole. Scientifically considered,

Fig. 11. Location and shape of "white vapor (白氣)" described in the *Eryue Zhongxing-tu* (二月中星圖) of Yuan Qi (袁啓)'s *Tianwen Tushuo* (天文圖說).

aurora is not observable in Hanyang (Seoul) even towards the lowest altitudes to the horizon. Furthermore, the strongest evidence against the assumption of aurora is the record that it was seen towards the western horizon (西方天際). If the 'white vapor' had been an aurora, it must have been seen towards the northern horizon, but there is no record in the *Deungrok* to support it. Also it says that the 'white vapor' set in the west over time. Therefore, the 'white vapor' cannot be an aurora at all.

Records of the *Deungrok* in the possession of Nha last only four days from 26th to 29th of January on the lunar calendar. It may be probable that the original *Deungrok* does not end at January 29 but continuing on for at least several more days, and the later parts should have excluded from the copy-making. When they close a series of each celestial event, it was a customary practice of *Gwansang-gam* in Joseon to state that the event had been concluded and to list at the end of the *Deungrok* all names of the observing staffs participated. Unfortunately this important part is missing in the copies of Nha.

6. EXAMINATIONS AND NEW FACTS

Lynn (1882) re-examined several observing reports available in Europe on this 'celestial event'. The observations were performed in 1668 in various places such as Lisbon, Cape of Good Hope, Goa, San Salvador, etc., but in his brief report, Lynn paid more attention to the observational record by Father Valentin Estancel (1674) at San Salvador. Some parts of Lynn's article are introduced here as follows.

"The comet was observed for a few days, commencing on the 5th of March. He saw it in the evening, and was surprised to find it of extraordinary brightness when first seen, and then decreasing, instead of becoming brighter by degrees as he had noticed in other comets. As to the color of this comet, it was at first very splendid, but the brightness lasted only for three days, after which it did considerably decay. But that which seemed somewhat strange was, that having lost so much of its light, yet its bulk was diminished, but continued rather increasing until the comet disappeared."

Lynn followed up with that the perihelion distance of this comet was reported by Henderson to be 0.25113 AU. Considering that the perihelion distance of Mercury is 0.307 AU, this comet entered into the orbit of Mercury.

There is another supporting article, and according to this

No details were provided, but later orbits indicated the

comet was then in Cetus and it was probable that only the tail was seen. The comet had passed only $1^{\circ}.5$ from the sun on February 29. ----- Giovanni Cassini obtained his first observation on the 10th (= 28th day of the first month) during the first hour of the night and saw a "path of light" which he presumed was a comet, extending from Cetus through Eridanus. The tip of the tail lay near 14 Eridani, while the head was either hidden by "horizontal clouds" or still below the horizon.

(<http://cometography.com/lcomets/1668e1.html>)

The above statement, 'he *presumed* was a comet', is indeed a sentence by Cassini who left his mark on the history of astronomy as an excellent observer. And the statement 'the head was either hidden by "horizontal clouds" or still below the horizon' is completely consistent with the record by *Gwansang-gam* on 10th and 11th of March. With an insight on the situation, Lynn made a conclusion at the end of his article introduced above as "Any attempt to identify the comets of (omitted) with that of 1668 can be but of little weight." This shows well that this 'celestial event' was regarded as extraordinary also in Europe. Considering those opinions together, we understand better the difficulties that the observing staffs at *Gwansang-gam* had at that time.

Also in China, there are records of celestial events written in a period close to the occurrence of the 'white vapor'. Here we count dates on the solar calendar. First, there is a record on a comet from January 14 to February 11 in 1668 (Beijing Observatory 1989a), but this has nothing to do with the 'celestial event' in question. The second record was made after about one month, on March 2, 1668. It says 'A comet appeared at night in the west. The length of its tail was a few jangs, and it disappeared after several days' (Beijing Observatory 1989b). This is clearly a record of comet. However, also in China, there are more than a few dozens of observing records on 'white vapor' and 'black vapor' (黑氣) during the same period. The first one on March 3 says 'Vapor appeared in the west, which was red then looked white. The bottom of it was 'black vapor' and its shape is similar to a cloth (布)' (Beijing Observatory 1989c). After this record, there are a number of records from March 6 using only the term 'white vapor'. Two examples are as follows. '(March 6): White vapor appeared with a shape like white silk (煉), which passed through the southwest and pointed straight to the northeast' (Beijing Observatory 1989c) or '(March 7): White vapor like a spear (槍) appeared in the west at the 19th of the 24 periods of the day, and black vapor like a sword (刀) with three blades appeared at the night of 27th day' (Beijing Observatory 1989d). Such Chinese records are

interesting, but on the other hand, are difficult to interpret since they did not describe the shapes and positions scientifically, not like the records by the observing staffs at Gwansang-gam of Joseon.

Now we return to the records in Joseon. In addition to the *Deungrok*, there are other records on the ‘white vapor’ also in *Hyeonjong Sillok* (顯宗實錄) and *Seungjeong-won Ilgi* (承政院日記). Among those records, the following three records in *Seungjeong-won Ilgi* should need new attentions.

1) On the 4th and 5th days of the second month in the 9th year of Hyeonjong, the expression of chiugi (蚩尤旗) was used. This is an expression for a comet splitting into two tails.

2) On the 4th day of the second month in the 9th year of Hyeonjong, an unbelievable tail of 7 jangs long, which was longer than 5 jangs in the *Deungrok*, was observed.

3) On the 5th day of the second month in the 9th year of Hyeonjong and several days afterward, a ‘light’ was introduced as ‘vapor like fire light (有氣如火光).’

Except for 1) above, those records are against the assumption of comet. Therefore, it is clear that the 1668 celestial event is a new sample for studies on the solar activity and abnormal phenomena of the earth atmosphere. It might be such an important discovery in the ancient observing records in China, Korea, and Japan as the facts that sunspots were observed with the unaided eye and that guest stars were supernovae which made significant impacts on modern science.

As briefly mentioned earlier, there is an interesting article in the *Deungrok* on the 28th day of the first month in the 9th; ‘---stating that although the Cheomseong-dae needed to have a clear view, the nearby trees obscured the view. These trees had not been cut back for several years, so that the observers made their observations at the house of Rangseon-goon.’ We became aware from this article that the observing site in Hanyang at that time was North Gwangwha-bang (北部廣化坊) which is to the west of the main gate of the Changdeok Palace and in front of the current office building of <Hyundai Engineering and Construction>. This observing site was named Gwancheon-dae (觀天臺) in 1983, about 30 years ago by Jeon & Nha (1983). However, this place should now be rightly called Cheomseong-dae in North Gwangwha-bang (北部廣化坊瞻星臺) since the old name was given without clear references at that time. At the same time, also the name of Gwancheon-dae in the Changgyeong Palace should be corrected to be Cheomseong-dae. Rangseon-goon (朗善君) is a grandson of King Seonjo and was famous as a writer. The location of

Table 2. Names of the 12 Chookhoo-gwan (測候官, astronomers).

Deungrok	Kim Go-seung (金郜昇), Nam Mong-sam (南夢參), Seong Hoo-gwan (成厚寬), Song Seom (宋暹), Yoon Seong-sam (尹省三), Yi Jin-seon (李震善), Jeong Deok-je (鄭德齊), Whang Hyo-gong (黃孝恭)
Seungjeong-won Ilgi	Kim Man-gi (金萬基), Kim Si-jin (金始振), Shin Hoo-jae (申厚載), An Myeong-no (安命老)

Cheomseong-dae is now clear considering that he lived in this North Gwangwha-bang.

The recovery of the 12 observing staffs in total is also a significant result. Among them, 8 were found in the *Deungrok* and 4 in *Seungjeong-won Ilgi*, whose titles and names are listed in Table 2. It would be one of future work to determine who were participated in the comet observation four years before, the 5th year of Hyeonjong.

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