

THE CHINESE CALENDARS

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Abstract. In this article we try to answer the question how and why did Chinese ancient astronomy come into being and how did one lonesome and original calendar system on the very end of the world develop. At the beginning, Chinese people distinguished time of the year by the annual cycles of plants and animals, but soon began to determine seasons by observing celestial bodies. Early successful measuring of tropical year and synodic month made possible for Chinese people to issue first calendars very early.

Spring and Autumn (Chunqiu) period (770 - 476 BC) brought forward first official calendars. Further improvement of calendars is due to the development of new astronomical instruments.

Chinese calendars also originate from the metaphysical concepts of Qi, Yin-Yang and 5 elements. 5 elements were connected with Chinese 5 seasons of the year and this was the first form of solar calendar. Later, it developed into solar calendar with 10 months.

In the next phase, Chinese calendar turned into lunisolar calendar which also has its evolution. Chinese people invented Calendar "with division by four" (the name of this calendar). They also added 24 solar terms to make calendar harmonize with natural cycles. Li Chunfeng rearranged intercalations and used month without main solar term and divided months into short and long months.

Sexagesimal system of time measuring refers to the system of Chinese 10 Heavenly Stems and 12 Earthly Branches. Its purpose is to measure time and define years, months, days and hours.

1. INTRODUCTION

This article contains a brief survey of principal calendrical rules, and of the history and significance of the Chinese calendars, as an example of general systems of organizing units of time for the purpose of reckoning time over extended periods.

At first, we must notify implicit convention: the day is the smallest calendrical unit (of time). The measurement and summarizing of fractions of a day are classified as timekeeping and time scales building. The generality of this definition is due to the diversity of methods that have been used in creating calendars and technology of timekeeping.

Although many of significant calendars replicate astronomical cycles according to recognizable eternal or cyclic rules, others are based on abstract, perpetually repeating

cycles of no astronomical significance. Many of them are regulated by astronomical observations and measurements either by carefully and redundantly enumerating the units or contain ambiguities and discontinuities.

To serve practical purposes, in compiling of calendars units of time were organized to satisfy the needs and requirements of the society. If calendars had astronomical base then they served as a link between mankind and the cosmos. It is not a wonder that calendars have held a sacred status and have served as a source of social order and cultural identity.

Like in other ancient cultures, Chinese calendars have provided the basis for planning agricultural, hunting and migration cycles, for divination and prognostication, and for maintaining cycles of religious and civil events. In the literature one can find usual misconception that the agriculturists have made first calendars. The truth is simpler: all mankind's heritage is produced by "social parasites": scientist, writers, artists, clerics, ... which we can find throughout history as interesting symbiosis with hard workers of any kind.

Whatever their scientific sophistication, calendars must ultimately be judged as social contracts, not as scientific treatises (Dogget 1992).

This article is limited to the principal calendars in the present and in the history of China. Furthermore, the emphasis of the text is on function, calculation and on cultural features. The fundamental bases of the calendars are given, along with brief historical summaries. Although algorithms are given for correlating different systems, close examination reveals that calendars are subject to local variation. Despite a vast literature on calendars, truly authoritative references are difficult to find. Some surveys of a broad variety of calendrical systems, stress their cultural contexts rather than their operational details.

2. HISTORY

Chinese astronomers recorded astronomical events since the 22nd century BC. Well-known writings, significant to the whole world by their detailed descriptions of celestial phenomena are: "Master Shi's Star Canon" (4th century BC), "Historical Records – The Book of Constellations" (2nd century BC) and "The Star Classic from Kaiyuan period" (8th century AD).

"The Book of History - Legendary Emperor Yao's Classic" quotes that 2200 years BC ancient Chinese people used sunrise accurately on the East and "Bird Star" Alphan first dusk occurrence on the southern meridian line to determine middle of Spring. When the Sun rose the highest in the sky and when at dusk Antares ("Big Igneous Star", or "Big Mars" as Chinese used to call it) conjuncted the southern meridian line it meant middle of Summer arrived. When the Sun descended exactly on the West, and Sadalsuud (Chinese "Star of Emptiness") was placed on the southern meridian line, it marked middle of Autumn, and, finally, when the Sun is on the lowest point and at dusk "7 Sisters Stars" (Pleiades) were located on the southern meridian line, this determined middle of Winter.

The origin of Chinese calendars isn't religion or mythology, but pure philosophy. The basic concepts are: **Qi energy**, **Yin** and **Yang** - whose changes and interactions cause the shifts of seasons during the year. There are 2 sorts of Qi: Yin Qi and Yang Qi. The earliest origin of Yin and Yang is connected with calendrics and annual season changes. According to the records like "The Book of Changes", Yin and Yang

entire history, Chinese astronomers altogether compiled more than 100 different calendars, including official and nonofficial calendars, among which, the most significant were:

- **Sifen** calendar (8th century BC), so called calendar "with division by four" considered the duration of tropical year to be 365.25 days; This was discovered by summing up of the Sun shadow length for the Winter solstice. Chinese astronomers measured this shadow continuously for few hundred years, and found out that if the first year the shadow at noon was the longest, the second year it was a little bit shorter, the third year even shorter, the fourth year it would be of the same length as the second year, and, finally, the fifth year it would be as long as the first year, i.e. the longest. After that, they summed up the number of the days from the first to the fifth Winter solstice, the acquired amount they divided by four and finally got the above mentioned result of 365.25 days per year;
- **Taichu** calendar (104 BC) – for the first time 24 solar terms were established in the calendar;
- **Linde** calendar (7th century AD) – new method of intercalations;
- **Shoushi** calendar (1280) – the best representative of ancient Chinese calendars. Guo Shoujing was chosen by Kublai Khan, the first emperor of the Yuan dynasty, to work out a new calendar for the whole empire. For this reason, Guo developed many new instruments and carried out numerous nationwide astronomical observations. He acknowledged that the tropical year duration was 365.2425 days, which is equal to the year duration in Gregorian calendar. The error between the duration of Shoushi tropical year and the revolution of the Earth around the Sun was only 26 seconds. The duration of the lunar month was fixed to be 29.530593 days. This calendar was used in China continuously for 360 years.

5. FEATURES OF CHINESE LUNISOLAR CALENDAR¹

Chinese lunisolar calendar combines tropical year and synodic month to measure time. As early as the 7th century BC, Chinese astronomers became the first in the world to intercalate 7 months into 19 years in order to reconcile differences between the lunar calendar and the solar one. In the 5th century AD intercalations were corrected into 221 leap month during 600 years. In the 7th century AD Chinese astronomers abandoned intercalations, so that the month without main solar term was further used as leap month. Contemporary Chinese lunisolar calendar developed to the higher stage. The year with 13 lunar months is called the leap year. The first month in the leap year without the main solar term is leap month. This type of intercalation successfully harmonized lunar and solar cycles of nature.

¹At this point we must notify that only for this type of calendars it is better to use a more precise term "solilunar".



Figure 2: Chinese 12 animal signs.

The main characteristics of the Chinese lunisolar calendar are:

- combinations of 10 Heavenly Stems and 12 Earthly Branches make sexagesimal system for measurements of hours, days, months and years. According to the archeological excavations from Yin dynasty (i.e. late Shang dynasty, 14 – 11 century BC) there are a plenty of characters representing Heavenly Stems and Earthly Branches , and their purpose was to mark date and time. This shows that Heavenly Stems and Earthly Branches were widely used in China as early as Shang dynasty. Heavenly Stems belong to solar calendric system while Earthly Branches belong to the lunar one;
- 24 solar terms precisely determine annual weather changes. Solar terms divide the Earth orbit around the Sun into 15° sections, which means that 24 sections altogether give 360° on the path. Since the Earth revolution velocity is not always the same, some solar terms last for 14 days, the other for almost 16 days. 24 solar terms represent solar calendars, and their combining with synodic month is the main characteristic of the Chinese lunisolar calendar;
- years got names over Chinese animal signs, i.e.: rat, ox, tiger, rabbit, dragon, snake, horse, goat, monkey, rooster, dog, and pig. Since common Chinese people couldn't remember the names of 12 Earthly Branches, they started to use 12 animal signs to substitute them. As early as Western Han dynasty (2nd century BC) people used 12 animal signs to record years, months, days and hours (Fig. 2).

6. EPILOGUE

Starting from the 3rd millenium BC until the 14th century AD Chinese calendrics developed following the path of Chinese astronomy, and at the same time, totally

independent from the calendrics of other nations and cultures. During Ming and Qing dynasties (14th – 19th century) astronomy ceased to develop in China. The main reason for stagnation could be inherited position at the Imperial Observatory, which caused ignorance and non-professionalism of the astronomers of this epoch. Until the beginning of Qing dynasty Chinese people continued to use Guo Shoujing's calendar. And then, about 1640, so called "New Western Calendar" was brought to China by Catholic missionaries. China officially accepted Gregorian calendar in 1949, nevertheless even nowadays old Chinese lunisolar calendar is still being used by Chinese people.

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