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# Solar Eclipses in Ancient China

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# Solar Eclipses in Ancient China 日食

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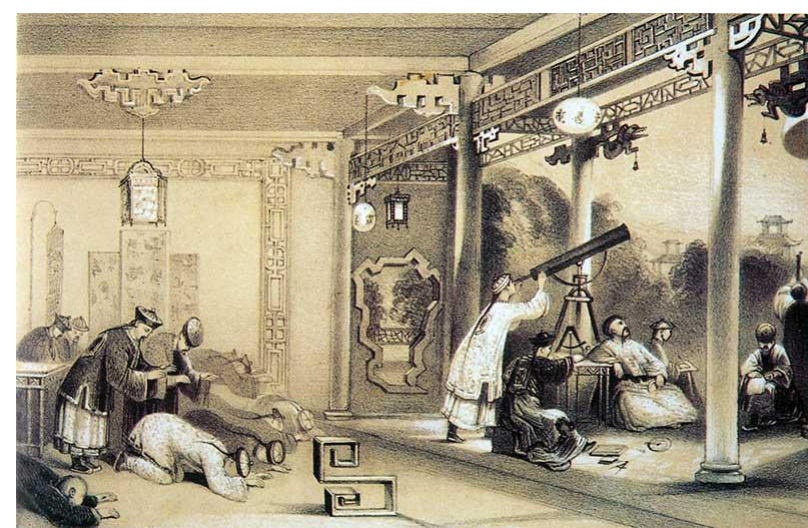
## The Shang Dynasty

Chinese astrology began in the Shang Dynasty. (1226 BCE to 1161 BCE) The Chinese culture believed that solar eclipses were caused by a mythical dragon devouring the sun.



It was also believed that eclipses in general told the future of the emperor. Due to this, predicting solar eclipses was deemed of the highest importance; so much so, that two astrologers were once beheaded because they failed to predict a solar eclipse.

Astrologers not wanting to be beheaded used many methods and tools in order to try and accurately predict solar eclipses.



## How Ancient Chinese Astrologers Predicted Solar Eclipses

Chinese astrologer Yi Xing; predicted solar eclipses by analyzing the moon's motion and position. For every revolution westwards of the celestial globe, the sun would revolve one degree eastwards and the moon would revolve 13 and 7/19 degrees eastwards as well. After 29 rotations of the celestial globe, the moon and sun would meet creating a solar eclipse. A celestial globe the celestial globe at that time was a huge globe, showing the 28 mansions, celestial equator and ecliptic.



Celestial Globe

Chinese astrologers also used the Metonic Cycle, which they called the Zhang cycle due to the dynasty in which it was discovered. The Metonic Cycle converts 19 solar years to 235 lunar months.

$$235 \text{ months} \times 29.53 = 6939.6884 \text{ hours}$$

$$19 \text{ years} \times 365.2422 \text{ days} = 69369.6018 \text{ hours}$$

This also helped Chinese astrologers predict solar eclipses because it helped them form the calendar that they used, and therefore were able to predict which day a solar eclipse would take place.



Chinese astrologers used the Chinese calendar, where the days begin and end at midnight. The months begin on the day with the dark (new) moon. The years begin with the dark moon near the midpoint between winter solstice and spring equinox. The solar terms are the important components of the Chinese calendar.

## The 28 Chinese Mansions Asterisms/ Day Names & their Associated 28 Mansion Animals

| 青龍 (Blue-green Dragon) |        |         |        |       |       |         | 玄武 (Dark Warrior or Black Tortoise) |     |       |       |         |      |       | 白虎 (White Tiger) |        |          |          |      |        |       | 朱雀 (Vermillion Bird) |       |         |       |        |       |        |
|------------------------|--------|---------|--------|-------|-------|---------|-------------------------------------|-----|-------|-------|---------|------|-------|------------------|--------|----------|----------|------|--------|-------|----------------------|-------|---------|-------|--------|-------|--------|
| 角                      | 亢      | 氏       | 房      | 心     | 尾     | 箕       | 斗                                   | 牛   | 女     | 虚     | 危       | 室    | 壁     | 奎                | 婁      | 胃        | 昂        | 畢    | 觜      | 參     | 井                    | 鬼     | 柳       | 星     | 張      | 翼     | 軫      |
| Horn                   | Neck   | Bottom  | House  | Heart | Tail  | Winnow  | Dipper                              | Ox  | Woman | Empty | Danger  | Room | Wall  | Stride           | Tether | Stomach  | Pleiades | End  | Beak   | Tree  | Well                 | Ghost | Willow  | Star  | Extend | Wing  | Sorrow |
| 1                      | 2      | 3       | 4      | 5     | 6     | 7       | 8                                   | 9   | 10    | 11    | 12      | 13   | 14    | 15               | 16     | 17       | 18       | 19   | 20     | 21    | 22                   | 23    | 24      | 25    | 26     | 27    | 28     |
| YIR                    | YIR    | LIB     | SCO    | SCO   | SCR   | SCR     | CAP                                 | AQR | AQR   | AQR   | PEB     | PEB  | AND   | PSC              | ARI    | ARI      | TAU      | TAU  | ORI    | ORI   | GEM                  | CNC   | NYA     | NYA   | NYA    | CRB   | CRY    |
| 蛟                      | 龍      | 貉       | 兔      | 狐     | 虎     | 豹       | 獬                                   | 牛   | 蝠     | 鼠     | 燕       | 猪    | 猿     | 狼                | 狗      | 雉        | 雞        | 鳥    | 猴      | 猿     | 犴                    | 羊     | 獐       | 馬     | 鹿      | 蛇     | 蚓      |
| Dragon                 | Dragon | Raccoon | Rabbit | Fox   | Tiger | Leopard | Hsiai-Chai                          | Ox  | Bat   | Rat   | Swallow | Pig  | Tapir | Wolf             | Dog    | Pheasant | Chicken  | Crow | Monkey | Ape   | Wild Dog             | Sheep | Roebuck | Horse | Stag   | Snake | Worm   |
| 5                      | 4      | 3       |        |       |       |         | 2                                   | 1   | 12    |       |         |      | 11    | 10               | 9      |          |          |      | 8      | 7     | 6                    |       |         |       |        |       |        |
| Dragon                 | Rabbit | Tiger   |        |       |       |         | Ox                                  | Rat | Pig   |       |         |      | Dog   | Chicken          | Monkey |          |          |      | Sheep  | Horse | Snake                |       |         |       |        |       |        |

Predictions of Eclipse Times in Chinese History

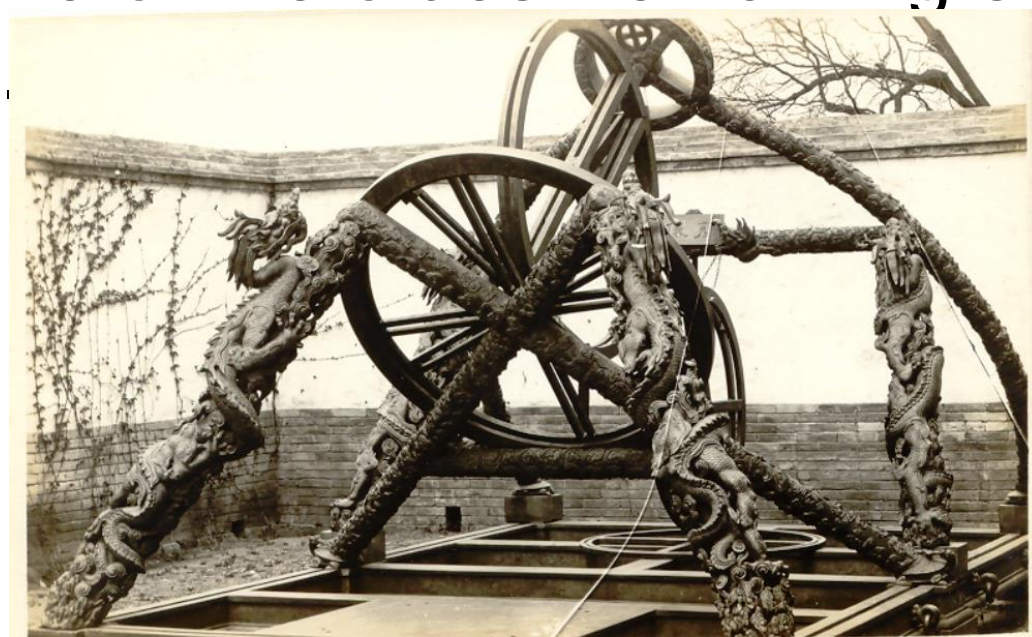
TABLE 1. Eclipse predictions recorded in the Sung-shu, the Sui-shu and the Sung-shih.

| Source    | Date        | Type  | Contact | Pred. LT (h) | Obs. LT (h) | Comp. LT (h) |
|-----------|-------------|-------|---------|--------------|-------------|--------------|
| Sung-shu  | 434 Sep 4   | Lunar | 1       | 6.00         | 1.61        | 0.32         |
|           | 437 Jan 8   | Lunar | 1       | 18.00        | -           | 17.83        |
|           | 437 Dec 28  | Lunar | 1       | 20.00        | 22.04       | 21.87        |
|           | 438 Jun 23  | Lunar | 1       | 20.00        | -           | 16.65        |
|           | 440 Oct 26  | Lunar | 1       | 23.00        | 20.70       | 20.66        |
| Sui-shu   | 585 Jan 21  | Lunar | M       | 18.00        | 19.50       | 20.36        |
|           | 585 Aug 1   | Solar | M       | 11.00        | 13.48       | 15.54        |
|           | 586 Jul 6   | Lunar | M       | 18.00        | -           | 21.63        |
|           | 586 Dec 16  | Solar | M       | 7.00         | 7.72        | 8.40         |
|           | 590 Apr 25  | Lunar | M       | 20.00        | -           | 19.59        |
|           | 590 Oct 19  | Lunar | M       | 2.00         | -           | 1.69         |
|           | 592 Aug 28  | Lunar | 1       | 20.00        | 20.06       | 21.71        |
|           | 594 Jul 23  | Solar | M       | 10.00        | 13.84       | 15.18        |
|           | 595 Dec 22  | Lunar | M       | 22.00        | 21.41       | 21.18        |
|           | 596 Dec 11  | Lunar | M       | 2.00         | -           | 22.71        |
| Sung-shih | 1168 Mar 26 | Lunar | 3       | 19.60        | 19.84       | 19.62        |
|           | 1168 Mar 26 | Lunar | 4       | 20.84        | 20.84       | 20.65        |
|           | 1185 Apr 18 | Lunar | M       | 21.69        | 23.61       | 22.85        |
|           | 1245 Jul 25 | Solar | M       | 13.84        | 14.98       | 16.50        |

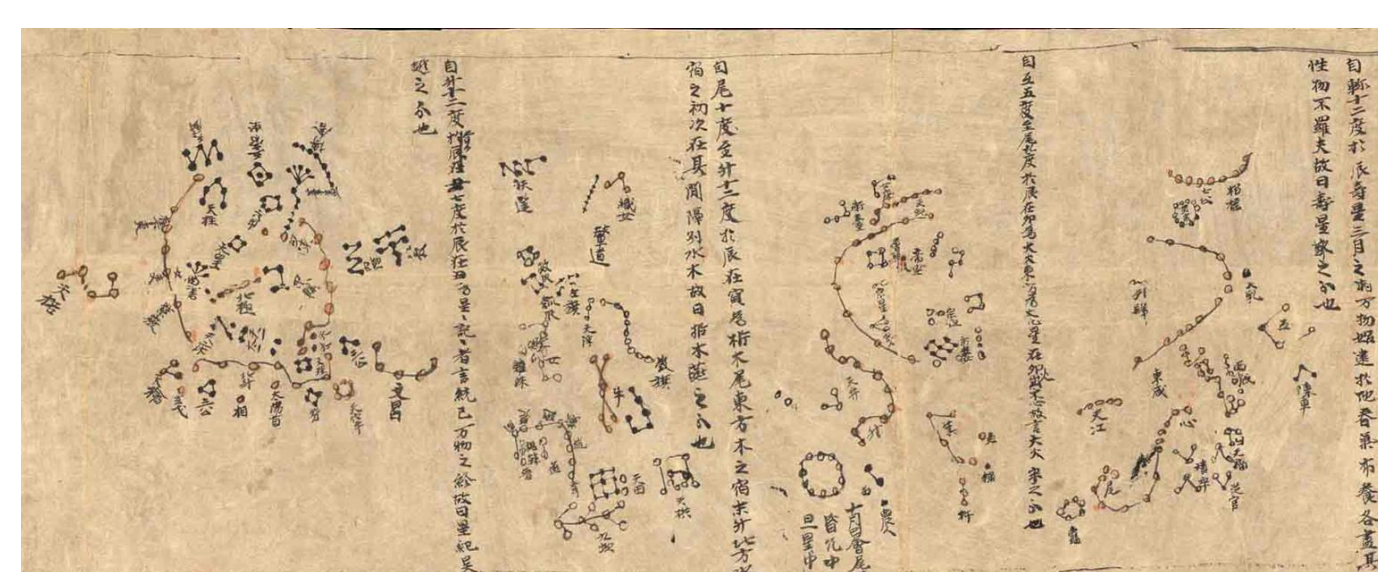
## Ancient Chinese Solar Eclipse Predictions

## Solar Eclipse Tools

Ancient Chinese astrologers used an array of different tools and methods to predict solar eclipses; including celestial globes, star maps, and armillary spheres. Astrologers would aim artificers at stars through a sight tube, and could be used to decipher them by looking at dials on its equatorial ring. The Dunhuang Star chart is one of the oldest remaining star maps in the world.



Abridged Armilla



The Dunhuang Star Chart

## Conclusion

- Chinese astrologers took a trial and error approach to finding solar eclipses
- There were many different methods in predicting eclipses.
- Chinese astrologers preferred a more tool oriented approach to predict eclipses, and accurately predicted ways to discover solar eclipses.

