Chapter 5: Ancient and Medieval Far East

Ancient and Medieval China by Shi Yun-li

Geologically, China occupies a large and central position in East Asia. It is one of the first places in the world where agricultural civilization originated, and it remained an agriculture-dominated culture until the end of the imperial period in 1912. For this reason, Chinese people became keen observers and worshippers of celestial phenomena from very early times. For them, these phenomena high above were mandates from Heaven 天, revealing sacred regulations and admonishments important not only for their agricultural economy but also for all social activities centred upon this economy. They called the regular motions and cycles of the celestial bodies Calendrical Phenomena 历象, and the general astronomical and meteorological sky, as well as any occurrences in this sky, Heavenly Patterns 天文. For Calendrical Phenomena they developed and continued to improve systems of Calendrical Method 历法 as a way to describe and predict the motions of the sun, the moon and the five major planets and thus to regulate economic, political and even daily activities in accordance with the rhythm of the heavens. In the meantime, vigilant eyes were kept on Heavenly Patterns in order promptly to discover any omens and portents meaningful to the rulers. This gave rise to the two core branches of traditional Chinese studies of Heaven which, in modern terms, can be portrayed roughly as calendrical astronomy and astrology.

These two branches of heavenly studies helped give rise to two central concepts of traditional Chinese philosophy, the Uniformity of Heaven and Man 天人合一 and the Sympathy between Heaven and Man 天人感应, which support the idea that Man and Heaven are made of and connected with the qi 气, a kind of ether or pneuma, and therefore influence each other. The ancient Chinese created a sophisticated system of rituals founded on these concepts, which constituted the ideological cornerstone of their politics and administration. The system consisted of a series of activities and ceremonies carried out by various official institutions devoted to calendrical astronomy, sky-watching, astrology and celestial worship. It continued uninterrupted for thousands of years from the origin of Chinese civilization, leaving behind an abundant succession of cultural heritage, including a number of heritage sites. These attest to the long and continuous evolution of an extraordinary tradition of cultural astronomy.

Documentary evidence for the existence of this ritual system and its institutional basis can be traced back to the first Chinese dynasty Xia 夏, from the 23rd to the 17th century BC, as recorded in The Book of Documents, or Shujing 书经. This is a Confucian classic believed to have been composed between 550 and 200 BC but which incorporated materials from very early times. The first article, “The Canon of Yao”, contains a lengthy description of how Yao, an ancestral king of the Xia dynasty, ordered the brothers Xi 羲 and He 和 “reverently to conform themselves to august heaven, to calculate and plot the sun, the moon, the stars and the celestial houses, and respectfully to submit a calendar for humankind”. The brothers Xi and He then went in four directions and used four constellations as indicators of the approach of the equinoxes and solstices. The Small Calendar of the Xia, or Xia xiaozheng 夏小正, now preserved in the Confucian classics, is believed to be a calendar of the Xia dynasty. The book not only describes the celestial and biological-meteorological phenomena that indicate each month, but also the agricultural and social activities that should be carried out in each month.
Archaeological discoveries have confirmed the special role of astronomy in the early history of Chinese civilization. In 1988, a tomb dating to 4000 BC was excavated in Puyang County, Henan province. Its occupant was surrounded by a group of figures made up of clam shells: a dragon to the east, a tiger to the west, and a ladle to the north. Archaeologists believe that this configuration is a representation of the Chinese sky developed between 770 BC and 221 BC: the ladle represents Ursa Major, a major constellation in the circum-polar region; the dragon is the eastern asterism Blue Dragon; and the tiger the western asterism White Tiger.

During the 1970s, archaeologists excavating at Juxian, a late Neolithic site (Dawenkou Culture) in Shandong province dating from 4040 to 2240 BC, unearthed some pottery decorated with a special symbol. Since then, pottery with the same symbol has also been found at contemporary sites nearby, as well as the Yuchisi site in northern Anhui province. Archaeologists differ in their interpretations of the symbol’s exact meaning, but its connection with celestial phenomena is undisputed.

In 2003, archaeologists excavated a sacrificial area at Taosi (see Case Study 5.1), a site in the southern central part of Shanxi province, which is now known to be a large city of about 3.0 km² surrounded by a long wall, dating to between 2300 and 1900 BC. A terrace with three concentric semi-circular levels built from rammed earth, which forms the main part of the sacrificial area, seems to have been an altar. On the rims of the innermost two terraces are 13 small, rammed earth blocks (one rectangular and twelve square) which archaeologists believe
to be the foundations of 13 pillars. When viewed from an observing point close to the centre of the altar, the 12 gaps between the pillars created a set of special alignments with the skyline, which is formed by a chain of distant mountains. Calculations and experimental observations indicate that 4000 years ago the sun would have risen in the northernmost slot at the June solstice, and in the slot next to the southernmost at the December solstice. This means that the altar could also have functioned as an observatory.

During the second Chinese dynasty Shang (商), between the 18th and 12th centuries BC, astronomical rituals became more sophisticated. Oracle-bone inscriptions that have been discovered since the end of the 19th century contain valuable information in the form of calendar tables and records of celestial phenomena such as eclipses and the names of stars. The calendar was now based more upon mathematical rules than upon direct observations as had been the case in the Xia dynasty. Instruments such as gnomons and clepsydrae are believed to have been widely used for observations and time-keeping.

From at least the time of the Zhou dynasty (mid 11th century to 256 BC), astronomical rituals became wholly controlled by the central government. The emperors named themselves the Son of Heaven, or tianzi (天子), and the rituals became a symbol of their authority. This meant that only the emperor had the right to maintain the institutions responsible for astronomical rituals, and in particular the Platform for Heavenly Communication, or lingtai (灵台), an observatory for sky-gazing. According to the political geography of the time, the territories of the emperor formed the whole world under heaven, or tianxia (天下), and the capital, the seat for the Son of Heaven, including his Platform for Heavenly Communication, had to be built in the centre of this world. In consequence, the initial task for ‘political astronomy’ was to determine where the centre was. In Dengfeng County, Henan province, is a site called Duke Zhou’s Terrace for Gnomon Measurement, or Zhouggon ceyingtai (周公测影台). Historical records assert that this was centre of the world as determined from gnomon observations by Duke Zhou, a founding duke of the Zhou dynasty. For this reason, the site became a sacred place and remained so throughout the later history of Chinese astronomy. A monumental stele was erected here in AD 723 by an astronomical official of the Tang dynasty (AD 618–970) (See Case Study 5.2).

The institutional control of astronomical rituals established during the Zhou dynasty became the norm during all the later Chinese dynasties. Each of them maintained a similar system centred on an official observatory, although this was not always located at the place considered to be the ‘centre of the world’. The remains of one of these later observatories are located in Luoyang (洛阳), Henan province, the capital city of the Eastern Han dynasty (AD 25–220). The Dengfeng observatory was built in about AD 56 and functioned for over 250 years. The site, which was excavated in 1974–75, covers an area of some 44,000 m² surrounding a square terrace of compacted earth. The base of the remaining part of the terrace measures about 41m from south to north, 31m from east to west, and 8m in height. The terrace had two levels, with buildings on the upper level. The remaining walls reveal that the rooms in the east, west, south and north were painted in blue, white, red and black respectively, corresponding to the colours assigned to the four directions in ancient Chinese cosmology.

Fig. 5.0.3. The remains of the observatory in Luoyang. © Authorised for non-profitable use
The Luoyang observatory is famous for Zhang Heng 张衡 (AD 78–139), one of the greatest astronomers in ancient China who was the Head Grand Historian, i.e. the chief astronomer, from AD 115 to 120 and again from AD 126 to 133. During these periods, he invented the world’s first seismograph and constructed a new type of large armillary sphere driven and controlled by water, which is the first astronomical clock in China.

From at least the Spring and Autumn period (722–481 BC) onwards, the precision of the system of calendrical astronomy was considered a key factor in ensuring the peace and prosperity of the country. Maintaining a precise calendar became a measure of the power, capacity and legitimacy of a monarch. Given this motivation, calendrical astronomy became a leading science in every dynasty and continued to be expanded and improved, finally reaching its apex in the Yuan dynasty (1271–1368). In 1276, the Yuan government launched a large-scale project of calendar reform and entrusted it to a group of astronomers and mathematicians including Guo Shoujing 郭守敬 (1231–1316). Charged with the responsibility of making observations, Guo Shoujing invented a number of ingenious instruments, such as the famous ‘simplified instrument’, the high gnomon and the shadow definer, and obtained the most accurate values for the basic astronomical constants of all the traditional Chinese astronomers. Nonetheless, the most important observational work carried out by Guo Shoujing was undoubtedly a nationwide programme of observation at different latitudes. For this purpose, he built 26 observational stations across the country in addition to a spectacular observatory in the capital Dadu (大都), which is now Beijing. On the old site of Duke Zhou’s Terrace for Gnomon Measurement in Dengfeng, he built a large observatory, which still stands intact and has become a permanent monument to traditional Chinese astronomy (see Case Study 5.2).

With the fall of the Yuan dynasty in 1368, some of Guo Shoujing’s instruments in Beijing were transported all the way south to Nanjing by the Yangtze River, the capital of the newly established Ming Dynasty, where a new observatory was built on top of the Purple Mountains, or Zijin shan (紫金山). The Ming government also constructed two sets of new armillary spheres to equip the observatory. All these instruments were still on the site in 1598, but they mysteriously disappeared after the fall of the Ming dynasty in 1644.

In 1406 the Ming government moved its capital to Beijing, and in 1442 a new observatory was built near the site of the old Yuan observatory, which gave birth to the present Beijing Ancient Observatory. In 1438, a ‘simplified instrument’, an armillary sphere and a high gnomon were constructed according to the designs of the same instruments on top of the Purple Mountains. They had been in use for nearly 130 years when, in 1669, the Flemish Jesuit Ferdinand Verbiest (1623–1688) re-equipped the observatory with six new instruments based on Tycho Brahe’s designs. The old Ming instruments were moved from the top of the observatory and finally transported in 1933 to the Purple Mountains, where they still remain today.

From 1583 onwards, European astronomy and instruments were systematically introduced into China by generations of Jesuit missionaries like Verbiest. However, while traditional Chinese techniques were superseded, the entire system of Chinese astronomical rituals remained unchanged. Given this historical context, the Old Observatory in Beijing—itself a hybrid of Chinese and European astronomical culture (see Case Study 5.3)—serves as an example of how European techniques were used in the service of Chinese ideology in the Qing dynasty (1644–1912), the last imperial dynasty in China.

Since the establishment of the People’s Republic of China, the central government has paid great attention to the preservation of cultural relics and heritage, including astronomical heritage. The Old Observatories in Dengfeng and Beijing have both been developed into museums. In 1986, a new museum was built in Puyang city to house the Tiger and Dragon Tomb in Puyang. While the Chinese economy has been booming in recent years, the government has launched a series of projects for the preservation and effective presentation of both material and intangible heritage. One of these projects is the ‘Compass Plan for the Exploration and Exhibition of the Value of Ancient Chinese Inventions and Creations’, launched in 2008 through the National Bureau for Cultural Relics. Its objective is to incorporate the most important cultural heritage in science, technology and engineering into museum exhibitions.
At the same time, local governments have begun to increase their investment in promoting the development of culture- and heritage-related facilities in their regions. In this context, the preservation of astronomical heritage has received renewed emphasis.

**Japan and Korea by Clive Ruggles**

For over a millennium and a half, Japanese culture has continually absorbed influences from mainland Asia and yet retained a distinct identity. Even the Japanese language, when it was first written down in the middle of the first millennium AD, used kanji characters imported from the Chinese.
From the fourth century until the end of World War II, the principles of Shinto religion forged unbreakable links between cosmology, political structure, and the sun. Successive emperors traced their ancestry directly back to the Sun Goddess, helping to forge a national identity linked with the sun that is still evident in the national flag. Shinto persisted despite the strong influence of Buddhist traditions from China that have coexisted in this island nation from the 6th century onwards. This coexistence involved some remarkable compromises, for instance, in locating and aligning temples and palaces. In the Shinto tradition this would be done with respect to places of spiritual power in the landscape, whereas in the Chinese tradition they would typically be aligned cardinally, reflecting the principle that spiritual and imperial power derived from the north celestial pole as the pivot of the heavens, and ensuring that the emperor would be approached, like the celestial pole itself, from the south. The plan of ancient Kyoto, for example, built in 794, with its palace complex approached from due south, reflected such principles every bit as faithfully as Beijing itself.

Aside from institutionalized astronomy, elements of star lore and folk calendars have been transmitted through countless generations of ordinary people, and some have persisted in rural areas despite the introduction of the Gregorian calendar. For example, the changing patterns of appearance of the Pleiades (Subaru), Hyades, and Orion’s belt provided a succession of seasonal rules of thumb for farmers. One of these was that when Subaru—which resembled a collection of rice seedlings—set progressively earlier in the evening sky in the spring, this indicated the time for planting the actual rice seeds in the ground.

Archaeoastronomy is in its infancy in Japan. The Asuka plain, to the east of Osaka, contains several tombs (kofun) of high-status individuals that were erected in the 7th and early 8th centuries. Two of them, only about 1km apart—Takamatsu Zuka Kofun, excavated in 1972, and Kitora Kofun, probed in 1998 using a miniature camera—contain paintings with strong astronomical associations. The ceilings depict the 28 lunar ‘mansions’ (known in Japan as shuku) and other constellations, while the walls show the animal gods associated with each of the cardinal directions. The two tombs demonstrate clear but nonetheless different Chinese and Korean influences. The region also contains a number of granite megaliths carved in the shape of human figures. These are of uncertain origin, date, and purpose, and while some have attracted archaeoastronomical interest, they are far more speculative.

The development of astronomy in Korea was also heavily influenced by China. For two thousand years, astronomical (and also meteorological) events were seen as portents with strong political implications.

Korean history is divided into three major dynastic periods: the Three Kingdoms period (56 BC–AD 916), the Koryo dynasty (early 10th century – late 14th century), and the Choson dynasty (1392–1910). Historical records of astronomical observations go back to the early Three Kingdoms period. A remarkable 67 records of solar eclipses exist from this first period, stretching over nine centuries. There are also records of comets, lunar occultations of planets, and other unusual events. The 12th-century Samguk sagi (Chronicles of the Three Kingdoms), documents hundreds of observations.

The best known astronomical structure from the Three Kingdoms period is the Cheomseongdae observatory at Gyeongju (see Case Study 5.4). In fact, the word cheomseongdae means ‘star-gazing tower’ and Korean historical records mention at least three cheomseongdae, of which another survives in good condition in the outskirts of Gaeseong, North Korea.

The first Korean calendars were probably introduced from China early in the Three Kingdoms period, and Korea started to influence Japan in its turn during the 6th and 7th centuries, as Japanese sources attest.

Extensive records of observations also exist from later periods, and it is clear that continual exchanges with China had a very significant and positive effect on the subsequent development of Korean astronomy—and in particular observation methods, the production of star maps, improvements in calendar systems, and the construction of ever better instruments.
Case Study 5.1: Taosi Observatory, China

Xu Fengxian and He Nu

Presentation and analysis of the site

Geographical position: Xiangfen County, Shanxi province, China

Location: Latitude 35° 52′ 55.9″ N, longitude 111° 29′ 54.9″ E. Elevation 573m above mean sea level.

General description: Taosi ancient observatory forms part of the Taosi archaeological site, one of the most famous of the eighty or so Longshan Culture (c. 3000–2000 BC) sites in north