

# Lunar Eclipse Records in *Đại Việt Sử Ký Toàn Thư*

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## Abstract

We present the latest version of the lunar eclipse list (55 records in total) in *Đại Việt Sử Ký Toàn Thư* (TT, 大越史記全書), one of the most important historical sources in Vietnam. Keeping in mind that the two Chinese characters "日" and "月", which are similar to one another in form, have been occasionally confused when they are used for the eclipse, we investigated all the eclipse records including solar ones. We examined such confusion as well as contradiction in the described date found in the records to resolve them as much as possible. We discuss the reliability of the lunar eclipse records in TT by comparing with the results of astronomical calculation. We also briefly discuss the day start time considered by Vietnamese people in those days.

## 1. Introduction

It is well known that many astronomical records are found in Chinese, Korean and Japanese historical sources. Comparatively little is known, however, about Vietnamese historical astronomical records. There are a few important Vietnamese historical sources, such as *Đại Việt Sử Ký Toàn Thư* (TT, 大越史記全書, Complete Volumes of the Historical Memoirs of Great Vietnam) and *Việt Sử Lược* (VSL, 越史略). The former is the official historical book compiled by royal historians of Lê dynasty (黎朝) in 15th through 17th centuries, and the latter, perished in Vietnam but conserved in a few Chinese library series, is believed to be published much earlier.

Ho Peng-Yoke (1964) listed the natural phenomena (including many astronomical ones) recorded found in TT. Okazaki and Yokoo (1983) also surveyed the astronomical records in VSL.

## 2. Lunar eclipse records

Concerning lunar eclipse, a number of records are found in TT while none in VSL. Ho Peng-Yoke (1964) listed 34 lunar eclipse records in TT from ancient times through AD1675. Recently, Tanokura and Okazaki (2011) surveyed solar and lunar eclipse records by referring to the collated version of TT by Chen Chingho (1984-86). His collated version contains, besides TT itself, another historical source entitled *Đại Việt Sử Ký Toàn Thư Tục Biên* (大越史記全書續編, Supplementary Volumes

of TT), which covers the period up to AD1789. From their survey, Tanokura and Okazaki (2011) listed 52 lunar eclipse records. Although their list lacks two lunar eclipse records that should be included, their study conducted to large increase of the number of known Vietnamese lunar eclipse records.

For convenience of later discussion, we present the latest version of the list of lunar eclipse records in TT as Table 1 at the end of this note. The table presents 55 records in total, including the two records (Nos.1A and 2A) that are lacking in Tanokura and Okazaki's (2011) list and also one eclipse (No.5A) that is mentioned in an episode of a royal astronomer in 15th century. The latter record will be discussed in the next section.

The first column of the table gives sequential number of the lunar eclipse record. For the records except Nos. 1A, 2A and 5A, we assigned number identical to that in Tanokura and Okazaki's (2011) list to avoid confusion in future studies.. The second column presents a passage of the record in original text of TT.

The third and the fourth columns yield the date (in the format of *yyyy mm.dd*) described in the lunar eclipse record and the date at mid-eclipse in Hanoi determined by astronomical calculation, respectively. The described date has been converted to the Julian (before 1582) or Gregorian Calendar date by using Lê Thành Lân's (2007) table. It is noted that before AD 1544 his table substantially gives the Chinese calendar only because no local Vietnamese calendar in those days is available. For the described date in the third column, in the case of a little uncertain date like "the full moon day (望)" given in the record, we obtained the date by simply assuming that it would be "15th day" in luni-solar calendar, and showed it in parenthesis. For the calculated date in the fourth column, we adopted the date in Universal Time (UT) rather than the date in Hanoi Local Time because date (UT) remains constant throughout the night, and this will be convenient for later discussion. Calculations were made with the astronomical simulation software Stellar Navigator ver.6 (AstroArts Inc).

The fifth column shows symbols representing how the eclipses are observed in Hanoi judging from astronomical calculation: Symbols  $\partial$  and  $\circ$  mean a partial and a total eclipse observed in Hanoi, respectively, symbol X no eclipse observed in Hanoi though the date is not incorrect, and symbol - no eclipse occurred on any days of the month described in the record. We will discuss a possible one day shift in the date in the next section.

The sixth and the seventh columns give the corresponding Oppolzer (1887) number and remarks, respectively.

### 3. Discussion

#### 3.1. Confusion between "日" and "月"

The collated version of TT by Chen Chingho (1984-86), to which our study has referred, remarks on the difference of used Chinese characters, if any, among all the available versions of TT. In that case, in Table 1, we add another (less plausible in many cases) alternative in parenthesis that

is given in his remarks, like "九 [ 七 ] 月". As seen in the table, the two Chinese characters "日" and "月", which are similar to one another in form, are occasionally confused among the surviving versions of TT caused probably by a careless mistake in their transcription process.

Keeping in mind the confusion, we checked the described dates for all the record using the words of not only "solar [lunar] eclipse (日 [ 月 ] 食)" and "lunar [solar] eclipse (月 [ 日 ] 食)" but also "solar eclipse (日食)", and found that the described dates for some of these records correspond to "the full moon day (望)" or "someday around 15th day" in luni-solar calendar. Since such records can be judged to be lunar eclipse ones, they are included in Table 1.

### 3.2. Contradiction in described date

We also see some contradiction in the described date in a few records.

For example, record No.17 says "五月望丙戌, 月食巽方, 殆盡一箇時復圓", but "day 丙戌 (= 22nd day of the month)" does not correspond to "the full moon day (望)". We may conclude, however, that the record should describe a lunar eclipse because "望" is often used for a lunar eclipse and never used for a solar eclipse and also because a total lunar eclipse (lasting for 1h37m) was seen in Hanoi on "the full moon day (望)" of the month in almost the same way as described in the record.

Next example is record No.24 saying "春正月二十六日, 月有食之", which gives contradictory date for a lunar eclipse. The contradiction can be resolved by assuming that only one character "二" has been added erroneously. On the other hand, in order to consider the record to be for a solar eclipse, we have to assume that two words "朔"(or "初一日", "晦") and "日" have been erroneously replaced by "二十六日" and "月", respectively. It is also noticed that a lunar eclipse was seen in Hanoi on "十六日 (=16th day of the month)" of the month while no solar occurred on the day of neither "朔/初一日 (=1st day of the month)" nor "晦 (=the last day of the month)". Therefore, we may conclude that the record should also describe a lunar eclipse.

Another example is record No.43 saying "六月庚寅, 月 [ 日 ] 食". Since "day 庚寅 (= 9th day of the month)" is favorable to neither lunar nor solar eclipse, it is very hard to infer, only from this description, which eclipse the record concerns.

It is noted that record No.50 should be identical with record No.51 if we assume that one character "三" has been erroneously replaced by "二", which is very similar to "三" in form.

As for record No.4, although the collated version by Chen Chingho (1984-86) does not make any remark on it, we find that some other versions of TT, including the Vietnamese edition published in 1993 by the Institute of Hán Nôm in Hanoi, read "五月" not "五日" for the two characters in the passage given as "夏四月, 龍見..., 五日, 地震, 望月有食之" in Chen Chingho's (1984-86) version. We see here the confusion between "日" and "月" again. We adopt "五月" for the record so that the described date correspond to the date on which a lunar eclipse was seen in Hanoi.

### 3.3. Possible one month/day shift

As mentioned in the previous section, the described date before AD1544 has been converted to the Julian Calendar date on the assumption that Vietnamese calendar is identical to Chinese one. Therefore we should keep in mind that there could exist one-month difference between Vietnamese and Chinese calendars due to a slight different way in inserting an intercalary lunar month in their calendars.

Record No.1 says "A lunar eclipse was seen in April 15, 1169", which is exactly one month after the date when a lunar eclipse was seen in Hanoi. As mentioned above, this record might give a correct date in Vietnamese calendar, though we have no evidence for its correctness.

Moreover, one-day shift could also arise for the period before AD1544 due to a slight difference between Vietnamese and Chinese calendars in arranging 29-day and 30-day months in a year. Apart from the calendar difference, the date of a historical lunar eclipse record is involved with the issue of day start time considered by people in those days, which will be discussed in later subsection.

### 3.4. Observed or predicted

Some, probably many, of the lunar (and solar) eclipse records in historical sources of those days are believed to be those predicted by calendar calculation rather than actually observed. In the lunar eclipse records of in TT (Table 1), we find a few passages supporting this interpretation.

For example, the records No.18 and No.28 says "There was an eclipse of the moon. It rained heavily. (月食, 天大雨)" and "There was an eclipse of the moon. It was rainy, windy and dark. (The eclipse) was not seen. (月食, 適風雨晦冥不見)", respectively.

TT also contains an episode of the royal astrologist who was judged by the Imperial Court to have made a false lunar eclipse prediction. However, a slightly partial eclipse actually occurred at very low altitude in the sky from Hanoi in the almost predicted hour of the very predicted day (September 12, 1448) according to astronomical calculation.

### 3.5. Reliability of records

By comparison with the results of astronomical calculation, among 55 lunar eclipse records in TT, we found that ten records (with symbol X in Table 1) yield an incorrect month for the lunar eclipse date. A few of those records may have been affected by the confusion of Chinese characters used there and also by a slight difference of Vietnamese calendar from Chinese one, as discussed above. Anyway, those 10 records should be regarded as doubtful.

Besides them, we also found two records (with symbol - in the table) giving a correct date, on which, however, no eclipse was observed in Hanoi: record No.5 and No.10 correspond to a penumbral eclipse and a day-time lunar eclipse, respectively. Although these two records are also regarded as doubtful, they may have remained rather free from the effect such confusion of characters as described above since 15th century because the described date is correct. If so, we may have some idea of the accuracy of Vietnamese calendar calculation in 15th century by analyzing these two

records as well as other records in the same century. It may be noticed that the above mentioned episode of the astrologist also belongs to 15th century.

Finally, we find that the remaining 43 records (with symbols and in the table) are reasonable, which correspond to 78% of all the lunar eclipse records in TT,

### 3.6. Day start time

It is important to learn the day start time (i.e., the time indicating the boundary of a day) considered by people in old days because, without such knowledge, we cannot correctly specify the date for an event occurred at sometime in the night. For example, it is reported that medieval Japanese people considered the day start time to be around 3:00 am (e.g., Saito 1995).

The dates described in lunar eclipse records of TT would give us some idea of the day start time considered by Vietnamese people in those days. Using all the records (32 records) for that we can specify their described date, we investigated the start and the end time of the lunar eclipse as well as the date. We find that, among the 32 lunar eclipses, 12 of them (group A) end before midnight while 14 of them (group B) start after midnight and that 6 of them (group C) runs over midnight.

The results of our investigation are as follows: (1) All the twelve records of group A have given the same date as the daytime. (2) Nine of the fourteen records of group B have yielded the date of the next day while five have provided the same date as the daytime. (3) Five of the six records of group C have given the same date as the daytime while one has yielded the date of the next day.

From these results, we can say that Vietnamese people did not consider a date as remaining unchanged all the night through. A more detailed study will be reported elsewhere.

## References

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Table 1 Lunar Eclipse Records in *Dai Viet Sū Kij Toàn Thu*

No.†	Record (Original Text) in TT	Described Date* (1169.04.15)	Calculated Date (UT)	How Observed**	Oppolzer No. (3676)	Remarks
1	政隆寶應七年，春三月望，月蝕	(1306.10.22)	1306.10.22	-	3895	calendar shift by one month?
1A	興隆十四年，秋九月十五日戌時，月蝕	(1388.11.13)	1388.11.14		4017	
2	昌符十二年，冬十月望，月食既	1437.04.20	1437.04.20		4091	"乙巳" is "十五日" of the month
2A	紹平四年，三月...乙巳，月有食，太史裴時亨密奏、隱之不救	(1439.08.24)	1439.08.24		4094	
3	紹平六年，秋七月望，月有食之	(1443.06.12)	1443.06.12		4100	see text
4	大和元年，夏四月[五月]...望，月有食之	(1444.11.24)	1444.11.25	×	-	Penumbral eclipse
5	大和二年，冬十月...，月食	1448.09.13	1448.09.13		4107	see text
5A	大和六年，八月...時亨密奏是月十六日卯時月食、...月不見食	1465.04.11	1465.04.11		4131	
6	光順六年，三[十三]月十六日，月食既	1476.03.11	1476.03.11		4148	
7	洪德七年，春二月...十六日，月食既	1476.09.03	1476.09.03		4149	
8	洪德七年，八月十六日，夜五更初刻，月蝕全分	1478.01.18	1478.01.19		4150	
9	洪德八年，十二月十五日，月食既	1479.01.08	1479.01.08	×	4152	
10	洪德九年，十二月十六日，月有食之	1482.10.26	1482.10.26		4157	
11	洪德十三年，九月十五日，戌時，月蝕	1525.07.05	1525.07.05		4220	
12	統元四年，夏六月...十五日，月食	1525.12.30	1525.12.30		4221	
13	統元四年，十二月...十七日，月食	1526.04.26	—	-	-	No eclipse
14	統元五年，三月十五日，月食	1587.09.17	1587.09.17		4315	"辛未" is "十四日" of the month
15	光興十年，八月壬申望夜，月食	1589.08.26	1589.08.26		4318	
16	光興十二年，七月十六日，丑時，月食在北方，過半復圓	(1591.07.05)	1591.07.06		4321	see text
17	光興十四年，五月望丙戌，月食巽方，殆盡一箇時復圓	(1594.05.04)	1594.05.04		4323	
18	光興十七年，三月望，月食，天大雨	(1596.05.11)	—	-	-	No eclipse
19	光興十九年，夏四月...望，月食	1599.08.06	1599.08.06		4334	
20	光興二十二年，六月...十六日酉時，月食	(1602.06.04)	1602.06.04		4338	
21	弘定三年，夏，四月...是月望，月有食之	(1613.07.02)	—	-	-	No eclipse see text
22	弘定十四年，五月望，月[日]有食之	(1613.08.30)	—	-	-	No eclipse
23	弘定十四年，秋七月望，月有食之	1616.03.03	1616.03.03		4359	see text
24	弘定十七年，春正月二十六日，月有食之	(1617.02.20)	1617.02.20		4361	
25	弘定十八年，春正月望，月有食之					

† : Sequential number is identical to that used in the list of Tanokura and Okazaki (2011) to avoid confusion except for Nos. 1A, 2A and 5A.

\* : For the record where a little uncertain date like "望" or no date is given, we simply assumed it as "15th day", and showed it in parenthesis.

\*\* : Symbols and mean a partial and a total eclipse observed in Hanoi, respectively; symbol X no eclipse observed in Hanoi though the date is correct, and symbol - no eclipse occurred on any days of the month described in the record.

Table 1 Lunar Eclipse Records in *Dại Việt Sử Ký Toàn Thư* (continued)

No. <sup>†</sup>	Record (Original Text) in TT	Described Date*	Calculated Date (UT)	How Observed**	Oppolzer No.	Remarks
26	弘定十八年，秋七月...十六日，月有食之	1617.08.16	1617.08.17		4362	
27	弘定十九年，春正月望，月有食之	(1618.02.09)	1618.02.09		4363	
28	德隆二年，冬十月...十七日壬戌，月有食之	1630.11.20	1630.11.20		4382	
29	德隆三年，夏四月...十六日己未，月食，適風雨晦冥不見	1631.05.16	1631.05.16		4383	
30	德隆三年，十月...望，月有食之	(1631.11.08)	1631.11.09		4384	
31	德隆四年，三月十六日，酉時，月食	1632.05.04	1632.05.04		4385	
32	德隆四年，秋九月望，卯時，日食	1632.10.28	1632.10.28		4386	see text
33	德隆六年，春二月望，月食	1634.03.14	1634.03.15		4387	
34	景治四年，五月...甲午望，月[日]有食之	1666.06.16	1666.06.17		4437	"甲午" is "十四日" of the month
35	景治五年，冬十月丙戌望，月有食之	1667.11.30	1667.11.30		4440	"丙戌" is "十五日" of the month
36	永盛三年，秋九[七]月乙丑，月[日]有食之	1707.10.11	1707.10.11		4504	"乙丑" is "十六日" of the month
37	永慶二年，六月...壬子，日[月]食	1730.07.29	1730.07.29		4541	"壬子" is "十五日" of the month
38	永慶三年，十一月甲戌望，月[日]食	1731.12.13	1731.12.13		4543	"甲戌" is "十五日" of the month
39	永慶四年，閏四月望，月[日]食	(1732.06.07)	1732.06.08		4549	see text
40	永慶四年，秋八[七]月望，月[日]食	(1732.10.03)	—	-	-	no eclipse
41	龍德元年，冬十月戊辰望[朔]，月食	1732.12.01	1732.12.02		4545	"戊辰" is "十四日" of the month
42	永祐三年，春二月[春正月朔]甲戌，月[日]食	1737.03.16	1737.03.16		4552	"甲戌" is "十六日" of the month
43	永祐四年，六月庚寅，月[日]食	1738.07.25	—	-	-	no eclipse see text
44	景興十四年，春正月...望，月有食之	(1753.02.17)	1753.04.17		-	no eclipse
45	景興二十三年，九月望，月食	(1762.10.31)	1762.11.02		4593	
46	景興二十六年，春正月壬辰望，月食，	1765.03.07	1765.03.07		4596	"壬辰" is "十六日" of the month
47	景興二十七年，春正月丙戌[望]，月食	1766.02.24	1766.02.25		4598	"丙戌" is "十六日" of the month
48	景興二十九年，十一月望，月食	(1768.12.23)	1768.12.23		4602	
49	景興三十二年，九月癸丑，月食[朔，日有食之]	1771.10.23	1771.10.23		4606	"癸丑" is "十四日" of the month
50	景興三十三年，二月庚辰，月食	1772.03.18	—	-	-	no eclipse
51	景興三十三年，三月庚戌，月食	1772.04.17	1772.04.17		4607	"庚戌" is "十五日" of the month
52	景興三十三年，九月丁未[望]，日食	1772.10.11	1772.10.12		4608	"丁未" is "十五日" of the month

† : Sequential number is identical to that used in the list of Tanokura and Okazaki (2011) to avoid confusion except for Nos. 1A, 2A and 5A.  
 \* : For the record where a little uncertain date like "望" or no date is given, we simply assumed it as "15th day", and showed it in parenthesis.  
 \*\* : Symbols and mean a partial and a total eclipse observed in Hanoi, respectively; symbol X no eclipse observed in Hanoi though the date is correct, and symbol - no eclipse occurred on any days of the month described in the record.