

SCIENTISTS OF THE GWANSANG-GAM. 1: OBSERVERS OF COMET 1P/HALLEY IN 1759

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Abstract: A project on researching the scientists of the Joseon Dynasty (Korea) has been carried out by the authors in the last decade by focusing mainly on the officials of the *Gwansang-gam*, the Bureau of Astronomy and Meteorology. This paper presents research that relies on the 1759 *Seongbyeon Deungrok* (*Compilation of Daily Observational Records of Celestial Events*) of the *Gwansang-gam*, and reviews the records of observations and observers of Comet 1P/Halley during its 1759 apparition. This record includes a series of archival sketches of the comet.

In order to describe this work, the *Seongbyeon Deungrok* is first introduced, and then the observations of Comet 1P/Halley in the 1759 *Deungrok* are presented. The observers on duty each night during this series of observations from 1 to 14 April 1759 are also introduced, and there is a brief biographical investigation of five hereditary astronomers who made important contributions at the *Gwansang-gam* during the mid-eighteenth century, both as observers and calendrical researchers.

Keywords: *Gwansang-gam*, 1759 *Seongbyeon Deungrok*, Comet 1P/Halley, An Gook-bin, Song Whan-gyu, Bak Jae-so, Kim Tae-seo, Kim Je-gong

1 INTRODUCTION

The *Gwansang-gam* 觀象監 is the name of the Bureau of Astronomy and Meteorology in the Joseon Dynasty (1392–1910), and its organization was succeeded from its predecessor, the *Seowoon-gwan* 書雲觀 in the previous Koryo Dynasty 高麗 (918–1392) in Korea. All of the original observations made by the observers at the *Gwansang-gam* were reported in the *Seongbyeon Chookhoo Danja* 星變測候單子 (*Danja* for short), which were compiled afterwards in a separate book, the *Seongbyeon Deungrok* 星變曆錄 (*Deungrok* for short) by the Bureau. Most of these observations were transcribed without any changes into the *Seungjeong-won Ilgi* 承政院日記 (the *Daily Journals*) by scholar-officials in the Office of the Royal Secretary at that time, and later into the *Wangjo Sillok* 王朝實錄 (the *Veritable Records of the Joseon Dynasty*), in a much-reduced form where the names of the observers were omitted.

The *Seongbyeon Chookhoo Danja* (*Danja*) is the name of the observer's report of celestial and terrestrial phenomena that was made by each observer on duty at the Observatory during the Joseon Dynasty. *Danjas*, signed jointly by the participating observers, had to be submitted

to the court after dawn each day. The recording format of a *Danja* for the observation of a comet was set by the *Gwansang-gam*, and had to include the following information:

- ① Date and time, ② location of the comet among the stars, ③ reference star of the *xiu* 宿距星, which is equivalent to the Right Ascension and the polar distance (Declination), ④ color, ⑤ length of the tail, ⑥ brightness, and ⑦ a sketch if possible. (Seong, 1818).

The paper size of a *Danja* is approximately 28 × 40 cm. *Danjas* for each comet were made until the comet was no longer visible to the naked eye. Therefore, the number of *Danjas* for each comet differed, depending on how long they remained visible. *Danjas* were disposable and not meant to last, but some of them survived in a transcribed form in the *Deungroks*.

In fact, with the passage of time, it was difficult to preserve the large amount of paper (*Danjas*) that accumulated. Therefore, the *Gwansang-gam* had skilled calligraphers made a series of copies, and these were bound in a separate volume called a *Deungrok* for each object or event. Therefore, *Deungrok* is a generic name for a compilation of *Danjas*, but often they were referred to by three different names: *Seong-*

byeon *Deungrok* 星變曆錄, *Cheonqbyeon Deungrok* 天變曆錄 and *Gaekseong Deungrok* 客星曆錄. Their literal meanings are respectively: the Register of Stellar Changes, the Register of Heavenly Changes and the Register of Guest Stars, but none of these matched perfectly the actual events recorded except for the *Seongbyeon*.

In 1917 the Korean-based Japanese meteorologist Wada Yuji (1859–1918; Nha and Nha 2017) discovered the existences of eight *Deungroks* in an old *Gwansang-gam* warehouse, and he published a paper in Japanese that included a photograph of a sketch of the Great Comet of 1664 (Wada, 1917). Nearly two decades later, four more photographs of sketches of this comet appeared in a paper written in English by the American astronomer W.C. Rufus (1936). These are the eight *Deungroks* discovered by Wada:

- The 1661 *Seongbyeon Deungrok*
- The 1664 *Cheonbyeon* (天變) *Deungrok*
- The 1668 *Seongbyeon Deungrok*
- The 1695 (?) *Deungrok*
- The 1702 (?) *Deungrok*
- The 1723 *Seongbyeon* (星變) *Deungrok*

- The 1759 *Seongbyeon* (星變) *Deungrok*
- The 1760 *Gaekseong* (客星) *Deungrok*

But, unfortunately, their locations were kept hidden for a long time, and it seems that until the early 1970s no-one was interested in this sort of material. About that time a few researchers realized that the *Deungroks* had all disappeared. Accordingly, a search was initiated, and fortunately the last three *Deungroks* listed above (and see Figure 1) were purchased by Yonsei University Library in Seoul in 1978 from an undisclosed vendor. Subsequently, these three *Deungroks* were designated a Seoul City Treasure, which was a cause for great celebration. General information about these three volumes and their contents is given by Nha (1982).

In the caption of Figure 1, "... the twenty-fourth year of the Qianlong reign" is the 35th year of the Joseon King Yeongjo's reign. During the Joseon Dynasty, the Chinese Emperor's reign title was used until 1894. There are a number of publications available for the cross-checking of days and years for the three countries, China, Korea and Japan. We can refer to a table by Kang (1997) for the first half of the fifteenth cen-

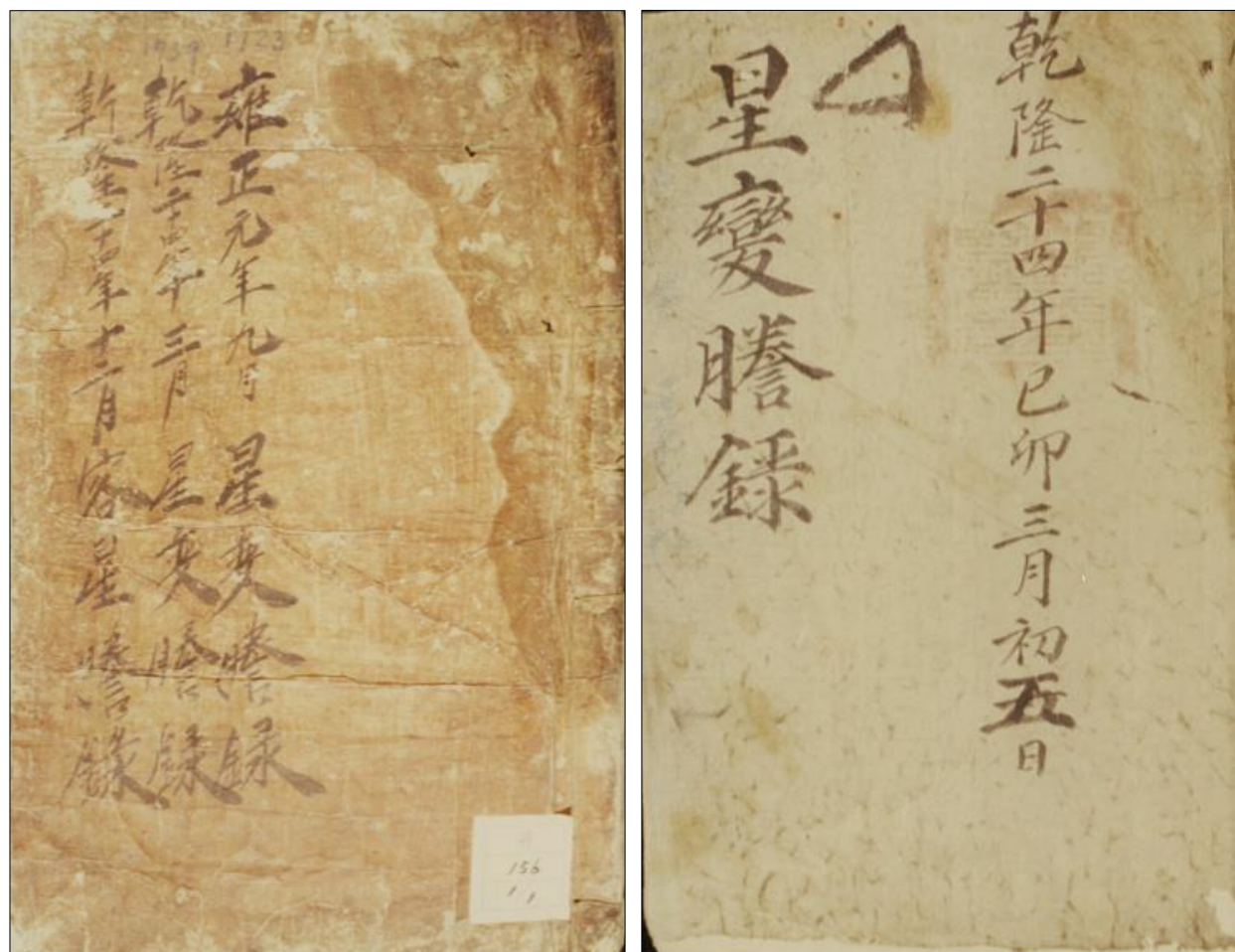


Figure 1. The image on the left shows the front cover of the 1723 and 1759 *Seongbyeon Deungroks* and the 1760 *Gaekseong Deungrok*, all of which are bound together. The image on the right is the front cover of the 1759 *Seongbyeon Deungrok*, which has the date on the right-hand side: "The fifth day of the third month of the twenty-fourth year of the Qianlong reign (1759), jima [16])."

ture. Meanwhile, the number [16] after *jimao* in the caption indicates the number of the sixty-year cycle *ganzhi* 干支 counted from the first *ganzhi jiazhi* 甲子[1] to the sixtieth *guihai* 癸亥[60]. This number will be listed whenever *ganzhi* appears in this manuscript.

The marvel is that nearly two decades later photocopies of the first three *Deungroks*, of 1661, 1664 and 1668, were delivered to one of us (NI-S) by the late Professor Hasegawa Ichiro in Japan. However, these were not originals and accordingly the quality was inferior. Therefore, they were reprinted by the Korea Academy of Meteorology and Climate in 2014, as shown in Figure 2 (Hong, 2012). Unfortunately, the locations of the originals, and the two remaining *Deungroks* (1695 and 1702), are still unknown.

In the case of *Danjas* and *Deungroks* that contain records of Comet 1P/Halley, these documents include the names of observers, which is a unique feature of Korean manuscripts unless they belong to private individuals. Each *Danja* has a description and sketch of the comet if the night was clear, and the names of the observers, with their official titles at the Bureau, are always recorded. For these reasons, the 1759 *Deungrok* became an important source of data for those astronomers researching observations made of Comet 1P/ Halley during its 1759 apparition. Some observers were unable to make any observations because of bad weather during their assigned shifts, but we included them in our research because we are very interested in the names of scientists who were active during the Joseon Dynasty.

2 RECORDS OF COMET 1P/HALLEY DURING THE 1759 APPARITION

The 1759 Korean records of Comet 1P/Halley have already been mentioned by Nha and Lee (2004), but that paper merely contained a brief introduction to the archival records of the comet observations and there was no mention of the associated observers. In this paper, on the other hand, we plan to focus on two topics. Firstly, we will review the records and sketches of the comet as recorded in the 1759 *Deungrok*, and secondly we will scrutinize the observers who made the observations. All observations were carried out with the naked-eye from *Gwangwha-bang Cheomseong-dae* 廣化坊瞻星臺 (Figure 3), one of three small observatories that were located in the north-eastern part of old Seoul.

The 1759 *Deungrok* has 29 *Danjas* altogether for the period 1–29 April (inclusive), and observations of Comet 1P/Halley were recorded on ten nights: 1, 2, 4, 6, 7, 9, 10, 11, 12 and 13 April. Eight of these *Danjas* have sketches of the comet and background stars. Although no

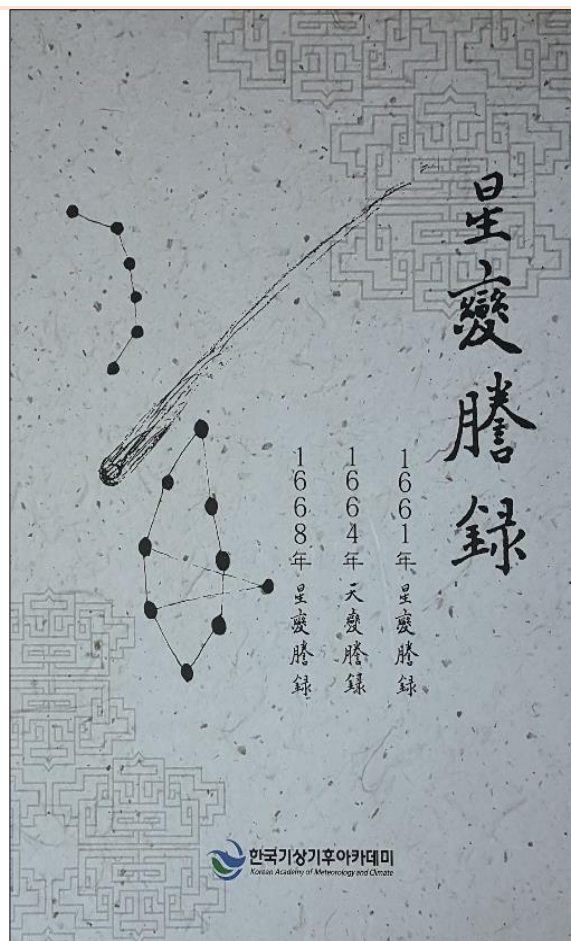


Figure 2: The cover of the box that was made for the copies of the 1661, 1664 and 1668 *Seongbyeon Deungroks*. These *Deungroks* were restored by conservation staff at the Korea Academy of Meteorology and Climate on the basis of photocopies provided by Nha Il-Seong (2012).



Figure 3: The current appearance of *Gwangwha-bang Cheomseong-dae* (photograph: Nha Il-Seong).



Figure 4: The *Danja* of Comet 1P/Halley on 1 April 1759. The comet is barely visible in the lower part of the drawing as a star with a short tail.

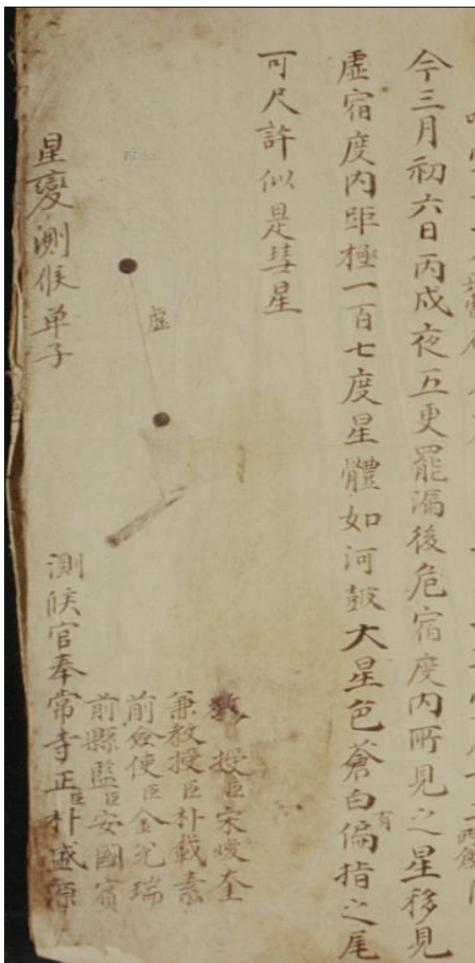


Figure 5: The *Danja* of Comet 1P/Halley on 2 April 1759. The comet had moved westward, and its tail was clear and longer.

observations were made on the remaining nineteen nights, because of cloudy or rain, or because the comet was too faint to be seen with the naked-eye, five observers were required to remain at the observatory throughout the night on these nights. Although they could not carry out comet observations on these nineteen nights, it is worth mentioning that their time was not wasted because other natural phenomena—such as clouds, rain, thunderstorms etc.—also were important objects or events that had to be observed and recorded for the Bureau of Astronomy and Meteorology. Therefore, the observer's name and official title in each *Danja* is, needless to say, extremely important for our research project on the scientists of the Joseon Dynasty. For this reason, we have listed all of the observers in Appendix 1.

Now we will present ten *Danjas* and Figures 4–13, where observations of the comet are recorded in detail. They are followed by the last *Danja* (Figure 14), which marked the end of the Korean observations of this famous comet.

2.1 1 April 1759

On the 5th day of the 3rd month [i.e. 1 April 1759], at night after the fifth gyeong [3–5h] *paru*,¹ a star was seen in the Wei lunar lodge [危宿 α Aqr and θ , ε Peg]. It has a trace of a tail. [See Figure 4.]

2.2 2 April 1759

On the 6th day [丙戌 *bingxu* [23]] of the 3rd month [2 April 1759], at night after the fifth gyeong [3–5h] *paru*, a star was seen in the Wei lunar lodge [危宿 α Aqr and θ , ε Peg]. This star moved into the Xu lunar lodge [虛宿 β Aqr and α Equ]. Its polar distance is 107 *do*² and it is as large [bright] as Altair [α Aql, $m_v = 0.8$]. The color is whitish [蒼白] and its tail 1 *cheok*³ long, and thus this is certainly a comet. Observers: Song Whan-gyu, Bak Jae-so, An Gook-bin, Kim Tae-seo, Bak Seong-won. [See Figure 5.]

2.3 4 April 1759

On the 8th day [戊子 *wuzi* [25]] of the 3rd month [4 April 1759], at night after the fifth gyeong [3–5h] *paru*, the comet was seen in the Xu lunar lodge [虛宿, β Aqr and α Equ] and to the north of the constellation of Liyu [離瑜, α , γ , ε Mic]. Its polar distance is 111 *do* and it is as large [bright] as Altair [α Aql, $m_v = 0.8$]. The color is whitish and its tail 2 *cheoks* long. [See Figure 6.]

2.4 6 April 1759

On the 10th day [庚寅 *gengyin* [27]] of the 3rd month [6 April 1759] at night after the fifth gyeong [3–5h] *paru*, the comet has moved and is now in the Xu lunar lodge [虛宿, β Aqr and α Equ] and north of the constellation of Liyu [離瑜, α , γ , ε Mic]. Its polar distance is 115 *do*. The brightness, color and length of

the tail are the same as the previous sight.
[See Figure 7.]

2.5 7 April 1759

On the 11th day [辛卯 xinmao [28]] of the 3rd month [7 April 1759], at night after the fifth gyeong [3–5h] *paru*, the comet was seen in the Xu lunar lodge [虛宿, β Aqr and α Equ] and above the constellation of Liyu [離瑜, α , γ , ϵ Mic]. Its polar distance is 116 *do*. The brightness and color are the same as the previous sighting, but the length of the tail is 1.5 *cheoks* long. [See Figure 8.]

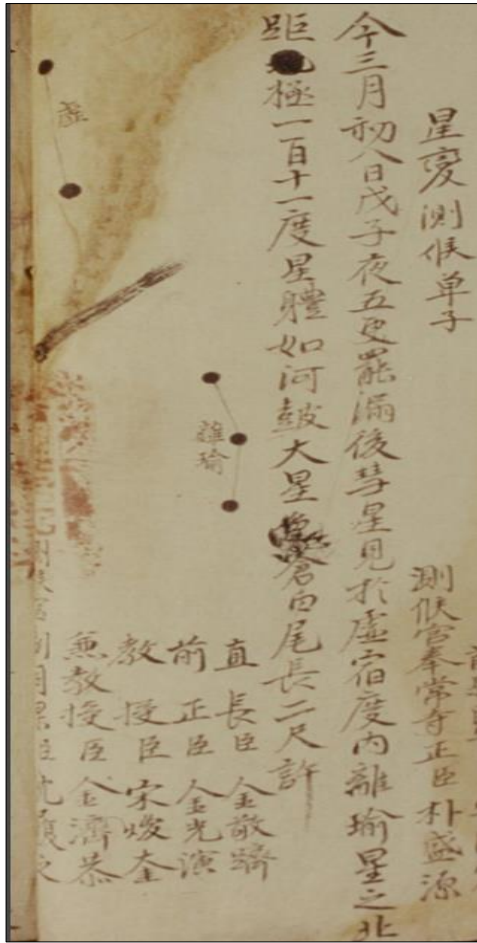


Figure 6: The *Danja* of Comet 1P/Halley on 4 April 1759.

2.6 9 April 1759

On the 13th day [癸巳 guise [30]] of the 3rd month [9 April 1759], at night after the fifth gyeong [3–5h] *paru*, the comet was seen in the Xu lunar lodge [虛宿, β Aqr and α Equ] and above the constellation of Liyu [離瑜, α , γ , ϵ Mic]. Its polar distance is 117 *do*. The brightness and color are slightly fainter than on the previous sighting, and the length of the tail is about 1 *cheoks* long. [See Figure 9.]

2.7 10 April 1759]

On the 14th day [甲午 jiawu [31]] of the 3rd month [10 April 1759], at night after the fifth gyeong [3–5h] *paru*, the comet was seen in the Xu lunar lodge [虛宿, β Aqr and α Equ] and

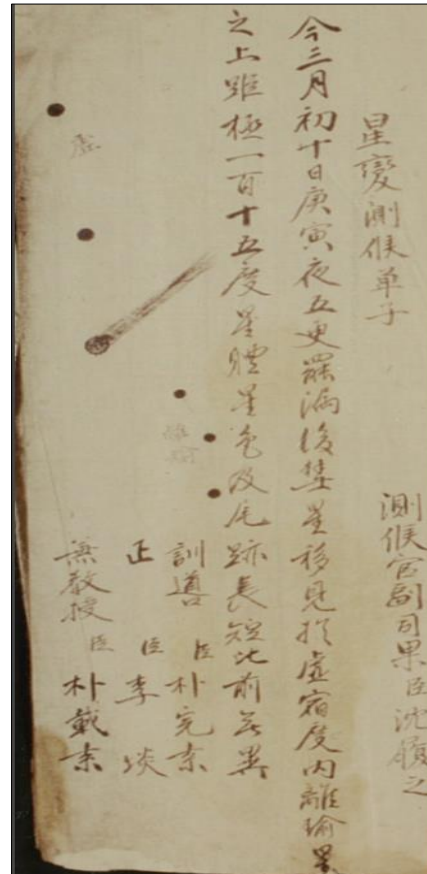


Figure 7: The *Danja* of Comet 1P/Halley on 6 April 1759. For some unknown reason there were only three observers on this night.

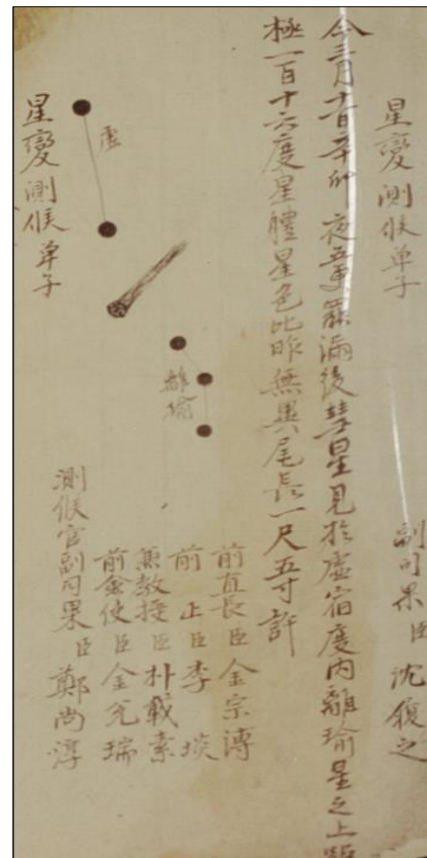


Figure 8: The *Danja* of Comet 1P/Halley on 7 April 1759.

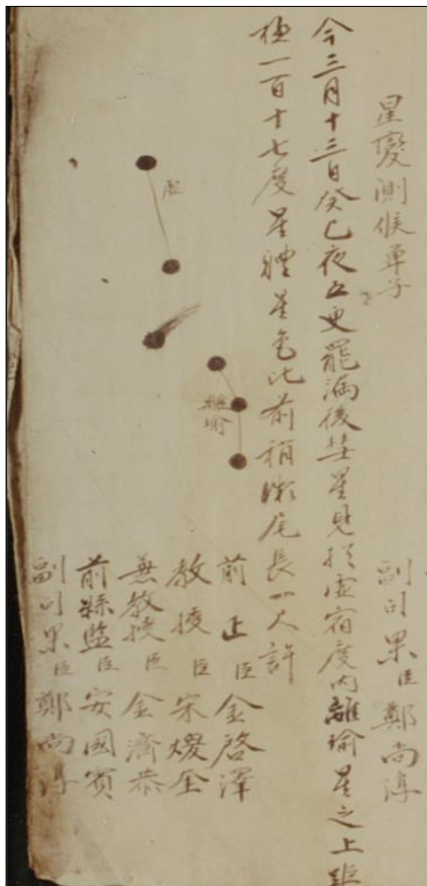


Figure 9: The *Danja* of Comet 1P/Halley on 9 April 1759.

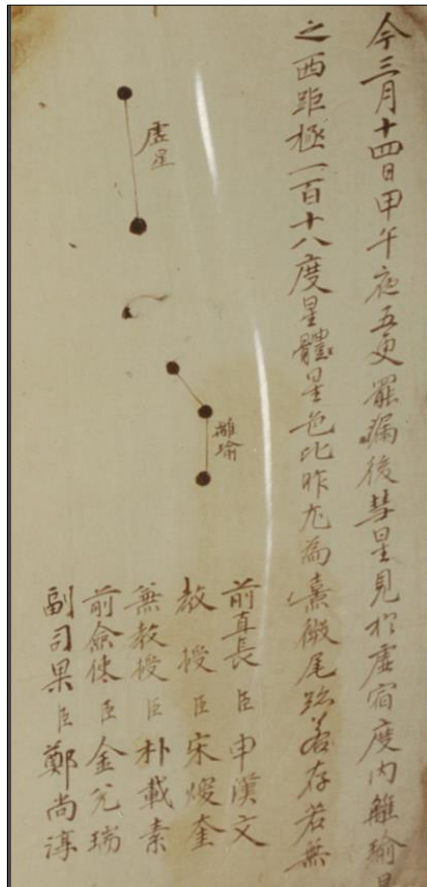


Figure 10: The *Danja* of Comet 1P/Halley on 10 April 1759.

to the west of the constellation of Liyu [離瑜, $\alpha, \gamma, \varepsilon$ Mic]. Its polar distance is 118 *do*. The brightness and color are slightly fainter than on the previous sighting, but the trace of the tail is difficult to judge. [See Figure 10.]

2.8 11 April 1759

On the 15th day [乙未 yiwei [32]] of the 3rd month [11 April 1759], at night after the fifth gyeong [3–5h] *paru*, the comet was seen in the Xu lunar lodge [虛宿, β Aqr and α Equ] and to the west of the constellation of Liyu [離瑜, $\alpha, \gamma, \varepsilon$ Mic]. Its polar distance is 119 *do*. The brightness, color and the trace of the tail are fainter than on the previous sight. [See Figure 11.]

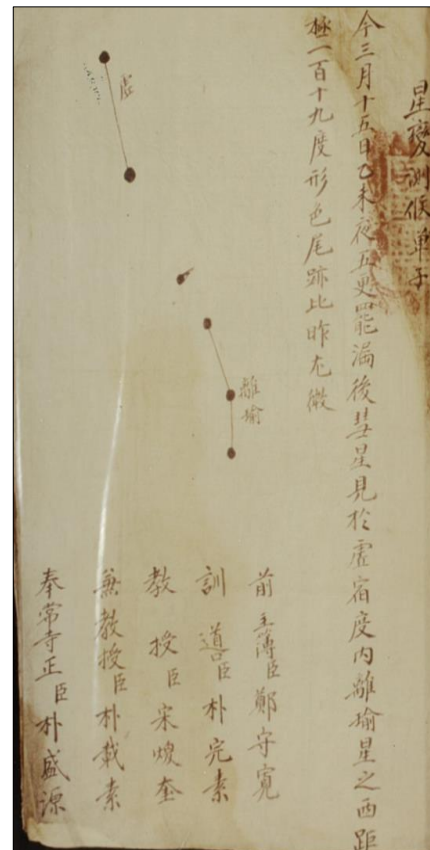


Figure 11: The *Danja* of Comet 1P/Halley on 11 April 1759.

2.9 12 April 1759

On the 16th day [丙申 bingshen [33]] of the 3rd month [12 April 1759], at night after the fifth gyeong [3–5h] *paru*, the comet had moved into the Nu lunar lodge [女宿, ε, μ Aqr]. Its polar distance is 121 *do*. The brightness and color are no different to the previous sighting. [See Figure 12.]

2.10 13 April 1759

On the 17th day [丁酉 dingyou [34]] of the 3rd month [13 April 1759], at night after the fifth gyeong [3–5h] *paru*, the comet was seen in the Xu lunar lodge [女宿, ε, μ Aqr]. Its polar distance is 121 *do* and a half. The brightness and color are fainter than on the previous sighting. [See Figure 13.]

2.11 25 April 1759

On the 29th day [己酉 jiyou [46]] of the 3rd month [25 April 1759], after the fifth gyeong [3–5h] *paru*, moonlight was no longer a problem and many stars are visible in the sky, but the comet's whereabouts could not be confirmed. There is now no doubt that it is too faint to observe.

Observers: Song Whan-gyu, Kim Je-gong, An Gook-bin, Kim Tae-seo, Jeong Sang-soon.
[See Figure 14.]

2.12 A Review of the Korean Observations

As Figure 4 shows, the first reported Korean sighting of this comet was made by the three observers on duty at the Royal Observatory in the

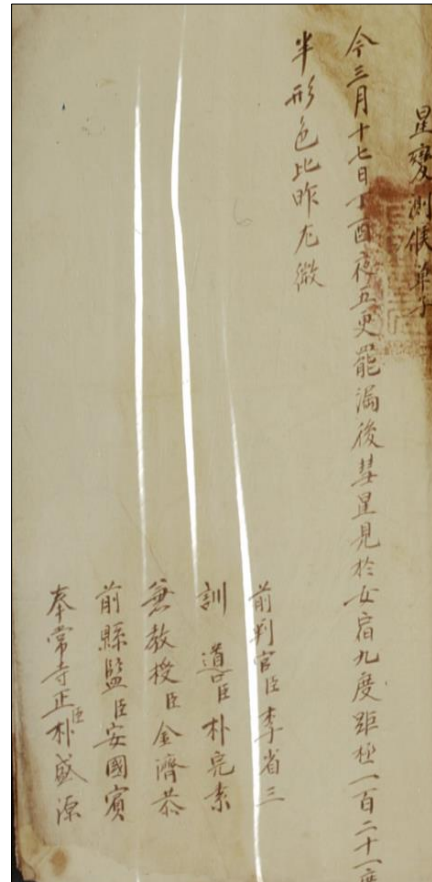


Figure 13: The *Danja* of Comet 1P/Halley on 13 April 1759.

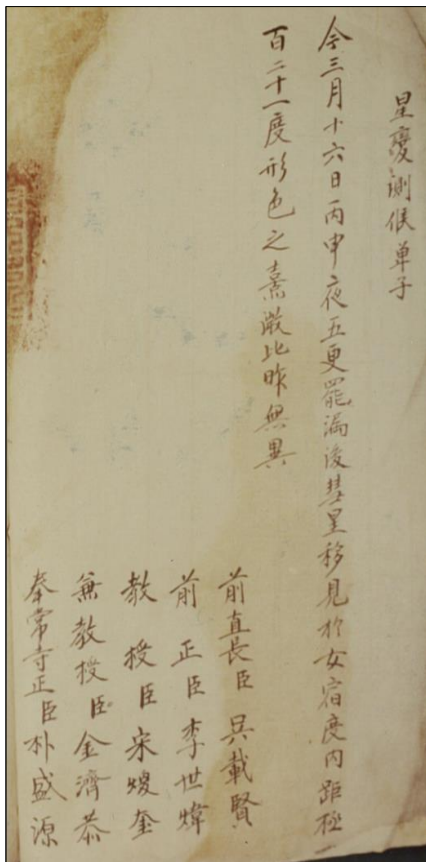


Figure 12: The *Danja* of Comet 1P/Halley on 12 April 1759. No sketch of the comet is included on this or the following days.

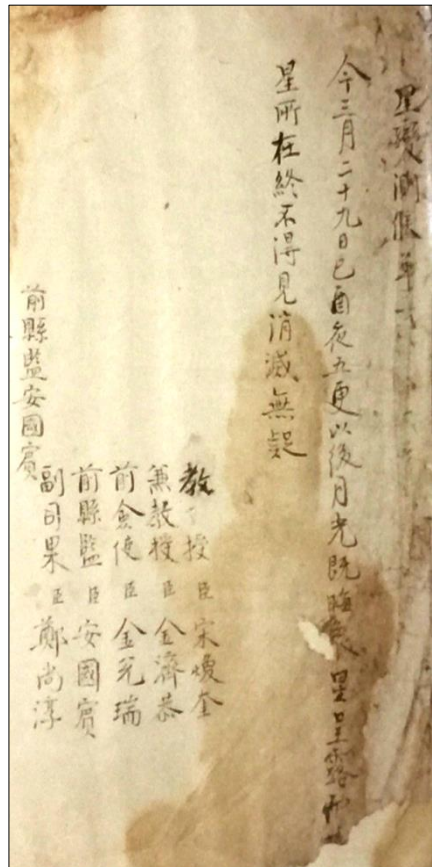


Figure 14: The last *Danja* for Comet 1P/Halley, on 25 April 1759.

35th year (1759) of the reign of King Yeongjo (r. 1725–1776), the 21st King of Joseon Dynasty.

These observations were made in Korea without the knowledge that Edmond Halley (1656–1742) had suggested that the object now known by his name was a periodic comet and “Hence I do venture to foretell, That it will return again in the Year 1758.” (Halley, 1705: 22). At the Cabinet meeting early next morning in the presence of King Yeongjo this comet came high on the agenda to arrange further observations. His Majesty accepted the recommendation put forward by Seo Myeong-eun (1716–1787) and other

cabinet members that the staff of the Observatory should be reinforced by the appointment of more observers, including Bak Seong-won (1711–1779), Jeong Sang-soon (1723–1786) and Sim I-ji (1720–1780).⁴

It is very interesting that the five new observers appointed only one day after the first observations of the comet were by then all well-known veteran astronomers (see Figure 4, Table 1 and Appendix 1). Actually, two of them, An Gook-bin and Kim Tae-seo, had already retired and probably were resting and enjoying life in Seoul. Therefore, the appointment of this urgent ‘task force’ of five observers indicates how important King Yeongjo and his high-ranking officials felt it was to clarify the nature of this rare celestial visitor.

From that date, observations were continued for the next 25 nights, regardless of whether the skies were clear or cloudy. Although the ob-

servers rostered on each night at the Observatory (Appendix 1) worked on rotation so that there would be non-stop observation of the sky in every direction, on the final night a further group of five very experienced observers was present to confirm that the comet was no longer visible (Figure 14). The three observers (Song Whan-gyu, An Gook-bin and Kn Tae-seo) who had reported the discovery of the comet on 2 April were there again on this final night, 25 April, to confirm its disappearance.

Korean observers involved in the 1759 Comet 1P/Halley apparition are listed alphabetically in Table 1, and the red stars (★) indicate the dates when they made observations. However, 31 individuals who were present on 24 April and 35 astronomers present on 25 April are not included in this table because they were not on duty on these nights. Instead, they are listed in Appendix 1.

Table 1: The thirty-five observers who were on duty at *Gwangwha-bang Cheomseong-dae* and made observations of Comet 1P/Halley in 1759.

Name	Days of April, 1760																									Total	
	0 1	0 2	0 3	0 4	0 5	0 6	0 7	0 8	0 9	1 0	1 1	1 2	1 3	1 4	1 5	1 6	1 7	1 8	1 9	2 0	2 1	2 2	2 3	2 4	2 5		
An Gook-bin		★	★		★				★	★				★			★	★		★			★	★	★	★	13
An Sa-haeng	★																		★								2
Bak Jae-so		★	★			★	★			★	★				★	★	★				★	★	★				12
Bak Seong-won		★	★							★	★	★	★	★		★	★										9
Bak Wan-so					★	★				★		★															4
Choe Taek-wha																								★			1
Gang Hui-eon																						★					1
Jeon Jong-ui																★											1
Jeong Sang-soon						★	★	★	★															★	★	★	7
Jeong Soo-gwan											★																1
Jeong Soo-wan																	★										1
Kim Ge-taek									★	★																	2
Kim Gwang-yeon				★	★																		★		★		4
Kim Gyeong-je				★																							1
Kim Je-gong				★	★			★	★			★	★	★					★	★	★			★	★		12
Kim Jong-bu	★						★	★																			3
Kim Jong-yoon																						★	★				2
Kim Tae-seo		★	★			★	★			★				★	★	★	★				★			★	★	★	13
Oh Jae-hyeon												★															1
Sim Yi-ji				★	★	★														★	★	★					6
Sin Han-moon										★																	1
Song Whan-gyu		★	★	★					★	★	★	★							★		★	★				★	11
Yang Do-min																							★				1
Yang Do-sang																				★							1
Yi Dam						★	★																				2
Yi Dong-seong															★												1

and Lee, 1991e; 1991f). He was then 26 years of age. Jae-so's major contribution was in calendar-making (the Naeyong Samseo in 1752; and the Shixiao-li in 1754, 1765 and 1773). He observed Comet 1P/Halley on 12 nights. Bak Jae-so was raised as a member of an astronomical family, in which his father, step-father, one brother and two sons were all hereditary astronomers.

3.4 Kim Tae-seo

Kim Tae-seo 金兌瑞 (b. 1714) is younger than An Gook-bin by 15 years, but they collaborated with each other for a long time. Tae-seo passed the State Examination for Astronomy and Meteorology in the eleventh year of King Yeong-jo's reign (i.e. 1735) at his age 22 (Lee and Choi, 2002; Whang and Lee, 1991g; 1991h), the year in which his second son, Kim Je-gong was born (see Section 3.5 below). Kim Tae-seo visited Beijing (China) often with An Gook-bin and brought back home a large telescope and a set of the *Xinfa Lixiang Kaocheng Houbian* (Moonheon Bigo, 1906; Sillok, 1745). He observed Comet 1P/Halley on 13 nights. He also engaged in calendar-making at the Bureau of Astronomy and Meteorology (e.g. the Shixian-li in 1744 and 1746).

Apart from his son Kim Je-gong, Kim Tae-seo had another son, Kim Je-yang, and a grandson, Kim Seong-won, who were astronomers.

3.5 Kim Je-gong

Kim Je-gong 金濟恭 was born in 1735, and passed the State Examination for Astronomy and Meteorology in the 24th year of King Yeongjo's reign (i.e. 1753), at the age of 19 (Lee and Choi, 2002; Whang and Lee, 1991i, 1991j). He observed Comet 1P/Halley on different 12 nights, four of them jointly with his father Kim Tae-seo, but his other contributions to Korean astronomy and meteorology are unknown at present and will be the subject of future research.

4 CONCLUDING REMARKS

One of the primary aims of this paper, as stated in Section 2, was to learn about the Korean astronomers from the Bureau of Astronomy and Meteorology who observed Comet 1P/Halley during its 1759 apparition. By using the 1759 *Seongbyeon Deungrok*, the names of 35 astronomers were collected, some of whom were already known from previous studies. Nonetheless, it was a triumph to uncover so many new astronomers' names through the study of just this one *Seongbyeon Deungrok*.

Although the birth years of most of these observers are known, it is pity that we know the years in which very few of them died. Fortunately, the years in which they were born, along

with their home town and father's name, were recorded on the application form when they applied for the National Examination for Astronomy and Meteorology, but there are no official documents that record their deaths. None of the scientists under discussion is listed in directories such as the *Joseon Myeongsin-rok* 朝鮮名臣錄 (Yi, 1925), and only two names are mentioned briefly in the latest directory, the *Hankuk Jeongsin Moonwha Dae-baek'gua Sajeon* (Daebaek'gua, 1991). Since it is not an easy task to determine the dates when and the places where most of these astronomers died, this will be left for a future project.

In spite of this setback, we have discovered some very interesting and unusual families, as a by-product in our study. For instance, we found several cases of two generations of the same family working together during the observation of Comet 1P/Halley. As listed in Table 1, An Gook-bin and his grandson An Sa-haeng were on duty for 13 and 2 nights, respectively. Kim Tae-seo and his son Kim Je-gong also were on duty for 13 and 12 nights, respectively, and worked together on 4 of these nights. A third example involves Song Whan-Gyu and his son-in-law Kim Jong-bu. The former was on duty for 11 nights, and the latter for 3 nights, but they never observed together. The case of Song Whan-gyu and his ties to the Kim family—another Korean dynasty of hereditary astronomers—is worthy of further study.

The second objective of this paper was to document the observations made by the astronomers from the Bureau of Astronomy and Meteorology during the apparition in 1759 of what is now known as Comet 1P/Halley. This comet was visible as a naked-eye object for 10 nights between 1 and 13 April, and fortunately clouds only prevented observation on three of these nights (3, 5 and 8 April). This means that at that time the Korean astronomers enjoyed nearly 77% clear nights, which is far better than the present-day statistic of ~45% clear nights recorded in Seoul during the first half of April in 1995 and 1996 (Nha Observatory Log book 1995–1997).

The 1759 apparition of Comet 1P/Halley is discussed in detail by Kronk (1999) in his masterful *Cometography*, and he summarizes all known naked-eye and telescopic observations by different observers in various locations, but the Korean observational records were not available to him when he researched his book. Accordingly, the Korean observations provide some useful new data, and they also offer confirmation of some of the details recorded in his book.

According to Kronk, the French astronomer Charles Messier (1730–1817) detected the comet on 1 April using a Newtonian reflector of

4.5-foot focal length. He reported that the nucleus exceeded in appearance stars of the 1st magnitude and was whitish, while there was a tail over 25° in length. Messier's observations agree rather well with the Korean *Danja* of 2 April except for the length of the tail. Although the length of the tail is not recorded in every *Danja*, the series of sketches in the *Danjas* show that the tail reached its greatest length between 2 and 6 April. By then the comet was positioned in the sky between the first star in the Xu lunar mansion 虛- (β Aquarii) and the third star in the constellation of Liyu 離瑜三 (δ Microscopium), with the polar distance changing from 107° to 115°.

The comet then faded rapidly, showing no significant change in right ascension while it continued to move towards the south. The *Danjas* of 14 April and thereafter describe how the skies were then cloudy or moonlight interfered with the observations, and from that date until 25 April the comet was not seen again.

5 NOTES

1. *Paru* is a signal that was beaten 33 times on iron drum in Seoul after the curfew was lifted at 5h in the morning.
2. A *do* is $360^\circ/365 = 0.986^\circ$.
3. A *cheok* (尺) is a unit of length and also an angle. 1 *cheok* = 10 *chon* (寸), 1 *chon* $\doteq 1^\circ$.
4. Normally the sky was watched at any time day or night by a group of three astronomers from the *Gwansang-gam*. There were three 8-hr shifts every 24 hours, so a different astronomer was rostered on duty for each shift. However, the number of astronomers assigned to each 24-hr observing period was automatically increased from three to five as soon as a strange object was observed and reported next morning at the Court. This is why there were three astronomers on the final observing shift on 1 April, and they were increased to five for the next 24-hr period. The cabinet searched for astronomers who were experienced in cometary observations, because the *Danja* of 1 April stated that the newcomer "... has a trace of a tail."

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7 REFERENCES

- Daebaek'gua, 1991. *Hankuk Jeongsin Moonwha Daebaek'gua Sajeon*.
- Halley, E., 1705. *A Synopsis of the Astronomy of Comets*. London, John Senex.
- Hong, Y., 2012. Preface. *Seongbyon Deungrok*. Seoul, Korea Academy of Meteorology and Climate. Pp. III, VII.
- Ilgi, 1754. *Seungjeong-won Ilgi*, National Institute of Korean History, 61, 627.
- Kang, Y-W., 1997. Cross index of dates used in Chinese, Korean and Japanese calendars for the period, 1401–1450. In Nha, I.-S., and Stephenson, F.R. (eds.). *Oriental Astronomy from Guo Shoujing to King Sejong* [The Proceedings of ICOA-1]. Seoul, Yonsei University Press. Pp. 349–350, and 383–401.
- Kronk, G.W., 1999. *Cometography. A Catalogue of Comets. Volume 1: Ancient – 1799*. Cambridge, Cambridge University Press.
- Lee, S.-M., and Choi, J.-O., 2002. *Japgua Bangmok* (雜科榜目) CD-ROM.
- Moonheon Bigo, 1906. *Jeungbo Moonheon Bigo*, 1, 74.
- Naeyong Samseo, 1752.
- Nha, I.-S., 1982. Seongbyeon Deungroks reserved in the Yonsei University Library. *The Dong Bang Hak Chi* (*The Journal of Korean Studies. Institute of Korean Studies, Yonsei University*), 143, 207–247 (in Korean).
- Nha, I.-S., 2012. Annotation. *Seongbyon Deungrok*. Seoul, Korea Academy of Meteorology and Climate. Pp. III, VII.
- Nha, I.-S. and Lee, J.-B., 2004. The long-term project on astronomical archives in Korean history. In Chen, K.-Y., Orchiston, W., Soonthornthum, B. and Strom, R. (eds.), 2006. *The Fifth International Conference on Oriental Astronomy (ICOA-5)*. Chiang Mai, Chiang Mai University, Pp. 103–108.
- Nha, I.-S., Nha, S.L., and Orchiston, W., 2017. The development of astronomy in Korea and the emergence of astrophysics in South Korea. In Nakamura, T., and Orchiston, W. (eds.). *The Emergence of Astrophysics in Asia: Opening a New Window on the Universe*. Cham: Springer.
- Nha Observatory Log book 1995–1997. Nha I.-S. Collection.
- Rufus, W.C., 1936. Astronomy in Korea. *The Transactions of the Korea Branch of the Royal Asiatic Society*, 26, 1–53.
- Seong Ju-deok, 1818. *Seowun'gwan-ji*.
- Shixian-li, 1732 calendar.
- Shixian-li, 1744 calendar.
- Shixian-li, 1746 calendar.
- Shixian-li, 1752 calendar.
- Shixian-li, 1754 calendar.
- Shixian-li, 1765 calendar.
- Shixian-li, 1767 calendar.
- Shixian-li, 1772 calendar.
- Shixian-li, 1773 calendar.
- Shixian-li, 1774 calendar.
- Shixian-li, 1775 calendar.
- Shixian-li, 1777 calendar.
- Shixian-li, 1779 calendar.
- Shixian-li, 1782 calendar.
- Shixian-li, 1784 calendar.
- Shixian-li, 1787 calendar.
- Shixian-li, 1788 calendar.

- Shixian-li, 1789 calendar.
 Shixian-li, 1793 calendar.
 Shixian-li, 1795 calendar.
 Shixian-li, 1797 calendar.
 Sillok, 1744. *Yeongjo Sillok*, 59:29b. 15th day (壬辰) of the 5th month of the 20th year of Yeongjo reign.
 Sillok, 1745. *Yeongjo Sillok*, 62:4b. 13th day (癸未) of the 7th month of the 21st year of Yeongjo reign.
 Wada, Y., 1917. Seongbyeon Chookhoo Danja. In *Josen Kodai Kansoku Kiroku Josha Hokoku*. Kansokusho, Josen Sotokufu. Pp. 173–176.
 Whang, W.-G., and Lee, J.-Y., 1991a. Samryeok-cheong Seonsaeng-an. In *Roster of Calendar-makers in the Late-Joseon Dynasty and Index*. Seoul, Han'gook Moonwha-sa. P. 878.
 Whang, W.-G., and Lee, J.-Y., 1991b. Un'gua Bamgmok. In *Roster of Calendar-makers in the Late-Joseon Dynasty and Index*. Seoul, Han'gook Moonwha-sa. P. 813.
 Whang, W.-G., and Lee, J.-Y., 1991c. Samryeok-cheong Seonsaeng-an. In *Roster of Calendar-makers in the Late-Joseon Dynasty and Index*. Seoul, Han'gook Moonwha-sa. P. 876.
 Whang, W.-G., and Lee, J.-Y., 1991d. Un'gua Bamgmok. In *Roster of Calendar-makers in the Late-Joseon Dynasty and Index*. Seoul, Han'gook Moonwha-sa. P. 810.
 Whang, W.-G., and Lee, J.-Y., 1991e. Samryeok-cheong Seonsaeng-an. In *Roster of Calendar-makers in the Late-Joseon Dynasty and Index*. Seoul, Han'gook Moonwha-sa. P. 874.
 Whang, W.-G., and Lee, J.-Y., 1991f. Un'gua Bamgmok. In *Roster of Calendar-makers in the Late-Joseon Dynasty and Index*. Seoul, Han'gook Moonwha-sa. P. 807.
 Whang, W.-G., and Lee, J.-Y., 1991g. Samryeok-cheong Seonsaeng-an. In *Roster of Calendar-makers in the Late-Joseon Dynasty and Index*. Seoul, Han'gook Moonwha-sa. P. 875.
 Whang, W.-G., and Lee, J.-Y., 1991h. Un'gua Bamgmok. In *Roster of Calendar-makers in the Late-Joseon Dynasty and Index*. Seoul, Han'gook Moonwha-sa. P. 808.
 Whang, W.-G., and Lee, J.-Y., 1991i. Samryeok-cheong Seonsaeng-an. In *Roster of Calendar-makers in the Late-Joseon Dynasty and Index*. Seoul, Han'gook Moonwha-sa. P. 872.
 Whang, W.-G., and Lee, J.-Y., 1991j. Un'gua Bamgmok. In *Roster of Calendar-makers in the Late-Joseon Dynasty and Index*. Seoul, Han'gook Moonwha-sa. P. 803.
 Yi, J.-H., 1925. *Joseon Myeongsin-rok*.

Appendix 1: Names of observers on duty each night for Comet 1P/Halley. The symbol ○ in the third column indicates that the characters are indecipherable.

Days of the 3rd month of the 35th year of King Yeongjo	Days of April, 1759	Observers
5th	1	An Sa-haeng 安思行, Kim Jong-boo 金宗溥, Yi Gyeong-bin 李景彬
6th	2	Song Whan-gyu 宋煥奎, Bak Jae-so 朴載素, Kim Tae-seo 金兌瑞, An Gook-bin 安國寶, Bak Seong-won 朴盛源
7th	3	Song Whan-gyu 宋煥奎, Bak Jae-so 朴載素, Kim Tae-seo 金兌瑞, An Gook-bin 安國寶, Ak Seong-won 朴盛源
8th	4	Kim Gveona-ie 金敬躋, Kim Gwang-yeon 金光演, Song Whan-gyu 宋煥奎, Kim Je-gong 金濟恭, Sim Yi-ji 沈履之
9th	5	Kim Gwang-yeon 金光演, Bak Wan-so 朴完素, Kim Je-gong 金濟恭, An Gook-bin 安國寶, Sim Yi-ji 沈履之
10th	6	Bak Wan-so 朴完素, Yi Dam 李淡, Bak Jae-so 朴載素, Kim Tae-seo 金兌瑞, Sim Yi-ji 沈履之
11th	7	Kim Jong-boo 金宗溥, Yi Dam 李淡, Bak Jae-so 朴載素, Kim Tae-seo 金兌瑞, Jeong Sang-soon 鄭尙淳
12th	8	Kim Jong-boo 金宗溥, Kim Ge-taek 金啓澤, Kim Je-gong 金濟恭, An Gook-bin 安國寶, Jeong Sang-soon 鄭尙淳
13th	9	Kim Ge-taek 金啓澤, Song Whan-gyu 宋煥奎, Kim Je-gong 金濟恭, An Gook-bin 安國寶, Jeong Sang-soon 鄭尙淳
14th	10	Sin Han-moon 申漢文, Song Whan-gyu 宋煥奎, Bak Jae-so 朴載素, Kim Tae-seo 金兌瑞, Jeong Sang-soon 鄭尙淳
15th	11	Jeong Soo-gwan 鄭守寬, Bak Wan-so 朴完素, Song Whan-gyu 宋煥奎, Bak Jae-so 朴載素, Bak Seong-won 朴盛源
16th	12	Oh Jae-hveon 吳載賢, Yi Se-wui 李世煒, Song Whan-gyu 宋煥奎, Kim Je-gong 金濟恭, Bak Seong-won 朴盛源
17th	13	Yi Seong-sam 李省三, Bak Wan-so 朴完素, Kim Je-gong 金濟恭, An Gook-bin 安國寶, Bak Seong-won 朴盛源

18th	14	Yi Dong-seong 李東成, Yi Gyeong-jik 李擎稷, Kim Je-gong 金濟恭, Kim Tae-seo 金兌瑞, Bak Seong-won 朴盛源
19th	15	Yi In-dae 李仁大, Yi Gyeong-sim 李景深, Bak Jae-so 朴載素, Kim Tae-seo 金兌瑞, Bak Seong-won 朴盛源
20th	16	Jeon Jong-ui 全宗毅, Bak Jae-so 朴載素, Kim Tae-seo 金兌瑞, An Gook-bin 安國寶
21st	17	Jeong Soo-wan 鄭守完, Bak Jae-so 朴載素, Kim Tae-seo 金兌瑞, An Gook-bin 安國寶, Bak Seong-won 朴盛源
22nd	18	An Sa-haeng 安思行, Yi Jeong-han 李挺漢, Song Whan-gyu 宋煥奎, Kim Je-gong 金濟恭, Bak Seong-won 朴盛源
23rd	19	Kim Jong-voon 金宗潤, Yang Do-sang 梁道常, Kim Je-gong 金濟恭, An Gook-bin 安國寶, Sim Yi-ji 沈履之)
24th	20	Kim Jong-voon 金宗潤, Song Whan-gyu 宋煥奎, Kim Je-gong 金濟恭, Kim Tae-seo 金兌瑞, Sim Yi-ji 沈履之
25th	21	Gang Hui-eon 姜熙彦, Yi Jeong-boong 李廷鵬, Song Whan-gyu 宋煥奎, Bak Jae-so 朴載素, Sim Yi-ji 沈履之
26th	22	Kim Gwan-yeon 金光演, Yang Do-min 梁道敏, Bak Jae-so 朴載素, An Gook-bin 安國寶, Yi Seong-gyu 李聖圭
27th	23	Choe Daek-wha 崔宅華, Bak Jae-so 朴載素, Kim Tae-seo 金兌瑞, An Gook-bin 安國寶, Jeong Sang-soon 鄭尚淳
28th	24	Kim Gwan-yeon 金光演, Kim Je-gong 金濟恭, Kim Tae-seo 金兌瑞, An Gook-bin 安國寶, Jeong Sang-soon 鄭尚淳
	same day	Yi Un-gseo 李應瑞, Yi Cheon-pil 李天弼, Jo Sa-yang 趙思良, Yi Gyeong-jik 李擎稷, Song Whan-gyu 宋煥奎, Yi Se-wui 李世煒, Yi Jin-tae 李震泰, Bak Jae-so 朴載素, Jeon Deok-voon 田德潤, Yi Je-○ 李齊○, Yi Dam 李淡, Yang Do-min 梁道敏, Bak Choon-wook 朴春煜, Bak Wan-so 朴完素, Yi Jeong-boong 李廷鵬, Yi Jeong-han 李挺漢, Song Seo-gyu 宋瑞奎, Yi Jeong-seo 李廷瑞, Yi Dong-○ 李東○, Yang Do-min 梁道敏 (appeared twice), Choe Daek-wha 崔宅華, Kim Jong-voon 金宗潤, Yi Dong-seong 李東成, An Sa-haeng 安思行, Yi Gyeong-sim 李景深, Gang Hui-eon 姜熙彦, Yi Seong-sam 李省三, Yi In-dae 李仁大, Jeong Soo-gwan 鄭守寬, Kim Jong-yeon 金宗連, Yi Dong-Jeub 李東楮
29th	25	Song Whan-gyu 宋煥奎, Kim Je-gong 金濟恭, Kim Tae-Seo 金兌瑞, An Gook-Bin 安國寶, Jeong Sang-soon 鄭尚淳
	same day	Yi Un-gseo 李應瑞, Yi Dong-van 李東樑, Jo Sa-yang 趙思良, Yi Gyeong-jik 李擎稷, Song Whan-gyu 宋煥奎, Yi Se-wui 李世煒, Yi Jin-tae 李震泰, Bak Sang-in 朴尚寅, Bak Jae-so 朴載素, Jeon Deok-voon 田德潤, Yang Do-min 梁道敏, Yi ○-○ 李○○, Bak Choon-○ 朴春○, Yi Jeong-han 李挺漢, Song Seo-gyu 宋瑞奎, Kim Gwan-yeon 金光演, Bak Jong-so 朴綜素, Yi Jeong-seo 李廷瑞, Yi Dong-jo 李東柱, Kim Je-gong 金濟恭, Yang Do-sang 梁道常, Choe Taek-wha 崔宅華, Kim Heong-taek 金興澤, Kim Jong-voon 金宗潤, ○ ○-il ○ ○-, ○ ○-○ ○○○, ○ ○-sim ○○深, Gang Hui-eon 姜熙彦, Yi Seong-sam 李省三, Yi In-cheon 李仁天, Jeong Soo-gwan 鄭守寬, Yi Haeng-○ 李行○, Yi Dong-Jeub 李東楮, Kim Ge-jin 金啓晉, Yi Eui-chang 李宜昌

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