

Study on the Astronomical Scale of the Jin Dynasty

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Abstract: The Jin Dynasty's astronomical calendar was established on the basis of the Liao and Northern Song dynasty. Its astronomical ruler was the same length as HeXian's ruler in Northern Song, and one foot was about 24.5cm. The scale originated from the small rulers of Sui and Tang, and its influence was to ensure the length of the astronomical ruler remained unchanged for more than 1,200 years to Yuan and Ming Dynasty. And promoted the continuous development of the traditional astronomical calendar research.

1. Introduction

The astronomical ruler, also known as the "shadow ruler", is the size engraved on the scene table or standard table. It is used to observe the calendar, sun, moon, and stars. It is used to determine the length of the sun's shadow, grasp the laws of celestial changes, measure the sundial, and make the armillary sphere. After the Yuan Dynasty, it was renamed as "measuring the sky ruler". In the traditional period, various regimes paid great attention to the accuracy of astronomical calendars and wind and cloud observations. The root cause was that this accurate measurement meant whether the regime had the symbolic power granted by heaven to set time coordinates, and indicated whether its regime had legitimacy.

Especially in the Song Dynasty, when multiple political powers coexisted in the tenth to thirteenth centuries, the politicized connotation of the astronomical calendar was particularly prominent, which attracted great attention from the academic circles. Scholars represented by Dong Yuyu, Wei Bing, and Wang Xiaohu, based on the astronomical calendar of the Song Dynasty, investigated the important role of the astronomical calendar in the political culture of the Song Dynasty and in foreign exchanges, and discussed the astronomical calendar of the Jin Dynasty to a certain extent. The focus of the discussion lies in the influence and penetration of the central culture on the Liao and Jin minority regimes. These studies remind us that the astronomical calendar of the Jin Dynasty did not exist in isolation. It should also be placed in the political structure of the entire East Asia from the 10th to the 13th centuries. In addition, scholars such as Qu Anjing, Deng Wenkuan, and Li Haonan focused on a certain calendar of the Jin Dynasty, or focused on the special features of the Jin Dynasty's astronomical calendar different from the central regime at the same time.

Whereas the process of transmutation, the length of the astronomical ruler and its influence are not discriminated. The author is not shameful and contemptuous, just talk about the length of the astronomical ruler of the Jin Dynasty, and ask my colleagues in the academic circle for advice.

2. The Origin of the Jin Dynasty Astronomical Calendar

The raw Jurchen who lived in the northeast corner of the world, before Zhaozu Shilu, didn't know the time and year. Since the rebellion against Liao in the fourth year of tianqing (1114), it had been immersed in the Chinese breeze, and the Chinese holiday were known, and the birthday was chosen as the best day. Jin Taizu Wanyan Aguda established the Jin Dynasty in 1115. The Tianhui three years (1125) had occupied the five capitals of the Liao Dynasty, and Yanjing (now Beijing) was "civilian official, private household, technology, prostitute, and Huangguan, Qu Tan, Jinbo, etc. swept east". A large number of properties and technicians from the richest areas of the Liao

Dynasty were transported back to the Jurchen hinterland, which enriched the foundation of the Jin Dynasty astronomical calendar research. In the fifth year of Tianhui (1127), the Jin captured the Northern Song Dynasty Bianjing (now Kaifeng, Henan), “the instrument of ritual and image were all returned to the Jin”, such as “the sky wheel, the equatorial pitch, the dial, the hanging elephant, the bell and the drum, the Sichen, the Kebao, Tianchi, kettle, etc.” “Only the copper armillary sphere was placed on the waiting table of the Taishi Bureau.”

Since the Jinggang Rebellion, all the instruments and astronomical officials in the central China were transported to Yanjing, and the Jin Dynasty placed these instruments for viewing calendar day system in Sitiantai. Considering that the distance between Bianjing and Yanjing was more than a thousand miles, “the topography was different, and the polar star in the observation tube was slightly worse”. Jin Dynasty could use it “moving down four degrees” during astronomical observation. In August of the sixth year of Mingchang (1195), in the event of thunderstorms, “the dragon rised from the armillary sphere and the clouds and the water smashed down, the platform suddenly cracked and destroyed, and the armillary sphere fell down”. Zhang Zong ordered the Sitiantai to be repaired and “replaced on the stage”. In 1214, Xuanzong Zhenyou moved to the south, “using the armillary spheres to melt into objects, and could not bear to destroy them”, considering the inconvenience of long-distance transportation, “then went away”. It was thus clear that the Jin Dynasty cherished this batch of astronomical instruments acquired from the Northern Song Dynasty and used them until the end of the Jin Dynasty.

In summary, the Jin Dynasty’s astronomical calendar was established on the basis of the death of the Liao and the Northern Song Dynasty. The Jin Dynasty directly absorbed the Liao and Northern Song astronomical instruments and technical officials. The Jin people’s understanding of astronomical calendars and astronomical calculation methods acquisition all originated from the central China, which provided support for the Jin Dynasty’s independent astronomical calendar research.

3. The Evolution of the Official Calendar of the Jin Dynasty

In the fifth year of Tianhui (1127), in the same year when the Northern Song Dynasty was destroyed and the astronomical instrument and technical officials were acquired, Yang Ji, the official of the Jin Dynasty, began to create the “Da Ming Calendar”. After ten years, the “Da Ming Calendar” was finally completed and issued.

However, since the early years of Hailing Zhenglong, Yang’s “Da Ming Calendar” “accumulated slight immersion”, often did not match the celestial phenomenon: Xinyou in March of Zhenglong three years (1158), “Si Tian calculated an eclipse of the sun, didn’t happen”, the eclipse was miscalculated. In the third year of Shizong’s Dading 3rd year (1163), the May Renshen solar eclipse, and in the 14th year of Dading (1174), the November solar eclipse were inaccurate prediction; and in the 17th year of Dading (1177), September Dingyou,”the eclipse was the day after tomorrow”. Yang Ji’s “Da Ming Li” made many inferences about the solar eclipse before it actually happened. After that, the “Da Ming Li” got worse, and there were many mistakes. In the eighteenth year of Dading (1178), when the Jin Dynasty sent an envoy to the Song Dynasty to celebrate the emperor’s birthday, there was a calendar dispute with the Southern Song Dynasty. The calendars issued by the Jin and Song in the same year were different, and there was a difference of one day between the first day of October, and the Jin Dynasty was one day earlier than the Southern Song Dynasty. Qiu Chong, the ambassador and Xiangjian of Song, debated with the envoy of the Jin, and the result of the debate was that the envoy of the Jin Dynasty “had no answer”. Song Xiaozong ordered Meng Bangjie, an official of the Ministry of Ritual, to test the number of lunar eastward travels and the moon travels on September 30 and October 1, and finally measured the Southern Song calendar “faith in the way of heaven”. The Jin lost the calendar argument with the Southern Song Dynasty.

Frequent astrological errors and failure in diplomatic disputes caused the Jin Dynasty to focus on correcting the calendar of the dynasty, looking for loopholes in the “Da Ming Calendar” of the Yang Ji. In the twentieth year of Dading (1180), Shizong ordered the “Da Ming Calendar” to be

rebuilt by Zhao Zhiwei, and the calendar had been made up in one year later. In the same year, Ye Lvlv, the Hanlin Yingcheng, submitted the “Yi Wei Calendar”. After the “Rebuilt Da Ming Calendar” was completed, Shizong ordered the Yuanwai Lang in Ministry of Rites Ren Zhongjie and Sitiantai to forecast the Wangri and eclipse in November of the 21st year of Dading (1181) with “Yi Wei Calendar” and “Rebuilt Da Ming Calendar” respectively. It was found that “Zhao Zhiwei’s calendar predicted more accurately”, and just used Zhao Zhiwei’s “Rebuilt Da Ming Calendar” to “the end of the Jin Dynasty”.

4. Discrimination of the Length of the Astronomical Ruler in the Jin Dynasty

According to the “Jin Shi”, the source of Yang Ji’s “Da Ming Calendar”, “could not be studied in detail, or it was added or lost due to the Song Ji Yuan Calendar”, namely, Yang Ji’s “Da Ming Calendar” was based on the Northern Song Dynasty Yao Shunfu’s “Ji Yuan Calendar”. The calendar of the Southern Song Dynasty was also “the same as the previous calendar”, “the previous calendar” meant “Ji Yuan Calendar”. The calendars of the Jin and Southern Song Dynasty were deeply influenced by the Northern Song Dynasty. The structure of the calendar, calculation procedures and mathematical methods were followed in the “Ji Yuan Calendar”. Zhao Zhiwei’s “Rebuilt Da Ming Calendar” “can also be viewed as the same”. The Jin and Song calendars had the same origin, and the length of astronomical ruler used by the Jin Dynasty for astronomical measurement should be the same as that of the Southern Song Dynasty.

On the occasion of the Jin and Yuan dynasty changed, in the early Yuan Dynasty, its calendar inherited the “Da Ming Calendar” which was Zhao Zhiwei’s “Rebuilt Da Ming Calendar”, went on for 100 years until the Yuan Dynasty To Zhiyuan Xinsi (1281). In other words, before the issuance of Guo Shoujing’ “Shou Shi Calendar”, the Yuan Dynasty always used the Zhao Zhiwei’s “Rebuilt Da Ming Calendar”. The research team of the Chinese astronomical history found that the main data and calculation methods of the “Xizheng Gengwu Yuanli” made by Yelv Chucai in the early Yuan Dynasty were the same as the “Rebuilt Da Ming Calendar”. In addition, Yelv Chucai measured the length of the winter and summer solstice noon day shadows in Zhongdu (now Beijing) of Jin Dynasty. The records of the length of the sundial in the winter and summer solstice in the Jin and Yuan histories were the same, except for the difference between “Yong’an” and “Dizhong”. Liu Pujiang’s made a rather deep research and believed that “Yong’an” was derived from the change of the name of Yanjing in the third year of Tiande (1151). After the capital was moved to Yanjing in the first year of Hailing Zhenyuan (1153), it was still called Yong’an. Zhongdu was the “Dizhong” of the Jin, and “Yong’an” definitely refers to Yanjing. Based on this, we can also believe that the astronomical scales used by Jin and Yuan are similar.

So far, the scholar has not discovered the relevant physical objects of the Jin Dynasty astronomical ruler, but the astronomical ruler length of the Jin Dynasty can be investigated from the calculation of the astronomical scale of the Song and Yuan and the evolution of the astronomical scale.

In the early years of the Northern Song Dynasty, the ruler of Wang Pu in Later Zhou Dynasty was used. In the fourth year of Jianlong (963), He Xian, chamberlain for ceremonials erudite, remeasured the Sitiantai shadow table stone ruler, and used its length to revise the calendar system. So as to the Song Dynasty “measures and weighs were to be correct”. According to “Song Shi-Lv Lizhi”, Si Tiantai’s shadow table stone ruler was equivalent to He Xian’s ruler, which was more larger than Wang Pu’s ruler “four points”. In other words, Wangpu’s ruler was “four points shorter than stone ruler”. In addition, Wangpu’s ruler was longer than the size of Hanqian ruler “about two points”. Based on the “Hanqian ruler” being 23.1cm, the Wang Pu’s ruler was deduced 23.585cm ($23.1 \times 1.021 = 23.585\text{cm}$), and the length of the Sitiantai shadow table stone ruler was deduced 24.528cm ($23.585 \times 1.04 = 24.528$). In Song Dynasty, He Xian’s ruler was more longer than the Hanqian ruler “six minutes and three centimeters”, so as to calculating the length of He Xian’s ruler was 24.555cm ($23.1 \times 1.063 = 24.555\text{cm}$). Based on this, Qiu Guangming pointed that the Song Dynasty always continued the Hexian’s Ruler and without change, and calculated the length of astronomical ruler in Song Dynasty was 24.578cm ($23.1 \times 1.064 = 24.578\text{cm}$). Based on the “Hanqian

ruler” length of 23.1cm, Guo Zhengzhong determined that the He Xian’s ruler was 24.528cm-24.555cm in length.

The Ancient Star Observatory in Gaocheng Town, Dengfeng County, Henan Province is an important physical material for investigating the astronomical ruler length of the Yuan Dynasty. According to Yi Shitong’s investigation, the surface of this camera is 3119.6cm, plus the stone water trough protruding near the surface at the north end, the total length is 3129.4cm. Compared with the standard table in “Yuan Shi” which is “100 hundred Twenty-eight feet”, the Yuan Dynasty astronomical ruler is calculated to be 24.448cm in length per foot ($3129.4 \div 128 = 24.448\text{cm}$).

A comprehensive survey of the various sets of measurement data about the astronomical ruler in the Song and Yuan Dynasty shows that the astronomical ruler’s length of 1 foot is between 24.448cm-24.578cm, which is approximately 24.5cm, the same length as the Sitiantai shadow table stone ruler in Tang Dynasty. In other words, the length of the astronomical ruler remained basically unchanged from Tang to Song and Yuan. According to previous studies in the academic circles, the ruler used for the astronomical calendar was around 24.5cm in the Sui, Tang and Song dynasty, and even in the Yuan and Ming dynasty. From the analysis of this article, this conclusion is in line with the actual situation at that time. The Jin Dynasty was between the Song and Yuan, and the length of the astronomical ruler should be around 24.5cm. It inherited the small ruler system of the Sui and Tang dynasty.

5. Conclusion

The above examines the length of the astronomical ruler of Jin Dynasty from the tenth to thirteenth century when multiple political powers were in parallel. As we all know, the astronomical calendar is a research that is biased towards natural sciences. It pays great attention to the accuracy of measurement methods and deduction techniques. Changes in the smallest amount will affect the accuracy of measuring solar shadows, formulating calendars, and observing celestial phenomena. In order to ensure the accuracy and scientificity of the measurement, the Jin Dynasty’s astronomical calendar was established on the basis of the Liao and Northern Song. The length of the astronomical ruler in Jin Dynasty followed the small rulers in Sui and Tang, and the length of one foot was equal to that of the He Xian’s ruler in Song Dynasty, roughly around 24.5cm, and continued to the Yuan and Ming, to ensure that the length of the astronomical ruler remained unchanged for more than 1,200 years, and promoted the continuous development of the traditional astronomical calendar research.

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