Strings of Long Months And Short Months in the Chinese Calendar

Zhang Jieping, Helmer Aslaksen

Department of Mathematics, National University of Singapore,
Singapore 117543.
Semester II, 2000/2001

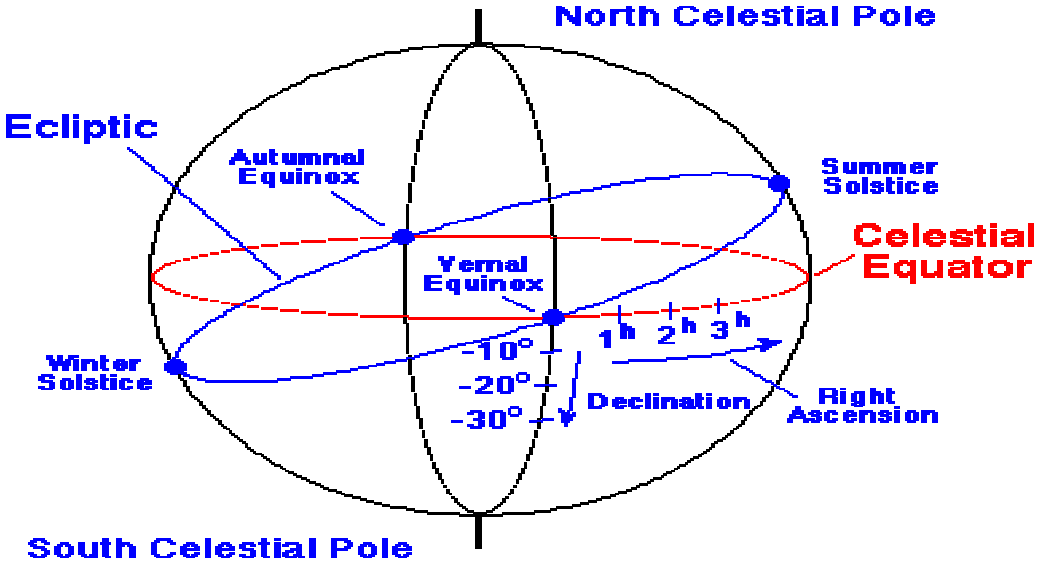
Abstract

1. Preface

The purpose of this project is to discuss the development of the Chinese calendar and the last reform of the calendar in 1645 during the Qing Dynasty (清朝, 1645-1911). The project also goes further to discuss the strings of three short months and four long months on basis of the calendrical views.

2. Introduction

1). Some useful information:



The terms --- the ecliptic plane, equinoxes and solstices can be referred to the figure above.
The aphelion/perihelion are points on the Earth's orbit where the separation between the Earth and the Sun is the largest/smallest.
The apogee/perigee are points on the Moon's orbit where the separation between the Moon and the Earth is the largest/smallest.

2). Classification of calendars

A \ B	1.Arithmetical	2.Astronomical
1.Solar	Gregorian	French Revolutionary
2.Lunisolar	Jewish	Chinese
3.Lunar	Civil Muslim	Religious Muslim

3. The development of the Chinese calendar

Theory/concept	When first introduced	When commonly accepted
Inconsistent motion of the moon	First discovered by JiaKui (贾逵？-92 A.D) in the Eastern Han period (东汉朝 25-200 A.D); first discussed in the Sifen calendar (后汉四分历 85 A.D) of the Eastern Han Dynasty (25-200A.D)	After the Qian Xiang calendar (乾象历 233 A.D) of the Three Kingdoms (三国时代 220-280 A.D)
Inconsistent motion of the sun	First discovered by Zhang Zixin (张子信 6th century A.D) during the North and South Dynasty (南北朝 386-589 A.D); first mentioned in the Huang ji calendar (皇极历 600 A.D) of the Sui Dynasty (隋朝 589-618 A.D)	After the Da Yan calendar (大衍历 729 A.D) of the Tang Dynasty (唐朝 618-907A.D)
Ping shuo	From the first Chinese calendars in the Shang Dynasty (商朝 1523-1027 B.C)	
Ding shuo	First proposed in the Yuan Jia calendar (元嘉历 445 A.D) of the North and South Dynasty (386-589A.D); first used in the Wu Yin calendar (戊寅历 619 A.D) of the Tang Dynasty (618-907A.D)	After the Lin De calendar (麟得历 665 A.D) of the Tang Dynasty (618-907 A.D)
Ping qi	Zhuan Xu calendar (174 B.C) of the Warring States (春秋战国时代 770-221 B.C)	
Ding qi	Huang Ji calendar (皇极历 600 A.D) of the Sui Dynasty (589-618 A.D)	After the Shi Xian calendar (时宪历) of the Qing Dynasty (清朝 1645-1911 A.D)

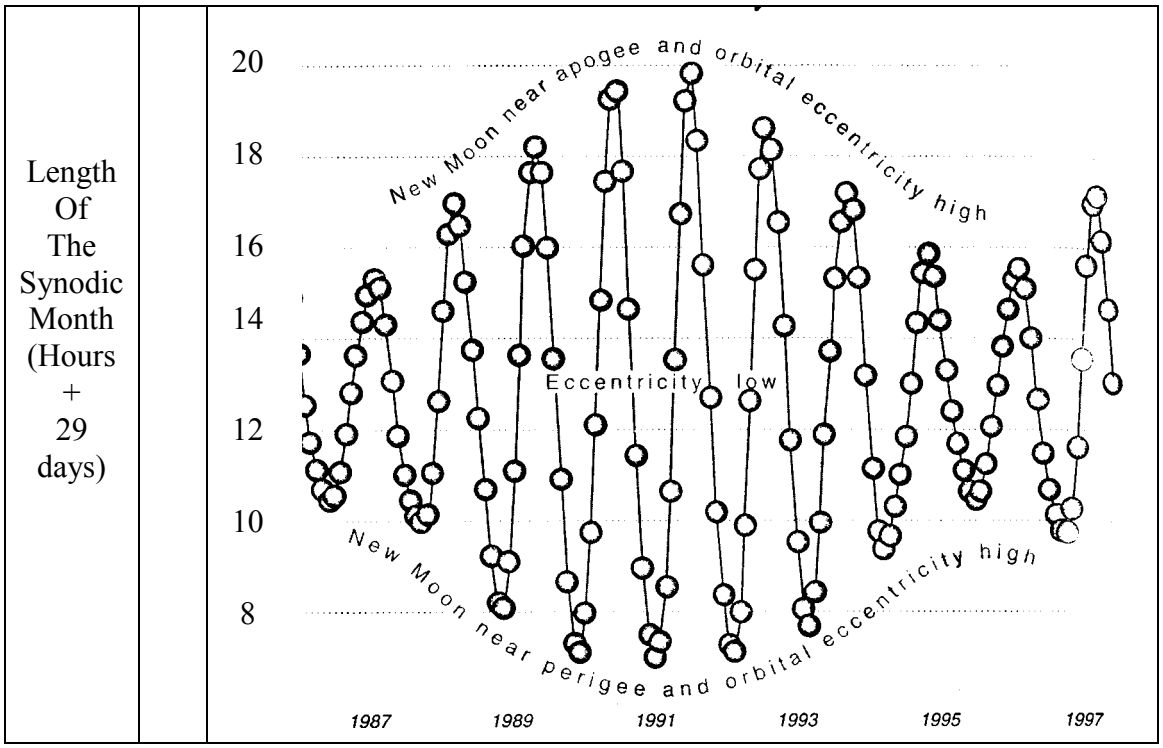
4. The Last Reform of the Chinese Calendar in the Qing Dynasty (清朝, 1645-1911)

In the reform of 1645, there were four main changes made by the Jesuit Adam Schall, Johann Adam S, von Bell:

1). Change "觜 (zui) before 参 (can)" to "参 before 觜";
2). Defining the day into 96 quarters, and one quarter is 15 minutes;
3). Adding of timings for sunrise and sunset, and the timetable for 24 Jie Qi (节气) with respect to all different provinces through China;

4). Chang Ping qi (平气) to Ding qi (定气).

5. Strings of 3 Short Months and 4 Long Months in the Chinese calendar:



If there is a good alignment of the axes of the Moon, the Earths' orbit and the line through Sun/Earth/Moon at the new Moon, it will be possible to have a sequence of three short months and four long months. However, to have 3 short months in a row also requires that the period between 4 consecutive new Moons must be less than 88 days and the time of the first new Moon should be a bit after the midnight. And to have 4 long months in a row requires that the length between 5 consecutive new Moons be greater than 119 days and the first new Moon should occur a bit before the midnight.

We propose that, to get strings of short months or long months, we need X synodic months, Y anomalistic months and Z years to be fairly close together, where X synodic months are also close to an integer number of days. Here X, Y and Z are integers. We name the periods as the resonance periods. Calendrically speaking, there are in total 8 different resonance periods, which are (1) 384 days; (2) 2126 days; (3) 2510 days; (4) 2894 days; (5) 3278 days; (6) 6644 days; (7) 16862 days; (8) 19756 days.

Further we find:

Periods	Days	Frequency of periods for strings of short months	Frequency of periods for strings of Long months
1	384	17 (most frequently)	
2	2126	1	
3	2510	5	

4	2894	7	9 (frequently for both strings)
5	3278	2	
6	6644	1	
7	16862		3
8	19756		2

(1). The eight periods are surprisingly related to each other.

For strings of short months:

$$2510 = 2126 + 384,$$
$$2894 = 2510 + 384 = 2126 + (2 * 384),$$
$$3278 = 2894 + 384 = 2126 + (3 * 384);$$

For strings of long months:

$$19756 = 16862 + 2894.$$

(2). The period of 2894 days happens frequently for strings of both short and long months.

(3). For the strings of both short months and long months, the shortest period happens the most frequently.

(4). The periods of 16862 days and 19756 days only happen for strings of long months.

(5). The periods of 384 days, 2126 days, 2510 days, 3278 days and 6644 days only happen for strings of short months.

(6). There are more strings of short months than strings of long months.

6. References:

[1] Helmer ASLAKSEN, The Mathematics of the Chinese Calendar, web page, "http://www.math.nus.edu.sg/aslaksen/calendar/chinese.shtml.

[2] "Calendars, Interpolation, gnomons and Armillary Spheres in the Work of Guo ShouJing" by Ng Say Tiong.

[3] http://csep10.phys.utk.edu/astr161/lect/history/kepler.html

[4] http://www.cvc.org/science/kepler.htm

[5] Astronomical Computing by Roger W. Sinnott ("How Long Is A Lunar Month") Sky & Telescope, November 1993

[6] "Scientific Dispute in the Inperial Court: The 1664 Calendar Case" by PingYi Chu, Chinese science, 14, 1997

[7] "清前期對觜、參兩宿先後次序的爭執—社會天文學史之一個案研究" by 黃一农

[8] "湯若望與清初西曆之正統化" by 黃一农

http://www.hss.nthu.edu.tw/~NHCS/huang.htm