

# Celestial Events Recorded in *Memoir of Ming Dynasty*

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Abstract: Over six thousand celestial events were recorded in the *Memoir of Ming Dynasty*, which is the largest source of celestial events in ancient China except for astronomical treatises of official histories. The density of these records is 38 accounts per year before the reign of *Zhengde*, while it is only seven accounts per year after the reign of *Jiajing*. Nearly 3000 records, including solar and lunar eclipses, positions of the Moon and planets, can be verified based on modern astronomical calculation method. The error rate of the lunar or planetary approaches or occultations, 4.1%, is the best of past dynasties.

## 1 Introduction

It has been a tradition that celestial events were observed and recorded in ancient China. These celestial events, through the path of *houbu* “候簿” (record book of astronomical observation), *rili* “日历” (record on emperor's daily life), *zouben* “奏本” (memorial to the emperor), *qiju zhu* “起居注” (official imperial diaries), and *shilu* “实录” (memoir), eventually entered official history (Twenty-Four Histories). According to statistics, there were 15,292 records of celestial phenomena in total contained in the Twenty-Four Histories before the Ming Dynasty (see Liu and Liu, 2014).

Expect for astronomical treatises of Twenty-Four Histories, there are few astronomical records before the Ming Dynasty (see Liu, 2012a; Liu and Ma, 2013a, 2015). Since the mid-Ming Dynasty, the practice of compiling local annals became very popular and quite a number of local annals contain records of celestial events, which tend to focus on events that have a significant impact, such as total solar eclipses, comets, and bolides. Compared with official records, they are vague and unprofessional, having high error rates (see Liu and Zhuang, 1998; Ma, 2004). We call them “local records”. Some types of astronomical events are collected in the *General Collection of Ancient Chinese Astronomical Records* (Beijing Astronomical Observatory, 1988).

After one emperor died, the next emperor compiled a chronicle (memoir), known as *shilu*, for him. Being different from previous dynasties, the memoirs of the Ming Dynasty have been remained basically intact (collectively known as the *Memoir of Ming Dynasty*) so that we can get more original, more detailed and a great amount than those of astronomical treatises of the Ming Dynasty.

## 2 Astronomical Records in the *Memoir of Ming Dynasty*

The Memoirs of the Ming and Qing Dynasties are basically complete, while the earlier Memoirs before the Ming Dynasty rarely retained. There are 13 Memoirs of the Ming Dynasty. At present, the most complete and popular one is the collative photocopy by the Institute of History and Philology, Academia Sinica based on the red grid copy (红格抄本) collected in the Beijing Library. The photocopy is also the basis of this work.

The *Memoir of Ming Dynasty* contains vast number of pages, including more than six thousand celestial records. Except for astronomical treatises of official histories, the *Ming Shilu* is the largest source of astronomical records in ancient China. Table 1 presents statistics of astronomical records in the *Memoir of Ming Dynasty*. Words (the fourth column) are counted by ten thousand words. Density (the fifth column) is that words divided by reigning years. Hence the fifth column reflects density of general events.

Table 1: Statistics of Celestial Events in the *Memoir of Ming Dynasty*

Book Name	Reign Title	Volumes	Words	Density	Reigning Years	Cosmic Events	Annual Average
<i>Taizu Shilu</i>	<i>Hongwu</i>	257	107.1	3.5	31	801	25.8
	<i>Jianwen</i>	↓			4	78	19.5
<i>Taizong Shilu</i>	<i>Yongle</i>	274	71.4	3.2	22	694	31.5
<i>Renzong Shilu</i>	<i>Hongxi</i>	10	9.0	9.0	1	141	↓
<i>Xuanzong Shilu</i>	<i>Xuande</i>	115	74.9	7.5	10	807	86.2
<i>Yingzong Shilu</i>	<i>Zhengtong JingtaiTianshun</i>	361	206.7	14.8	29	1358	46.8
<i>Xianzong Shilu</i>	<i>Chenghua</i>	293	143.5	6.2	23	699	30.4
<i>Xiaozong Shilu</i>	<i>Hongzhi</i>	224	122.5	6.8	18	780	43.3
<i>Wuzong Shilu</i>	<i>Zhengde</i>	197	106.4	6.7	16	458	28.6
<i>Shizong Shilu</i>	<i>Jiajing</i>	566	261.2	5.8	45	307	6.8
<i>Muzong Shilu</i>	<i>Longqing</i>	70	48.8	8.1	6	55	9.2
<i>Shenzong Shilu</i>	<i>Wanli</i>	596	329.8	7.0	47	348	7.4
<i>Guangzong Shilu</i>	<i>Taichang</i>	8	6.8	6.8	1	7	↓
<i>Xizong Shilu</i>	<i>Tianqi</i>	87	122.2	17.5	7	59	8.2
<i>Chongzhen Shilu</i>	<i>Chongzhen</i>	17	11.0	0.7	17	33	1.9
<i>Chongzhen Changbian</i>	<i>Chongzhen</i>	66	84.8	5.3	↑	↑	↑
Total			1706.1		277	6625	

There is no statistical significance due to only one year during the reign of King *Hongxi* and *Taichang*, hence annual records of them are included in that of the following memoir.

As can be seen from Table 1, the *Yingzong Shilu* and *Xizong Shilu* have the highest density concerning density of general events. Density of the *Taizu Shilu* and that of the *Taizong Shilu* are relatively low. Densities of other Memoirs are roughly equal. Regarding astronomical records, those before *Wuzong* have high recording densities, an annual average of 38 records. However, the number of astronomical records suddenly decreased from the reign of *Jiajing* Emperor, and completely lost appearance as simple and formulaic as general official records in the *Chongzhen Shilu* and *Chongzhen Changbian*. In other words, there is no great change in density of general events in the *Memoir of Ming Dynasty*, but the number of astronomical records has decreased dramatically since the late Ming Dynasty when *Jiajing* Emperor began. Changes in compiling system of Memoirs and concept of historiographers compiling Memoirs should contribute to this decrease. As seen from the details of the *Memoir of Ming Dynasty*, the Imperial Astronomical Bureau still works well in the late Ming Dynasty. Hence lots of astronomical events should be recorded. As far as deficiency of astronomical records in the reign of *Chongzhen* Emperor, obviously warfare resulted in loss of data.

The *Astronomical Data in the Ming Shilu* compiled by Ho Peng-Yoke and Zhao Lingyang

(1986) based on the red grid copy, brings great convenience to our work. While astronomical events during the reign of the *Chongzhen* Emperor are not included in this book, Liu Ciyuan and Liu Rui (1998) supplemented cosmic events according to same style based on the *Chongzhen Shilu* and *Chongzhen Changbian*.

Classified statics of celestial events in the *Ming Shilu* are listed in Table 2.

Table 2. Classified Statics of Celestial Events in the *Memoir of Ming Dynasty*

Period	Solar Eclipses	Lunar Eclipses	Moon O/A Stars	Moon O/A Planets	Planet O/A Stars	Planet O/A Planet
<i>Hongwu</i>	16	23	171	12	178	18
<i>Jianwen</i>	0	0	14	0	18	0
<i>Yongle</i>	8	20	111	18	93	11
<i>Hongxi</i>	0	1	12	1	8	1
<i>Xuande</i>	3	9	70	8	60	5
<i>Zhengtong</i>	4	11	108	16	50	10
<i>Jingtai</i>	4	7	77	7	50	12
<i>Tianshun</i>	4	9	112	1	53	11
<i>Chenghua</i>	9	25	252	14	111	8
<i>Hongzhi</i>	7	19	266	15	110	12
<i>Zhengde</i>	6	12	136	4	54	4
<i>Jiajing</i>	17	34	59	13	49	10
<i>Longqing</i>	2	6	14	0	6	0
<i>Wanli</i>	18	45	43	10	55	14
<i>Taichang</i>	0	1	1	0	1	0
<i>Tianqi</i>	1	3	11	1	23	1
<i>Chongzhen</i>	6	6	0	1	8	0
Total	105	231	1457	121	927	117

Period	Meteors/Aerolites	Comets/Guest Stars	()	Cloudy Obscured Hazes	Seeing Venus/Jupiter in the Daytime	Canopus	Others
<i>Hongwu</i>	194	27	7	74	42	0	46
<i>Jianwen</i>	45	0	0	0	1	0	0
<i>Yongle</i>	396	3	2	8	8	17	1
<i>Hongxi</i>	98	0	0	19	1	0	0
<i>Xuande</i>	516	16	7	102	7	1	10
<i>Zhengtong</i>	173	11	4	106	7	0	14
<i>Jingtai</i>	118	10	5	68	19	2	7
<i>tianshun</i>	156	24	4	73	18	3	3
<i>Chenghua</i>	164	21	2	59	25	0	11
<i>Hongzhi</i>	107	33	6	68	85	33	25
<i>Zhengde</i>	166	6	1	16	32	0	22
<i>Jiajing</i>	21	29	11	12	54	0	9
<i>Longqing</i>	6	6	2	4	7	0	4
<i>Wanli</i>	76	29	13	13	11	2	31
<i>Taichang</i>	1	0	0	3	0	0	0

<i>Tianqi</i>	7	2	2	5	5	0	0
<i>Chongzhen</i>	4	1	1	4	1	0	3
Total	2248	218	67	634	323	58	186

Notes: totally 6625 records; O/A means occulting or approaching.

Table 3 presents comparison of the number of celestial events between the early and late Ming Dynasty. The ratio of annual average between the late period to the early period is 0.17.

Table 3: Comparison of the Number of Celestial Events Between the Early and Late Ming Dynasty

Period	Gregorian Calendar	Total Records	Annual Average
洪武元年—正德十六年	A.D. 1368 to 1521	5861	37.8
嘉靖元年—崇祯十七年	A.D. 1522 to 1644	123	6.6

The difference in annual average between the early and late Ming Dynasty is closely related to types of celestial events according to comparison of annual number of astronomical records between the early and late Ming Dynasty. Those being recorded most in past dynasties, such as events of the Moon, planets, meteors and cloudy obscured hazes (*yunqi*), had been greatly decreased in the late Ming Dynasty. The number of solar and lunar eclipses had basically remained the same. The number of comets records decreased, but the number of comets didn't decrease indicating that a decrease in the number of records of a comet, but the occurrences of comets was recorded.

Among the total 2622 records of the Moon and planets in the *Memoir of Ming Dynasty*, 107 records are error according to modern astronomical computational methods. The error rate is 4.1%. Table 4 presents error rates of the Moon and planets positions recorded in past dynasties. The relevant data originate from our statistics (see Liu, 2012a, 2012b, 2013, 2015b; Liu and Ma, 2013b; Ma, 2013). Most of the wrong records can be judged by astronomical calculations and other books (see Liu, 2015a).

Table 4: Error Rates of Lunar and Planetary Records in Past Dynasties

Dynasty	Han, Wei, Jin	South	North	Sui, Tang, Five Dynasties	Song	Jin	Yuan	Ming
Records	655	640	706	612	5278	228	1476	2622
Error Rate	29	15	17	27	9.9	14	4.1	4.1

### 3 Various Celestial Events

Various celestial events were recorded in the *Memoir of Ming Dynasty*. Let us begin with solar and lunar eclipses.

#### 3.1 Solar and Lunar Eclipses

In the *Memoir of Ming Dynasty*, there are 105 records of solar eclipses: 90 occurred in the capital and 11 occurred in other place rather than in the capital; two occurred in other countries; the date of one record was new moon while no eclipse occurred on that day; the date of another record was not new moon. The calculation results show that there were 106 solar eclipses visible from the capital, of which 90 were recorded. Besides, eight (different from the 90 records), mainly occurred in the late of the Ming Dynasty, were recorded in the *History of Ming Dynasty*. The missing eight may not be predicted (at the same time they did not be seen) or the documents were lost.

One obvious feature of these eclipse records is particularly simple. The description, such as *ji*

“既”, can be found now and again in the historical eclipses. Nevertheless, there is no such description in the *Memoir of Ming Dynasty*. In contrast, there are large quantities of more detailed records of total solar eclipses and near-total eclipses in local records during the same period (Liu, Dou and Zhuang, 1998; Ma, 2004).

In order to discuss the accuracy of calculation and require changing calendar, a few solar eclipses with more details of the late Ming Dynasty were recorded in the *Memoir of Ming Dynasty*.

In the *Memoir of Ming Dynasty*, there are 231 records of lunar eclipses, including 8 *yinyu bujian* “阴云不见” (eclipse was not seen due to clouds), 11 *dangshi bushi* “当食不食” (an expectant eclipse didn't occur), and 14 *shiji* “食既” (total eclipse). There are a dozen records with simple location and time. Individual records are interesting and recorded in detail.

The calculation shows below the results: there are 190 lunar eclipses visible from the capital; seven out of 190 differed by one day, which can be considered basically correct; eight occurred in other countries; 26 were penumbral eclipses; six are error. The records of lunar eclipses in the Ming Dynasty, between the beginning of Ming Dynasty and the early year of *Tianqi* (A.D. 1621), come primarily from those in the *Memoir of Ming Dynasty* (see Liu and Ma, 2012 ).

### 3.2 the Moon and Five Planets

The positional records of the Moon and five planets (Venus, Jupiter, Mercury, Mars and Saturn) are the most type of astronomical records in past dynasties. *Fan* “犯” (approach), within one degree, is usually used to describe positional relation of the Moon, planets and stars. In addition, a small quantity of *yan* “掩” (occultation), *ru* “入” (access), *shou* “守” (stationary), *he* “合” (conjunction) and *ju* “聚” (gather), which are generally called occultation and approach together with *fan* in our category, are used to describe positional relationship between celestial bodies. There are more than 2600 records of occultation and approach, including 1457 records of the Moon occulting or approaching stars, 121 records of the Moon occulting or approaching five planets, 927 records of planet occulting or approaching stars, 94 records of one planet occulting or approaching another planet, and 23 records of planetary gather. Since such astronomical phenomena can be calculated using modern methods, we can explore some related issues, such as the date used in Chinese historical annals (see Kiang, 1980).

Compared with traditional star names in ancient China, there are a few changes in the *Ming Shilu*. We can't find “*Juxing*”, title of determinative star, which was usually used to record determinative star of some lodge in *tianwen zhi*. For instance, the determinative star of the lodge *di* 氐 is called the southwest star of the lodge *di*.

### 3.3 Meteors and Aerolites

Records of meteors and aerolites account for one third of all celestial events in the *Ming Shilu*. This is the highest proportion in historical records. Spaces of these meteors and aerolites account for roughly half. These records are detailed and standardized, usually including the size (brightness) of meteors, color, the direction and constellation of starting, passing and termination.

### 3.4 Comets (Guest stars)

In ancient China, comets were named by various names according to the shape, commonly known as guest stars. There are 218 comets (guest stars) retrievable from the *Ming Shilu*, corresponding

to 67 comets roughly according to the time and location. As we all know, one comet appears, the Imperial Board of Astronomy often record its shape and color many times, as well as the direction of action, passing constellations.

Besides comets, guest stars also include some alien stars. There are six possible novae or supernovae according to the *General Collection of Ancient Chinese Astronomical Records* (Beijing Astronomical Observatory, 1988).

### 3.5 Other Celestial Events

The last four columns of Table 2 are included in other celestial events, namely 141 records of *tianming* “天鸣” (sky cry), 634 records of *yunqi* “云气” (cloudy obscured hazes), 23 records of solar halos, 58 records of *laorenxing xian* “老人星见” (seeing Canopus), 261 records of *Jingxing zhoujian* “金星昼见” (seeing Venus in the daytime), and 62 records of *Muxing zhoujian* “木星昼见” (seeing Jupiter in the daytime).

## 4 Conclusions

In addition to *tianwenzhi* of past dynasties, the largest source of astronomical records in ancient China is the *Ming Shilu*, in which there are abundant celestial events, far more than *Ming Shi*.

Totally 6,625 records can be divided into the following types: 105 solar eclipses, 231 lunar eclipses, 1578 lunar dynamics, 1044 planetary dynamics, 2248 meteorites, 218 comets (guest stars), 634 cloudy obscured hazes, 323 seeing Venus/Jupiter in the daytime, and others 244 (see Table 2).

The densities of different reigns are normal regarding general events in the *Memoir of Ming Dynasty*. Regarding the density of astronomical records, an annual average of 38 records before the *Zhengde Shilu*, while that is 7 records annually between the *Jiajing Shilu* to *Tianqi Shilu*, and that is 2 records annually in the *Chongzhen Shilu*. The astronomical records are rarely and not standardized in the *Chongzhen Shilu* and *Chongzhen Changbian*, apparently due to lack of information caused by the war in the late of the Ming Dynasty. Changes in concept of historiographers compiling Memoirs and compiling system of Memoirs should contribute to significant decrease after the *Jiajing* Emperor.

The different densities of the early and late Ming Dynasty associated with types of celestial events. The number of celestial events such as the Moon, planets, meteors, and cloudy obscured hazes, which were the largest in history, drastically decreased. The number of solar and lunar eclipses is basically consistent with those of past dynasties. The accounts of comets had been reduced, but the number of comets had not diminished. This reflects the choice of all types of celestial events made by the late historians (see Table 3).

According to modern astronomical calculations, 107 records are error among the 2622 records of the Moon and planets. The error rate is 4.1%, which is equal to that of the Yuan Dynasty, far better than those of past dynasties. The errors should be mainly caused by the process of data compilation and book copying.

In the *Ming Shilu*, there are 105 solar eclipses and 231 lunar eclipses, which cover most actual visible eclipses in the capital. Some eclipses were visible from other countries due to inaccurate forecasts, which mixed into the measured records. The eclipse records echoed with many records of rescue ceremonies in the Ming Dynasty.

A feature of astronomical records is that quite a lot of meteors and aerolites recorded in detail

with standardized form. Also most aerolites have specific location and description of process.

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Note: in the following reference (C) indicates books, research paper written in Chinese. Most of these have English abstracts.

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