

Ancient Chinese Records of Approaches and Occultations

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Abstract: There is a large quantity of astronomical records in extant literature, especially in the Twenty-Five Histories. Among these records, those of approaches and occultations have been recorded in the largest number since ancient Chinese times. In the official histories, the records of approaches originated from the Western Han Dynasty and lasted to the Qing Dynasty, and a high recording density was maintained in the Song, Yuan and Ming dynasties. The reliability of these records is rather high. Approach or occultation of a planet by another planet has not been investigated. The distribution of the stars is uneven. The stars being most occulted and approached should play an important role in Astrology.

Key words: approaches; occultations; Moon; planets, ancient China

1 Introduction

The quantity of the records of approaches and occultations is the largest in the ancient Chinese records of various celestial phenomena. The records of approaches and occultations can be classified into three categories: approach or occultation of a star or planet by the Moon, approach or occultation of a star by a planet, and approach or occultation of a planet by another planet — which will not be discussed in this paper. The records of approaches and occultations are of great importance to the study of ancient measurement systems, astronomical observation methods, ancient star names, ancient astronomy theories and the origin and revolution of their carriers.

Chen (1984) collected some records of planetary approaches and occultations. As long ago as 1930s, Ogawa (1932, 1933, and 1934) applied lunar and planetary approaches/occultations to make some textual research on Chinese traditional star names. Liu (1988a) investigated secular variation of the Earth's rotation with the records of lunar occultations kept before 600 AD in China. Furthermore, Liu (1988b) analyzed the records of planetary occultations in the Twenty-Four Histories. Li (2007) examined 34 ancient Chinese timing records of lunar occultations of planets. Jiang (1980), Wang (2008) and Zhang (2010) also referred to the records of lunar or planetary approaches/occultations of stars in their studies. Shi et al. (2013) studied the records of approaches and occultations occurred in the 10th year of Xuande's Reign.

Liu (1992) analyzed the ancient Chinese data of lunar occultations and close approaches of stars/planets. Nevertheless, there has been no comprehensive statistical analysis of the records of lunar and planetary approaches/occultations of stars. In order to make full use of these records, I conducted a statistical analysis of records documented in the official historical books in different dynasties with modern astronomical computational methods.

2 The Meaning of Approach and Occultation

When referring to a moving celestial body or a celestial body which suddenly appears approaching another celestial body, *Fan* (approach) is used in ancient China. *Fan*, a unique term in ancient Chinese astronomical observation, is used the most in astronomical records. According to the study of Liu (1987), the definition of *Fan* should be one degree. A passage in the 2nd *tianwen zhi* (astronomical treatise) of the *Mingshi* (*History of the Ming Dynasty*) notes that occultation means two stars occupying the same longitude and latitude and approach means the meeting of light.

The naked eye could not catch sight of the darker stars (such as magnitude of two or more) on the edge of the bright Moon when the phase of the Moon is relatively large. It is very likely that the observations were obtained by the relationship between the Moon and the surrounding constellations for most dark stars.

Lots of astronomical records consist of the event, divination and *yan* 驗 (the corresponding event happened later) in ancient China. It was not until the Five Dynasties (AD 907) corresponding events happened were basically canceled in the records of approaches and occultations. For instance, the year *Qinglong* 4, month 7, day *jiayin*, Venus approached the big star of *xuanyuan* 軒轅(α Leo). The divination prophesied: “the Empress should be worried”. The year *Jingchu* 1, the Empress Mao died (Treatise 13, Volume 23 of the 1st *tianwen zhi* of the *Songshu* (*Song Annals*). Distance, even direction were recorded in some events.

3 Statistics of These records in Official Histories

Compared with other records of celestial phenomena, the records of approaches and occultations appeared later. Due to plenty of opportunity to occult and approach, the number of these records became the largest in extant literature since the Jin Dynasty.

It is noted that most astronomical records of the Qing Dynasty are unreal (calculated). There are only lunar and planetary approaches/occultations of planets in the *Qingshi Gao* (*History of Qing Dynasty*) and there are few celestial events in the *Qingshi Lu* (*A Record of the Qing Dynasty*). For the reasons above, the records of the Qing Dynasty were not considered. The records of approaches and occultations are commonly retrievable in official histories, for instance in astronomical treatises and other treatises. There are also plenty of such records in the *Mingshilu* (*Ming Documentaries*).

3.1 Lunar and planetary approaches/occultations of stars

Table 1 provide a summary of lunar and planetary approaches/occultations of stars in the *Twenty-Four Histories*. In this table, data tabulated are as follows: Dynasty or Dynasties, the number of the records of lunar approaches, lunar occultations, planetary approaches, planetary occultations, the years of the Dynasty or Dynasties, and frequency for 10 years. In Table 2, the following details are listed column by column: Dynasty or Dynasties, the errors of Moon, the error rates of Moon, the errors of planets, and the error rates of planets.

Table 1: Accounts of lunar and planetary approaches/occultations of stars
in the *Twenty-Four Histories*

Dynasty or Dynasties	Lunar approaches	Lunar occultations	Planetary approaches	Planetary occultations	Years	Frequency for 10 years
Western Han	1				230	-
Eastern Han	23	1	48		195	3.7
Wei	37		16		42	12.6
Wu			10		58	1.7
Western Jin	1		10		52	2.1
Eastern Jin	112	32	133	4	103	27.3
Song	53	15	83	4	59	26.3
Qi	153	14	90		23	111.7
Liang	3	1	2	2	55	1.5
Chen	22	3	21		32	14.3
Northern Dynasties	223	83	177	15	195	25.5
Sui			3		37	0.8
Tang	56	66	140	12	289	9.5
Five Dynasties	32	13	68	2	53	21.7
Northern Song	1402	122	1136	22	167	160.6
Southern Song	370	37	415	1	152	54.1
Jin	55	32	64	7	119	13.3
Yuan	734	31	534	4	104	125.3
Ming			736	1	276	26.7

As can be seen from Table 1 and Table 2, these records in the official histories originated from the Western Han Dynasty and lasted to the Ming Dynasty. High frequency of approaches was documented throughout the Song, Yuan and Ming Dynasties. Among the 7485 records of close approaches in the *Twenty-Four Histories*, more than 90% (6932) are records of approaches. The Northern Song Dynasty had the most records, up to 2 682, followed by the Yuan Dynasty, more than 1300. These two dynasties accounted for 53% of all records. Referring to the total number of records or the number of that for every 10 years, the Northern Song is the first both in I and Liu's statistics. According to my statistics, lunar and planetary approaches/occultations of stars, Dynasties recorded more than 100 accounts for every 10 years, in turn, are the Northern Song, Yuan, and Southern Qi Dynasty, while are the Northern Song, Southern Qi, and Yuan Dynasty for the records of planetary approaches/occultations.

The official sources of the records of lunar and planetary approaches/occultations of stars are nearly same to those of lunar approaches and occultations of stars/planets, which was given by Liu (1992). The former are summarized in Table 3.

Table 2: Error accounts and error rates of lunar and planetary approaches/occultations of stars in the *Twenty-Four Histories*

Dynasty or Dynasties	Errors of Moon	Error rates of Moon	Error rates of planets	Error rates of planets
Western Han	0	-	-	-
Eastern Han	7	0.29	10	0.21
Wei	13	0.35	7	0.44
Wu				
Western Jin	0	-	3	0.30
Eastern Jin	37	0.26	30	0.22
Song	5	0.07	5	0.06
Qi	22	0.13	23	0.26
Liang	2	-	1	-
Chen	3	0.12	3	0.14
Northern Dynasties	31	0.10	41	0.21
Sui	-	-	0	-
Tang	23	0.19	29	0.19
Five Dynasties	10	0.22	14	0.20
Northern Song	101	0.07	155	0.13
Southern Song	51	0.13	28	0.07
Jin	8	0.09	12	0.17
Yuan	38	0.05	20	0.04
Ming			98	0.13

Table 3 Lunar and planetary approaches/occultations of stars recorded in the official sources

Dynasty or Dynasties	Literature sources
Han Dynasty	<i>tianwen zhi</i> of the <i>Hanshu</i> and <i>Hou Hanshu</i>
Wei and Jin Dynasties	<i>tianwen zhi</i> of the <i>Songshu</i> and <i>Jinshu</i>
Northern and Southern Dynasties	<i>Songshu</i> , <i>Nan Qishu</i> , <i>Weishu</i> , and <i>Suishu</i>
Sui Dynasty	<i>tianwen zhi</i> of the <i>Suishu</i>
Tang Dynasty	<i>tianwen zhi</i> of the <i>Xin Tangshu</i> and <i>Jiu Tangshu</i>
Five Dynasties	<i>tianwen zhi</i> of the <i>Jiu Wudaishi</i> and <i>sitian kao</i> of the <i>Xin Wudaishi</i>
Song Dynasty	<i>tianwen zhi</i> of the <i>Songshi</i>
Yuan Dynasty	<i>tianwen zhi</i> of the <i>Yuanshi</i>
Jin Dynasty	<i>tianwen zhi</i> of the <i>Jinshi</i>
Ming Dynasty	<i>tianwen zhi</i> of the <i>Mingshi</i> , the <i>Mingshilu</i> ¹⁾

Notes: 1) the records in the *Mingshilu* are not included in this paper.

3.2 Lunar approaches and occultations

As mentioned above (Section 1), Liu (1992) analyzed the ancient Chinese data of lunar approaches and occultations. The length of every dynasty before the end of the Yuan Dynasty, the number of the records and the number of that for every 10 years are given in Table 1 in his article. Figure 1 shows the distribution of lunar approaches and occultations in ancient China. The abscissa stands for dynasty, and the ordinate for the number of the records. Particularly worth mentioning is the Nan Qi Dynasty in the ancient Chinese records. Glorious records of this dynasty, only 23 years, have been handed down. The records of the Song, Yuan and Ming Dynasties are all large quantity due to the value of history compilation, developed printing and asymptotic time.

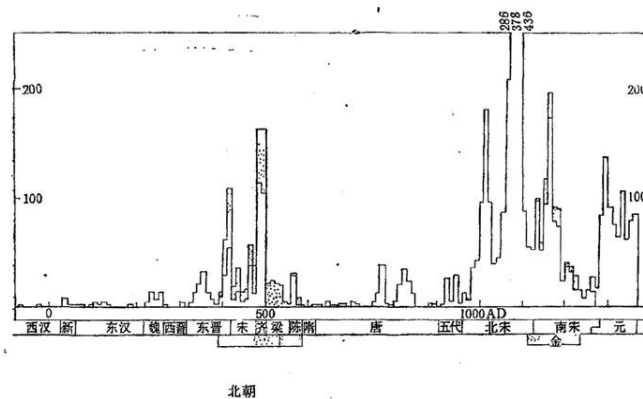


Figure 1: Distribution of lunar approaches and occultations (frequency for 10 years)

4 The Reliability of The Records of Approaches and Occultations

The reliability of these records is rather high, in that since the Northern Song Dynasty, the error rate for the lunar and planetary approaches/occultations of stars has obviously fallen from 20% to an average of 10%. Let us look at the reliability of the lunar approaches and occultations (Liu, 1992): among the 1229 records of lunar approaches and occultations before the Five Dynasties, 20% (249) are error. While among the 808 records of that in the *Yuanshi*, 4% (30) are error. Such an error rate can be considered to be partially due to issues in relation to the spreading of historical materials and many errors can be corrected through making textual research. The following categories are included mainly in these examinable records: the confusion of celestial bodies, the error of ellipsis of months, the error of years, and the error of the heavenly stems and earthly branches (*ganzhi*).

5 Commonly Occulted and Approached Stars

According to my statistics, the number of stars being occulted and approached by the Moon and the five planets are 503 in total, of which 47 stars belong to *Jinxu* 井宿, one of Chinese constellations. Other constellations which were occulted and approached over 30 times are ranked as *Douxu* 斗宿, *Xuanyuan* (also called *Quan* 权 in the Southern Song Dynasty) and *Bixu* 毕宿. All these stars belong to 108 Chinese traditional constellations. The stars being occulted and approached more than 20 times are displayed in Table 4. We can be seen that the distribution of the stars was uneven. The stars being most approached or occulted should play a more significant role in astrology.

Table 4 The stars being occulted and approached more than 20 times

No.	Chinese star	Frequency	Western star	
			Tradition	YXKC ¹⁾
1	<i>Youzhifa</i> 右执法	260	β Vir	
2	<i>Zuozhifa</i> 左执法	253	η Vir	
3	<i>Xishangjiang</i> 西上将	215	σ Leo	
4	<i>Xuanyuandaxing</i> 轩辕大星	208	α Leo	
5	<i>Jishi</i> 积尸	167	π Per	
6	<i>Jinxian</i> 进贤	110	θ Vir	$\kappa/44$ Vir
7	<i>Dongshangxiang</i> 东上相	107	γ Vir	
8	<i>Xindaxing</i> 心大星	90	α Sco	
9	<i>Yue</i> 钺	85	η Gem	
10	<i>Xinqianxing</i> 心前星	70	σ Sco	
11	<i>Tianguan</i> 天关	69	ζ Tau	
12	<i>Bidaxing</i> 毕大星	68	α Tau	
13	<i>Jianbi</i> 键闭	64	ν Sco	
14	<i>Fangbeidiyixing</i> 房北第一星 / <i>Fangshangxing</i> 房上星(相)	43 /20	β Sco	
15	<i>Fangjuxing</i> 房距星	52	π Sco	
16	<i>Xinhouxing</i> 心后星	50	τ Sco	
17	<i>Kangjuxing</i> 亢距星	46	κ Lib	
18	<i>Xixiannanyixing</i> 西咸南一星	45	θ Sco	
19	<i>Dijuxing</i> 氐距星	39	α Lib	
20	<i>Yue</i> 月	38	37 Tau	
21	<i>(Nei)Pingnanxing</i> (内)屏南星	36	ν/π Vir	
22	<i>Doukui</i> 斗魁 ²⁾	31	$\phi, \sigma, \tau, \zeta$ Sgr	
23	<i>Guixibeixing</i> 鬼西北星	31	η Cnc	
24	<i>Jingjuxing</i> 井距星	28	μ Gem	
25	<i>Bijuxing</i> 毕距星	26	ε Tau	
26	<i>Jixin</i> 积薪	22	μ Cnc	κ Gem
27	<i>Fangbeidi2xing</i> 房北第2星	22	δ Sco	
28	<i>Maojuxing</i> 昂距星	22	17 Tau	
29	<i>Maodongbeixing</i> 昂东北星	22	27/28 Tau	
30	<i>Didongnanxing</i> 氐东南星	22	l Lib	
31	<i>Jiaojuxing</i> 角距星	20	α Vir	
32	<i>Ri</i> 日	20	2 Sco	

Notes: 1) YXKC, abbreviation of *Yixiang Kaocheng* 仪象考成 (1752). *Yixiang Kaocheng* and Continuation of *Yixiang Kaocheng* 仪象考成续编 compiled in the Qing Dynasty. Nowadays, Yi Shitong's star chart (1981) is the most commonly-accepted chart with Sino-Western star names. The contents of the chart were based on these two great works. The different name of star is listed in this column. 2) *Doukui* includes four stars.

6 Conclusions

There are abundant records of the Moon or a planet either occulting or approaching a star or a planet in the official histories, which lasted nearly 2,000 years. More than 90% are records of approaching. The reliability of these records is rather high. Ancient lunar and planetary approaches/occultations records can be used to identify names of traditional stars.

7 Acknowledgements

I am greatly indebted to Prof. LIU Ciyuan for his constructive comments. The project was supported by National Natural Science Foundation of China (project number: 11473030). I am grateful to Dr M. Soma for his invitation, and also grateful to Dr K. Tanikawa. The expenses for my travel and stay are financed by their research funds.

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