

## A NEW APPROACH TO TRADITIONAL CHINESE ASTRONOMY

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**ABSTRACT.** We have made a systematic investigation of the traditional Chinese stellar sky, using Yi-Shitong's precise stellar maps at the Amsterdam Zeiss Planetarium, reproducing the positions of pole, hour circles and equator for any epoch between 1000 and 3000 BC at the latitude of Xian.

The right ascensions of the 28 boundary hour circles of the traditional lunar lodges, as well as the declinations of the various determinative stars, give insight into the possible original meaning of star names and ages. The four cardinal directions along the celestial equator ( $\alpha$  Hya,  $\eta$  Tau,  $\beta$  Aqr and Sco) fit best with 2250 $\pm$ 50 years BC.

### 1. MAPPING THE CHINESE CONSTELLATIONS

Yi Shitong's catalogue and atlas with 22 star-maps (Yi 1981) have opened a new way to approach Chinese astronomy. The publication of the Yixiang Kaocheng Xubian in 1844 AD was the end of an old Chinese tradition of political astrology based on ever improving star-catalogues. The precision of the astronomical instruments in Beijing and Nanjing could no longer meet the international standards of positional astronomy of the 19th century.

Lack of good star-maps has been a reason for underestimation of origin and age of Chinese astronomy and cosmology. Catalogues and calendars are not the best way to get insight into big scale changes during millenia. People have to see maps on which the course of the equator can be demonstrated as a function of time, as well as the immense changes in the positions of the spring and autumn equinoxes. Also maps on which one can see the different positions of the celestial pole are necessary.

There have been attempts by Schlegel (1875) and afterwards by the Japanese astronomer Tsuchihasji (1911) to make such maps. In recent times Chen (1984) published accurate positional star maps in his Hengxing Tubiao (Chen 1937), a publication of the Nanjing Observatory. But none of them demonstrated at the same time the following:

1. all the visible stars, 1st to 6th magnitude,
2. precise positions in a system of Declination and Right Ascension,
3. a background network of the presentday internationally accepted Western constellations,
4. a complete set of Chinese constellations, named and numbered as in the ancient catalogues of China.

This task has been accomplished by Yi Shitong and co-workers between 1956 and 1978 (Yi 1981). Their Catalogue was published in 1981 and contains 3246 stars. It is based on two big catalogues published during the Qing dynasty:

- 1) Yixiang Kaocheng (1736-44 AD),
- 2) Yixiang Kaocheng Xubian (1844 AD).

During the reduction on the epoch of 1950 Yi Shitong met many difficulties. Although the Yixiang Kaocheng catalogue gives star positions in arc seconds, its reliability was sometimes not better than 12 arc minutes.

Originally Chinese astronomers measured right ascensions inside the 28 lunar lodges relative to the bordering hour circles. The missionaries introduced a division of the ecliptic in 12 equal sectors and determined longitudes inside these sectors. Yi Shitong introduced the modern astronomical system of right ascensions measured in hours, counting from the solar spring equinox of 1950 in the direction of the annual motion of the sun. These transformations of coordinate systems have of course not influenced the appearance of the sky, nor the accuracy of star positions. The reliability of the 18th century catalogues is in general quite satisfactory for bright stars down to the 4th magnitude. But positions of 5th and 6th magnitude stars sometimes deviate seriously from modern Western catalogues.

The calculation procedure was as follows:

- 1) The equatorial coordinates of each star were corrected for the precession of the vernal equinox on the 1950 epoch;
- 2) The new position was compared with corresponding star positions for 1950 from the

- a) General Catalogue for the Epoch 1950 by B. Boss (1937),
- b) Atlas Coeli Skalnat Pleso 1950 by A. Becvar (1958),
- c) Atlas of the Heavens-II Catalogue by A. Becvar (1964),

The corresponding star was chosen according to position, relative distances and magnitude.

3) In case there was no correspondence the calculated Chinese star position was put on the map as "Added Star", together with the most probable Western reference star.

4) The same projection method was used as in the 3rd edition of the Atlas Coeli Skalnat Pleso.

If more than one data source were used the reliability of the sources was taken into account.

The Yi Shitong Catalogue of 1981 can be obtained from the Ancient Observatory of Beijing, Jiang guomen, Beijing. A critical analysis of the discrepancies between the Yixiang Kaocheng and the General Catalogue of Boss is given. In four

special tables one can find the astronomical positions of about 350 faint stars presented on Yi Shitong's maps (1981) as Added Stars.

At the end of the 16th century the Jesuit missionary Matteo Ricci (Li Madau) came to Beijing and awoke some interest by his criticism of traditional Chinese astronomy (see J. Needham, 1981). In 1600 AD Xing Yunlu produced an excellent source for calendar studies, the Guin Luliko and in 1609 Wang Qi published the Sancai Tuhui with some crudely drawn star maps derived from Song sources.

The influence of the Jesuit missionaries has been enormous. In 1631 AD the Siu Guanggi catalogue appeared, edited by J.A. Schall von Bell (Tang Ruowang). It was the first big effort to rescue the contents of many documents which mostly had been forgotten. At Qintianjian, the Imperial Astronomical Office, in total about 50 missionaries have been working from 1583 till 1826 AD.

To translate and understand the names of stars and constellations is an etymological problem needing the help of specialists in the field. Some of them are working on this problem (Zhao Yuanren and Zhongsì Ximeng Toucao, 1917). We have done our utmost to translate the ancient names and symbols of Yi Shitong's maps, comparing with preceding translations (Schlegel 1875, Tsuchihashi et al, 1911, Needham 1959, Rufus and Hsing-chih Tien 1945, and De Saussure 1925) and books (Gao Lu, 1933 and Chen Zungue and Zong Guo, Tian Wen Xue Shi, 1984). The help of the Institute of History (Soc. Acad. Sin.) Beijing was appreciated. Our work will be published in the near future including 22 star-maps covering the whole sky.

## 2. CELESTIAL ARCHEOLOGY

Observations in the Amsterdam Zeiss Planetarium, adjusted to 35° N. Lat. (Xian) showed several interesting facts. We studied especially the position of the polar coordinate system between 3000 and 1000 BC, and compared the results with Yi Shitong's star-maps.

We want to mention first, that the determinative stars of the 28 lunar lodges fall apart in two groups. About half of them follow the celestial equator of about 2400 BC whereas the other half are related with the ecliptic. The equatorial group corresponds with the position of the full moon in autumn and winter (Yin-season), the ecliptical group with spring and summer (Yang-season);

Second, the eldest canonical books four cardinal directions in the sky are mentioned. They correspond with the equatorial determinative stars:

$\eta$ Tau, Mao, West	$\alpha$ Hya, Xing, Sough
$\pi$ Sco, Fang, East	$\alpha$ Aqr, Wei, North

These stars were exactly in those positions at sunset and at the spring equinox, in 2250±50 years BC; each of the four

cardinal directions is the center of an equatorial palace:

Palace of White Tiger;	about $\eta$ Tau	size 4h55m
Palace of Black Warrior;	about $\alpha$ Hya	size 7h27m
Palace of Green Dragon;	about $\pi$ Sco	size 4h45m
Palace of Scarlet Bird;	about $\alpha$ Aqr	size 6h53m

The ratio of solstitial to equinoxial palaces is 1.49. This can cosmographically be understood if the lunar lodge system originates from  $48^{\circ} \pm 2^{\circ}$  N.Lat. (Heilongjian, Mongolia, Kazakhstan of Kirgizia);

The Seasonal Tale of the Spinster ( $\alpha$  Lyr) and Cowboy ( $\alpha$  Aqr) marrying at the end of their field work corresponds with the position of the sun in the lunar lodge Niu (Cow)  $\beta$  Cap, next to the lodge Nu (Woman)  $\varepsilon$  Aqr, about 15th November, 3000-2800 BC;

The Chinese names for  $\delta$ ,  $\beta$ ,  $\gamma$ ,  $\delta$  and  $\varepsilon$  UMa suggest observation of solar or lunar positions about the solsticia, between 2000 and 1500 BC. The great circles through these stars were supposed to "regulate" the solar and lunar activities.

The names of  $\xi$  and  $\eta$  UMa are connected with Chinese New Year about

the middle of the 3rd mill. BC.

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#### LIST OF REFERENCES

- Allen, R. H. 1963, Star Names, Their Lore and Meaning, Dover Publications, New York 1963.
- Becvar, A. 1958, Atlas Coeli Skalnaté Pleso for the Epoch 1950, Sky Publ. Corp., Cambridge, Mass.
- Becvar, A. 1964, Atlas of the Heavens II, Sky Publ. Corp., Cambridge, Mass.
- Boss, B. 1937, General Catalogue of 33342 Stars for the Epoch 1950, Carnegie Institute, Washington.
- Chen, Z. 1937, Star Maps and Catalogue, Shang Wu, Shanghai.
- Chen, Z. 1984, History of Chinese Astronomy, Peoples Publishing House, Shanghai.
- De Saussure, L. 1925, Les Origines de l'astronomie chinoise, Maisonneuve Frs., Paris.
- Gao, L. 1933, Evolution of Chinese Astronomy, Nat.Res.Inst.Astr. Monograph No. 2.
- Kogler, J. et al., 1757, Annals of Qintianjian, Beijing.
- Needham, J. 1959, Science and Civilization in China, Univ. Press Cambridge, U.K.
- Rufus, W. C. and Tien, H. 1945, Soochow Astronomical Chart, Univ of Michigan, Ann Arbor.
- Schlegel, J. 1875, Uranographie Chinoise, Martinus Nijhoff-E.J.Brill, The Hague & Leyden.
- Tsuchihashi, I. et al. 1911, Ann. de l'Obs. Astr. de Zo-Se VII.
- Verbiest, F. et al. 1674, Annals of Qintianjian, Beijing.

- Yi, S. 1981, Atlas Comparing Chinese and Western Star Maps and Catalogues, Science Press, Beijing.
- Yixiang Kaocheng Catalogue, 1844, Qintianjian, Beijing.
- Zhao, Y. 1917, Study of Star Maps and Star Names, Science Magazine III, no. 3.

## Discussion:

**STEPHENSON** I have expressed concern at the early date for the origin of the lunar mansions derived by Nivison (1985) and others. This is a millennium before the earliest surviving Chinese texts.

**KISTEMAKER** I am not at all certain that the lunar lodges (boundaries), determinative stars are of Chinese origin. The strong analogies observed if looking at all the vedic naxatras, suggests that the Chinese and the Indian system have a common origin in the 3rd millennium BC and from a rather Northern latitude ( $45^{\circ}$  to  $50^{\circ}$ ). My guess is that the ancient cultures in North Iran (Kirgisia Kazakhotan) might be the origin. They invaded China as well as India and Europe.