# On the History of Vietnamese Mathematics and Astronomy

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# 汉字文化圈数学传统与数学教育

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## 内 容 简 介

本书为"第五届汉字文化圈及近邻地区数学史与数学教育国际学术研讨会"的会议论文集。这个研讨会是一次关于东亚数学史与数学教育学术研讨会的会议，有来自美国、日本、印度、韩国，加拿大及中国内地与台湾的学者共70余人出席并宣读论文。论文内容涉及东方古典数学研究、汉字文化圈数学的交流史研究、亚洲数学由传统向现代化发展的历史研究，以及关于亚洲数学教育的比较研究。报告的论文都是上述学术领域中的最新研究成果，具有较高的学术价值。本书选收了29篇具有一定代表性的论文。

本书适于数学史工作者及师范院校相关专业的师生参考阅读。

# On the History of Vietnamese Mathematics and Astronomy

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## 1. Introduction

There are four main countries where Classical Chinese was used as the official language of the traditional learning, namely, China, Korea, Japan, and Vietnam. Recently, international symposiums on the history of science are frequently held in China, Korea, and Japan, and the history of mathematics and astronomy in these countries are relatively well known. In the 9th International Conference on the History of Science in East Asia held at Singapore in 1999, there was a session of the "Preliminary Research on Vietnamese Scientific Tradition", and I could know that several sources on Vietnamese traditional mathematics and astronomy are preserved in Hanoi. I could visit Vietnam in 2000, and consulted some sources on Vietnamese astronomy written in Classical Chinese.

In this paper, I would like to discuss some aspects of Vietnamese mathematics and astronomy based on the sources which I consulted and some Japanese works.

## 2. Previous Researches

In 1934, Mikami Yoshio (三上義夫) (Mikami is surname), a pioneer of the study of the history of Eastern mathematics in Japan, wrote the following paper.
(See Fig. 1.)

(1) Mikami, Yoshio : "Annan no ichi sansho ni tsuite" (安南ノ一算書ニツイテ) (On a mathematical work of Annam, in Japanese), *Gakko sugaku* (學校數學), no.14, 1934, 3～11.

This is a study of a Vietnamese mathematical work entitled *Chi-minh toan-phap* (指明算法) (or *Zhiming suanfa* in Beijing pronunciation), written in classical Chinese, which was brought to Japan by Matsumoto Nobuhiro (松本信廣) (Matsumoto is surname), a famous authority of Vietnamese study in Japan. Some Vietnamese books which were in the collection of Matsumoto are now preserved in the library of Keio University (in Mita, Tokyo), but the *Chi-minh toan-phap* is not there.

Therefore, the paper of Mikami is a valuable record of this book.

In 1940, Yung Chang (as transliterated in his own paper, where Chang is surname; or Zhang Yong (章用) in modern Pinyin transliteration)(1911～1939) wrote the following paper. (See Fig. 2.)

(2) Zhang, Yong (＝Chang, Yung) : "Yue-li shuorun-kao" (越曆朔閏考) (Sur la concordance des dates neomeniques du calendrier annamite et du calendrier chinois de 1759 a 1886, in Chinese with French abstract), *Xinan yanjiu* (西南研究), no. 1, 1940, 25～35.

This is a pioneer study of the Vietnamese calendar, and I was much impressed by this work. Zhang Yong also wrote a paper on the calendar of Dai (傣) people in Yunnan (雲南) province, which is also a pioneer study of this field.

Zhang Yong also studied the history of Vietnamese mathematics. For his study of the history of mathematics, the following paper may be consulted.

(3) Li, Yan (李儼) : "Zhang Yong jun xiuzhi Zhongguo suanxue-shi yishi" (章用君修治中國算學史遺事) (In memory of Zhang Yong's study of the history of Chinese mathematics, in Chinese), (originally published in the *Kexue* (科學), **24**(11), 1940, 799～804), in the *Li-Yan Qian-Baocong kexue-shi quanji* (李儼錢寶琮科學史全集), Vol. 10, 1998, Liaoning jiaoyu chubanshe (遼寧教育科學出版社), Shenyang, pp. 239～249.

The following work contains some comments on Vietnamese calendar.

(4) Yamamoto, Tatsuro (山本達郎) : *Annan-shi kenkyu I* (安南史研究 I) (*Recherches sur l'histoire de l'Annam*, in Japanese), 1950, Yamakawa shuppansha (山川出版社), Tokyo, pp. 39～41, and 272～273.

In the 1960's, Huard and Durand wrote popular articles on the history of Vietnamese science as follows.

(5) Huard, P. and M. Durand : "The Beginnings of Science in Viet Nam", in Rene Taton (ed.) (translated by A.J. Pomerans) : *Science in the Nineteenth Century*, (French original: *La Science Contemporaine*, 1961, Presses Universitaires de France), English translation : 1965, Thames and Hudson, London, pp.579～584.

(6) Durand, M. and P. Huard : "The Spread of Modern Science in Viet Nam", in Rene Taton (ed.) (translated by A.J. Pomerans) : *Science in the Twentieth Century*, (French original: *La Science Contemporaine*, // 1964, Presses Universitaires de France), English translation : 1966, Thames and Hudson, London, pp.594～596.

From the above articles, we know that there were several studies of Vietnamese medicine.

The following paper is a list of natural phenomena, including astronomical phenomena, recorded in a historical work of Vietnam.

(7) Ho, Peng-Yoke : "Natural Phenomena recorded in the Dai-Viet Su-ky Toan-thu, an Early Annamese Historical Source", *Journal of the American Oriental Society*, 84, 1964, 127~149.

It will be necessary to continue this kind of work, compare the records with other East Asian records, and check them with modern calculation.

In 1979, the following book was published in Hanoi.

(8) Vien Su hoc (Institute of history)(ed.) : *Tìm hieu khoa hoc ky thuat trong lich su Viet Nam* (Study of Science and Technology in Vietnamese history, in Vietnamese), 1979, Nha xuat ban Khoa hoc xa hoi (Social science publishers), Hanoi.

This paper includes 12 papers. Among them is a paper on the history of Vietnamese mathematics written by Ta Ngoc Lien (pp.289~314). As far as I know, this book is the most detailed work on the history of science and technology in Vietnam.

In 1991, Han Qi (韓琦) (Han is surname) wrote the following paper.

(9) Han, Qi : "Zhong-Yue lishi-shang tianwen-xue yu shuxue de jiaoliu" (中越歷史上天文學與數學的交流) (The Ancient Sino-Vietnamese Astronomical and Mathematical Relations, in Chinese with English summary), *Zhongguo keji shiliao* (中國科技史料) (*China Historical Materials of Science and Technology*), 12(2), 1991, 3~8.

This is a convenient overview of Vietnamese astronomy and mathematics.

In 1999, the 9th International Conference on the History of Science in East Asia was held at Singapore. In this conference, there was a session "New Topics in the History of Science in East Asia - Preliminary Research on Vietnamese Scientific Tradition". In this session, Chu Tuyet Lan (朱雪蘭) (Chu is surname) and Nguyen Xuan Dien (阮春面) (Nguyen is surname) introduced Vietnamese works on science, medicine and technology, and Alexei Volkov read a paper on the *Toan-phap dai-thanh* (算法大成) of Luong The Vinh (梁世榮), a mathematical work of Vietnam. Among the papers presented at this conference, the following papers are included in its proceedings.

(10) Nguyen, Dien Xuan : " Ancient Vietnamese Manuscripts and Printed

Books Related to Science, Medicine and Technology (Inventory, Classification and Preliminary Assessment)", in Chan, Alan K. L., Gregory K. Clancey and Hui-Chieh Loy (eds.) : *Historical Perspectives on East Asian Science, Technology and Medicine* (Proceedings of the 9th ICHSEA), n. d. (actually published in 2002), Singapore University Press and World Scientific, Singapore, pp.547~554.

(11) Chu, Tuyet Lan : "An Introduction to the History of Traditional Medicine and Pharmaceutics in Vietnam", *ibid*, pp.264~275.

In 2000, I could visit the Institute of Sino-Nom Studies (漢喃研究院) in Hanoi, and consulted some Vietnamese astronomical works with the help of Ms. Chu Tuyet Lan and Mr. Nguyen Xuan Dien.

When I visited Vietnam, I could find the following book in a bookshop.

(12) Le, Minh Quoc : *Danh nhan khoa hoc Viet Nam* (Famous Vietnamese scientists, in Vietnamese), 1999, Nha xuat ban Tre (Youth publishers), Ho Chi Minh City.

This is a popular book for youths. This book includes bibliographies of 13 Vietnamese scientists, both pre-modern and modern.

## 3. The mathematical work *Chi-minh toan-phap* studied by Mikami

I would like to review Mikami Yoshio's paper (1) briefly. I have not seen the original text of the *Chi-minh toan-phap*, and this is only a preliminary report for the future research. However, I believe that this report is still useful, because Mikami's paper is little known to modern historians of science, especially to foreign historians.

The author and date of this work are not known. This work consists of the main part, which consist of four chapters, and an appendix. Rough contents are as follows. Chapter 1: basic calculations etc. Chapter 2: calculation of square root etc. Chapter 3: calculation of volume etc. Chapter 4: calculation of proportional distribution etc. Appendix: several calculations. It is interesting to note that the calculation for the preparation of gunpowder is mentioned there. Therefore, we know that this work reflects certain development of Chinese science after the 10th century or so.

This work mentions the counting rods, but does not mention the abacus. The method to use the counting rods described there is different from Chinese ordinary method. In China, there are two styles to express numbers by counting rods, namely, the "vertical style" for the odd figures (1, 100 etc.), and the "horizontal style" for the even figures (10, 1000 etc.). However, in this work, the "vertical style" is

used for odd numbers (1, 3, 5, 7, and 9), and the "horizontal style" is used for even numbers (2, 4, 6, and 8). This may be the special method of Vietnam.

This work also contains the multiplication table, which starts from "9 × 9 = 81". This is the original style of China. At present, the table starts from "1 × 1 = 1". This is interesting that this work retains the old style.

Basically, this work is based on the Chinese classical mathematics, but there are some specialties of Vietnam. It will be necessary to consult other mathematical works of Vietnam also, and compare them with Chinese works.

## 4. Vietnamese astronomy

### (1) A record of Japanese drifters

There is an interesting Japanese document entitled *Annan-koku hyoryu monogatari* (安南國漂流物語), which is a record of Japanese drifters who happened to visit Vietnam from 1765 to 1767. [There are some editions of this document. One relatively popular edition is in the *Nihon shomin seikatsu shiryo shusei* (日本庶民生活史料集成), vol.5, San'ichi shobo (三一書房), Tokyo, 1969, pp.589~598.]

According to this document, they have got calendars of Annam, and found that the intercalary month for the year 1767 was after the 9th month, which was the same as the Japanese intercalary month for the same year, although the Chinese intercalary month was after the 7th month.

In the East Asian calendars, one year is divided into 24 jieqis (節氣). There are two methods to divide one year. One method called "*pingqi*" (平氣) is to divide one year into 24 equal time intervals, and is the original method which was used since the creation of the *jieqi* in the early Former Han dynasty or so. Another method called "*dingqi*" (定氣) is to divide one year by the sun's longitudinal change of 15 degrees, where the equation of centre of the sun is considered. The "*dingqi*" method has been used in China since the *Shixian* calendar (時憲曆) (1645) of Qing dynasty, and has been used in Japan since the *Tempo* calendar (天保曆) (1844) of Edo period.

The intercalary months are determined by the relationship between the time of new moon and the time of the 12 "*zhongqi*" (中氣) which are selected from 24 *jieqi* alternately.

When the Japanese drifters visited Vietnam, the *Shixian* calendar already had been used in China, while the *Horyaku* calendar (寶曆曆) (1755), where the "*pingqi*" was used, was used in Japan. This is the main reason of the difference of

intercalary months. As we shall see later, the *Datong* calendar (大統曆) (1368) of Ming dynasty, which was almost the same as the *Shoushi* calendar (授時曆) (1281) of Yuan dynasty where the "*pingqi*" was used, was used in Vietnam at that time.

The record of the Japanese drifters can be said to be a valuable record of the actual use of the calendar in Vietnam at that time.

### (2) Rough history of Vietnamese calendars

#### 1) Acceptance of Chinese calendars, notably *Shoushi* calendar

The *Yuanshi* (元史) tells that a Chinese calendar was given to the Vietnamese king (Tran (陳) dynasty) in 1265 [*Yuanshi*, vol.209, "Annam", the 2nd year of Zhiyuan]. At that time, the *Shoushi* calendar had not been made, and the *Daming* calendar (大明曆) of the previous Jin dynasty was still used in China.

The *Dai-Viet su-ky toan-thu* (大越史記全書) tells that the *Shoushi* calendar was given to Vietnamese king (Tran dynasty) from Chinese Emperor in 1324 [*Dai Viet Su Ky Toan Thu*, Vol.4, Nha Xuat Ban Khoa Hoc Xa Hoi, Hanoi, 1998, (hereafter DVSKTT), p.220, (vol.6, "42 b" in the original block print)].

From the above sources, we can suppose that the Chinese calendars were accepted in Vietnam until the early 14th century.

#### 2) Hiep-Ky calendar (協紀曆)

The *Dai-Viet su-ky toan-thu* tells that the *Shoushi* calendar was changed into the *Hiep-ky* calendar in 1339 (Tran dynasty) [DVSKTT, p.229, (vol.7, "9 b - 10 a" in the original block print)]. This record possibly means that the name of the calendar was changed, and does not necessarily mean that the method of calculation was changed.

The *Mingshi* (明史) tells that the *Datong* calendar of China was given to the Vietnamese king (Tran dynasty) in 1369, the next year of the establishment of the Ming dynasty [*Mingshi*, vol.321, "Annan", the 2nd year of Hongwu].

It may be that the *Datong* calendar was harmoniously accepted in Vietnam at that time.

#### 3) Thuan-thien calendar (順天曆)

The *Dai-Viet su-ky toan-thu* tells that the *Hiep-Ky* calendar was abolished, and the *Thuan-thien* calendar was adopted in 1401 (Ho (胡) dynasty) [DVSKTT, p.267, (vol.8, "39 a" in the original block print)].

The difference between these two calendars is not recorded.

#### 4) Acceptance of the Chinese *Datong* calendar

Vietnam was directly ruled by the Ming dynasty of China from 1413 to 1428,

and the *Datong* calendar must have been used. The Le (黎) dynasty was founded in 1428 in Vietnam, but there is no record that the calendar was changed.

The *Mingshi* tells that the *Datong* calendar was given to the Mac (莫), who ruled Vietnam for certain period, in 1540 [*Mingshi*, vol. 321, "Annan", the 19th year of Jiajing].

In 1829, Nguyen Huu-than (阮有慎) wrote in his *Y-trai toan-phap nhat-dac-luc* (意齋算法—得錄) that the *Datong* calendar had been used until the *Hiep-ky* calendar (協紀曆) (= *Shixian* calendar) was adopted in 1813 [See Zhang Yong's paper, op. cit., p.34.].

The record of the above mentioned Japanese drifters (1765~1767) also belongs to this period.

5) *Hiep-ky* calendar (= *Shixian* calendar)

According to Nguyen Huu-than, as we have seen above, the *Shixian* calendar of China was adopted in Vietnam as the *Hiep-ky* calendar in 1813 (Nguyen (阮) dynasty). This *Hiep-ky* calendar should not be confused with its previous namesake.

Zhang Yong compared Vietnamese chronological tables with Chinese calendar, and pointed out that the *Shixian* calendar was actually used in Vietnam from 1813 to 1840 [See his paper, op. cit.].

6) Consideration of the longitudinal difference

Zhang Yong pointed out that the Vietnamese *Hiep-ky* calendar differs from the Chinese *Shixian* calendar since 1841.

This must be due to the consideration of the longitudinal difference between Vietnam and China.

(3) Calendar reformation under Minh-menh

In order to reform the calendar, astronomical observations were made under Minh-manh (明命) (reign 1820~1840) of the Nguyen dynasty. There are some source materials about this reformation.

The *Dai-Nam hoi-dien su-le* (大南會典事例) (1855) is a comprehensive official record of the system of the government of the Nguyen dynasty. It has a section of the Kham-thien-giam (欽天監) (National astronomical observatory). According to this section, it was declared in 1837 that the prime meridian for Vietnam passed through its capital (Hue), whose latitude was determined to be 16°22'30", and longitude measured from the "Western prime meridian" to be 105° [*Dai-Nam hoi-dien su-le*, vol. 259, "13 a-b", block print "VHv 1570/42" of the Institute of Sino-Nom Studies, Hanoi].

The actual position of Hue is 16°27'N, and 107°33'E (from Greenwich). so, the above mentioned "Western prime meridian" must be Paris (2°20'E from Greenwich).

There is another interesting work entitled *Thien-van-khao* (天文考) (Study of astronomy) which is Vol. 1 of the *Su-hoc bi-khao* (史學備考) of Dang Van-phu (鄧文甫) [photocopy "VHc 02030" of manuscript "A 1490" of the Institute of Sino-Nom Studies, Hanoi]. (See Fig.3.)

This text records longitude and latitude (from Hue) of several places determined in 1837. According to this text, the longitude seems to be determined by the observation of lunar eclipses using local time. Actually, this text mentions the method to use the observation of solar eclipses also, but I suspect that it is scribal mistake. Chinese characters for solar and lunar are quite similar. The longitudinal difference cannot be obtained from simple comparison of observed local time of solar eclipses using local time, because its time itself differs at different places. On the contrary, the longitudinal difference can be obtained correctly from the observed local time of lunar eclipses, because its time itself is globally uniform.

From the above sources, we know that Vietnamese astronomers made efforts to make the calendar more suitable for Vietnam.

(4) Additional remark

Another interesting work is the *Quoc-trieu thien-van-chi* (國朝天文志) [photocopy "VHc 01610" of manuscript "VHv 370" of the Institute of Sino-Nom Studies, Hanoi]. This is a chronological compilation of the records of heavenly phenomena from 1569 to 1888. (See Fig.4.)

## 5. Conclusion

I have discussed only a few topics of the history of mathematics and astronomy in Vietnam. It is necessary to continue to study this subject, and compare Vietnamese source materials with other East Asian sources very carefully.

As most of the historical source materials of Vietnam are written in Classical Chinese, this subject will interest the participants of this conference.

## 第 一 部

### 安南ノ一算書ニツイテ

#### 三 上 義 夫

1　畏友松本信廣氏ハ昨昭和八年夏秋ノ頃ニ安南ヲ旅行シテ,其ノ地方ノ歷史文物ニ關スル調査ヲ試ミ,其ノ研究調査ノ旅行談ヲ去ル十二月二十日ニ東京帝大内ノ東洋史談話會デ試ミラレタガ,同氏ノ將來品中ニ一部ノ算書ガ有リ,之ヲ示サレタノデアツタ。私ガ安南ノ算書ヲ見タノハ,從來未ダ嘗テ無イノデアリ,誠ニ珍ラシク感ジタ。此ノ算書ニ就イテハ個別ニ委細ノ調査ヲ要スルケレド,ソレハ他日ニ讓リ,今ハ共ノ席上デ筆錄シテ歷イタ簡單ナ「ノート」ニ依ツテ唯々餘リノ珍ラシサヲ紹介シ,且ツ松本氏ガ此ノ種ノ舊物ヲモ持チ歸ツテ我々ニマデモ研究資料ヲ供給サレタ好意ヲ感謝シタイ。

2　此ノ安南ノ算書ハ指明算法ト云フ。言フマデモナク漢文デ撰ラレテヰル。初メニ目録ガアルガ,之ヲ見ルト,卷之一ニ算法綱領詩,九章算數法式等ガアリ,卷之二ニ開平方法等ガアリ,卷之三ニ盈脀齊歌等ガ有リ,之ハ會脀テ量ルノ歌ト訓ムベキデ,合廉ノ内容卽チ立積ニ關スルモノナドデアル。卷之四ニ八平分法詩等ガアル。卽チ差分ニ關スル。ソレカラ異乘同除等ガアリ,又盈不足詩法,兩盈兩不足詩法,盈適是不足適足詩法等ガアリ,比例ヤ復假定法ナドヲ説ク。更ニ一壘木高求路遠法ガアツテ,測量ニ關スルコトモ見エ,算題試文格式ダノガアル。
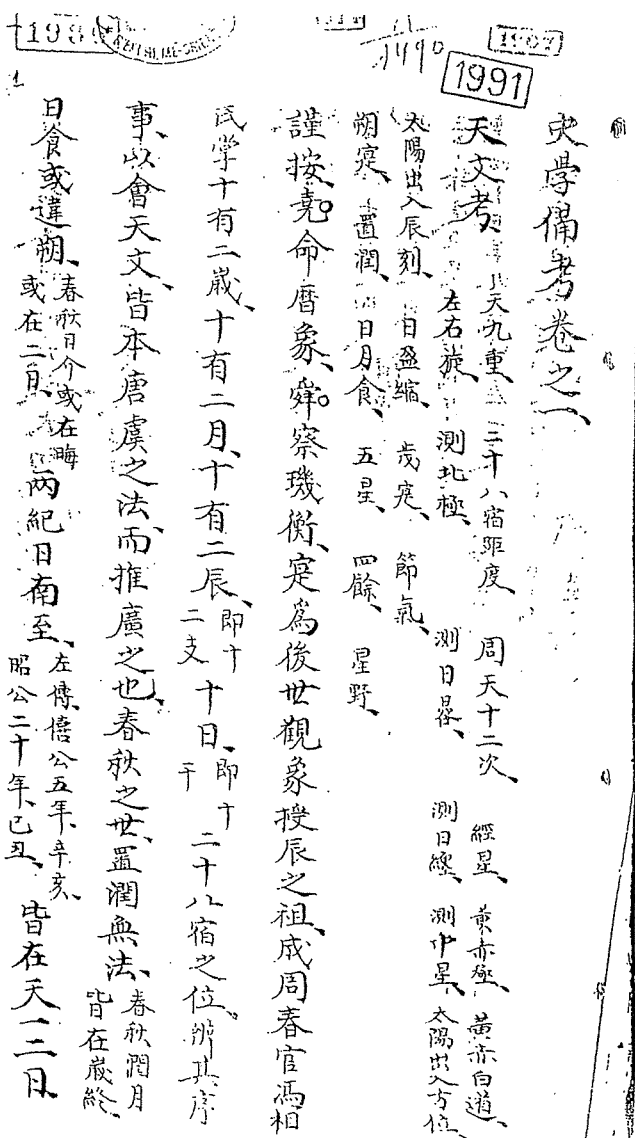
Fig.1　The first page of Mikami Yoshio's paper (1934)

## 越 曆 朔 閏 考

#### 章 用

越南史,自鴻厖氏迄今,計4817年.其信史,斷自趙佗以來,得2145年.其間内屬牽諸夏正朔之期,與夫自主帝制之時,修短相埒,各有其半.是故越南曆術與中國列朝天官所守,分合因革損益之跡,可得而論者蓋寡也,惜國内外東洋史家尚未涉及皇越曆陽署此止我1802年以來朔閏,太半據黄伯祿之所爲.以攻越史,難免宋人章甫之誚矣.余近訪河内遠東博古學院,取其安南志目A 2517題百中經者而閲之,則赫然1759年至1886年長曆具焉.

梁百中經,偶抄本,共十二紙,編次各有頁數誌於左上角,別有重出一頁,未編次合裝於卷首.第一頁首行:大越景奥二十年,歲次己卯,下註小字丙寅,則是年正月月建也,年建当用未筆勾出,大行記每月大小,下以小字記朔日日名,自正月至九月止,十八入第三行,歲終置閏,後記二十一年更辰,以此例他,每兩行第一年之朔閏,推遠新王改元,則紀年専居一行,如首行例,此外可

註1. 參考 Cadiere, Tableau chronologique des dynastie annamites, BEFEO t.v., 1905 越南歷朝世系,馮承鈞譯,收入史地叢考續編(1933);徐延旭,越南輯略.
2. 計自一109至543(603-988(1414-7;共990年內經.
3. 附歷代編年保大十年出版,葛逸樓葛遥亭同講校. (Concordance des calendriers lunaire & solaire de 1802 a 2010, par G. Cordier avec la collaboration de Le-Duc-Hoat, Imprimerie Chanphuong, Hanoi, 1935.)
4. 國立北平圖書館藏有副本.

Fig.2　The first page of Zhang Yong's paper (1940)

史學備考卷之一

天文考

太陽出入辰刻、朔朢、置閏、日月食、五星、節氣、星野

謹按堯命羲和欽察璣衡定爲後世觀象授辰之祖,成周春官馮相氏掌十有二歲,十有二月,十有二辰,即十日,即十二辰,即十二支,二十八宿之位,卽其序事以會天文,皆本唐虞之法而推廣之也,春秋之世置閏無法,皆在歲終,日食或違朔,或在二月,在晦,兩紀日南至,昭公二十年己丑,皆在天二月

Fig.3　The first page of the *Thien-van-khao*

天文志略編

太祖嘉裕皇帝之巳十二年,當黎英宗正十二年,十月地震,十一月星
隕長五丈,陸地聲如巨雷,黎上相鄭檢病,解兵權,
上如西京謁黎帝于安場,行在其明年鄭檢卒,鄭檜
上還自西都,杉營于茶鉢,社名屬,後二年康禄
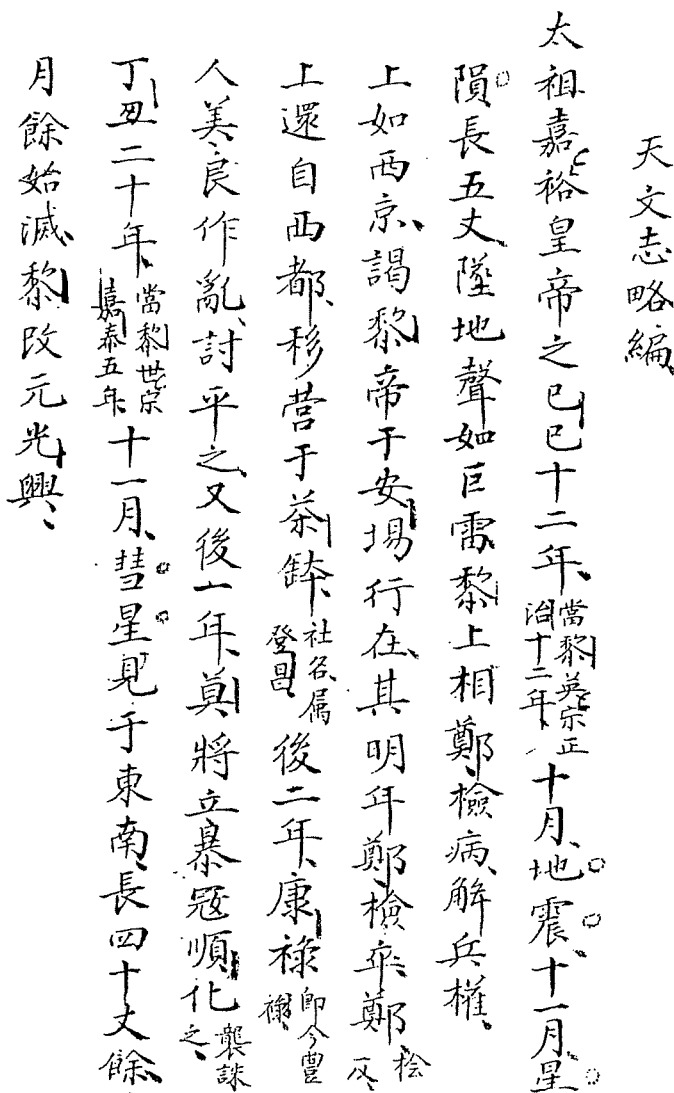人美良作亂,討平之,又後一年,眞將立暴冠,順化之
丁丑二十年,當黎世宗五年,十一月,彗星見于東南,長四丈餘
月餘始滅,黎政元光興、

Fig.4　The first page of the *Quoc-trieu thien-van-chi*