

Study for the Dating of the Old Chinese Star Charts

: The oldest star chart “Moon’s path chart in grid paper”[格子月進図] that conveys the image of the constellation at the beginning of Tang[初唐]

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1. Introduction

The dating of the ancient Chinese star chart, so far has been carried out by finding the date at which the error with the width of 28 xiu [28 宿広度] (1) or the identified stars are minimized by the precession. These methods estimate the dates from the observation date of star catalog used for star charts. However, the same value of width of 28 xiu were used long time, and the value of Han Dynasty[漢朝] has been only revised at Tang Dynasty[唐朝](618-907) and Song Dynasty[宋朝] (960–1279). In addition, the star catalog is also used in Tang Dynasty, which was measured in Han Dynasty[漢朝] and Jin Dynasty[晉朝] (265–420). Therefore, in the date estimation by the present method, only the result with Han Dynasty or Jin Dynasty is obtained. (2)

In this way, in the ancient China where the same star catalog was used for a long time, the dating when the star chart was actually drawn, for example, the estimation of the date of the star chart drawn in Tang Dynasty, it cannot be done by using the observation date of star catalog in principle.

The date estimation method proposed in this paper is not an estimation method based on one dimensional information based on the position of the stars so far, but it is multidimensional, such as the shape, positional relationship, and name of constellations drawn on each star chart. It is a comparative age estimation method based on information. In this method, even if multiple star charts use the same star catalog, it is possible to estimate the date using unique information of each star chart.

For example, although it has not been noted that the shape and positional relationship of Chinese constellations changed according to the period of the time, K. Ogawa of the Tokyo Astronomical Observatory points it out from the study of the occultations of stars by the moon and the planet in the ancient record. K. Ogawa (1932) says that “(chapter 5.) The disappearance of the *Ku* 哭星 (γ , δ Cap) and expansion of the *Leibizhen* 墨壁陣. In the China, *Ku* 哭星 was absorbed during the 11th century, probably as a result of the astrological advance of the *Leibizhen* 墨壁陣.” It is supposed that the constellation *Ku* 哭星 is absorbed by the constellation *Leibizhen* 墨壁陣. By using this, it is possible to estimate that the star chart where the *Leibizhen* 墨壁陣 is not expanded to the position of *Ku* 哭星 (γ , δ Cap) is a star chart before the middle of the 11th century.

In addition to this, in *Kaiyuanzhanjing* [開元占經] compiled by Gautama Siddha[瞿曇悉達] during the first half of the ‘period of Emperor Xuan Zong [開元年間](713-741). In this text, here is document called “Star chart” [星圖](Vol. 106-110), which summarize the transition of the ancient constellation, although there are only few clearly changed constellations. It can be used for dating the star charts, this document shows the difference between the current shape of the constellation[今図] in Tang Dynasty’s and the old shape in the old period[旧図].

In addition to *Kaiyuanzhanjing* [開元占經], astronomical related documents describe the approximate positional relationship of constellations and the constellation name of that period. We will compare and estimate the creation date of star charts based on those documents.

Note) The star charts in the following documents are used in this study.

Su Song star chart[蘇頌星図]: S.Osaki(1987)p.232-234

Moon’s path chart[格子月進図][格子月進図]: Photo of National Observatory and E.Sasaki(1984)

Dunhuang star chart[敦煌星図]: S. Whitfield (2009) p.41

Chart of sky[天象列次分野之図]: Nara cultural Labo.(2016) (PL.7)

Suzhiu shike xingtu[淳祐石刻天文図]: Nara cultural Labo. (2016) (PL.6)
Kitora Astronomical Diagram[キトラ古墳天文図]:Nara cultural Labo. (2016) (PL.3
Takamatsuzuka Astronomical Diagram[高松塚古墳星宿図]:Nara cultural Labo.
(2016) (PL.5))

Sankebosan[三家簿讃]: Daito Univ. (2004)

The Chinese constellations are referred to as XingXiu[星宿] for 28 xiu constellations, and other constellations are referred to as XingGuan[星官], but in this paper they will be unified and referred to as Constellations[星座].

2. Star chart for the dating

This study is based on Su Song star chart[蘇頌星図] in Song dynasty(960–1279), as a main reference, we make a comparative dating of three star charts older than that. In addition, there is also a star chart called Suzhiu shike xingtu[蘇州石刻星図(淳祐星図)] in Song dynasty. (3) Su Song Star Chart[蘇頌星図] is a star chart created by astronomer Su Song[蘇頌](1020-1101) in North Song dynasty(960–1127), and it is printed in the book on the astronomical observation instrument called Xin yixiang fayao[新儀象法要](completed in 1086 to 93) K. Yabuuchi (1990) p.125-126 states that the Su Song star chart[蘇頌星図] is drawn based on the observations during [元豐年間] (1078-85). However, it is said that the original book has not been transmitted, and there may be a modification in the later version. In the Su Song star chart[蘇頌星図], the *Ku* 哭星 (γ , δ Cap) mentioned above was absorbed by the western end of the *Leibizhen* 星壁陣 expanded to *Xu xiu* 虛宿 and becomes a star that composes the *Leibizhen* 星壁陣.

1) Moon's path chart in grid paper[格子月進図] (hereinafter abbreviated as Moon's path grid chart)

Moon's path chart[格子月進図] is a star chart of Tuchimikado [土御門], and it is a copy of the original drawing by Y. ABE [安倍泰世] around the first year of Bunpo[文保] (1317). In addition, it is described as "moon grid figure" in the note of the book (1215) of the transcription of the old document of the constellation "Sankebosan" [三家簿讃](4), and it is said that the original drawing existed by this time. Moon's path chart[格子月進図] was discovered by Susumu Imoto during the 2nd world war, but it was destroyed by air raids (1945) during the exhibition at Yurakucho Tonichi Kaikan[有楽町東日会館]. Luckily, there are still photos taken before the fire and a restored version of chart has been published by E. Sasaki (1984). Moon's path chart[格子月進図] consisted of a circular diagram of the northern sky and a square diagram of the mid latitude. The square star chart was drawn on a sheet of 1degree interval grid. The constellations were drawn in three colors of yellow, red and black according to the three family's classification. (5) In this star chart, the western end of the Leibizhen [星壁陣] mentioned earlier is in *Wei xiu* 危宿, and *Ku* 哭星 (γ , δ Cap) has not been absorbed by the *Leibizhen* 星壁陣, so the original chart is drawn before the Song Dynasty[宋朝].

About the date of the original drawing, S. Imoto (1942) p. 69 had suggested almost the same age as Su Song star chart in the AD 1100 from the spring equinox, and it is supposed to that the chat was based on the observation of Yuan Zhen period [元豐年間] (1078-85). T. Watanabe (1987) p.762-764 suggested based on the width of 28 xiu [28 宿広度](1), it has a slight difference from the value of Yixing[一行] (about AD720) who made Dayan calendar[大衍曆], 2) Based on the description of Song Shi[宋史], the width of 28 xiu [28 宿広度] did not change from Han Dynasty to Yixing[一行]. Based on these, Watanabe thought Moon's path chart[格子月進図] was produced from 720 to 1215. S. Osaki (1987) p.256-273 suggested, 1) From the analysis of the area of 12 section[12 次] which represent season indicate the date is $BC188 \pm 21$ years. 2) From the analysis of declination of position of the stars, the date is $AD 500 \pm 50$ years.

Since this star chart has been burned in the war, so detailed research has only been conducted by S. Osaki, and identification work with the modern star catalog has not been conducted.

2) Dunhuang star chart[敦煌天文圖]

In 1900, a large number of documents were found at the Mogao Caves[莫高窟] in Dunhuang in western China, and the British explorer A. Stein bought part of them and brought it back to the British Museum (1907). The documents contained star chart called Dunhuang star chart[敦煌天文圖] (Stain, MS3326). Afterward, Needham introduced a part of this chart in "Science and Civilization of China" (1959) and revealed its existence. He estimated the date of the star chart is around AD940, but did not show the basis of it. (6)

Ma[馬世長](1989) p. 198 suggested based on 1) in the divination part of MS 3326, the taboo characters (avoid the characters of the emperor's close relatives) of min 民 of [太宗・世民] is modified (one line of the character is deleted), 2) the text in the star chart From the fact that the characters of tan[旦] of Ruizong [睿宗・旦] is not absconded, 3) the nonuse of the Modified Chinese characters by Wu Zetian [則天文字], the date was during Zhongzong 中宗 period (705~710) in the Tang Dynasty. Furthermore, S.I. Whitfield (2009) p.50 dates back to the Gao Zong 高宗 period (649 to 684) until the year when Ruizong [睿宗] ranked in 684 by the same reason. However, these estimations are not based on the star chart itself.

Dunhuang star chart[敦煌天文圖] is composed of a circular diagram of the northern sky and a square diagram of the mid latitude divided into 12th order (month). This star chart is very similar to Moon's path chart[格子月進圖], and the shapes and names of constellations are almost the same and can be compared easily. But there are many errors if it is copied by the person without knowledge of constellations. (7) This star chart seems to have been copied from the original chart in a short time, and the pictures and letters are also rough. The *Ku* 哭星 (γ , δ Cap) in this star chart has not been absorbed by the *Leibizhen* 壘壁陣, so the original chart is drawn before the Song Dynasty[宋朝] (960-1279).

3) Chart of the sky [天象列次分野之圖] (hereinafter referred to as [天象圖])

Chart of the sky is a stone shaped star chart transmitted to Korea, according to the inscription "When there was a stone caving star chart in the castle of Goguryeo Dynasty [高句麗], it was attacked by the coalition forces of Tang[唐] and Silla[新羅] and Goguryeo was destroyed (668). The chart of the stone sculpture was sunk in the river. However, the rubbed copy was remained. When Lee Chosun Taizu[太祖] (Reigned: 1392-1398) was crowned, it was presented to him. He ordered to create an stone caving star chart with the rubbed copy as an original drawing, and was completed in December of 1395 [太祖 4, 洪武 28]. (8) This stone caving star chart was caved again on the back during Song 肅宋 period (1674 to 1720). The rubbed copy being distributed is said to be a re craved figure. However, the rubbed copy of the original, which is considered to be the Goguryeo period, has not been transmitted.

As for the date of the original drawing, T. Watanabe (1987) p. 772 suggested, the value described in the inscription of Chart of the sky[天象圖] and the value of Shi shi xingjing[石氏星經] described in Jiu tang shu tianwenzhi[旧唐書天文志] and Kaiyuan zhanjing [開元占經] based on the observation of AD 200 is almost the same. Based on this, he believes the date of the chart is from AD 200 to 668 when Goguryeo was destroyed. However, this estimation has a problem, this estimation was not made based on a star chart itself, and it was made based on the star position and legend in the inscription described on 1495 without examination of these newly described materials.

In this star chart, the western end of the *Leibizhen* 壘壁陣 is in the *Wei xiu* 危宿, and the *Ku* 哭星 (γ , δ Cap) is not absorbed by the *Leibizhen* 壘壁陣, so it is a star chart before the Song Dynasty[宋朝] (960-1279).

We will start the dating of Moon's path chart[格子月進図]. Fig. 1 shows the area around *Xuanyuan* 軒轅 in chart.

This is a reproduction of a historical Chinese star map, likely from the 'Ming Shi Tian Wen Zhi' (Ming History Astronomical Chapter). The map displays numerous constellations and individual stars, each identified by traditional Chinese labels. Key features include:

- Top Labels:** Four large characters at the top represent cardinal directions or specific stellar regions: 壽星 (Shouxing), 鷲尾 (Jiuyei), 鷲火 (Jiuhuo), and 鷲首 (Jiushou).
- Star Groups:** Numerous clusters of stars are depicted, often enclosed in circles or polygons, representing major constellations like 大熊為衡 (Great Bear as Balance), 麒麟 (Qilin), 天狗 (Tiangou), and others.
- Astronomical Grid:** A network of lines indicates celestial coordinates, including the equator (赤道) and other significant parallels.
- Annotations:** Extensive handwritten-style text provides descriptions and names for the various star patterns and groups.

The first thing to notice when we look at Moon’s path chart[格子月進図] is that there is no number on the star in the row of stars extending northwest from *Xuanyuan* 軒轅 in the middle of Fig. 1. Since it is in the same constellation, this portion of constellation is considered to be added later. The *Xuanyuan* 軒轅 of Su Song star chart [蘇頌星図] also extends in the same northwest direction, but there is no branch at the end.

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tail is long sideways and heading west.) Therefore, the west facing tail is the tail of the star chart of the period when Gautama Siddha [瞿曇悉達] editing *Kaiyuan zhanjing* [開元占經], and the northwest facing diagonal tail is the tail of the old star chart.

Although the figure of the main constellation is drawn in *Sankebosan* [三家簿讚] and most of them are in the same shape as Moon's path chart[格子月進圖], *Xuanyuan* 軒轅 has a branched tail extending to the northwest (see FIG. 2). In the back of the book of Yasushi Abe (1215/2/21), who copied *Sankebosan* [三家簿讚] (on February 21, 1215), wrote that "As for the figure, if the difference is large, just copy it according to Moon path chart." However, since *Xuanyuan* 軒轅 has a large difference compared to *Sankebosan* [三家簿讚], it may have been added in Moon's path chart[格子月進圖]. The constellation with a branched end is one of the features of the constellations of *Sankebosan* [三家簿讚] and Moon's path chart[格子月進圖]. There are *Tiangou* 天狗 in the lower right of Fig. 1, and *Guki* 鼓旗 and *Zuoki* 左旗 in addition to the above, have branched end.

Summary of the tail of *Xuanyuan* [軒轅] is as follows.

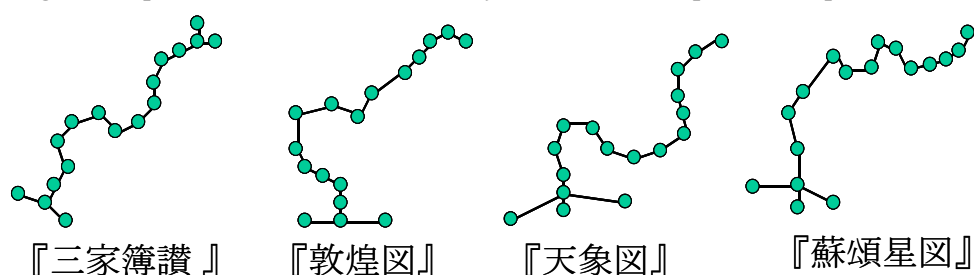
Old chart: A tail extending to the northwest. (The end of the tail was divided in *Sankebosan* [三家簿讚].)

Current chart (Period of Kaiyuan[開元年間]): A tail extending to west.

Song Dynasty (from Su Song star chart[蘇頌星圖]): A tail extending to the northwest. (The end of the tail is not branched.)

Therefore, the original shape of *Xuanyuan* 軒轅 in the Moon's path chart conforms to the description in *Kaiyuan zhanjing* [開元占經].

Fig. 2 Shape of constellation of *Xuanyuan* 軒轅 (except Moon's path chart[格子月進圖])



2) The position of *Guan* 燿

The square constellation in the south of the character of *Xuanyuan* 軒轅宮 in Fig. 1 is *Guan* 燿. It is a constellation that means a signal fire. About this constellation, *Kaiyuan zhanjing* [開元占經] (Vol. 109) state “燿星,舊圖在軒轅腹內,今測在軒轅尾南,近柳北四星” (*Guan* 燿, it is in the belly of *Xuanyuan* 軒轅 in the old chart. Now we measure, it is south of tail of *Xuanyuan* 軒轅. 4 stars are close to north of *Liu xiu* 柳宿) As it is unclear where the belly of *Xuanyuan* 軒轅, if we look at the description of *Neiping* 內平 located in the north of *Xuanyuan* 軒轅, it says “舊云在中台南,舊圖在軒轅腹,又在柳七星度,今測在中台南,張七度,複與星經同.四星,中台南.” *Kaiyuan zhanjing* [開元占經] (Vol. 109) From this description, the belly of *Xuanyuan* 軒轅 is south of *Zhongtai* 中台. Therefore it locates north of *Xuanyuan* 軒轅. The description of *Guan* 燿 is translated as follows. *Guan* 燿, was located north of *Xuanyuan* 軒轅 in the old chart, but now it is a four star south of the *Xuanyuan* 軒轅 and close to the north of *Liu xiu* 柳宿.

In the *Su Song star chart* [蘇頌星圖], *Guan* 燿 has moved to the northwest of *Gui xiu* 鬼宿. However, in *Sankebosan* [三家簿讚] (Daito Univ. (2004) No. 13 paper) says “燿四星在軒轅右角南、一曰在尾西”. (*Guan* 燿 is four stars, located in south of right hone of *Xuanyuan* 軒轅, other says it is west of tail.) If we are supplementing the latter half with “在[軒轅]尾西”(it was west of tail of *Xuanyuan* 軒轅), Therefore, it cannot be denied that it may have been in the west of *Xuanyuan* [軒轅] tail (north of *Gui xiu* 鬼宿) in old chart.(9) Fig. 3 shows the positional relationship between *Guan* 燿 and *Gui xiu* 鬼宿 in

each star chart. The summary of positions of *Guan* 熿 are as follows .

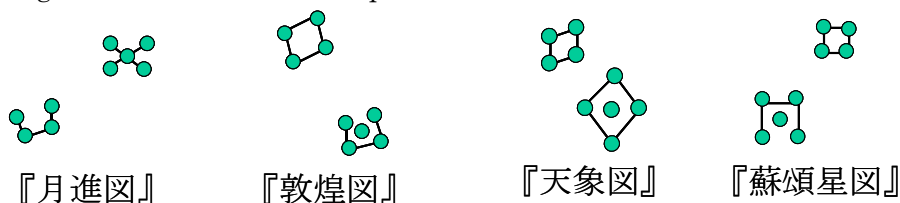
Old chart: North of *Xuanyuan* 軒轅. Or west of *Xuanyuan* 軒轅 tail (north of *Gui xiu* 鬼宿).

Current chart (Period of Kaiyuan[開元年間]): Close to the north of Liu xiu 柳宿 in the south of *Xuanyuan* 軒轅 tail (southeast of *Gui xiu* 鬼宿).

Song Dynasty (from Su Song star chart[蘇頌星圖]): Northwest of *Gui xiu* 鬼宿.

Therefore, the position of *Guan* 熿 in the Moon's path chat conforms to the description of the current figure in Kaiyuan zhanjing [開元占經].

Fig. 3 Positional relationship between *Guan* 熿 and *Gui xiu* 鬼宿



3) Direction of the mouth of *Dou* 中斗

As shown in Fig. 4, to the east of *Dizuo* 帝座, there are twin constellations in the north and south called *Dou* 中斗 and *Hu* 斛. There is a note in Sankebosan [三家簿讚], it says "one hundred" in red ink. (Daido Univ. (2004) sheet No. 12)

Kaiyuan zhanjing [開元占經] (Vol. 107) says "[中]斗,五星,在宦者西南.舊[中]斗星口仰兼背斛,今視天,[中]斗口向下覆斛." (The mouth of the old *Dou* 中斗 turned upwards and *Hu* 斛 turned to the back. If you look at the sky now, the mouth of *Dou* 中斗 will cover *Hu* 斛 downwards.) Since *Dou* 中斗 in Moon's path chat is facing *Hu* 斛 downwards, it matches the description in current figure in Kaiyuan zhanjing [開元占經]. Unlike the description of Kaiyuan zhanjing [開元占經], Su Song star chart[蘇頌星圖] is facing east.

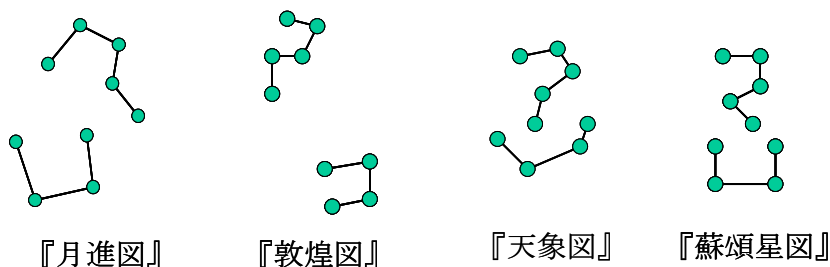
The summary of the direction of the mouth of *Dou* 中斗 is as follows.

Old chart: Upward with *Hu* 斛 in the back.

Current chart (Period of Kaiyuan[開元年間]): Downwards to cover the *Hu* 斛.

Song Dynasty (from Su Song star chart[蘇頌星圖]): Facing east.

Fig. 4 Orientation of *Dou* 中斗 and *Hu* 斛.



4) The position of *Jixin* 積薪

Jisui 積水 and *Jixin* 積薪 are at the end of the tail extending to the west of *Xuanyuan* 軒轅 in Fig. 1. The position of these constellations are "積水,一星,北河西北.積薪,一星,積水東南"(Jisui 積水, one star, north west of *Beihe* 北河. Jixin 積薪, one star, southwest of *Jisui* 積水) in Kaiyuan zhanjing [開元占經] (Vol. 107). There is no comparison with old chart because they were the same position. In the case of the Su Song star chart[蘇頌星圖], *Jixin* 積薪 has moved south, to the west of *Gui xiu* 鬼宿. Therefore, it is possible to determine whether it is a pre Song Dynasty[宋朝] star chart based on whether *Jixin* 積薪 is located to the north or south of *Beihe* 北河. Moon's path chart[格子月進圖] is a chart of the pre Song Dynasty[宋朝], because *Jixin* 積薪 is east of *Jisui* 積水 and north of *Beihe* 北河. In addition, it matches east of *Jisui* 積水 described in *Sui shu*

tianwenzhi[隋書天文志]. The summary of the positions of *Jixin* 積薪 are as follows.

Old chart: Southeast of *Jisui* 積水 and north of *Beihe* 北河 .

Current chart (Period of Kaiyuan[開元年間]): Southeast of *Jisui* 積水, north of *Beihe* 北河.

Song Dynasty (from Su Song star chart[蘇頌星圖]): South of *Beihe* 北河, West of *Gui xiu* 鬼宿. (However, Song shi [宋史] states that *Jixin* 積薪 is northeast of *Jisui* 積水)

5) The shape of *Leibizhen* 壘壁陣

The description of Kaiyuan zhanjing [開元占經] (Vol. 108) of *Leibizhen* 壘壁陣, which was used to identify whether it is a pre Song Dynasty[宋朝] star chart, is as follows. “壘壁陣,東頭第一星入東壁度,又西頭五星入危度.今測不入東壁度,又西頭六星入危度.” (Leibizhen 壘壁陣, in the old chart, one star of the east head was in *Bi xiu* 壁宿 and five stars of west head are in *Wei xiu* 危宿. When we measure now, no star of the east head was in *Bi xiu* 壁宿 and six stars of west head are in *Wei xiu* 危宿. Six stars are in the hotel.) In case of Moon’s path chart, no star of the east head was in *Bi xiu* 壁宿 and six stars of west head are in *Wei xiu* 危宿. Therefore, Moon’s path chart is in the middle of the old chart and current chart.

The summary of the form of *Leibizhen* 壘壁陣 is as follows.

Old chart: One star of the east head was in *Bi xiu* 壁宿 and five stars of west head are in *Wei xiu* 危宿.

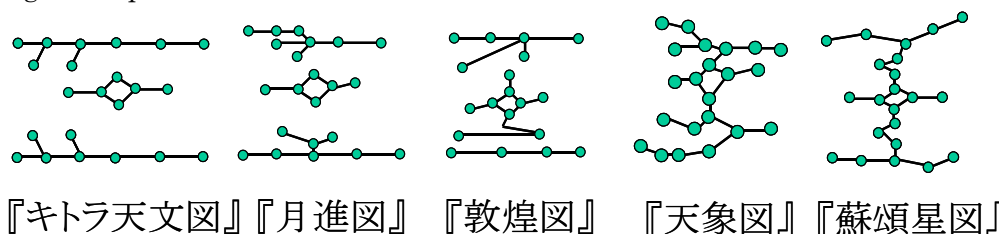
Current chart (Period of Kaiyuan[開元年間]): No star of the east head was in *Bi xiu* 壁宿 and six stars of west head are in *Wei xiu* 危宿.

Song Dynasty (from Su Song star chart[蘇頌星圖]): No star of the east head was in *Bi xiu* 壁宿 and five stars of west head are in *Xu xiu* 虛宿.

6) The shape of *Yi xiu* 翼宿

As shown in the lower left of Fig. 1, the *Yi xiu* 翼宿 is separated into three parts, upper, middle, and lower, in Moon’s path chart[格子月進圖]. This is exactly the same as the figure of Sankebosan [三家簿讚] (Daito Univ. (2004) paper No. 5). In addition, although *Yi xiu* 翼宿 in Kitora tomb astronomy diagram[キトラ古墳天文図] is designed symmetrically, it is common to be divided into three parts. (See Fig. 5) When this becomes Su Song star chart[蘇頌星圖], the three parts are in a series to change into an image of a bird. In addition, about *Yi xiu* 翼宿 of Takamatsuzuka tomb astronomy diagram[高松塚古墳星宿図], although the some of the restoration figure incorrectly using *Yi xiu* 翼宿 of Su Song star chart, there is only a small part of the upper and lower portion is remained (see Nara cultural property research Office (2016) (PL. 5)). Although it is slight, the existing part overlaps with the design of Kitora tomb astronomy diagram[キトラ天文図]. Therefore, it can be presumed that Moon’s path chart[格子月進圖] is a star chart of the same period as Kitora tomb around AD700.

Fig. 5 Shape of *Yi xiu*[翼宿]

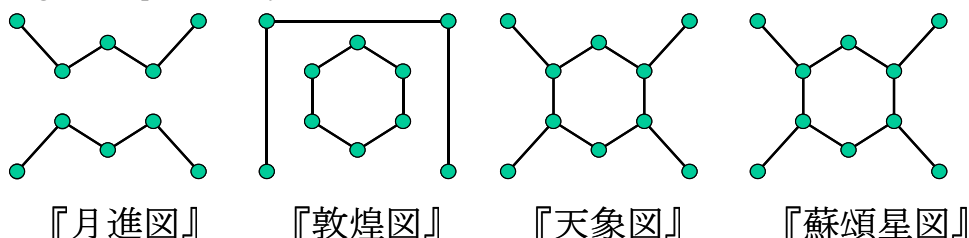


7) Shape of *Tianyuan* 天淵

There is a constellation with 10 stars named *Tianyuan* 天淵 to the south of *Dou xiu* 斗宿. As shown in Fig. 6, the letters of “M” are facing each other in Moon’s path chart[格子月進圖] and San Sankebosan [三家簿讚] (Daito Univ. (2004) paper17th), and they have the shape of a constellation like a river. This is converted to a form in which the

mountains facing each other in the letter “M” are connected by a line and the four vertices of the hexagon and the four-way star are connected in Su Song star chart[蘇頌星圖]. The change is small, but the appearance is very different, so it can also be used for the dating of the chart. The Suzhiu shike xingtu[蘇州石刻星圖(淳祐星圖)] is also the same shape as the Su Song star chart[蘇頌星圖].

Fig. 6 Shape of *Tianyuan* 天淵



8) The shape of *Tianda jiangjun* 天大將軍

There is a ship shaped constellation called *Tianda jiangjun* 天大將軍 in the northeast of *Kui xiu* 奎宿, and it is placed in horizontally in Moon's path chart[格子月進圖], but since Su Song star chart[蘇頌星圖] is place it almost vertical direction, this constellation can also be used for the dating of the chart.

9) The shape of *Hu* 弧

The *Hu* 弧 in the lower right of Fig. 1 is the same as the Sankebosan [三家簿讚] (Daito Univ. (2004) sheet No. 10), and the *Hu* 弧 in Kitora astronomy diagram is the same shape of figure. The Su Song star chart[蘇頌星圖] has also same form. Therefore, there is no change with age in *Hu* 弧. In Suzhiu shike xingtu[蘇州石刻星圖(淳祐星圖)], there is a star between the bow of the arrow and the strings.

10) The name of *Youqi* 右旗

There are constellations called *Hegu* 河鼓 and *Youqi* 右旗 in Su Song star chart[蘇頌星圖]. But there is no constellation name of *Youqi* 右旗 at the early days of Tang Dynasty when *Kaiyuan zhanjing* [開元占經] was compiled. *Kaiyuan zhanjing* [開元占經](Vol. 107) states “河鼓並旗,十二星,在牽牛北.” (*Hegu* 河鼓 and *qi* 並旗, 12 stars, it is north of *Nui xiu* 牛宿.) In the case of Sankebosan [三家簿讚] (Daito Univ. (2004), No. 6), it is called *HeguGuqi* 河鼓 > 旗 (河鼓鼓旗). Similarly, *Youqi* 右旗 is described as *Guqi* 鼓旗 in Moon's path chart[格子月進圖]. That is, it can be estimated that *Guqi* 鼓旗 changed to *Youqi* 右旗 after the middle of Tang dynasty. This can be used for the dating of the chart.

11) The name of *Huben* 虎賁 and *Tianyuan* 天淵 related to taboo character

Kaiyuan zhanjing [開元占經] (Volume 110) states that “虎賁,古今同,一星,下台南.” (*Huben* 虎賁, same as old chart, one star, south of *Xiatai* 下台. But the south of *Xiatai* “下台” in Fig. 1 is “武賁”. In the same way, this star was also called “武賁” in *Jin shu tianwenzhi* [晉書天文志](歷代天文律曆等志彙編(Compilation of the Astronomical document) Vol.1,p.179, hereinafter abbreviated as CA) and *Sui shu tianwenzhi* [隋書天文志](CA Vol.2,p.572) Osaki, M. (1987) p. 155 explained the reason that, because these was edited in the early Tang Dynasty, the character of Tiger “虎” was taboo character and transformed the tiger into “武”. In fact, *Taizu* 太祖[李虎] is the grandfather of the *Gaozu* 高祖[李淵] (reigned: 618-626) who is father of *Taizong* 太宗[李世民](reigned: 626-649).

In the same way, The name of *Tianyuan* 天淵 is also changed to *Tianchi* 天池 (pond in the sky) to avoided taboo character of “淵” which is name of *Lee Yuan* 唐·高祖[姓·諱: 李淵] in *Jin shu tianwenzhi* [晉書天文志] and *Sui shu tianwenzhi* [隋書天文志]. In case of Moon's path chart[格子月進圖], *Tianyuan* 天淵 is changed to *Tianquan* 天泉 (spring of the sky).

In addition, there are stars named *Youminjiao* 右民角 and *Zuominjiao* 左民角 beside the Ecliptic of *Xuanyuan* 軒轅 in Figure 1. The character of Min 民 is taboo character for Taizong 太宗[李世民]. But because this character is frequently used, it was permitted to use it alone during his reign. However, the following emperor Gaozong 高宗[李治]. (reigned: 649-683) made it taboo character on June 649. (10) Therefore, Original drawing of Moon's path chart was drawn between AD618 and 649, during this period, the “淵” is regarded as taboo character and “民” is not regarded as taboo character.

12) The dating by the spring equinox

There is a line that seems to be an ecliptic in Moon's path chart[格子月進図], and the date can be estimated from the spring equinox that intersect the equator. (11) But there are two points for autumnal equinoxes at left and right side in Moon's path chart[格子月進図] and they are not a same right ascension.

S. Imoto (1942) p. 69 first made an estimation with the spring equinox of this chart, and the estimated date is roughly the same as Su Song star chart[蘇頌星圖] in the AD 1100's. However, there is an error in this estimation. AD1100 is when the reference star of Kui xiu 奎宿 (ζ And) is at the spring equinox, and the spring equinox of Moon's path chart[格子月進図] is 5.5 degrees east of it, so it is before AD700.

Watanabe Toshio (1987) p.762 calculates the potential 3 reference stars of Kui xiu 奎宿, and gives the results of AD814 (δ And), AD653 (ζ And), AD466 (η And) respectively. (12) However he has describes that “the only thing that matches, as a result of the dating by width of 28 xiu [28 宿広度] (after AD720, see section 2.1), is δ And only, and it is difficult to decide which one to trust and we should investigate by other methods.”

However, if we look at *Kui xiu* 奎宿 in Moon's path chart[格子月進図], the star on the west of the three stars is ζ And, and this star is considered to be a reference star of Kui xiu 奎宿. This can also be confirmed from the Moon's path chart[格子月進図], even if we calculate with the star δ And which is close to the spring equinox, it is AD696. Therefore, the spring equinox of Moon's path chart[格子月進図] is the year 653 calculated with the star ζ And is 5.5 degrees east from the Spring equinox. As a matter of fact, when calculated with the left and right autumnal equinoxes, it will be AD345 and AD988, and the average will be AD666, which is a value close to the spring equinox.

13) Summary of dating of Moon's path chart[格子月進図]

Based on the above consideration, the most of the parts of original drawing of Moon's path chart[格子月進図] is same as Current chart (period of Kaiyuan[開元年間]) described in Kaiyuan zhanjing [開元占經] edited by Gautama Siddha[瞿曇悉達] except some constellation name to avoid taboo character.

The original drawing is considered to be drawn during Gaozu 高祖(reigned: 618-626) and Taizong 太宗(reigned: 626-649) period, base of the situation of taboo character. In addition, considering the use of new width of 28 xiu [28 宿広度] and the dating of the spring equinox, the relationship with Li Ruifeng 李淳風(602-670) is also considered, and as the date of original chart, Taizong 太宗(reigned: 626-649) period is most suitable date.

4. Dating of Dunhuang star chart[敦煌天文図]

1) The shape of *Xuanyuan* 軒轅

The tail of *Xuanyuan* 軒轅 extends northeast as shown in Fig. 2, but there is no branch at the end of the tail. Therefore, the date is estimated between period of Kaiyuan[唐・開元年間] and Song Dynasty[宋朝].

2) The position of *Guan* 燿

As shown in Fig. 3, *Guan* 燿 is located northeast of Gui xiu[鬼宿]. Therefore, the date is estimated to be the period before the current chart of Kaiyuan zhanjing [開元占經], or between period of Kaiyuan[唐・開元年間] and Song Dynasty[宋朝].

3) Direction of the mouth of *Dou* 中斗

Dou 中斗 is shown in the figure of October, but it is drawn to the east as shown in Fig. 4 and is different from the description of Kaiyuan zhanjing [開元占經] and it is the same as Su Song star chart[蘇頌星圖]. The date is estimated to be between period of Kaiyuan[唐・開元年間] and Song Dynasty[宋朝].

4) The position of *Jixin* 積薪

Jixin 積薪 is located to the north of *Beihe* 北河 and is presumed to be a chart before Song Dynasty[宋朝].

5) The shape of *Leibizhen* 罌壁陣

There is no line of 28 xiu reference star in Dunhuang star chart[敦煌天文圖], so we cannot judge the position of the stars of Leibizhen 罌壁陣.

6) The shape of *Yi xiu* 翼宿

Yi xiu 翼宿 is also divided into three parts as shown in Figure 5. However, unlike Moon's star chart[格子月進圖], the number of stars in the central star group has increased, and the tentacles are shaped to extend vertically. It is a state of one step before three parts are connected like Su Song star chart[蘇頌星圖]. From this, the age is estimated to be between period of Kaiyuan[唐・開元年間] and Song Dynasty[宋朝].

7) Shape of *Tianyuan* 天淵

As shown in Fig. 6, *Tianyuan* 天淵 has a ring consisting of six stars (correcting five stars in the original drawing) surrounded by a square gate consisting of four stars. It is a shape quite different from *Tianyuan* 天淵 in Moon's path chart[格子月進圖]. But it is a form where the four stars around in Su Song star chart[蘇頌星圖] are connected in square, and it is an age close to Su Song star chart[蘇頌星圖]. From the shape of the figure, there is no evolution to be considered in the direction from Dunhuang star chart[敦煌天文圖] to Moon's path chart[格子月進圖].

8) The shape of *Tianda jiangjun* 天大將軍

There is no name of in *Tianda jiangjun* 天大將軍 at the south of *Gedao* 閣道 in the figure in February, but there is *jiangjun* 天大將軍 put it in horizontally. Therefore, the date can be estimated as a period close to Moon's path chart[格子月進圖].

9) The shape of *Hu* 弧

Hu 弧 has almost the same form as Sankebosan [三家簿讚] and Moon's path chart[格子月進圖], except that there is a star between the bow of the arrow and the strings. This is the same as Suzhiu shike xingtu[蘇州石刻星圖(淳祐星圖)].

10) The name of *Youqi* 右旗

Youqi 右旗 in July chart is written as *Guqi* 鼓旗 as same as Moon's path chart[格子月進圖]. Therefore, the age of Dunhuang star chart[敦煌天文圖] is estimated to be earlier than the age of *Tan bu tian ge* [唐步天歌], which is close to period of Kaiyuan[唐・開元年間].

11) The name of *Huben* 虎賁 and *Tianyuan* 天淵 related to taboo character

Huben 虎賁 is in the upper right of the figure in July as "虎賁" and *Tianyuan* 天淵 is in lower right in November as "天淵". The date can be estimated after the period when the taboo character ended like Kaiyuan zhanjing [開元占經].

12) Text of Dunhuang star chart[敦煌天文圖]

According to 鄧文寬(1996) p.82-83 note (80) and (96), 『自柳九度至張十七度』 (in June chart) and 『自張十八度至軫[十]一度』 (in July chart), are same value of Kaiyuan

zhanjing [開元占經] (vol.64). Therefore, the text of Dunhuang star chart[敦煌天文圖] is considered to be taken from Kaiyuan zhanjing [開元占經], and it can be estimated as the time after Kaiyuan zhanjing [開元占經].

13) Summary of dating of Dunhuang star chart[敦煌天文圖]

The shape of constellation of Dunhuang star chart[敦煌天文圖] is similar to Moon's path chart[格子月進圖], and it can be estimated to be between after the period of Kaiyuan[唐・開元年間] and middle of Tang[唐] period.

5. Estimating the Age of Chart of Sky[天象圖]

1) The shape of *Xuanyuan* 軒轅

The tail of *Xuanyuan* 軒轅 extends to the northeast as well as Dunhuang star chart[敦煌天文圖] as shown in Fig. 2. There is no branch at the end of tail. Therefore, the date is estimated between period of Kaiyuan[唐・開元年間] and Song Dynasty[宋朝].

2) The position of *Guan* 燿

As shown in Fig. 3, *Guan* 燿 is located northeast of *Gui xiu* 鬼宿 like Dunhuang star chart[敦煌天文圖]. Therefore, the date is estimated to be the period before the current chart of Kaiyuan zhanjing [開元占經] or between period of Kaiyuan[唐・開元年間] and Song Dynasty[宋朝].

3) Direction of the mouth of *Dou* 中斗

As shown in Fig. 4, *Dou* 中斗 is drawn to the east almost the same way as Su Song star chart[蘇頌星圖], and it differs from the description of Kaiyuan zhanjing [開元占經]. Therefore, the date is estimated to be between period of Kaiyuan[唐・開元年間] and Song Dynasty[宋朝]

4) The position of *Jixin* 積薪

Jixin 積薪 is located to the north of *Beihe* 北河 and is presumed to be a chart before Song Dynasty[宋朝].

5) The shape of *Leibizhen* 壘壁陣

There stars of the east head was in *Bi xiu* 壁宿 and six stars of west head are in *Wei xiu* 危宿. The west head is the same as the figure of Kaiyuan zhanjing [開元占經]. Therefore, it is estimated from the west head of *Leibizhen* 壘壁陣 that the year is period of Kaiyuan[唐・開元年間], but the east head is very different from that period.

6) The shape of *Yi xiu* 翼宿

As shown in Figure 5, *Yi xiu* 翼宿 has the same figure which three parts are connected as Su Song star chart[蘇頌星圖]. *Yi xiu* 翼宿 of the two star charts of “吳越王錢氏家族墓室星圖”(Qian Chu Family Tomb Star Diagram, around AD900) published in 潘鼎 (2009)p.47 are also connected with three parts. If this figure is a correct copy of a mural, *Yi xiu* 翼宿 has been integrated at the end of the Tang Dynasty. Therefore, the date is estimated to be after the period of Dunhuang star chart[敦煌天文圖] and in the last period of Tang Dynasty [唐].

7) Shape of Tianyuan 天淵

As shown in Fig. 6, Tianyuan 天淵" is similar to Su Song star chart[蘇頌星圖] and estimated to be close to Song Dynasty[宋朝].

8) The shape of *Tianda jiangjun* 天大將軍

Tianda jiangjun 天大將軍 is placed vertically in the north and south, and it is presumed to be the date similar to the Su Song star chart[蘇頌星圖] and close to Song Dynasty[宋朝].

9) The shape of Hu 弧

Hu 弧 has two arrows and is shaped differently from the other three star charts.

10) The name of *Youqi* 右旗 and *Tianshi* 天矢

Youqi 右旗 is described as "右旗" as well as *Tan bu tian ge* [唐步天歌], not *Guqi* 鼓旗. In addition, *Tianshi* 天矢 is written as *Tianshi* 天矢 like other ancient star charts, unlike *Tang bu tian ge* [唐步天歌]. Therefore, it is presumed that the date is considered after the Dunhuang star chart [敦煌天文圖] and older than the *Tang bu tian ge* [唐步天歌].

11) The name of *Huben* 虎賁 and *Tianyuan* 天淵 related to taboo character

There are *Huben* 虎賁 and *Tianyuan* 天淵 in the chart, therefore, no character for taboo is used. It is estimated to be after *Kaiyuan zhanjing* [開元占經].

12) Peculiarity of this chart

There are many constellations that cannot be seen in other ancient star charts of the same period.

- In *Hu* 弧, there are two arrows instead of one.
- In *Bagu* 八穀 in north sky, the shape is not a rectangle but a pentagon.
- In *Gang* 紅 in north sky, the shape is not straight but curved.
- *Yulinjun* 羽林軍 is not a combination of triangles but the whole is connected.
- In *Laoren* 老人 is not west of *Hu* 弧 but east. This star cannot be seen from Seoul.
- 宗太夫 4 stars is added to the east of *Zongren* 宋人.(13)
- A circle of 12 zodiac zone has been added. It is influence of *Huihui Lee* 回回曆.

K. Yabuuchi(1959) p. 146 states "The figure created by Wu Yunfu 伍允孚, who became an official of the Observatory during King Zhonglie 忠烈王(1275-1308), was widely used in the observatory. "There is a possibility that the original image of this chart is not the same as Tang's original drawing, but after being transmitted to Goryeo 高麗, the modifications has been applied.

13) Dating by using spring and autumn equinox

The inscription is referred to as *Jin shu tianwenzhi* [晉書天文志], and it is said that "秋分:角五小弱,春分:奎十四小強"(Autumn:Jiao xiu 5 and few degrees(BC52), Spring:Kui xiu 14 and few degrees (BC48).) Reading from the star chart, Autumn equinox: 5 degrees (BC44), spring equinox: 4 degrees (AD776 years), and spring distribution is advancing, but autumn distribution is drawn as *Jin shu tianwenzhi* [晉書天文志].

K. Yabuuchi (1990) p. 124 says that the "Reading from *Suzhiu shike xingtu* [蘇州石刻星圖(淳祐星圖)], Autumn equinox is at Jiao xiu 角 5 degree and Vernal Equinox is at Kui xiu 奎 3 degree, the date is around AD900 from the Neugebauer star list." But, it has also an error in the fall equinox, and in any case, the vernal equinox and fall equinox of the 天象圖 are in almost the same position as the *Suzhiu shike xingtu* [蘇州石刻星圖(淳祐星圖)] and cannot be used for dating the chart.

14) Summary of dating of 天象圖

The date of the original drawing of 天象圖 can be estimated to be after Dunhuang star chart [敦煌天文圖] and before *Tang bu tian ge* [唐步天歌]. However after transmitted to Goryeo 高麗, modifications were made to the original drawing.

6. Summary of estimated date each star chart

The results of dating of chart are summarized in Table 1. There were only few contradictions of the times between items in each star chart. The estimated ages of the original drawings are summarized in the following order.

Moon's path chart [格子月進圖] ⇒ (*Kaiyuan zhanjing* [開元占經]) ⇒ Dunhuang star chart [敦煌天文圖] ⇒ Chat of sky [天象圖] ⇒ (*Tang bu tian ge* [唐步天歌]) ⇒ Su Song star chart [蘇頌星圖]

Among them, the establishment of the Tang bu tian ge[唐步天歌] is considered from its name to the Tang period, and assuming that each change requires 50 to 100 years, the approximate dates are estimated to be as follows.

- 1) Moon's path chart[格子月進図]: period of Taizong 太宗 (reigned: AD626-649)
- 2) (Kaiyuan zhanjing [開元占經]): period of Kaiyuan[開元年間] (AD713-741)
- 3) Dunhuang star chart[敦煌天文図]: Middle Tang[中唐期] (around AD800)
- 4) Chat of sky[天象図]: Late Tang [晚唐](around AD850-900)
- 5) (Tang bu tian ge[唐步天歌]): End of Tang [唐末](around AD900)

The above estimated date is the date when the original chart of each chart was created.

7. The time of transmission of Moon's path chart[格子月進図] chart to Japan and the relationship with the Kitora astronomy diagram

7.1 The time of transmission of the Moon's path chart[格子月進図] to Japan

According dating of the chart, Moon's path chart[格子月進図] is latest chart in Tang during 7th to 8th centuries. Based on the consideration of taboo character, Moon's path chart[格子月進図] was transmitted to Japan at the early stage of that period. As the transmission route, it is possible to think of the Japanese missions to Tang [唐] or Silla[新羅] who frequently traveled during Tennmu and Jitho[天武・持統] period. For example, Linde Li[麟德曆], which was compiled by Li Wei 李淳風 and enacted from period of Linde[麟德年間] (664-665), was transmitted to Silla[新羅] in 674, and in Japan in 690 as a name of Yifeng Li[儀鳳曆], it was used with Yuan Jia Li[元嘉曆]. (14) It is thought that Moon's path chart[格子月進図] has been transmitted to Japan around this period. In addition, it will also coincide with the time when the emperor Tenchi[天智] introduced a water clock(AD660) in Japan.

In period of emperor of Tenmu in Nihon Shoki[日本書紀], "Tenmu year 4, January 5th (675/2/5) Established Astronomical Observatory Place" is said. In addition, the first appearance of the planet name is "Tenmu year 10, September 17(681/11/3), Mars entered to Moon", and the first appearance of the constellation name is "Tenmu year 10, November 13 (684/12) There is star, the center is bright, the star moves along with Pleiades. " In addition, in Syokunihongi[続日本紀] says Jinki[神龜] year 4, March 丁酉 (727/4/20), Mars enter Westgate of east Jing (東井西亭門), east jing is alias of Jing xiu[井宿], but west gate is not unknown as the constellation name and star name. However, the note of *Jing xiu* 井宿 at the bottom right of Fig. 1 says "8 stars of Jing xiu[井宿], [Other name] Precious house[玉亭] [Other name] Precious gate[門玉]. Teimon[亭門] may be an abbreviated star name from these names. (15) These records are supporting evidence of the fact that Moon's path chart[格子月進図] had already been transmitted to Japan around this time.

7.2 The relationship between Moon's path chart[格子月進図] and Kitora astronomy diagram

Since Kitora astronomy diagram is a circular diagram centered on the North Pole, it is considered that the original chart was also a circular diagram. Therefore, Kitora astronomy diagram is not a direct copy of Moon's path chart[格子月進図]. It is thought that there is another star chart in which Moon's path chart[格子月進図] is drawn in a circle, and that is the original chart of Kitora astronomy diagram.

It is said that 283 constellations and 1464 stars are drawn in Moon's star chart, but Kitora astronomy diagram is drawn only about 74 constellations and 350 stars. However, because Kitora astronomy diagram also fills the circular drawing area, one constellation is drawn in two to three times the actual size. Therefore, Kitora astronomy chart is not an astronomical star chart but a decorative astronomical chart designed for mural paintings. As a result, constellations such as *Kulou*[庫樓], *Qiguan*[騎官] and *Jizul*[積卒] have not kept their original shape.

The positions of the 28 xiu reference stars in Kitora astronomy diagram are relatively

consistent compared with other constellations, so the drawing procedure in the sketch for the wall is as follows. The half of the drawing area were fill with the important constellations near the North Pole and the constellations of 28 xiu. Then the remaining area is drawn with a distinctive constellation. Therefore, the concept of the star chart is the same as those of the Takamatsuzuka Tomb[高松塚古墳] with the North Pole and 28 xiu constellations. In addition, the misplaced constellation between *Zhang xiu* 張宿 and *Yi xiu* 翼宿 in Kitora astronomy diagram is considered to be an error at the time of drawing in the stone chamber. But if change the position of two constellation, lower part of Yi xiu 翼宿 will stick out by the outer circle 外規. Therefore, it is thought that it was replaced from the design at the time of drawing creation. I think that the differences in the positional relationship around *Jiuzhou shukou* 九州殊口 (I think it is *Tianyuan* 天苑), *Tiancang* 天倉, *Tianyu* 天庾 and *Fuzhi* 鉄鎖 are also the same. In addition, astronomical accuracy is not much sought after because of its use for wall in tomb, including the reversal of the Ecliptic. I think sketch for the drawing was designed in Tang[唐] along with other mural figures and they were brought to Japan.

7.3 Situation after transmission of Moon's path chart[格子月進図] to Japan

In China, a new star chart was made even after Moon's star chart. For example, the original drawing of Dunhuang star chart[敦煌天文図] is considered to have been edited by dividing the revised version of Moon's path chart[格子月進図] into 12 drawings. However, the new star chart was not transmitted to Japan after Moon's path chart[格子月進図], because of the termination of Japanese missions to Tang [唐]. Because of this, it is thought that Moon's path chart[格子月進図] was used in Inyoudou 陰陽道 in the Middle Ages and transmitted to the present while keeping the original shape of constellation. This is the same situation as the Xuanming Li [宣明曆] used as original until the Edo period for 800 years.

8. Conclusion

The order of the creation date of the star chart, that was not clear until now, have been clarified to some extent by the comparative dating of the star chart. As a result, it was possible to clarify that Moon's path chart[格子月進図], which is photocopy of originals, is the oldest and most refined astronomical chart that conveys the image of the constellation of the beginning of Tang. At present, attention has been focused on Kitora astronomical diagram, but due to inaccurate dating far Moon's path chart[格子月進図], it was not used for the study of Kitora astronomical diagram. It is hoped that the precise astronomical chart drawn in the older period than Kitora tomb construction will be recognized, and that an accurate restoration work will be created to convey its value to the future. (16)

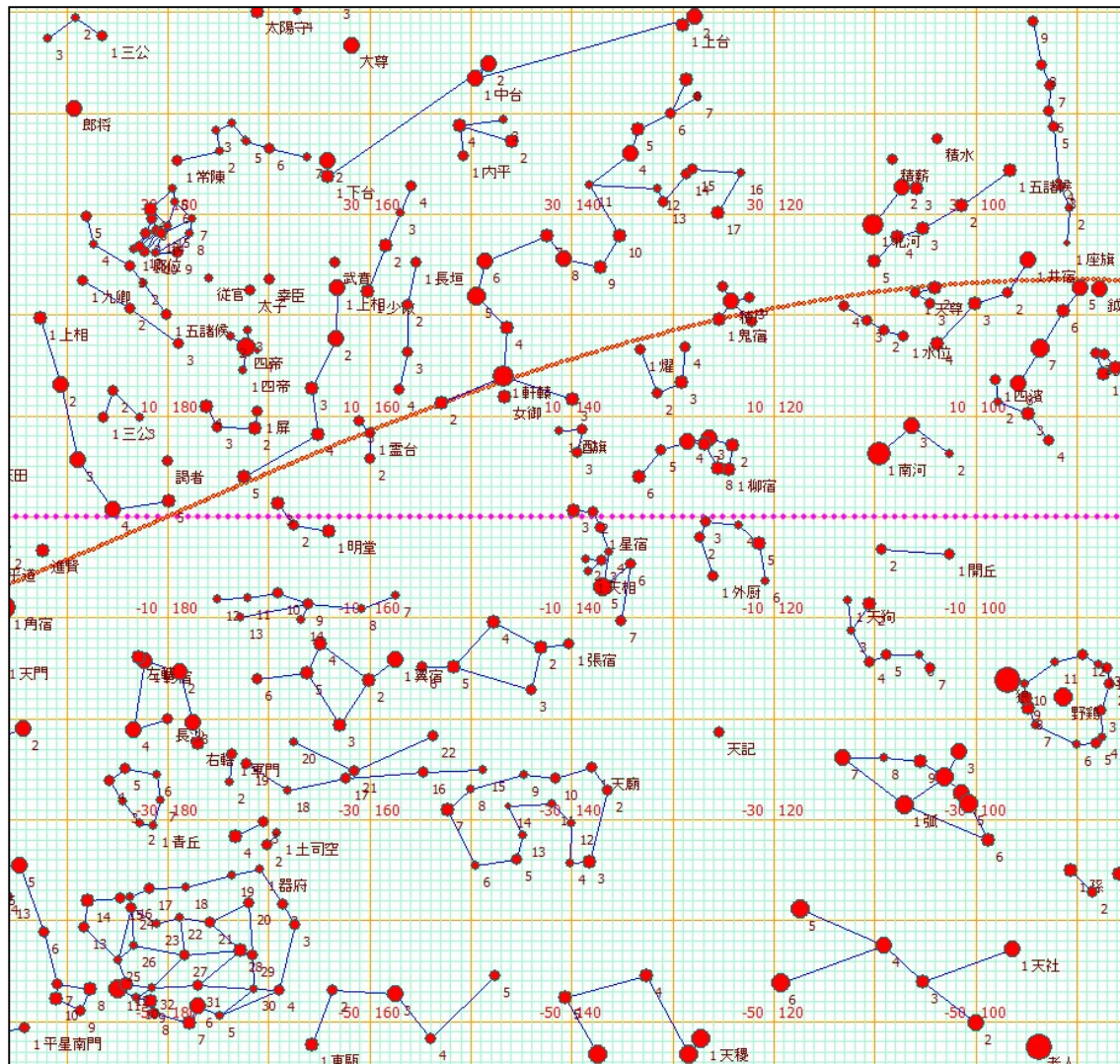
Finally, the Identified star chat of Moon's path chart[格子月進図] is attached as Figure 7. This chart shows same are as Figure 1.

Table · 1 Summary of dating of Old Chinese Star Chart

	Kayuan zhanjing 開元占經 Old Chart	Jin shu tianwenzhi 晉書天文志	Sanlebosan 三家漏刻	Sui shu tianwenzhi 隋書天文志	Kitora Astronomy Diagram	Moon's path Chart [月道圖]	Kayuan zhanjing 開元占經 Current Chart	Dunhuang star map 敦煌天文圖	Chat of sky [天象圖]	Tang bu tian ge 唐步天歌	Su Song star chart 蘇緯星圖	Son shi tianwenzhi 宋史天文志
Shape of 軒轅	Tail: North West Direction	-	Tail: North West Tail is divided	-	Non	Tail West direction	Tail: West direction	Tail: North West Tail is straight	Tail: North West Tail is straight	-	Tail: North West Tail is straight	-
Position of 魁	In the Belly of 軒轅 (North)	West of 軒轅	South of 軒轅 Right Hone (West of tale)	West of 軒轅	Non	South of 軒轅 tale and north of 柳	North of 軒轅 tale and north of 柳	North East of 魁	North East of 魁	North of 魁	North West of 魁	Northwest of 魁 (west of 軒轅)
Direction of 中斗	Upward (North)	-	-	-	(Unknown)	Downward (South)	Downward (South)	Facing left (East)	Facing left (East)	-	Facing left (East)	-
Position of 積薪	Southeast of 積水	North east of 積水	Southeast of 積水 東南	East of 積水	Non	East of 積水	Southeast of 積水	Southeast of 積水	Southeast of 積水	-	West of 西	Notheast of 積水
Shape of 車·壘壁陣	One star in 壘壁	-	-	-	(Unknown)	一星入 壘壁	不入 壘壁	-	3 stars in 壘壁	-	No star in 壘壁	-
Shape of 西·壘壁陣	Five stars in 范宿	-	-	-	(Unknown)	6 stars in 范宿	6 stars in 范宿	-	6 stars in 范宿	-	5 stars in 范宿	-
Shape of 翼	-	-	3divided	-	3divided	3divided	-	3divided with tentacle	3 parts are Connected	-	3 parts are Connected	-
Shape of 天端	-	-	Two sets of "W"	-	Non	Two sets of "W"	-	○ is enclosed in square	Extended to 4 direction from ○	-	Extended to 4 direction from ○	-
Shape of 天將軍	-	-	East West Direction	-	Non	East West Direction	-	East West Direction	South North Direction	-	South North Direction	-
Shape of 弧	-	-	One bow and one arrow	-	One bow and one arrow	One bow and one arrow	-	One bow and one arrow (One at arrow)	One bow and two arrows	-	One bow and one arrow	-
Name of 右旗	河鼓並旗	河鼓3星旗9星	河鼓>旗 (河鼓並旗)	河鼓3星旗9星	Non	鼓旗	河鼓並旗	鼓旗	右旗	右旗	右旗	右旗
Name of 天尿	天矢	無	矢	天矢	Non	天矢	天矢	無	天矢	天尿	尿	天尿
Name of 虎賁	虎賁	武賁 (Taizu太祖)	虎賁	武賁 (Taizu太祖)	Non	武賁 (Taizu太祖)	虎賁	虎賁	虎賁	虎賁	虎賁	虎賁
Name of 天淵	天淵	天池 (Gaozu高祖)	天淵	天池 (Gaozu高祖)	Non	天泉 (Gaozu高祖)	天淵	天淵	天淵	天淵	天淵	天淵
Taboo Character (Dating)	Period of Kaiyuan (713~741)	AD626 to 649 (Taizong)	Before Tang Dynasty	AD626 to 649 (Taizong)	Non	AD618 to 648	Period of Kaiyuan (713~741)	After Kaiyuan (After 742)	After Kaiyuan (After 742)	-	-	-
spring equinox autumnal equinox	-	BC48 BC54	-	AD540 AD513	(不明)	AD653 (AD345/988)	-	-	-	-	-	-
Dating	from ancient to 7th century	Jim Dynasty (Book was edited in period of Taizong)	from ancient to 7th century	Sui Dynasty (Book was edited in periodo of Taizong)	Around AD700	AD626 to 649 (Period of Taizong)	Kaiyuan (713~741)	Mid Tang Dynasty (Around AD800)	Late Tang Dynasty (AD850 to 900)	End of Tang Dynasty (Around AD900)	Noth Song北宋 Period of 天祐 (1086~93)	Song Dynasty (Book was released in 1345)

Same with Moon's Path chart

Fig. 7 Identified star chart of Moon's path chart[格子月進図]



Note: The same star area as in Fig. 1, drawn at AD 650. Identification was made from E. Sasaki (1983).

The tail of the old age of *Xuanyuan*[軒轅] in Moon's path chart[格子月進図] extends from the 8th star, but it is extended from the 11th star in Fig. 7 because there is no identifiable star in the vicinity. It seems that the tail of the old age of *Xuanyuan*[軒轅] in Moon's path chart[格子月進図] was roughly added in visually from the comparison with the figure of Sankebosan [三家簿讚].

After the tail of *Xuanyuan*[軒轅] moves to the north like Dunhuang star chart[敦煌天文圖] or Chat of sky[天象圖], it is thought that *Guan*[燿] has moved to the square formed by the remaining stars 13, 15, 16, 17 in Fig. 7 『月進図の同定図』(軒轅周辺部分)

Note

(1) In modern astronomy, the longitude of the star is displayed at 360 degrees, with a spring equinox point of 0 degrees, but in ancient Greek astronomy, 360 degrees is divided into 12 palaces every 30 degrees to make it easier to handle numbers. Similarly, in China's astronomy, the circumference of the equator was divided into 28 constellations, each of which was assigned a bright star (reference star) and represented the longitude of the star at an angle from the star. The angle between the stars is called the width of 28 xiu [28 宿広度]. Because the angle from the star to the specific star and the width of 28 xiu [28 宿広度] are relative angles unlike the angle from the spring equinox, the influence of precession is small. Therefore, the same star list has been used in China for a long time. In China, the equator is set at 365.25 degrees according to the speed of the sun. In addition, declination is expressed by the degree from the north pole.

(2) T. Nakamura (2015.10) uses 28 reference stars in Kitora astronomy diagram, and M. Soma (2015) uses 11 stars that can be regarded as declination drawn correctly, and estimates the precession dates, the results are $BC80 \pm 40$ years and $AD 300 \pm 90$ years respectively. T. Nakamura (2015.11) also analyzes using 28 stars in Chart of sky[天象図], he got the results of $BC 66 \pm 12$ years. By the result of both star charts, he has assumed that they were based on Shi shi xingjing [石氏星經] (estimated as $BC 54$ years ± 11 years).

(3) As a star chart of Song Dynasty[宋朝], there is also a Suzhiu shike xingtu[蘇州石刻星圖(淳祐星圖)] which is sculpted in 1247 by Wang Chihyuan 王致遠 based on the star chart produced by Huang Shang 黃裳 of North Song Dynasty[北宋朝] around 1190 as a star chart. Osaki, M. (1987) p. 231-237 states that there are many errors compared with Su Song star chart[蘇頌星圖]. He has also listed the locations of the error.

(4) Sankebosan [三家簿讚] is a document transmitted to the Wakasugi-ke 若杉家, who has the job responsible for home affairs for Tsuchimikado-ke 土御門家. According to k. Yamashita (2004) p.196, The book was established under the influence of followings.

1) Chen Zhuo (Taizi ling in Jin(265-420) 晉太子令) 陳卓 who reorganized the constellations established under the name of the three family (Shi 石 · Gan 甘 · Wu 巫) from the former Han's end to the later Han

2) Sen Lezhi(Taizi ling in Song(420-479)宋太子令) 錢樂之 who placed the three family's constellation in three colors.

Sankebosan [三家簿讚] is considered as Chinese orthodox heavenly document that has been augmented with some constellations before Tang[唐].

It is said that it was transmitted to Japan before 748, and the existing document is a copy of the early Kamakura[鎌倉時代] (1235). Specifically, in addition to individual constellation names and positions, constellation diagrams are described. Sankebosan [三家簿讚] is also a document that only remained in Japan. For details, see Daito Univ. (2004). The photocopy is also in S. Murayama (1987). Regarding to the three family Classification, please refer to A. Maehara (2015).

(5) The photo copy of the Moon's path chart[格子月進図] is black and white photograph, so the original color is unknown, but S. Imoto (1972) p.290 states that the stars of the 28 xui were plotted in yellow, red and black. In addition, there is also a description regarding the three colors on Moon's path chart[格子月進図], "三家簿讚 二百八十三官 一千四百六十四星 (略) 三色事 黄色殷巫咸 赤色魏石申 黒斉甘徳".

The magazine "別冊 太陽"(Besatsu Taiyo)Heibon,73 (1991) also has a photograph of Moon's path chart, but there is no photograph for central part around *Kui xiu* 奎宿.

(6) Please refer to H. Nojiri (1971) p. 189-197 "14. The Dunhuang old star chart".

(7) Please refer to the textbook of Deng Wenzhao 鄧文寬 (1996) pp. 58-93. However, there are the following mistakes in school textbooks compared to Moon's path chart[格子月進圖]. Also, from the content of the error, it is considered that there are also mistakes when split into 12 figures.

- 1) (60) *Shuifu* 水府 and *Sidu* 四瀆 are placed opposite.
- 2) (69) "晷" is considered as *Tiangou* 天狗, but in fact "天車" is an error of *Tianshe* 天社.
- 3) (70) "天苗" is an error of *Tiangou* 天狗.
- 4) (76) There is no indication that the position of *Neiping* 內平 is the north of *Xuanyuan* 軒轅.
- 5) (101) Corrected *Pingdao* 平道 to *Ping* 平, but Moon's path chart[格子月進圖] also *Pingdao* 平道.
- 6) (126) There is no need to add *Jingu* 神宮. The position of *Jingu* 神宮 is also different, and it is not in Moon's path chart[格子月進圖].
- 7) (146) "升" has been corrected without a note on *Dou* 斗.
- 8) (148) "由" is commented as "no star on chart", but it is an error of *Gou* 狗, because it is south of *Dou* 斗.
- 9) (156) It was assumed that [*Gou* 狗 · *Gouguo* 狗国] is wrong, but [*Tianji* 天雉 · *Gouguo* 狗国] is wrong.

(8) For the inscription and the written text in Japanese of Chat of the sky[天象圖], refer to Chiba City Folk Museum (2002) p.18-21.

(9) The other documents have the following descriptions about the position of *Guan* 燿
Jin shu tianwenzhi[晉書天文志]: "軒轅西四星曰燿"(4 stars at west of *Xuanyuan* 軒轅 is *Guan* 燿.) (edited in Tang, 彙編 vol.1, p.185)

Sui shu tianwenzhi [隋書天文志]: "軒轅西四星曰燿"(4 stars at west of *Xuanyuan* 軒轅 is *Guan* 燿.) (edited in Tang, 彙編 vol.2, p.579)

Kaiyuan zhanjing [開元占經]: "甘氏曰燿四星在軒轅尾南柳北"(Gan 甘 say *Guan* 燿 4 stars at south of tail of *Xuanyuan* 軒轅 and north of *Liu xiu* 柳宿)(Vol. 69)

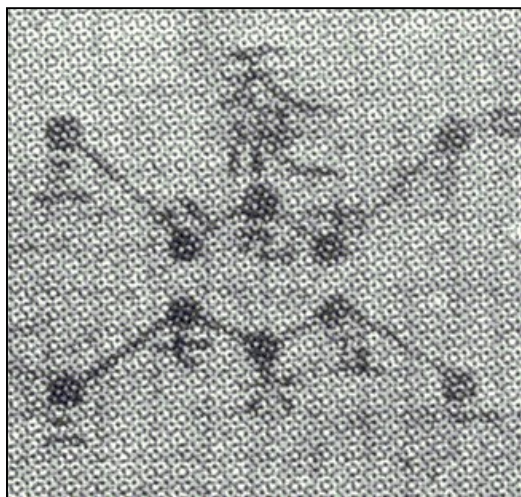
Son shi[宋史]: "燿四星,在鬼宿西北,一曰軒轅西"(Guan 燿 4 stars, at northwest of *Gui xiu* 鬼宿. Another book say at west of *Xuanyuan* 軒轅.) (彙編 Vol.3 p.902)

In addition, the Dunhuang document No. 2512, brought in by French Perrier introduced (Luo Zhenyu 羅振玉編(2004) includes as Astrology)by Y.Yamashita (2004) p.380, says "燿四星軒轅尾西" (p.380) (*Guan* 燿 4 stars at west of tail of *Xuanyuan* 軒轅) and "燿星鬼上懸"(p.386) (*Guan* 燿 is located to the north of *Gui xiu* 鬼宿). It is considered to be a transcript of around AD621 [武德四年], because there is a description of "自天皇帝來至武德四年二百七十六萬一千一百八歲"(p.376)(The emperor came here to be 2, 761, 108 years with AD621.) However, this document has taboo character in *Huben* 虎賁 (p. 381) and *Tianyuan* 天淵 (p. 382), so it can only be regarded as a document after AD621[武德四年]. In addition, *Youqi* 右旗 (p.382) is a misprint of *Zuoqi* 左旗. There are also two misprints for left and right name in Dunhuang star chart[敦煌天文圖]. The date of this document is considered to be the same age as Dunhuang star chart[敦煌天文圖] from constellation names such as *Guqi* 鼓旗 and *Tianshi* 天矢.

There is also a "鬼上四星是燿" (4 stars over *Gui xiu* 鬼宿 is *Guan* 燿) in Tang bu tian ge[唐步天歌] (Yuhai 玉海 vol. 3), which has an essay made by Dan Yuanzi 丹元子 of Sui 隋, but in the Tang bu tian ge[唐步天歌], *Youqi* 右旗 is described as "左旗右旗各九星河鼓兩畔" (*Zuoqi* 左旗 and *Youqi* 右旗 are each nine star along with *Hegu* 河鼓.) Since the constellation name of *Youqi* 右旗 is not in Kaiyuan zhanjing [開元占經], the date of Tang bu tian ge[唐步天歌] is considered to be after the period of Kaiyuan[開元年間]. S. Osaki

(1987) p.76-77 also says that the author of Tang bu tian ge[唐步天歌] is Dan Yuanzi 丹元子 of Sui 隋 or 王希明 Wang Ximing of Tang 唐, but they are actually an unknown person with the trace. However, in view of its contents, it shows a figure that lies between Jin shu[晉書]/ Sui shu[隋書] and Son shi[宋史], so it is true that it is the one that describes the constellations of the Tang Dynasty[唐朝]. Daito Univ. (2004) p.137/153 also says that the article *Hegu* 河鼓 *Youqi* 右旗 cannot be found in the documents of Jin shu[晉書] and Kaiyuan zhanjing [開元占經]. In addition, *Tianshi* 天矢 located south of *Shen xiu* 參宿 has also changed its name to *Tianshi* 天尿 in Song Dynasty[宋朝], but it is also considered as *Tianshi* 天尿 in Tang bu tian ge[唐步天歌]. Therefore, it is estimated that the date of Tang bu tian ge[唐步天歌] is the end of the Tang Dynasty[唐朝].

(10) Refer to M. Tsuji (2016) p.438. According to Wang 王諺坤 (1997) p. 314, “人” were often used as a substitute for “民”(min). For the taboo character of "虎" and "淵", see Wang (1997) p. 167 and p. 578. The situation of replace of taboo character is the same as Jin shu tianwenzhi[晉書天文志] and Sui shu tianwenzhi [隋書天文志], which were compiled in Taizong 太宗 period (reigned: 626-649). (Please refer to Y. Kegazawa (2005) p. 354 for compilation time). In Moon's path chart[格子月進圖] restored version, E. Sasaki (1984) states "天淵", but in the original picture, we can read it "天泉".



(This picture is added in English version only from Bessatus Taiyou 73(1991) p.39)

(11) M. Osaki (1987) p. 261 points out the possibility of moon's path, but there are many researchers who consider it as ecliptic (sun's path).

(12) T. Watanabe (1987) p. 762 does not describe the specific calculation method, but the results agree if the spring equinox is calculated 5.5 degrees east of the reference star of Kui xiu 奎宿 (ζ And).

(13) Zong Taifu 宗太夫 is in Sankebosan [三家簿讚] (Daito Univ. (2004) sheet No. 6), but it is not recognized as a constellation by Tianwenzhi 天文志 in China or Kaiyuan zhanjing [開元占經]. Please refer to Daito Univ. (2004) p.136.

14) It is a common theory that Linde Li[麟德曆] is referred to as Yi Feng Li[儀鳳曆] in Japan because it was transmitted during period of Yi Feng 儀鳳(676-679) of Tang Dynasty. However, in the “日本国見在書目録”(Japanese List of Bibliography) created during the Heian 平安 period, Linde Li[麟德曆] and Yi Feng Li[儀鳳曆] are described as different calendars and cannot be explained by common theory. H. Inoue (1980) p. 247 (note 73) says that this is Yi Feng Li[儀鳳曆] because it has been modified in Silla 新羅 and used since the period of Yi Feng 儀鳳(676-679). I agree with this, and I think that

Silla revised the first line of the calendar to the following and named it Yi Feng 儀鳳
新唐書曆志二『麟德曆 麟德元年甲子、距上元積二十六萬九千八百八十算』(彙編 7,p.2141)
儀鳳曆書 (my assumption)『儀鳳曆 儀鳳元年丙子、距上元積二十六萬九千八百九十二算』
(12 years have been added to the accumulation year from the origination year to the
calendar origin because the origination year has been lowered by 12 years)

(15) In K. Saito (1986) p.96 says that west house gate 西亭門 is unknown and it is
recorded that Mars enter Jing xiu 井宿. However, on this day (727/4/20), the Mars 熒惑
is near the northern star εGem of the four star rows of east of Jing xiu 井宿 and Mars is
moving in the direction of leaving from Jing xiu 井宿. The article says “熒惑東井西亭門ニ
入ル”(Mars enter the west gate), so the eastern star area adjacent to Jing xiu 井宿 is
seems to called house gate 亭門 and Mars enter the west of house gate 西亭門.

(16) T. Nakamura (2014) p.206 says that the negative of Moon's path chart[格子月進図]
is missing. Also, it should be noted that E. Sasaki (1984) has no grid (it cannot correct
the distortion of chart). The following stars in the original photograph is not
described either. 1) 鉞星(axe) in *Jing xiu* 井宿, 2) Zongzheng 宋正 2 stars, 3)Liyu 離瑜 2
stars. In addition, *Zhangren* 丈人 2 stars south of Dou xiu 斗宿 is an error of original
chart, it is Gouguo 狗 2 stars.

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