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Cosmological interpretation of architecture: cases from Ancient China and Mesoamerica

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5 Calendar, Religion, Architecture

Observing the sky was one of the most important ways for ancient people to understand the laws of the universe. No surprise, this was also the case in ancient China and Mesoamerica. These cultures focused on the most noticeable celestial bodies, and especially on observing the regularities of the movement of the Sun, the Moon, and other bright stars or planets. As a result, they developed their powerful astronomical systems, which, in turn, were the basis of their calendars.

The calendars of ancient China and Mesoamerica have interesting similarities in their structure and function. The calendars made it possible to keep track of the seasons and astronomical phenomena, to register historical events, to determine the adequate time for religious rituals, to make divinatory predictions, to plan social interactions and economic activities, etc. For both cultures, the calendar was intimately intertwined with religious ideas, reflected their concepts of the universe, and played an important role in their respective social systems and ideologies (Šprajc 2009:87-59).

This chapter will focus on the question of how architecture in both civilizations was related to the calendar. Therefore we will first focus on the structure and symbolic character of the calendar in each of the two civilizations and examine their implications for rituals and consequently for architecture related to these rituals. This section, therefore, corresponds to the third aspect of *Lindsay Jones'* interpretive scheme: *Architecture as Ritual Context*, which focuses on the presentation of ritual-architectural events (Jones 1995:211). Architecture often provides the background or decor for performing rituals; as such it is an intimate element and an important agent in the ritual event. Given this function, sacred architecture is often given formal aspects and decorative elements that are conducive to religious contemplation and supportive in concentrating and leading the mind and emotions of participants towards the canonical messages expressed in the ritual (cf. Rappaport 1999).

5.1 Calendar Creation: Based on Astronomical Observations

An essential function of the calendar is to calculate the progress of time and determine time intervals in accordance with the observation of astronomical patterns, which is used to determine the sequence of seasons, to predict the weather (crucial for agricultural societies) and, consequently, to organize social activities and rituals. At the same time, the calendar may be used for historical registers and divinatory purposes. Different cultures have their own sky maps with specific ideas about celestial bodies. For the creation of the calendar, in general, the Sun, the Moon, and Venus play a major role, as well as other celestial bodies that can be easily observed (e.g. the Polar Star, Big Dipper, etc.). The methods of creating calendars are diverse, however, the most common ways are to observe the celestial movements from a fixed site in their relation to specific points on the horizon or markers in the landscape (hilltops, rocks, houses, temples) or by placing a monument or a pole to survey its shadows.

5.1.1 Pole, Shadow, and the Chinese Calendar

Observing pole shadows to determine the time and distinguish directions has a very long history in ancient China. Evidence can be found in many historical books such as *Zhou Bi Suan Jing* (周髀算经) and *Zhou Li* (周礼). Through this method, people can not only know the hours of the day, but also accurately judge the nodes of equinoxes and solstices of the year, and all the directions, East, West, South, and North.

The instrument (竿) that was used in ancient China to distinguish time and directions, has many names in different documents such as pole (杆), pillar (柱), wood (木), *Biao* (表), *Gui* (圭), *Nie* (桲), and *Nie* (臬). The pole stands on the ground, its shadow changes with the movement of the sun, hence, the time can be judged by its shadow. The seasons and directions can be distinguished by observing the length of the shadows at noon and the locations of the sunrises.

The chapter *Chun Guan* (春官) of *Zhou Li* pointed out that “the pole shadow can know the four seasons and the movement of the Sun and the Moon”¹; both *Dong Guan* (冬官) of *Zhou Li* and *Zhou Bi Suan Jing* recorded a method to find the directions by the shadows of a pole: draw a circle with the pole as the centre and record the nodes where the shadow meets the circle at the moments of the sunrise and sunset. Connecting the two nodes, the straight-line drawn points to the East-West direction, while the connection between the midpoint of the line and the pole is the North-South direction.²(Figure 5-1)

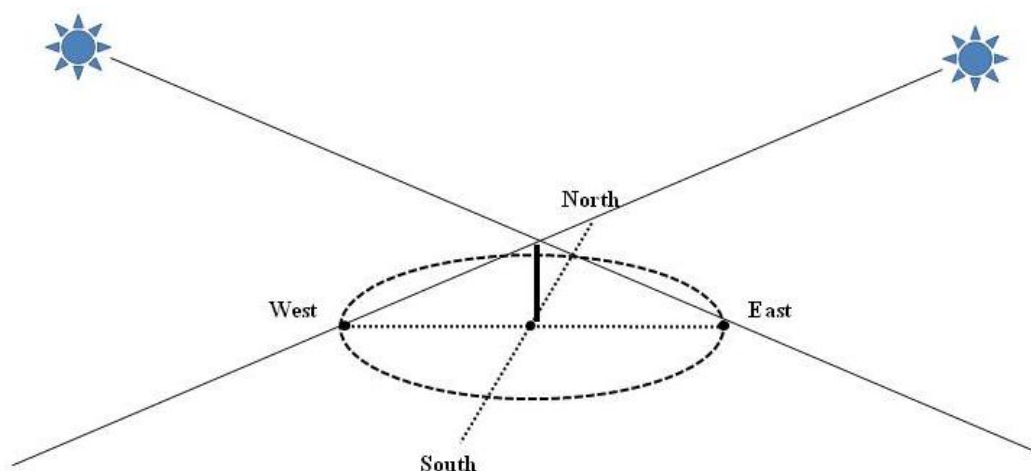


Figure 5-1 Schematic diagram of direction determination (drawing by author)

In terms of measuring time, the period of time from the shortest measured shadow to the longest shadow, and then back to the shortest shadow can be considered as a solar year. The months, seasons, and *Solar Terms* can be read from the perspective of the shadow of the pole, which is the basis for the creation of Chinese ancient calendars.

¹ *Zhou Li Chun Guan*: “Pole tell the time and Sun and Moon (土圭致四时日月)”.

² Refer to *Zhou Li-Dong Guan-Kao Gong Ji* and *Zhou Bi Suan Jing* (周髀算经).

Zhou Bi Suan Jing (周髀算经) is the oldest book on astronomy and mathematics in China. There has been controversy over the time of completion of the *Zhou Bi Suan Jing*. Generally it is considered that its main text was completed in the early *Western Zhou Dynasty*, about the 11th century BC. The mathematics theory and the universe model were completed in the 4th and 5th centuries BC. Later, some of its contents were revised, but this should not be later than 100 BC.

The pole shadow calendar in ancient China has a long history and was widely used. The sundial, a timekeeping instrument based on its principle, has also been widely used in many ways; the compass, another instrument used for determining the directions and time, is also created on the basis of this theory. Besides this method, the ancient Chinese also discovered the laws of the universe by observing other celestial bodies such as the Big Dipper, the Moon, and Venus.

5.1.2 Observatory, Alignments, and Mesoamerican Calendar

Mesoamerican astronomer-priests used natural places or buildings as points of observation (“observatories”), looking at the effects of light and shadow, and to scan the horizon to discover patterns in the complex motions of the Sun, the Moon, and stars, which they recorded and calculated in their books (codices). On the basis of such observations, Mesoamericans developed their calendar to keep track of the passage of time. In accordance with their religious worldview, the calendar structure reproduced the symbolic numerology of the cosmos, particularly highlighting the cosmologically relevant numbers 4, 9, 13, and 20.

Among the methods of observation, the connection of observatory uses and qualities with landscape features (caves, rocks) as well as with ceremonial architecture, was commonly used in city planning. In archaeological sites, multiple examples can be found of ceremonial buildings that were precisely aligned to the four directions or to places at the horizon where the sun rises on significant days (such as solstices, equinoxes, zenith passages). On such days, for example, Sun rays might be cast through a small hole, lighting up the interior walls of a tomb, cave or building.³

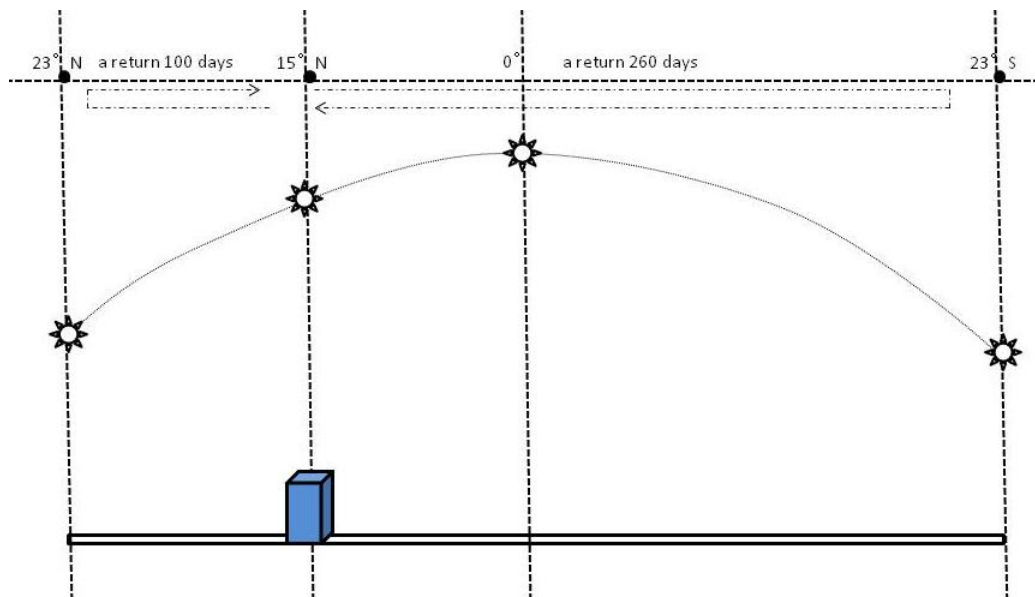


Figure 5-2 Schematic diagram of direction determination (drawing by author)

In the severely limited corpus of surviving codices, we find clear evidence of prolonged astronomical observations in the Maya codices (Dresden, Madrid, Paris, Grolier), including tables of the heliacal risings of Venus and of solar eclipses.

³ Such as some caves or tombs have a tube-like opening to get the zenith sun rays.

A characteristic of the Mesoamerican calendar that immediately calls the attention is the fact that the basic cycle consists of 260 days. It has been speculated that this 260-day unit originated near a latitude of 15°N, where there is a 260-day interval between transits of the zenithal Sun (Malmström 1973) (Figure 5-2). In-depth analysis of the calendar, however, suggests that the origin of this time unit must be sought in symbolic considerations: the combination of the number 13, associated with heaven and completion, with the number 20, the basic element in the vigesimal counting system, based on 20 as the total of fingers and toes in a human being (see below).

Regardless of the methods used to create the calendars, it is undeniable that ancient China and Mesoamerica created fascinating and world-renowned intellectual systems to capture time, which are worthy of their peoples' pride.

5.2 Calendar Structures: the Prescriptions of the Cosmic Order

The traditional Chinese calendar (officially called Agricultural Calendar) is a lunisolar calendar which is based on the structure of the Xia calendar (夏历) and absorbs some contents of the system of Heavenly Stems (天干), Earthly Branches (地支), and 24 *Solar Terms* (二十四节气) (Zhang 2008:2-28). It takes the cycle of the Moon as the length of each month and adds a "leap month" to make the "average year" consistent with the length of the solar return. There are 7 leap years in every group of 19 lunar years, and each leap year has one extra leap month, which creates an average calendar year of 354 days (Zhang 2008). With the use of the system of the Heavenly Stems and Earthly Branches, the years were organized as a Calendar Round in a repeated 60-year cycle.

The basis of the Mesoamerican calendar is a unit of 260 days (known as *tzolkin* in Maya and *tonalpoalli* in Nahuatl), which is composed of the combination of twenty day-signs with numbers of 1 to 13, resulting in a total of 260 (= 13 x 20) different days. The period of 260 days has no confirmed correlation to astronomical or agricultural cycles but approximates the period of human pregnancy (Miller & Taube 1993:48). This would suggest that it was originally designed for the divination of the character and destiny of the human individual (Anders & Jansen 1993: 50-510). Within this endless stream of days in 260-day cycles, another unit was distinguished, namely the year of 365 days (*haab* in Maya and *xihuitl* in Nahuatl), which was used for historical registers. This unit of 365 days was clearly based on observations of the sun (or rather of the consequences of the relative positions of the earth and sun with respect to each other). The units of 260 days (*tzolkin* / *tonalpoalli*) and of 365 days (*haab* / *xihuitl*) came together as a Calendar Round of 52 "historical years" (52 x 365 = 18980 = 73 x 260 days).

5.2.1 Day, Month, Year, and Calendar Round

The origin of the traditional Chinese calendar can be traced as far back as the 14th century BCE: the oracle bones of the *Shang Dynasty* give evidence of an existing lunisolar calendar, which has been much modified but persists until today (Xia 1985). It is said that the Yellow Emperor (黄帝) created the calendar in the years between 3000 and 2600 BCE,⁴ then, the Chinese followed it and calculated years, months, and days according to astronomical

⁴ This is a historical legend, and there is no evidence to prove whether this really happened.

phenomena.

Similarly, Mesoamerica has an ancient and distinguished calendar system which is already evident in inscriptions from as early as around 500 BCE, and which still plays an important role in several indigenous communities of the Guatemalan highlands (Tedlock 1992:1; Van den Akker 2018), and in the Mexican States of Veracruz, Oaxaca, and Chiapas (Miles 1952; Jansen 2012; Rojas Martínez Gracida 2014; Macuil Martínez 2017; Reyes Gómez 2017).

1. Days and Months

In the Chinese calendar, a common year has 12 months and around 353–355 days, while a leap year has one more month and a total of 383–385 days. Salient features of the Chinese traditional calendar are:

- Day: from midnight to the next.
- Month: one-month cycle, is 29 or 30 days.
- Date: one day of the month.
- Year: the period of a revolution of the Earth around the Sun. In general, the beginning of a year is the date of the Beginning of Spring (lunisolar year), or the Winter solstice (solar year).

There are several ways to record days and months in ancient China, but the most commonly used system is that of stem-branches (干支系统). For a long time, it was used to record the date in order to avoid ambiguity. The stem-branches system, also known as Celestial Stems, first appeared during the *Shang* dynasty (ca. 1250 BCE); it includes 10 Heavenly Stems (天干) and 12 Earthly Branches (地支) in a fixed order to form 60 basic units. These were constructed in the process of observing the laws of the Sun's movement (Chen 1988) and used to record the years, months, days, and hours (Chen & Wang 2001). It is a decimal system with names in a fixed sequence: *Jia* (甲), *Yi* (乙), *Bing* (丙), *Ding* (丁), *Wu* (戊), *Ji* (己), *Geng* (庚), *Xin* (辛), *Ren* (壬), and *Gui* (癸), together forming the names of the ten days of a week in the *Shang* dynasty (Smith 2011). For the record of a date, they were used in combination with the Earthly Branches, which might be related to the observation of the Moon (Chen, Jiu Jin 1988). The Earthly Branches, a similar cycle of twelve characters in a fixed sequence are: *Zi* (子), *Chou* (丑), *Yin* (寅), *Mao* (卯), *Chen* (辰), *Si* (巳), *Wu* (午), *Wei* (未), *Shen* (申), *You* (酉), *Xu* (戌), and *Hai* (亥). The *Earthly Branches* were considered an accompaniment of the *Heavenly Stems*. It is said that the ancient Chinese found there were 10 months in a year, while in the meantime, they observed the full moon 12 times, which could be the reason that the 12 *Earthly Branches* were created.

As already indicated, the *tzolkin* / *Tonalpoalli* defined and named the sequence of the 260 different days as combinations of two cycles, that of the 20-day signs, and that of the numbers 1-13 (Miller & Taube 1993:48). The twenty signs reflect the vigesimal counting system of Mesoamerican languages.

The signs used in Classic Maya inscriptions are: *Imix'* () , *Ik'* () , *Ak'b'al* () , *K'an* () , *Chikchan* () , *Kimi* () , *Manik'* () , *Lamat* () , *Muluk* () , *Ok* () ,

Chuwen (𐄂𐄃), Eb' (𐄂𐄄), Ben (𐄂𐄅), Ix (𐄂𐄆), Men (𐄂𐄇), Kib' (𐄂𐄈), Kab'an (𐄂𐄉),
 Etz'nab' (𐄂𐄊), Kawak (𐄂𐄋), and Ajaw (𐄂𐄌) (Pitts 2009:50-58).

In the Nahua and Ñuu Dzaui pictorial manuscripts these 20 signs are: Alligator, Wind, House, Lizard, Serpent, Death, Deer, Rabbit, Water, Dog, Monkey, Grass, Reed, Jaguar, Eagle, Vulture, Motion, Flint, Rain, and Flower (Jansen & Pérez Jiménez 2017:11). They appear in a fixed sequence from 1 to 20 (Figure 5-3).

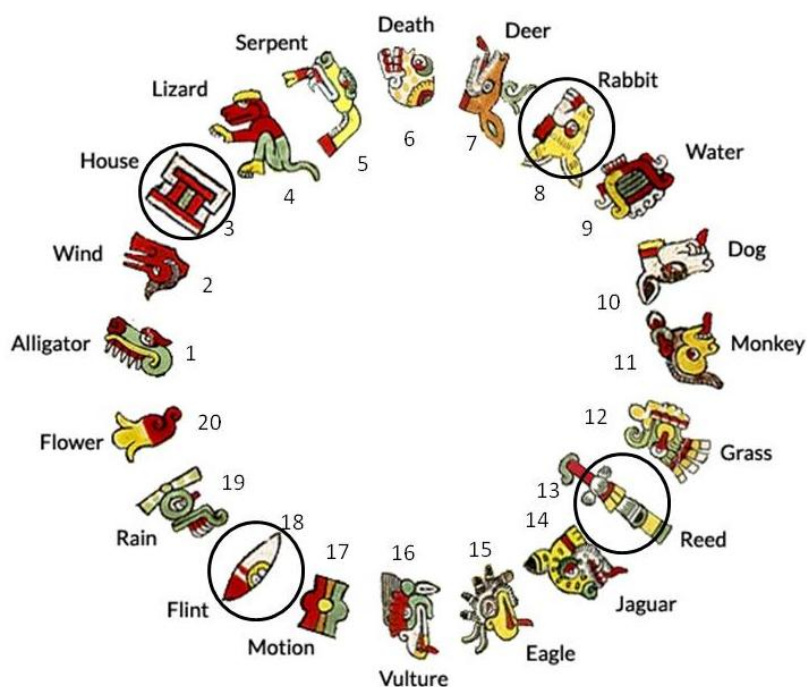


Figure 5-3 Mayan 20 day-signs and 4 year-bearers
 (<http://www.mesolore.org/tutorials/learn/13/Keeping-Time>)

In order to produce the 260 different day names, these twenty signs work together with numbers from 1 to 13. The *tonalpoalli* starts with the first sign combined with number 1: day 1 Alligator. Then the successive days follow: 2 Wind, 3 House, 4 Lizard, etc. After the 13-day sign is combined with the number 13 – day 13 Reed –, the next sign (the 14th of the sequence of twenty signs) is combined again with the number 1: 1 Jaguar, and so on. The final combination, which is the 260th day of the sequence, is that of the twentieth sign with the number 13: 13 Flower (Jansen & Pérez Jiménez 2017:11-13; Miller & Taube 1993:50).

The *haab* / *xihuitl* the unit of 365 days uses the same day names as the *tzolkin* / *tonalpoalli* but extends for 105 days more (thus 105 day names occur twice in the *haab* / *xihuitl*): it approximates the solar or agricultural year (Miller & Taube 1993:50). Structurally, it comprises 18 “months” of 20 days each, plus an additional five days (“superfluous days”) at the end of the year, thus in total a count of 365 days ($20 \times 18 + 5 = 365$). The position of the day within a month could be identified by a day number followed by the name of the month.

In Maya inscriptions the 18 months are successively: *Pop* (𐄂𐄃), *Wo'* (𐄂𐄄), *Sip* (𐄂𐄅),

Sotz' (), Sek (), Xul (), Yaxk'in (), Mol (), Ch'en (), Yax (), Sak' (), Keh (), Mak (), K'ank'in (), Muwan' (), Pax (), K'ayab (), and Kumk'u () (Pitts 2009:59-63).

The last five days without a month's name at the end of a year were together called *Wayeb'* () (Figure 5-4). Due to their separated position from the main body, they were considered not appropriate for normal activities and therefore were often seen as unlucky or even dangerous days (Miller & Taube 1993:51; Pitts 2009:64).



Figure 5-4 Months names in Mayan Calendar (Rice 2009:40)

To sum up, the elements are similar but different in *tzolkin* and *haab*, they are:

tzolkin

- Day: number (1-13) + day sign (cycle of 20): in total 260 combinations.
- Subdivision: twenty 13-day periods (each beginning with number 1)
- Date: a day (one out of a total of 260 possibilities).
- Cycle: 260 days.

haab

- Day: number (1-20) + month sign
- Subdivision: 18 periods of 20 days (“months”) with 5 extra days
- Date: a day (of the *tzolkin*) positioned within a 20-day period (“month”)
- Cycle: 365 days.

The Aztec year (*xihuitl*) was similarly structured in eighteen 20-day periods (“months”), which were identified with a sequence of rituals, most of which seem to have been determined by seasonality.

Each of the twenty day-signs had its patron deity. The same was true for each of the thirteen numbers. Moreover, there was a cycle of nine Deities of the Night, which accompanied the *tonalpoalli*: the first of these deities was the patron of the first day, and so on; the final (260th) day was governed by the last two of the nine Deities of the Night. Also, each of the twenty 13-day periods had a patron deity. The eighteen 20-day periods were characterized by rituals, which also implied an association with specific deities. In this manner, the birthday of a person would hold many associations with deities and, consequently, with divinatory symbols, which would influence the character and destiny of that person (Nowotny 2005). Equally, it was important to examine these associations with the divine world for planning a ritual, a battle, or some other activity.

The 365-day period approximates the tropical year. As the real length of the astronomical/natural year (the “tropical year”) is not exactly 365 days but close to 365.24219 days (average), a 365-days year runs out of pace with the seasons and needs some form of correction through the insertion of leap-days, as in the Julian and Gregorian calendars (an average of 1 day in 4 years, with additional corrections per century). It is a matter of debate if and how leap-days were introduced in the Mesoamerican calendar system. Several Spanish early colonial sources affirm that leap days occurred in the Aztec calendar, and indeed they would be important for keeping the agricultural rituals in pace with the seasons. On the other hand, other sources contradict this, and leap days cannot be observed in the on-going sequence of the days in historical registers and correlations. *Jansen and Pérez Jiménez* (2019) have suggested, therefore, that leap-days were not included in the formal count of the Aztec years as fixed units of 365 days, but were occasionally added to the duration of the agricultural feast-periods in accordance with astronomical observations (e.g. of the zenith passage of the Sun). That would have created a separate natural year that consisted of the sequence of seasonal feasts and that would start every year in accordance with the observation of a specific astronomical event. In practice, this would have connected the sequence of rituals to the seasonal and astronomical reality of the tropical year and have made it independent from the fixed 365-day period. Consequently, leap days were not included in the “historical years” of 365 days, but did occur in practice in the “natural years” of the successive seasonal rituals.

In the Classic Maya calendar, however, the position of the “months” was fixed and limited to 20 days in a fixed manner, without leap days. It still has to be investigated whether the monthly feasts within those “months” changed in character or moved in accordance with

seasonality and solar positions.

2. Years

In terms of naming the years, China and Mesoamerica have adopted different methods in their calendar systems.

In China, there are several methods to name or mark the years. The first way is to follow the name of a king, which first happened in the First Year of King Xuan of Zhou (周宣王, 827 BC). After this, the Year Name (年号), the name of a period of an emperor's rule, was taken as the new calendar year by Emperor Wu of the *Han Dynasty* (汉武帝) in the first year of his enthronement, which was called the First Year of Jianyuan (建元元年, 140 BC). This continued to the last feudal dynasty of China (*Qing Dynasty*). The stem-branches were used as a calendar system to mark the years by Emperor Guangwu of the *Han Dynasty* (汉光武帝), moreover, it was officially and widely used 30 years after he became emperor (AD 54) (Bao 2009). That is to say, in the early time of China, the King used his name to record the year; later, the Year Name and stem-branches system were the main ways to indicate the concrete time of the years, months, and days. Besides this, a zodiac system that includes a 12-year animal cycle was and is still used by the people to mark the years (Bao 2009).

In Mesoamerica, the Nahuas (Aztecs), Ñuu Dzaui (Mixtecs), and other peoples in the Postclassic period used to name the year of 365 days after one specific day, the “year bearer”. Dates were registered as the combination of the year-bearer and the day within that year.

The number of 365 days contains 18 times the twenty signs, with a remainder of 5 signs ($365 = 18 \times 20 + 5$). Consequently, the day-sign of the year-bearer will move forward five positions each year in the list of the 20 day-signs (Jansen & Pérez Jiménez 2017: 14). After four years the same day-sign returns as year-bearer, because four times 5 positions moved forward again completes the cycle of twenty signs and therefore returns to the same sign. That means that the year bearer can only fall on 4 signs within the cycle of 20 day-signs. In the Nahua and Ñuu Dzaui calendars, the signs of Reed, Flint, House, and Rabbit were taken as the day-signs of the year-bearer signs (Jansen & Pérez Jiménez 2017: 14-15) (Figure 5-3).

Similarly, the number of 365 days contains 28 times the series of 13 numbers, with a remainder of 1 ($365 = 28 \times 13 + 1$). This means that the number that accompanies the day-sign of the next year-bearer would be one digit higher. Different people might use different year-bearers, depending on the day they chose to begin the year.

3. Calendar Round and Long Count

In Mesoamerica, people used the calendar to record the passage of time. Especially the Maya achieved complex calculations of long time periods for registering historical and astronomical events.

The cycles of 260 days and 365 days in combination result in a Calendar Round of 52 years, after which the cycle of year-bearers is repeated. The total amount of year-bearers is 52 because only four day-signs qualify for the year-bearer position, but each may be combined with numbers from 1 to 13 ($13 \times 4 = 52$). Concretely, if we start with a year 1 Reed, the next year of the Calendar Round would be 2 Flint, to be followed by 3 House, to be followed by 4

Rabbit, to be followed by 5 Reed and so on until 13 Rabbit, after which the new cycle would again start with 1 Reed (Figure 5-5).

The 52-year cycle in Nahuatl is called *xiuhmolpilli*, “binding of the years”. This Calendar Round could be subdivided into 4 periods of 13 years each, starting with 1 Reed, 1 Flint, 1 House, and 1 Rabbit respectively: “the beauty of this mathematical organization is that the sign of the leading year-bearer during such a 13 year period will fall on the positions 1, 5, 9, and 13, which are symbolically associated with the Centre and the four directions of the Earth’s surface (1, 5), the Underworld where the dead ancestors are (9), and Heaven (13)” (Jansen & Pérez Jiménez 2017: 15).

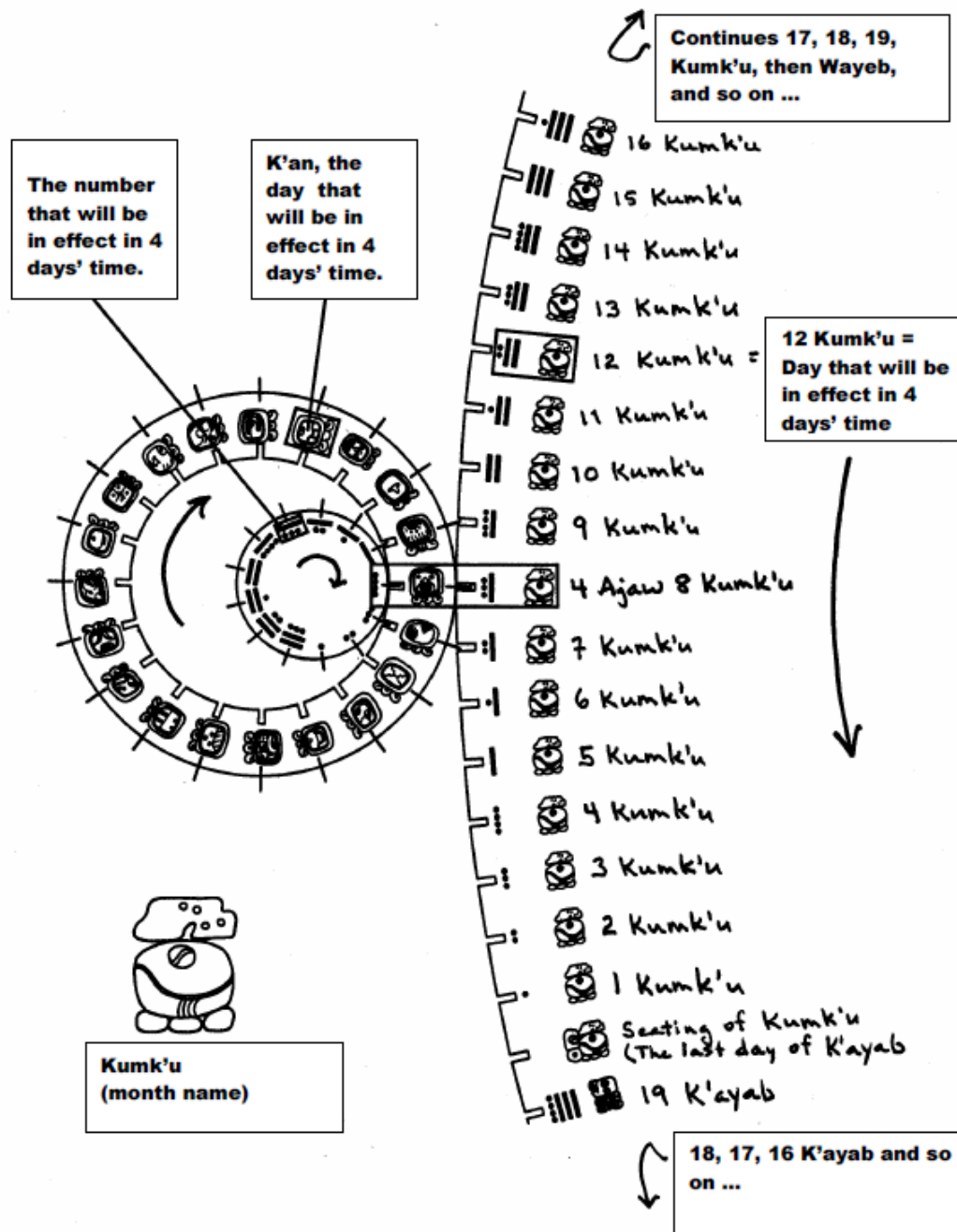


Figure 5-5 Calendar Round works (Pitts 2009:69)

The Codex Cihuacoatl (Borbonicus) is an early colonial copy of a precolonial pictorial manuscript (Anders, Jansen & Reyes 1991), which contains a full presentation of the Aztec calendar in four chapters:

- 1) The *tonalpoalli* of 260 days, divided into twenty 13-day periods, each with its central image of the patron deity and divinatory symbols; each day is listed with its respective Deity of the Night and its corresponding Deity of the Number, accompanied by an augural bird.
- 2) A list of the 52 year-bearers, making up the Calendar Round.
- 3) The 18-month rituals, paying special attention to the beginning of the Calendar Round with a New Fire ceremony in the year 2 Reed (1507).
- 4) The sequence of years in the next calendar round.

The precolonial *Codex Yoalli Ehecatl* (Borgia) contains a central chapter devoted to “temple scenes”, which shows the ritual activities and corresponding priestly experiences in a specific ceremonial centre during the 18 months of the Aztec year (Jansen & Pérez Jiménez 2017: chapter 7). Here we see the integration of architecture (temples, altars, plazas, ball courts, roads) with landscape features, ritual actions of the priests, and the presence of deities.

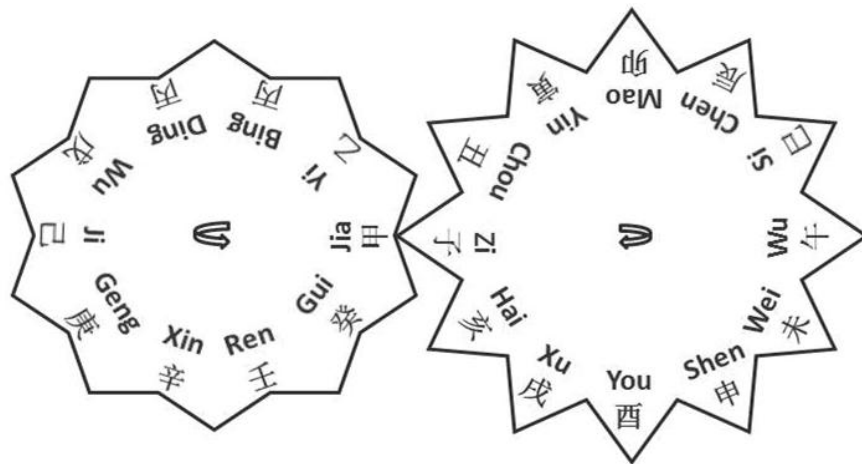


Figure 5-6 Chinese *Jia-Zi* works (drawing by author)

Similar to the Calendar Round of Mesoamerica, the stem-branches were the important recording system in ancient China, used to mark the years, months, days, and hours in different historical periods (Chen 1988); it produces a repeated 60-year cycle which is called *Jia-Zi* (甲子) in China. As mentioned before, the stem-branches system includes 10 Heavenly Stems and 12 Earthly Branches in total. The 10 Heavenly Stems, in general, are numbered from 1 to 10; combining with each of the 12 Earthly Branches in turn, they produce a cycle for 60 years (Figure 5-6). For example, the first year of the cycle is a combination of *Jia* (first of Heavenly Stems) and *Zi* (first of Earthly Branches), called the year of *Jia-Zi*; the second year is the year of *Yi-Chou*, from the combination of *Yi* (second of Heavenly Stems) and *Chou* (second of Earthly Branches); and so on, until the tenth year of *Gui-You*. From the 11th year onwards, the 10 Heavenly Stems have finished a cycle, so they must be repeated from the beginning. The same thing happened in the 13th year, at that time, the 12 Earthly Branches also have completed their first cycle, so they must enter a second cycle. Consequently, this combination of the stem-branches creates the sequence of the years: *Jia-Zi*, *Yi-Chou*,

Bing-Yin... until *Gui-Hai*. In this process, the Heavenly Stems have completed their cycle 6 times and the Earthly Branches have cycled 5 times, which forms a 60-year cycle in total. A 60-year cycle is called one *Jia-Zi*, that is, a *Jia-Zi* equals 60 years, which is thought of as closing the life destiny of a human being, hence, it makes people believe that after a *Jia-Zi* people will become much weaker.

To anchor a *tzolkin* / *haab* date further in time, the Classic Maya devised the “Long Count”, counting the number of days that had passed since the beginning date of the calendar: 4 *Ahau*, 8th day of the month *Cumku*, a virtual “year 0”, which, according to the most accepted correlation, corresponds to 11 August 3114 BCE (in the proleptic Gregorian calendar). The total number of passed days was counted in cycles in the vigesimal system, using a unit of 360 days (*tun*) as the basic unit: 20 *tuns* is a *katun*, 20 *katuns* is a *baktun*, 20 *baktuns* is a *pictun*, 20 *pictuns* is a *calabtun* (around 158 millennia), and another bigger one called *kinchiltun*, which consists of 20 *calabtuns* (around 3.16 million years) in total (Salyers 1954).

Historical inscriptions of the Classical period date important events in this Long Count, listing the total number of days passed since 4 *Ahau* 8 *Cumku* in a sequence of 5 digits: the *baktun*'s (units of 20 x 20 x 360 days), *katun*'s (units of 20 x 360 days), *tun*'s (units of 360 days), *uinal*'s (units of 20 days) and *kin*'s (individual days). For example, the accession date of Ah Pakal, ruler of Palenque, is given as the Long Count date 9.9.2.4.8, which means: 9 *baktun*, 9 *katun*, 2 *tun*, 4 *uinal* and 8 *kin* since the beginning date of the calendar (11.08.3114 BCE), arriving at 5 *Lamat* 1*Mol*, which corresponded to 27 July A.D. 615 (proleptic Gregorian).

In ancient China there was also a system to record very distant dates, but it appears in an ancient book and seems to not have been used in real life. According to the *Zhou Bi Suan Jing*: “19 years is a *Zhang* (章); 4 *Zhangs* is a *Bu* (部), a total of 76 years; 20 *Bus* is a *Sui* (遂), a total of 1520 years; 3 *Suis* is a *Shou* (首), a total of 4560 years; 7 *Shous* is a *Ji* (极), a total of 31920 years.”⁵ “When these times are over, everything begins again”.⁶ The *Zhou Bi Suan Jing* was one of the official mathematics textbooks in the *Tang Dynasty*, it has a very prominent historical position in the field of mathematics and astronomy in ancient China, however, its “Long Count” system was not so popular in history books since people preferred to record the history in periods corresponding to the rule of specific dynasties, the sequence of which was memorized. Consequently, they marked the time of the first empire as the *Xia Dynasty*, then the *Shang Dynasty*, the *Zhou Dynasty*..... until the New China of today. From this system, all Chinese can easily locate the historical stage for an event that occurred in its history. As for the concrete date, the use of the stem-branches combined with the King's name or Year Name clearly marks each day of the ancient past, and so there was no need to differentiate the years further in the record: the combination of the above-mentioned methods was clear enough (Zhang 1995).

Nevertheless, we note that the “Long Count” systems in the Maya and Chinese calendars, operated on similar principles.

⁵ The original words in *Zhou Bi Suan Jing* are: “19 years is a *Zhang*(章); 4 *Zhangs* is a *Bu*(部), a total of 76 years; 20 *Bus* is a *Sui*(遂), a total of 1520 years; 3 *Suis* is a *Shou*(首), consists of 4560 years; 7 *Shous* is a *Ji*(极), including 31920 years(十九岁为一章。四章为一部，七十六岁。二十部为一遂，遂千五百二十岁。三遂为一首，首四千五百六十岁。七首为一极，极三万一千九百二十岁。)”

⁶ The original words in *Zhou Bi Suan Jing*: “生数皆终，万物复始”。

5.2.2 Zodiac, Days, and Records

Another popular astrological and calendric element in China was the Zodiac, consisting of constellations, i.e. imaginary groupings of stars into forms of animals or other figures. The Chinese zodiac system originated following the 12 Earthly Branches (Ye 1998) before the *Qin Dynasty* (Ye 2015) and used to mark the years and hours (Wang 2008). It contains 12 animals, each of which is related to a year and an exact hour. The year of a specific zodiac animal appears every 12 years: it was believed that the year was associated with the character of the animal. The order of the 12 animals is: 1) Rat, 2) Ox, 3) Tiger, 4) Rabbit, 5) Dragon, 6) Snake, 7) Horse, 8) Goat, 9) Monkey, 10) Rooster, 11) Dog, and 12) Pig. Among these animals, the Dragon was the most important supreme sacred animal in Chinese legend; the Ox, Horse, Goat, Rooster, Dog, and Pig were six very important domestic animals for Chinese daily life and agriculture, while the other five animals were close to human society. The system of 12 zodiac years is still popular in today's China: when a child is born, it will be attached to the animal year it is born in, and as a result, in folk worldview, its character and destiny are associated with that zodiac animal. Besides this, the 12 animals are connected with the traditional hours (another use of Earthly Branches), each being attached to an exact hour that belongs to one of the total 12 hours a day. For example, the Rat ranks first and corresponds to *Zi* in Earthly Branches, the contemporary time is from 23:00 to 1:00, and so on:

Rat (coordinated with *Zi*)-from 23:00 to 1:00;
Ox (coordinated with *Chou*) -from 1:00 to 3:00;
Tiger (coordinated with *Yin*) -from 3:00 to 5:00;
Rabbit (coordinated with *Mao*) -from 5:00 to 7:00;
Dragon (coordinated with *Chen*) -from 7:00 to 9:00;
Snake (coordinated with *Si*) -from 9:00 to 11:00;
Horse (coordinated with *Wu*)-from 11:00 to 13:00;
Goat (coordinated with *Wei*) -from 13:00 to 15:00;
Monkey (coordinated with *Shen*) -from 15:00 to 17:00;
Rooster (coordinated with *You*) -from 17:00 to 19:00;
Dog (coordinated with *Xu*) -from 19:00 to 21:00;
Pig (coordinated with *Hai*) -from 21:00 to 23:00.

Moreover, the days, as well as the months, were also connected with the zodiac, for instance, a date can be named after a zodiac name such as Snake, Horse, Ox, etc. (Li 1999).

The ancient Mesoamerican zodiac has not been well documented. The 20-day signs of the Aztec and Mixtec calendar consist of animals, natural elements, or artefacts associated with people's daily life. It has been speculated that these day-signs were, at least in part, connected to a zodiac system. Although this argument has been questioned and indeed lacks proof, it is still thought-provoking and has attracted the attention of several scholars (Spinden 1928; Brotherston 1989). Anyway, it is interesting to note that these basic signs of the Mesoamerican calendar have symbolic meaning, similar to the use of the zodiac signs in China. Among those 20 signs, ten represent animals: *Alligator*, *Lizard*, and *Serpent* are

reptiles, which generally represent “Earth” in Mesoamerican culture; Deer and Rabbit are the typical animals of the mountain (symbolizing freedom) as well as animals that are hunted, the rabbit being particularly symbolically associated with *pulque*, a fermented beverage (prepared from maguey juice); the Dog is the only domesticated animal and associated with death (as it has to transport the soul of the river to Mictlan); the Monkey is seen as funny, and is associated with art and performance; the Jaguar symbolizes strength, courage, and bravery – these are five animals that are close to people’s daily life and important in the Mesoamerican worldview; *Eagle* and *Vulture*, the other two animals, are noticeable birds that can fly in the sky and touch Heaven. These ten animals, in summary, are associated with the Heaven, Earth, human life, and the Underworld. Besides these, the sixth sign of the 20 day-signs is Death, and therefore a reference to ancestors and the Underworld; the Grass, Reed, and Flower are representative of important plants, used by humans; Flint is an important artefact; the House is a hint of human family life and represents human beings; the Wind, Water, and Rain are elements of nature; and the sign Movement – which also refers to Earthquakes and to the Sun’s orbit – signals that there is dynamism in the universe. Each of these signs had symbolic and divinatory associations, which were important for the character of the person born on such a day (Anders & Jansen 1993; Nowotny 2005).

From the above, we find both similarities and differences in the ways that both cultures used animals and natural or cultural elements for referring to the passage and divinatory meaning of time.

Ancient China was a highly developed agricultural society, people paid attention to all activities related to agriculture; therefore, the main animals of the zodiac system are closely related to agricultural production. As a result, most of the animals belong to the category of domestic animals, and most others are close to people’s daily life. The Dragon is also extremely important to agriculture. It is not only a very auspicious animal but also the divine power that controls the rain, which directly affects agricultural production. In terms of recording time, whether it is the year, month, or hour, this list of animals is closely related to people’s daily life. Consequently, the Chinese zodiac system was connected to and serving its agricultural society.

In comparison, the Mesoamerican day signs cycle seems to reflect ideas about the structure of the cosmos. Firstly, it contains all the elements of the *Three Realms* of the universe: Heaven (Eagle and Vulture), Earth (Alligator, Lizard, Serpent as well as Rain), and the Underworld (Death, Dog and maybe Flint); secondly, it includes animals (Deer, Rabbit, Dog, Monkey, and Jaguar) as well as plants (Grass, Flower, and Reed) that play a role in the human world; thirdly, it refers to the powers of nature (Wind, Water, Rain, Flint, and Movement); fourthly, it, of course, contains the reference to human culture (House) – it should be noted that the corresponding sign in other Mesoamerican calendars is Darkness (Maya: *akbal*) or Owl.

5.2.3 Duality, Combination, and Circulation

The calendars of both China and Mesoamerica are deeply rooted in cultural memory and have an important symbolic and cosmological dimension. The dates and other segments of time on the one hand create historical consciousness, on the other have religious and ethical

meanings, which is relevant for human life in connection with Heaven, Earth, and Underworld (the world of the Ancestors).

In China, the name of a date is a combination of Heavenly Stems and Earthly Branches, which are two sides of the Chinese calendar, one related to the Sun and the other related to the Moon. The part of Heavenly Stems is always called *Yang* (related to the Sun), the other part from Earthly Branches called *Yin* (related to the Moon). Heavenly Stems were first used to mark the days recorded in the oracles, later, found to mark the months and years in the *Taichu Calendar* (太初历) of the *Western Han Dynasty* (206 B.C.-A.D. 24). The origins of the 10 characters of the *Heavenly Stems*, are not recorded, but scholars suspect several possibilities. Most scholars believe that the 10 characters came from the ten Suns of Chinese legend, since they had the same names (Zhou 2006). Besides this, there is a popular idea that the 10 characters are related to the movement of the Sun. *Chen Jiujiu* said, “the 10 characters are ten stages of the *Ten Months Solar Calendar*” (Chen 1988). He said the original meanings of the 10 characters are not to be taken as the numbers of 1-10 to be used, but were based on the periodic motion law of the Sun and associated with the agriculture. Each of them was linked with a stage of agricultural planting from cultivating the soil and preparing the land for sowing, to harvesting in the fall and storage in the winter. The sequence is:

Jia, the month of the plants come out from the soil;

Yi, the month of the plants bend to grow;

Bing, the month of the weather is bright;

Ding, the month of the plants’ growth;

Wu, the month of the plants are lush;

Ji, the month of recording and remembering;

Geng, the month of the plants’ maturity;

Xin, the month of the plants’ revivification;

Ren, the month of the plants breeding;

Gui, the month of the plants managed and harvest (Chen 1988).

According to his idea, the 10 characters were abstract graphs for describing 10 states of crops, 1 for each month. In other words, the 10 characters are 10 numbers related to the Sun movements for a whole year. The Sun, with its strong energy, is the best representation of *Yang*, which is a good representative of the Heaven (also belonging to *Yang*), that is why they were named as “Heavenly Stems”. Similarly, the Moon, which mostly comes out at night, looks like a cold pan, and generally was seen as *Yin*, opposite to the *Yang* of the Sun. The 12 Earthly Branches, as a result, which derived from the lunar calendar of 12 months, were associated with *Yin*, complementing the Heavenly Stems. The two parts of this duality are combined together to mark dates in detail with years, months, days, and hours. For example, a child’s birthday was marked by the Heavenly Stems and Earthly Branches in four units –year, month, day, and hour – which were composed of 8 characters and each with two parts of this duality.

In comparison, the way in which the *tzolkin* named the days, also includes two parts related to the Heaven/*Cosmos* and the Earth: The sequence of thirteen numbers seems to be related to Heaven/*Cosmos*) as they also appear as the number of thirteen layers of heaven in

Codex Vaticanus A. They also represent the 13 directional points of the cosmos: thus the thirteen numbers are related to the *Three Realms* of Heaven, Earth, and the Underworld (Austin 1980). The number 1 represents the Centre, and then in each of these realms, four directions can be distinguished: $13 = 1+4+4+4$ (Jansen & Pérez Jiménez 2010: 27). The central plane is therefore represented by the number 5 ($1+4$), adding the four directions of the Underworld we arrive at the number 9, indeed a number associated with death and the ancestors. The number 13 completes this structure with the four directions of heaven. Hence, whether the numbers were from the 13-layered sky or from 13 directional points of the *Cosmos*, they belong to the universe and particularly to Heaven.

The number of 10 Heavenly Stems, according to another argument, is related to the 10 fingers of the human body, which is the basic idea for the origin of the decimal counting system. Similarly, the amount of 20 day-signs in Mesoamerica came from the total number of fingers and toes (characterizing the human being), which is the source of the vigesimal counting system. At the same time, this sequence of day signs may symbolically be connected to Earth. The two parts of the date name may represent a concept of the intertwining of human society with the cosmos and time. When we look at the 13-day periods we find that the days (Nahuatl: *tonalli* = day, heat, light) have on the one hand a heavenly aspect associated with the Sun (Tonatiuh, the shining and bright one), which is symbolized by the 13 augural birds that accompany the deities of the 13 numbers. On the other hand, the days also include the nights, which are governed by the 9 Deities of the Night. The luminous and nocturnal aspects with which all dates are associated reflect the pervasive Mesoamerican duality of “hot” and “cold”, comparable to the *yang* and *yin* of Chinese philosophy. In both sets – the 13 deities of the numbers and the 9 deities of the nights – we find to some extent the same deities, of which some are clearly more associated with “hot” qualities (e.g. the Sun God and the Fire God) while others have a “cold” character (e.g. the Rain God, the God of Death).

5.2.4 Solar Year, Divisions, and Ecliptic

The 24 *Solar Terms* (24节气) was an important calendar element, which served to support the agricultural production in ancient China; it was formed by observing the solar anniversary movement and recognizing the season, climate, phenomenology, and other changes in the year. For easy use, ancient Chinese divided the trajectory of the Sun Anniversary into 24 equal parts, each of which was a *Solar Term*. A *Solar Term* has three climate periods, each of which is five days. Consequently, a solar year was divided into Season (季), *Jie* (节), *Qi* (气), and *Hou* (候), so that 1 Year = 4 Seasons = 24 *Solar Terms* ($12 \text{ Jies} + 12 \text{ Qis} = 72 \text{ Hous}$). The 24 *Solar Terms* express the concept of time as a connection between humans and the universe, which contains the long-term cultural memory and historical accumulation of China (Chen 1987).

The names of the 24 *Solar Terms* describe in a sequence of characters the climate of the whole year, i.e., from the first, which tells the beginning of spring, to the last, which shows the coming of the ice-cold period, they tell the people what the climate is at each stage, and what will happen in the next period. This aspect is clearly associated with traditional agriculture. The sequence of the names is:

Spring Begins (立春), February 3-5th;

Rains (雨水), February 18-20th;
Insects Awaken (惊蛰), March 5-7th;
Vernal Equinox (春分), March 20-22nd;
Clear and Bright (清明), April 4-6th;
Grain Rain (谷雨), April 19-21st;

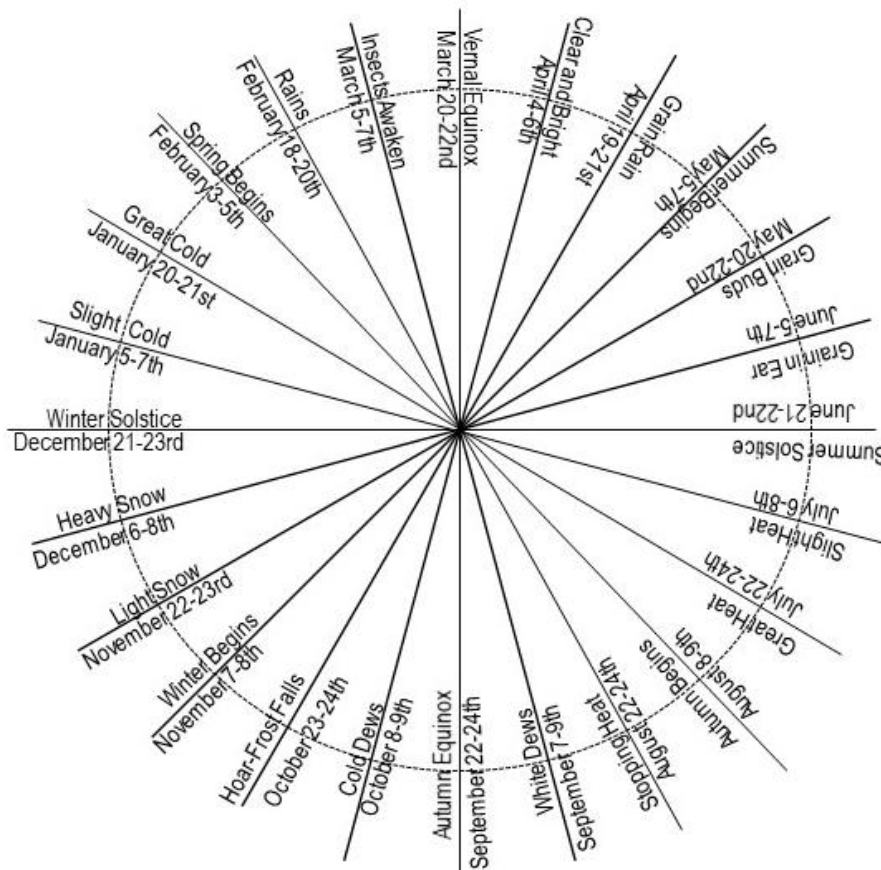


Figure 5-7 Chinese 24 Solar Terms (drawing by author)

Summer Begins (立夏), May 5-7th;
Grain Buds (小满), May 20-22nd;
Grain in Ear (芒种), June 5-7th;
Summer Solstice (夏至), June 21-22nd;
Slight Heat (小暑), July 6-8th;
Great Heat (大暑), July 22-24th;
Autumn Begins (立秋), August 8-9th;
Stopping Heat (处暑), August 22-24th;
White Dews (露水), September 7-9th;
Autumn Equinox (秋分), September 22-24th;
Cold Dews (寒露), October 8-9th;
Hoar-Frost Falls (霜降), October 23-24th;
Winter Begins (立冬), November 7-8th;
Light Snow (小雪), November 22-23rd;

Heavy Snow (大雪), December 6-8th;
 Winter Solstice (冬至), December 21-23rd;
 Slight Cold (小寒), January 5-7th;
 Great Cold (大寒), January 20-21st.

The 24 divisional points within this cyclical movement of time coincide with points 15° apart on the ecliptic, as they form a complete circle of 360° (Figure 5-7). The Sun needs to take 365 days to finish its journey of this cycle, which means, each *Solar Term* contains a journey of around 15 days, i.e., the whole Solar Year was divided into 24 parts and each part consists of 15 days.

As a comparison, the Mesoamerican calendar (whether *tzolkin* / *tonalpoalli* or *haab* / *xihuitl*) consists of cycles (which Western scholars tend to represent as circles), similar to that of Chinese 24 *Solar Terms*: the 20 day-signs, the 13 numbers and the day positions in the 18 months, all move in succession around their respective Centres (Figure 5-8). The 20 day-signs, as a basic unit, are repeated 13 times (in the *tzolkin* / *tonalpoalli*) or 18 times (in the *haab* / *xihuitl*). The 13 day-numbers, the other basic unit, are repeated 20 times (in the *tzolkin* / *tonalpoalli*) or 28 times (in the *haab* / *xihuitl*). The division of the 365-day year (*haab* / *xihuitl*) into 18 months of 20 days with 5 extra days is clearly based on the passage of the seasons – most of the rituals are intimately related to corresponding food producing activities of agriculture, hunting, etc. – and very comparable in its structural idea to the Chinese 24 *Solar Terms*.

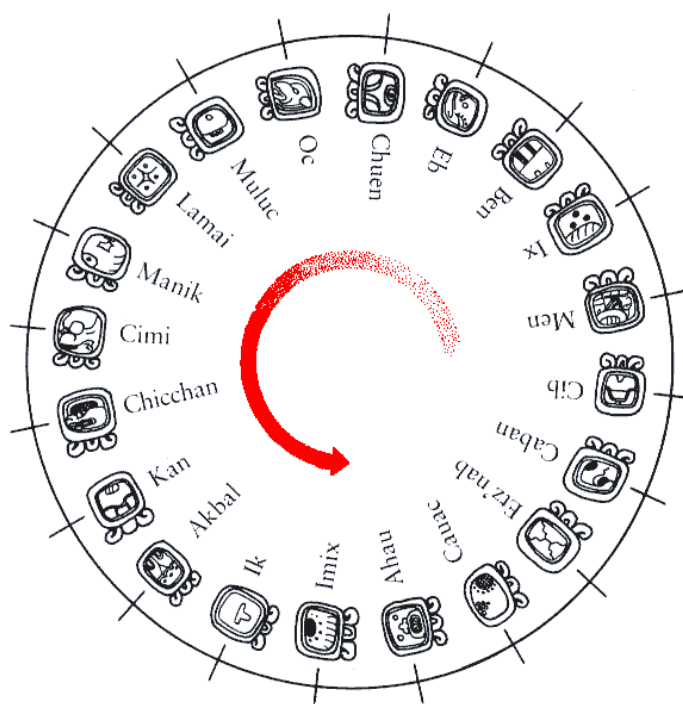


Figure 5-8 Mayan 20-day Signs (internet)

5.2.5 Summary, Similarities, and Comparison

Through the above analysis, the most salient similarities between the Chinese and Mesoamerican calendars are: they both use a combination of cycles to create a system for marking the time. As mentioned above, the ancient Chinese took the Stem-Branches system

to create a Calendar Round of 60 years. What makes this system special is: it consists of 10 symbols from the Heavenly Stems and 12 characters from the Earthly branches, which, when combined into one cycle, form a table of 60 small units that are different from each other, which were used to mark the years, months, and days. Similarly, the Mesoamerican calendar forms a Calendar Round of 52 years by combining the four year-bearer signs with the numbers 1-13. The 60-year and 52-year cycles of the two calendars (Chinese and Mesoamerican respectively) are very similar in terms of the composition of the calendar and its functions.

Besides this, the symbolic aspect of the calendar in both cultures is represented by means of 12 or 20 animals or elements, which reflect the human experience in both cultures, in China primarily connected to agriculture, in Mesoamerica related more generally to nature. In both calendar systems, these symbols connect people's daily lives to cosmological ideas.

It should be noted that Western society also has a zodiac system that includes 12 names of animals and some other figures. They were first used as star groups to be “the conceptualization of the sky” (Gurshtein 2005), then they were connected with many meanings and so developed into a divinatory system: astrology, rooted in the ancient Eastern and Mediterranean cultures (Tester 1987:1-3). The sequence of these Western zodiac signs, each associated with a month-length period, forms a parallel year calendar, not official but popular until today, which is supposed to influence the character of the periods and of the persons born in them. At the same time these signs are categorized symbolically according to the four elements (Fire, Earth, Air, and Water) and combined with the positions of the sun, the moon and the planets – all these are also associated with the different parts of the human body and for a long time influenced medical thought and practice.

5.3 Calendar Symbols: A Special Performance of Architecture

Calendars, which can tell people how the universe works and how time goes on, in general, are thought of as religiously charged, mysterious, and sacred thought systems, to be respected by the people. Architecture, which was associated with rituals and consequently also with calendars, was constructed by the same people who wanted to use it to inspire religious emotion, e.g. as a place of contact with the Numinous, as scenery for ritual events or as a dwelling for people of divine status. Besides those functions, the architecture, in certain circumstances, can also be used as tools for people to observe the movements of the celestial bodies, on which calendars and ritual cycles may be founded.

Nowadays, analyzing the way in which the calendars were associated with and expressed in architecture may shed light on their original nature and development. The structure, contents, and functions of a calendar (e.g. for historiography, astronomical observations, and seasonal predictions as well as for ordering religious associations and other symbolic aspects for ritual and divination), generally, have great relevance to the users. For that reason, the meanings associated with the calendar can be found in works of art; we encounter them when exploring its history and symbolism. For example, when architectural components follow the number of days, months, years, seasons, or when architectural decorations use calendric signs and numbers, we can find the special moments marked and symbolized in time, or the

structure of a calendar or its original meaning in ancient epochs. Astronomical alignment of architecture, as one of the most visible aspects of the calendars, is prominently present in the culturally important buildings of ancient Mesoamerica and China.

5.3.1 Calendar Numbers, Connection, and *Cosmos*

The number of days, months, and years – the main body of a calendar, the best reflection of the laws of the universe – was seen as a sacred connection with the Heaven/*Cosmos* and the Gods, which would not always appear to the Earth but were mysterious, fascinating and important to the people. Therefore, as a good way to show respect to the divine powers, and to make ritual participants think of the religious worldview, the ancients often included the central numbers of their calendar in their sacred buildings.

Many cases in Mesoamerica show that such a practice widely existed. For example, calendric inscriptions in Mesoamerican tombs and temples register events of ancient history as well as – politically important – rituals, while the calendar's numbers were used in complex buildings as symbolic references to the structure of the *Cosmos*. A well-known pyramid in *Chichen Itza*, called *El Castillo*, is an outstanding representative case of how calendar numerology could be used in sacred architecture. In doing so, it reminds the people of the ancient, sacred time and demonstrates the high quality of the Maya calendar system and of their excellent mathematicians and astronomers (Declercq, et al. 2004). The year, the seasons, the equinoxes, the days, the world directions, and the number of the Underworld all have a place in the building (Carlson 1999). The most straightforward way of displaying calendar numbers is in the number of steps of the four pyramid staircases (its liminal area, which connects the people with the Gods): each step stands for one day of the Maya *haab* year. The total number of steps on each of the four lateral staircases is 91, together these steps on the four sides add up to 364, with the top platform to be seen as the last one, bringing the total on 365, which is the number of days in one *haab* year. The season's separation points are also clearly reflected in the pyramid design: solstices and equinoxes. The *hierophany* of the descending Feathered Serpent described above reminds people of the religious dynamic of the ritual year: the arrival of the different seasons, associated with the world directions.

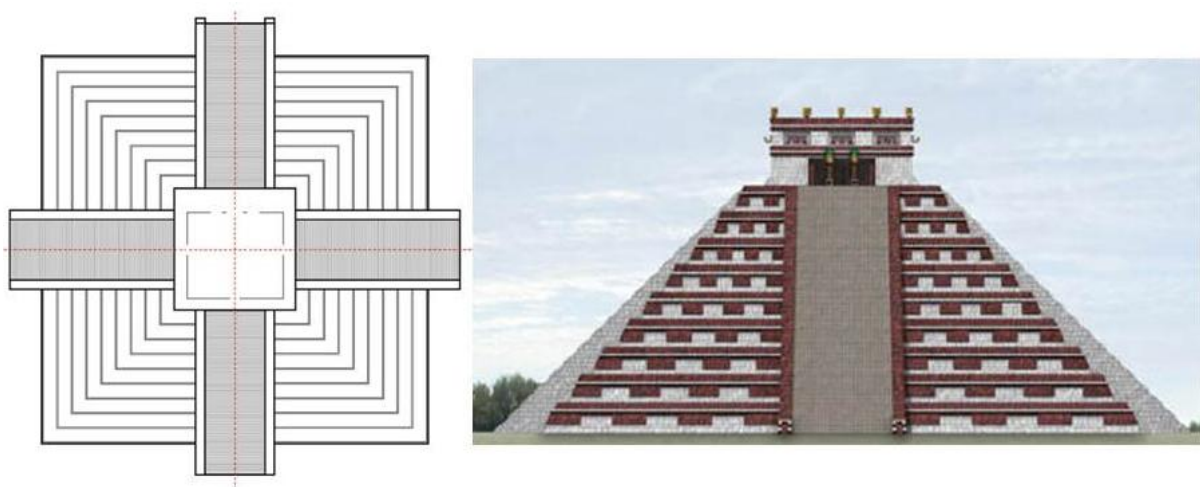


Figure 5-9 the plane and façade of *El Castillo* (internet)

Besides this, this pyramid consists of nine layers or platforms, which may be a reference to the cosmic meaning of the number 9, associated with the ancestors and the Underworld (Foster 2002: 204) (Figure 5-9). Often, the number of layers and steps of the Mesoamerican pyramids seem significant in terms of the calendar.

Not coincidentally, the calendar, as a mysterious intellectual construct that holds ancient wisdom, is a way to attach sacredness to those excellent architectures. That also happened in ancient China. For example, the *Hall of Prayer for Good Harvests* (祈年殿), the main palace in the Temple of Heaven (Chapter 3), as one of the most outstanding ancient buildings in China, shows a very close connection to the calendar in the use of numbers. The hall was used to worship Heavenly Gods who controlled the time for harvesting; consequently, it was designed as a body / spirit / cultural symbol of sacred time (Chapter 3). For that reason, its plan, architectural components (especially the columns), and decorative aspects were designed to show explicit associations with calendar numerology. A total of 28 columns were set in the building, which can be read as containing several symbolic references to the year, the months, the days, hours and seasons, the 24 *Solar Terms* (节气), and, last but not least to the *Twenty-eight Lunar Mansions* (28 星宿) of the Chinese calendar.

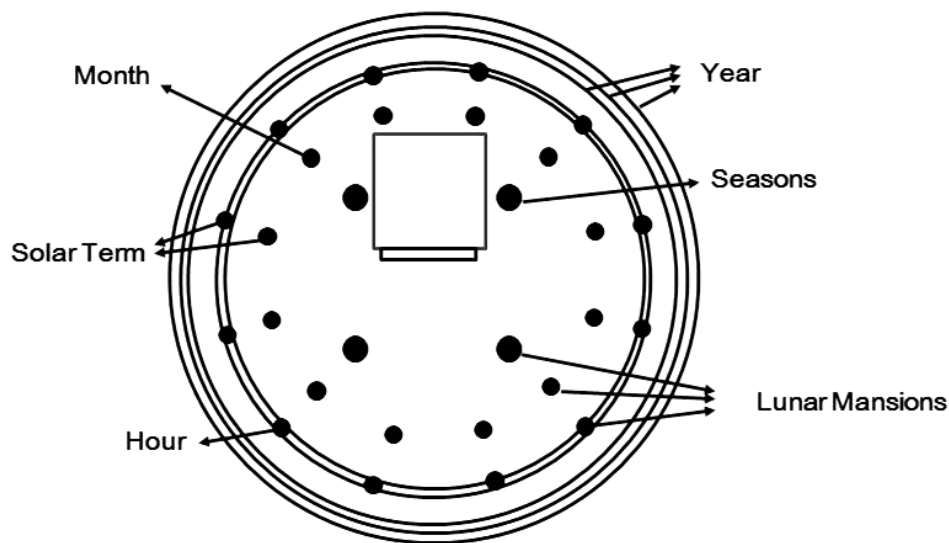


Figure 5-10 the columns and the symbols of the *Hall of Prayer for Good Harvests*
(drawing by author)

In detail, the 4 biggest pillars, separated toward the four directions in the Centre (Figure 5-10), supporting the main structure of the hall, stand for the four seasons of a year; the set of 12 pillars in the middle line and the set of 12 outer columns of the hall each represents the 12 months and the 12 Chinese traditional hours. The total of these 24 pillars refers moreover to the 24 *Solar Terms* of the ancient Chinese Solar Calendar; the total amount of the pillars (28), then represents the traditional *Twenty-eight Lunar Mansions*, which are the main bodies of the ancient Chinese constellations of the Ecliptic circle. The total number of fences on the outer

three enclosures of the hall is 360; it represents the days of a whole year in the traditional calendar.

In summary, calendar numbers were used in the constructions of both Chinese and Mesoamerican architectures as a way of connecting with the *Cosmos*. The *El Castillo* pyramid is the embodiment of the *cosmic order*, which is represented in various aspects: infinite time is symbolized by the use of the calendar numbers (days, seasons, years), in addition, spatial dimensions refer to the four world directions plus the upper and lower cosmic levels. Calendar numbers make a strong and significant statement of how time is going on in the Universe. The *Hall of Prayer for Good Harvests* shows the same idea about the embodiment of *cosmic order* in time and space. The time is reflected in those calendar numbers of years, seasons, days, months, hours, which are implied in the numbers of the columns. The spatial dimension of the universe can be seen in the vertical layer design of the building: the nine-layer Heaven. From the vertical height, the lowest three layers of white marble platforms represent the three layers of the sky, while each wall and roof of the building symbolizes a total of the six levels of the sky, that is, all the spaces of the universe. This combination of references to time and space in architecture to reflect the concept of the order of the universe may be observed in both civilizations.

5.3.2 Calendar, Towards, and Architectural Orientation

Chinese and Mesoamericans had similar ways of using accurate knowledge and astronomically derived concepts to express cultural meanings attributed to certain celestial events. Buildings, tombs, temples, even cities, were designed so that they expressed in their orientation an alignment with the movement directions of celestial bodies or the locations in which special celestial bodies were located on specific dates.

The cases discussed above show that temples and other important buildings were located and constructed in astronomical patterns in several ways. Especially architecture with religious or some emblematic status may express astronomical, cosmological, and astrological meanings through their shapes, proportions, decorations, and uses of cultural symbols and of sacred numbers. In this way, they are related to calendric calculations, astronomical predictions, and the observation of celestial events. As such, they could be oriented to mark or follow a specific location (rise or descent) of a specific celestial body (the Sun, the Moon, Venus, etc.) on a specific date (e.g. equinoxes, solstices, festivals, birthdays of great persons, etc.). Such particular orientations may have been determined by ritual requirements and were often relevant for agricultural ceremonies in the annual cycle.

"Facing East" is a general rule that comes out from the early buildings or structures in different cultures (Chen 2012:93-95; Lv 2011; Hoskin & Morales Núñez 1991). In early times, people did not know why the stars, the Sun, and the Moon come out every day in the same way, which made them imagine that their appearances were controlled by various Gods. The Sun was the most important celestial body since it is bright and hot, it rises in the morning and goes down in the evening, which made people link human beings' lives with its rebirth. As a result, people tried to construct their temples, tombs, and houses to seek rebirth channels for their souls.

Early Chinese architecture, especially tombs, shows a dominant alignment in East-West direction (Chen 2012:89-96). In the study of the Dolmen (石棚) tombs from the *Neolithic Age* in Northeast China, the author found that a number of Dolmen tombs had a regular layout with most of their entrances pointing to the sunrise direction of the Winter Solstice (Chen 2012:95-97). The central “Big House” (大房子) of the prehistoric site of *Banpo Village* (半坡村), Xi'an, China, has an entrance that faces to the true East, which reflects that ancient Chinese who built the house took the sunrise direction to determine the orientation of the house already 6000 years ago. Later, a large number of tombs were laid out in the southeast and northwest directions – the direction of sunrise at Winter Solstice –, which suggests that calendar dates and corresponding astronomical observations were widely used in architectural orientation in early China (Chen 2012:95-97).

The ancient worship of the Sun God is well documented in early China. The oracle bones, with the characters of Sunrise, Sunset, or Worship Sun, reflect the people's practice of observing the Sun and worshipping the Sun at the time. Some tombs, temples, and houses give further evidence of orientations towards the directions of the sunrise or sunset. Facing East is a natural orientation activity of human beings focusing on the Sun and seeking rebirth – this is well documented in ancient Chinese architecture (Chen 2012:93-95; Lv 2011).

In comparison, the vast majority of buildings in Mesoamerica, such as houses, temples, tombs, and other elements of ritual architecture during the entire pre-colonial period of the civilization, firmly points to the directions of sunrises and sunsets on specific days (Šprajc 2010). The "Eastward" layout of the building is an approximate range from Southeast to Northeast and that may correspond to diverse positions of the sunrise during the year (Šprajc 2010), i.e., the building orientations seem to locate the sunrise directions of meaningful dates, hence, they are not always pointing to the *True East*.

Fray Toribio de Motolinia mentioned in his *Memoriales* (1971) how the ancient *Aztecs* focused on astronomical observations (c.q. the calendar) in constructing their temples. He wrote a paragraph to describe the main calendar feast at the Main Temple (Spanish: Templo Mayor) in the capital *Tenochtitlan*:“(the ceremony) took place when the Sun stood in the middle of [the temple of] Huitzilopochtli, which was at the equinox, and because it was a little out of line, [King] Moctezuma wished to pull it down and set it right.”⁷

This statement clearly indicates that the ancient *Aztecs* tried to make their temples connect with relevant calendar dates, in this case the equinox. After many years of serious archaeo-astronomical research, Šprajc (2009) concluded that to connect the building directions with the calendar dates was a common thing in ancient Mesoamerica: “Mesoamerican architectural orientations exhibit a clearly non-uniform distribution and that civic and ceremonial buildings were largely oriented on the basis of astronomical considerations, particularly to the Sun's positions on the horizon on certain dates of the tropical year” (Šprajc 2009:87-95).

In fact, the locations of sunrise and sunset on solstice days are very easily identifiable in a whole year, for example because the shadow of a pole (or stela, building etc.) at noon on those days shows the farthest/nearest distance from the Centre, and the daily advance of the

⁷ See the discussion by Aveni in his book *Skywatchers* (2001)..

places of sunrise / sunset in a certain direction on the horizon also reaches a turning point, after which the Sun seems to stop and change direction. The junctions of the Sun's round-trip path are seen as the intersection of the transition between life and death, the places where the souls go to the Underworld⁸ and where life can be reborn. This is the main reason why ancient Mesoamericans oriented most buildings in these two directions. Another orientation phenomenon is the alignment with the sunset or sunrise directions on Quarter-days of a year, buildings are aligned with the East-West or South-North directions determined not by the Equinoxes but by the Solstices middle points (Šprajc 2009:87-95). A sacred building's cardinal direction in early Mesoamerica, as a result, is East-West, that means, to the sunrise-sunset directions.

Many buildings facing east document the importance of Sun worship in ancient Mesoamerica. The East, generally, was believed to be the place where the Sun God had his home (Tonatiuh Ichan), as he started his daily journey from there; consequently, most of the Mesoamerican architectures were oriented to that direction. The West, as the place of sunset, was associated with the entrance of Underworld and/or places of ancestors: this was also very important, thus some of the buildings were aligned to it.

The North-South direction, finally, the main alignment direction in China from ancient times till today, points to the Polar Star. This star and its surrounding stars were seen as the Heavenly Palace with the Heavenly Emperor in its Centre. The Polar Star, located in the true North of the Northern sky, was considered in Chinese astrology the embodiment of the Heavenly Emperor, who controlled the whole universe. Meanwhile, the Southern Sun at noon was believed to give the most energy; consequently, the direction of the true North-South was the most desirable for people. The alignment that *Facing South and Sitting North* (sitting in the direction of the North Star and facing to the Midday Sun), as a result, was taken as the best architectural direction to be widely used in various buildings. This custom continues in China until today.

For Mesoamericans, the East had great significance as the place of sunrise and of the origin of light and life. Many buildings, therefore, are oriented to that direction. Aveni in the process of investigation of the *Terminal Classic-Puuc* sites attempted to demonstrate that the calendar alignment played a role in certain stages of the city planning (Aveni & Hartung 1986). The same evidence may be found in some other emblematic sites, such as *Teotihuacan*, *Chichen Itza*, or *Uaxactun*: they all have clear axes from South to North, with temples facing East or West (Aveni & Hartung 1986). Overall, the buildings/cities in China and Mesoamerica seem to have established a relationship with the calendar, and their orientations appear to be aligned with the rising or setting Sun on important calendar dates. This shows that the calendar has played a crucial role in the architectural orientation of the two civilizations.

5.4 Celestial Events: Interactions Between Humans and Gods

From the above, we conclude that architecture has been married with astronomy for thousands of years: buildings / cities were matched with astronomy in alignments on a

⁸ This worldview exists in many civilizations, such as ancient China, Maya, Aztec, Egypt, and India.

calendar date, or in a certain circumstance, taking a symbolic meaning in close connection with the movements of the Sun, Moon, and stars.

There are many possible reasons for being matched together in this way, one of them being the purpose of building a channel between the Gods and human beings, to allow interaction with each other. Buildings that include references to celestial events help people to find a moment to contact the deities. Many temples and religious buildings around the world have been found to have this characteristic. In order to show the greatest respect to the Gods, finding out the best moment to interact with those Gods, and when it is the best time to do the ceremony is important in most religions. Therefore ancient peoples made the buildings connect to celestial events with great success both in China and Mesoamerica. The connection of architecture with a specific event and moment in time (which would repeat itself in accordance with the astronomical and/or seasonal cycles) might also produce a *hierophany*, a visible manifestation of the deity, while also symbolizing the cosmic order.

In ancient Mesoamerica, there were many sacred sites, connected with sacred dates for collective or individual religious celebrations, several of them associated with the calendar (and celestial events). One of the best-known examples is the pyramid *El Castillo* in the archaeological site *Chichen Itza* in central *Yucatan*. During the Spring and Autumn Equinox occurs a *hierophany* of the Plumed Serpent, *Kukulkan* in Maya, which is one of the most important deities in ancient Mesoamerica, the Maya version of the *Aztec* deity named *Quetzalcoatl* (Read 2000:180). At *Chichen Itza*, *Kukulkan* was likely thought of as a Vision Serpent connected to the ancestors. In a later period, his images served as a medium between the king and the ancestors or gods and became the symbol of the divinity of the state (Schele & Freidel 1990:394-395).

The *hierophany* at *El Castillo* is that during the days of the spring and autumn equinoxes every year, the shadow of the edges of the layers of the *El Castillo* pyramid, produce, together with the sculpted serpent head at the base of the northern stairway, a waving image of a descending serpent moving down the pyramid. This lively scene, still observable today, suggests that at this moment the deity *Kukulkan* (Plumed Serpent) is descending from the top of the pyramid, i.e. from Heaven to Earth, to give good things to human beings. For the believers, this is visible proof that the pyramid is a sacred temple where the deity may interact with human beings. Even today, every year thousands of people from all over the world, either because of curiosity or with religious inclinations flock to *Chichen Itza* to watch and experience this impressive moment.

El Castillo is a famous case of the connection between architecture, symbolism, and astronomy, but not an isolated one. Other Mesoamerican communities had their own precise astronomical calendars and religious *cosmovision*, which could affect their architectural design. Through their observations, they had acquired the knowledge to put the building in the precise spot and to give it the adequate shape so that it would produce such visual effects, with which it became a stage for rituals and religious experience as well as for celebrating and commemorating great historical moments.

The *hierophany* as a celestial event has also been created in temples of ancient China, even though there are not many cases to be found today. As an influential religion, *Buddhism*

has a long-standing dominance in ancient Chinese societies. In order to preach the Buddha's *mana*, which is very powerful and mysterious, Buddhist believers or monks made an effort to associate their buildings with astronomy to create “magical” effects to create religious emotion among their followers.

A typical case of such a miracle celestial event is the *Buddha's Halo* manifestation of the Three Saints Palace (三圣殿) in the Qixia Temple (栖霞寺), Nanjing, China. The palace built in the period of the *Southern Qi Dynasty* (484-489) has been located there for more than 1,500 years. It is reported that every year in the period of November 22-25 there is a circular Sunlight spot staying on the eyebrow of the biggest and central Buddha of the palace. When the Sunlight spot stays in the Centre of the eyebrow, its light illuminates the gems on the big Buddha's forehead, because of the light reflected by the stone, which makes the stone room where the Buddha is located amazingly full of many colourful light spots. The spot first appears on the right cheek of the Buddha and slowly moves up until it reaches the eyebrow. After shedding the spotlight on the gemstone for several seconds, it disappears (Figure 5-11).



Figure 5-11 the Sun light spot moves to the middle of Buddha's eyebrow
(Drawing by author)

The gemstone between the eyebrows of the Buddha had been there since the earliest construction period of the temple, as is clearly recorded in the history books of *Buddhism*. Unfortunately, it was taken away by others after one thousand years so that the amazing event of *Buddha's Halo* was gradually forgotten with the loss of the gemstone. In recent years, due to the reinstallation of the gems in the Buddha's eyebrows, the *Buddha's Halo* phenomenon has come back and has immediately drawn great attention of the public. Many people from everywhere come to Qixia Temple as pilgrims or as tourists to observe the special event when during the period of the annual festival *Buddha's Halo* appears.

It is said that the founder of the Qixia Temple was a monk with the name of *Sengshao Ming* (明僧绍), who once dreamed of the appearance of *Buddha's Halo* on the western stone-wall of the Qixia Temple, so he set up a volunteer to build Buddha statues here. It is believed that the *Buddha's Halo* phenomenon was caused by the Chinese monks who, well versed in astronomy and considering the Sun's movement, deliberately created the of *Buddha's Halo* celestial event, aimed at promoting pilgrimages to the Western Lord Buddha (Yi 2011).

From the above, we see that astronomical phenomena were used in China and Mesoamerica for a religious purpose, making buildings or monuments produce hierophanies

as miracle scenes on religiously relevant calendar dates. *El Castillo* makes the Feather Serpent descend to the Earth on the equinox days, the *Buddha's Halo* phenomenon in the Three Saints Palace is a wonderful light effect of the Buddha statue. Such miracle creations are not unique and not limited to the civilizations studied here; there are many more cases around the world. As long as any religious congregation identifies a celestial event that might contribute to creating a special religious emotive experience, the believers love to work hard to combine their sacred architecture with the mysterious working of the universe. Of course, the prerequisite is, they have good astronomical knowledge to support their activities.

5.5 Astronomical Predictive: Astrology in Daily Lives

Astrology, as a popular astronomical predictive system, uses the position of celestial bodies (especially Sun, Moon, and the planets of the solar system) to explain or predict human destiny, character and behaviour in daily lives, as well as in political and military actions that are directly related to the destiny of a country.

In China, astronomical observations from the beginning were associated with rituals, divination, and religion. Astronomy was astrology, which became widely used in the later period (Zhang 2013; Chen 1980:2-8). As a result, Chinese traditional calendars integrate the contents of astrology to a large extent, which means, that astronomy, calendar rituals, and religious ideas are difficult to distinguish from each other, even today. The constellations used for astrological purposes can be found in several ancient astronomical works such as the *Astronomical Astrology* (天文星占) of the *Chu State* (楚国, 740-223 B.C.) and the *Astronomy* (天文) of the *Wei State* (魏国, 403-225 B.C.), two works that were collectively referred to as the *Gan Shi Xing Jing* (甘石星经) in the *Warring States Period*. Later, *Sima Qian* (司马迁), a famous historian of the *Western Han Dynasty*, summarized and defined all stars and built a complete system of constellations from many ancient books (especially the two above mentioned books) in his famous book *Historical Records Tian Guan Shu* (史记•天官书). That book records a total of 1,465 stars, which belong to 283 asterisms, known as *Star Officials* (星官).⁹ These are the fundamental works that combined the aims of astrology and astronomy.

The 283 *Star Officials* were seen as the main body of Chinese ancient astronomy. Their names clearly reflect the social system of ancient time: some of them are named after countries or states, such as *Qi* (齐), *Zhao* (赵), *Zheng* (郑), *Yue* (越), *Zhou* (周); some are associated with the national *Star Officials'* positions, such as the *Crown Prince* (太子), *Captain of the Bodyguards* (郎将), *Nine Senior Officers* (九卿), *Three Excellences* (三公); some follow the names of buildings, for instance, *House* (房), *Room* (室), *East Wall* (东壁), *Heavenly Market* (天市), and so on. Each *Star Official* is a group of stars; each star was named after a specific aspect of the human world. In general, *Star Officials* are widely used for astronomical/astrological predictions in many aspects. If a celestial body changes its position within the scope of the *Star Official*, people can predict what will happen and the possible occurrence of the corresponding event according to the unique star name and its

⁹ The English translation *Officials* first was used in the article written by Hsing-chih T'ien and Will Carl Rufus, *The Soochow astronomical chart*, Ann Arbor : Univ. of Michigan Press, 1945.

changed position. For this reason, the contents of *Star Officials* became a fixed coordinate system of ancient Chinese astrology.

The astronomical entity among the *Star Officials* with the greatest influence in ancient China might be the Big Dipper. Its handle points in different directions in different seasons: this phenomenon was used for building a normal calendar to be served for agriculture; besides this, it moves around the Polar Star, and is visible throughout the whole year and very eye-catching in the sky. Regarded by predictors as the Heavenly Carriage of the Heavenly Emperor who traveled in the sky, it was taken as an important *Star Official* to predict the life conditions of an emperor. The seven stars of its body also symbolized the seven officials of the Heavenly Palace. When the brightness of any of its stars changed significantly, that would indicate a problem with the work of the corresponding official, reminding the emperor that he should be replaced. The eclipse is another astronomical phenomenon that provoked preoccupations among the people. In ancient Chinese thought, the Sun symbolizes the emperor; when a Sun eclipse occurs, it means that the emperor is blocked by the shadow, which suggests that the position of the emperor is being violated or endangered. In the case of a solar eclipse, the emperor will take a series of measures to ensure that his ruling power is not affected.

Chinese prediction or divination has a long history: it is a huge knowledge system based on ancient calendars and combined with Chinese traditional cultural concepts such as *Taiji* (太极), *Eight Diagrams* (八卦), *Yin and Yang* (阴阳), *Heavenly Stems* (天干), *Earthly Branches* (地支), and *Five Elements* (五行). According to *Zhou Li* (周礼), there are three sacred books associated with predictions in early time called *Zhou Yi* (周易), *Lian Shan* (连山), and *Gui Zang* (归藏) – unfortunately, only *Zhou Yi* has been handed down till today, and the other two have been lost. *Zhou Yi* is used to predict success, failure, peace, and danger in the past, present, and future events and affairs of people. It is worth noting that most of the above-mentioned elements such as *Taiji*, *Eight Diagrams*, and so on, were not used for divination at the beginning, but used by ancient people to understand and explain the characteristics of the universe in philosophical categories. Later, the combination with astronomy made them into a Fortune-telling theory widely used. For example, the technique *Eight Characters of Birthday* (生辰八字), based on the fact that a birth date consists of eight characters, was widely used to predict the destiny and marriage of a person in ancient China, and even remains popular today. It is defined by the concrete year, month, day, and hour equipped with Heavenly Stems (天干) and Earthly Branches (地支) at the moment of birth, which are combined into eight characters, so it is called *Eight Characters of Birthday*. A person's character and personality is identified at the very moment of his or her birth, so his or her destiny, future life, happiness, family, marriage, and personhood itself could be revealed through the analysis of these eight characters.

Similarly, in Mesoamerica, the birthdate of a person implies links with a series of deities: the patrons of the day-sign and the number, of the night, of the 13-day period, etc. but also deities in charge of special almanacs listed in the religious codices (Nowotny 2005; Anders & Jansen 1993; Boone 2007). The influences of all these deities together determined the character and the destiny of the person. Of the small corpus of manuscripts that have survived

the destruction of the Spanish conquest and colonization, several books mention subdivisions of the calendar with deities and symbols used for divination and for planning rituals: “almanacs” that indicated the aspect of time, i.e. the role and influence of deities in undertaking all kinds of activities during specific periods. Some of these pre-colonial religious books are in the pictographic tradition of Central Mexico (the Teoamoxtli Group, also known as Codex Borgia Group), others are in the hieroglyphic script from the Maya region.

The Mesoamerican calendar was a pivotal device for recording human life events and organizing life in accordance with religious principles. Mesoamericans believed that each day and each period was linked with a specific god, world direction, and a set of (divinatory) symbols, which allowed them to foresee threats and opportunities.¹⁰ In these scenes, we find references to the Sun and Venus. The ancient Maya could calculate solar and lunar eclipses (Bricker et al 1983; Knowlton 2003); they connected the eclipses with darkness and death. Mesoamericans, in general, saw these events as indications of dangers or insecurity. For example, the *Codex Mictlan (Laud)*, page 24, shows an eclipse: the God of Death is blowing darkness on to the precious bright disc of the Sun God, while at the same time, taking the life of a man by cutting out his heart (Figure 5-12). Clearly this indicates life-threatening danger (Anders & Jansen 1994). *Codex Yoalli Ehecatl (Codex Borgia)*, another manuscript with predictions, tells people what period is bad for the activities of rulers, priests, women, farmers, ballplayers, merchants, etc. and also contains prognostications for marriages, childbirth and



Figure 5-12 part of page 24 of *Codex Mictlan*

other aspects of personal life (Anders & Jansen & Reyes 1993). In order to avoid negative influences and to implore the favour of the gods, people were counselled to make offerings, say prayers, and behave ethically. In both the Maya and the Central Mexican divination books we find a chapter that deals with the effects of Venus at heliacal rising: the Venus god is shown throwing spears (probably a metaphor for rays of light) to persons that stand for certain social groups (rulers, warriors, etc.). The Maya Codex Dresden connects these images with a

¹⁰ Jansen states: “Each of the 260 days, but also each of the many periods defined within the calendar, was associated with specific patron deities, mythical personages and events, as well as with cosmologic realms” (Jansen 2012: 43,44, 77-94).

precise calculation of the periods of visibility and invisibility of Venus in a period of 104 years, i.e. two calendar rounds (Bricker & Bricker 1992).

The calendars of ancient China and Mesoamerica, therefore, were not only used as a calendar to record the passage of time but also had a religious dimension and were used for divination, prediction, and rituals. To an ancient Chinese, the decision of a large part of the matter of his daily life depended on the warrant of "Heaven", that is, his "fate", and his destiny could be predicted by his calendar date. Similarly, Mesoamericans' lives tried to maintain harmonious relationships with the deities: people took the calendar to find out to which deity to turn for orientation and support, as well as for identifying the positive, negative, or indifferent influences of the deities in certain moments of time.

5.6 The character of time: Rhythm and Uniform

Anthropological and historical studies show that many cultures have developed a concept of time as an abstract measure of duration, and have invented ways to express this in metric quantities through a calendar, which makes it possible to determine the sequence of the seasons, to register history and to plan the future (see the classic publications by Munn 1992 and Gell 1992). Consequently, time perception contains an interaction of cyclical (seasonal) and linear (historical) aspects. Some cultures stress the cyclical aspect in their worldview, according to which time is experienced as unchangeable, continuous, homogeneous, infinitely continuing without beginning and without end. In other cultures a linear perception may be dominant, for example, in Christian thought time is seen as moving from Creation to a Last Judgment. In Western culture, this teleological orientation has developed into an idea of progress and economical accumulation, in which the West is seen as modern and leading in the world, while other cultures are seen as "primitive", "underdeveloped", "in another time" (Fabian 1983).

Chinese tradition is not teleological. When we read the ancient calendar texts and related literature, we find the following aspects in the way Chinese perceived, practiced and understood time:

1. Time is flowing rhythmically.

The Chinese perceive time as flowing with a certain rhythm, like a heartbeat. Time can be measured by labelling some important nodes. Specifically, time is accumulated from small to large, in a certain rhythm and scale: "5 days is a *Hou*, 3 *Hous* is a *Qi* (*Jie*), 6 *Qis* is a *Shi* (season), 4 *Shis* is a *Sui* (year)"¹¹. The time nodes here can be summarized as:

$$1 \text{ Sui} = 4 \text{ Shis} = 24 \text{ Qis} = 72 \text{ Hous} = 365 \text{ days}$$

From here, longer periods of time can be distinguished¹²:

$$1 \text{ Ji} = 7 \text{ Shous} = 21 \text{ Suis} = 420 \text{ Bus} = 1680 \text{ Zhangs} = 31920 \text{ Suis}$$

The above-mentioned nodes of the time from the small to the large is: Day - *Hou* - *Qi* - *Shi* - *Sui* - *Zhang* - *Bu* - *Sui* - *Shou* - *Ji*. This is just a cycle of time, when it is over, another

¹¹ Refers to the chapter of *Six Jie Zang Xiang Lun* (六节藏象论) in *Su Wen* (素问), "5 days is a *Hou*, 3 *Hous* is a *Qi*, 6 *Qis* is a *Shi*, 4 *Shis* is a Years 五日谓之候, 三候谓之气, 六气谓之时, 四时谓之岁".

¹² Refers to the *Zhou Bi Suan Jing*, "19 years is a *Zhang* (章); 4 *Zhangs* is a *Bu* (部), a total of 76 years; 20 *Bus* is a *Sui* (遂), a total of 1520 years; 3 *Suis* is a *Shou* (首), consists of 4560 years; 7 *Shous* is a *Ji* (极), including 31920 years".

cycle (*Ji*) will begin. In a period of a *Ji*, the time flows evenly and has a certain sense of rhythm. It jumps forward like an hour-hand, and also has life phases like human beings. The rhythm of time as a cultural order (calendar) expresses and structures the social and economic rhythms (cf. Lefebvre 2004).

2. Time is phased, with beginning and end.

According to the *Zhou Bi Suan Jing*, a life cycle consists of a total of 31920 years, called *Ji*. This cycle is controlled by Heaven; when it is over, all creatures will die¹³, and a new *Ji* will begin.¹⁴ That is, the time is phased in cycles, its life periods, which run from a beginning to the end. It is started by Heaven and will end its life after 31920 years.

3. Time is promoted by the dualistic parts of Yin and Yang.

In traditional Chinese worldview, the original universe was a mass of chaos. The light gas rose, and heavy dust fell, forming Heaven and Earth, *Yang* and *Yin*.¹⁵ The dualism of *Yin* and *Yang* is manifest in the alternation of Day and Night, which promotes the time to move forward (Zhan 2008). This idea was shown in *Cheng Ma* (乘马) of *Guan Zi* (管子), “the changing of Spring, Autumn, Winter, and Summer is the result of the transition of *Yin* and *Yang*...the alternation of day and night is caused by the change of *Yin* and *Yang*.”¹⁶ Other books such as the *Book of Changes* and *Huainan Zi* also reflect the same idea. For example, the *Astronomy* in *Huainan Zi* records, “Heaven and Earth are inherited by *Yin* and *Yang*. The movement of *Yin* and *Yang* forms the four seasons.”¹⁷ Consequently, the changes in the dualistic parts of *Yin* and *Yang* promote the moving of the time.

4. Time has meaning and character.

Time in China is an abstract period of duration in which events happen, but those events do not repeat themselves: each of the time periods is different. The change of day and night, and the change of seasons, not only reflect the movement of time, but also a process of *Yin* and *Yang* alternation and time-space conversion. The changing from Spring to Summer, for example, reflects many aspects: (1) the alternation from *Yin* to *Yang*, (2) the agriculture period from sowing to plant cultivation, (3) the space connected with time shifts from the East to the South, and so on. The length of each time period is the same, but in fact, its contents, essence and connotation are not the same. Each time period (such as year, seasons, *Jie* and *Qi*, *Hou*, even the date, hours) is related to many aspects, such as *Yin* and *Yang*, agriculture, directions, good or bad, building activity, and even human life.

In comparison, what was the time concept of Mesoamerica? The passage of time was characterized by its association with the patron deities of the cyclical periods and this was expressed in rituals: “the temporal structure and organization of the 260-day calendar, the 365-day calendar, the 52-year calendar, and the Long Count calendar inform about the perception, purpose, and the characters of the respective ritual practices.” (Pharo 2013:11).

¹³ The original words in *Zhou Bi Suan Jing* is: “all creatures will die, everything begins again 生数皆终，万物复始”.

¹⁴ *Zhou Bi Suan Jing*: “Heaven changes the time, and makes a new calendar. 天以更元，作纪历”.

¹⁵ Refer to Xu Zheng, *Three and Five Calendars, Three Kingdoms*, “Yang and clear is Heaven. Yin and turbid is the Earth.”

¹⁶ The original words in *Cheng Ma* (乘马) of *Guan Zi* (管子) is: “春秋冬夏，阴阳之推移也……日夜之易，阴阳之化也。”

¹⁷ It was recorded in the chapter *Astronomy* of *Huainan Zi*, “Heaven and Earth are inherited by *Yin* and *Yang*. The movement of *Yin* and *Yang* forms the four seasons (天地之袭精为阴阳，阴阳之专精为四时).”

The structure, character and content of the different Mesoamerican calendar cycles, may be summarised as follows:

1) Time is structured in a vigesimal system.

As we have seen, the calendars in Mesoamerica have a vigesimal structure (consisting of multiplications of 20 days), which could be interpreted as a rhythm. The basic unit of calendars is the set of 20 day-signs: in the *tzolkin* / *tonalpoalli* the 20 day-signs are paired with 13 numbers leading to a 260-day cycle; in the *haab* / *xihuitl* calendar, 18 periods of 20 day-signs plus extra 5 days, in the end, form a unit of 365 days. That is:

$$13 \times 20 = 260$$

$$18 \times 20 + 5 = 365$$

From the above, both units can be seen as based on a multiplication of 20. In Mesoamerica, a day called *kin*, a 20-day signs circle called *uinal* (month), a year of 360 is a *tun*. So, there is a basic system of *tun* is:

$$1 \text{ tun} = 18 \text{ uinals} \times 20 \text{ kins}$$

Furthermore, the Classic Maya “Long Count” shows the same vigesimal structure, the total number of passed days being counted in multiplications of 20, with the *tun* (360 days) as the basic unit. As we have seen, the largest time unit is the *alautun*, which corresponds to about 63,000,000 solar years or 23 billion days (Penprase 2017:181; Kremer 2000), and the time units on which it is based decrease step by step in a 20-fold relationship, forming a series of rhythmic time units, making time move forward at a uniform speed:

$$1 \text{ alautun}$$

$$= 1 \times 20 \text{ kinchiltun}$$

$$= 20 \times 20 \text{ calabtuns}$$

$$= 20 \times 20 \times 20 \text{ pictuns}$$

$$= 20 \times 20 \times 20 \times 20 \text{ baktuns}$$

$$= 20 \times 20 \times 20 \times 20 \times 20 \text{ katuns}$$

$$= 20 \times 20 \times 20 \times 20 \times 20 \times 20 \text{ tuns}$$

In comparison, the time units of China show a constant, but evenly expansion one by one, while the units of time in Maya expand rapidly with a 20-fold relationship. The largest time unit in China *Ji* includes 31,920 years, while Mayas' *alautun* has reached 63 million years. Obviously, the date recorded in the time units of the Maya is even more distant.

2) Time has a beginning and end.

Similar to the Chinese idea of the life cycles of time, the Mesoamerican worldview was that there were several successive creations of the cosmos. The duration of these creations was defined in significant calendar periods. Thus the Maya seem to have believed that the present universe was created and exists in a period of 2,880,000 days long (about 7885 solar years), then it will be destroyed finally and recreated to the next universal cycle. The Maya world is a process of creation and destruction, and so is time. The current calendar cycle has a beginning date, which may mark the beginning of the present universe: 4 *Ahau* 8 *Cumku*, corresponding to the Gregorian date 13 August 3114 BC (Penprase 2017:180), and September 6, 3114 BC in the Julian calendar; this count came to a completion on 4 *Ahau* 3 *Kankin*, corresponding to 21 or 23 December, AD 2012 (Penprase 2017:181; Kremer 2000). In the

view of the Mayas, time exists in a sequence of cycles, each with a beginning and an end: when this “time” dies, the next “time” will start. That is, the time cycle, like a person’s life, has a beginning and an end. This idea is similar to that of ancient China.

3) Time is moved forward by the “Bearers”.

As was explained by *Thompson*, the time units of the Maya calendar are carried and moved forward by series of “Bearers”: “Maya conceived of the divisions of time as burdens which were carried through all eternity by relays of bearers... [not] the journey of one bearer and his load, but of many bearers, each with his own division of time on his back.” (Rice 2004). These bearers are all deities and each bearer / god is paired with and in charge of a time-period (Montejo 1999). Each time bearer plays its own role in a cosmic relay, and when he passes his burden to the next bearer his work is completed and he may rest (León-Portilla 1990:24).

Generally speaking, the time of China is driven by the interaction of *Yang* and *Yin*, manifest in the alternation of Day and Night. Strictly, the two dualistic sides are not gods, they are seen as aspects of a spiritual cosmic force (Zhan 2008). In contrast, the Maya bearers are regarded as individual gods who are responsible for taking care of a (cyclical) unit of time and pushing it forward. When the period finishes, the patron or bearer goes to “rest” and another bearer will come to take over the responsibility (burden) for the next period of time.

4) Time has its character and links with rituals.

In Mesoamerica, “every time interval and calendar has its own character” (Pharo 2013:11), that is, the calendar is not only a counting device but has a complex meaning of its own, intimately related to deities, religious symbols and ritual practices (Pharo 2013:1). Because of these relations, the units and cycles of time have augural qualities: specific days or periods may be good, indifferent or bad for specific actions and may impress those qualities on events that take place and persons that are born then. Similarly, time is always linked with the rituals since people who want or need to carry out a ritual must choose a special time, and since the repetitive character of the rituals tends naturally to coincide with calendar cycles. Consequently, time in Mesoamerica is a “social, cultural, religious, and political construction” and “cannot be understood as a universal and uniform category” (Pharo 2013:6).

Generally speaking, the combination of time and architecture is achieved under religious needs. Architecture achieves its special performance in the universe through being an external symbol of or having an internal alignment with celestial bodies in order to achieve religious purposes. Because the time, as the given form in the calendar, has many religious aspects, the buildings associated with it added to the sacredness of ritual actions.

This is an example of Non-verbal Communication (as analysed by Rapoport). On the one hand, the exterior aspects of architecture (e.g. shape, size, scale, height, colour, materials, textures, decorations), as well as its internal structure (proportions, numbers of components, etc.) was associated with aspects of the religious worldview, time perception and cultural memory (calendar numbers, star maps, historical figures, cosmological theories, astronomical symbols, day signs, etc.), which could evoke people's emotions (happiness, surprise, fear, respect, sadness, loss, and so on); on the other hand, ceremonial buildings might be physically

aligned to the world directions and the positions of the celestial bodies and the gods, resulting in celestial events (*hierophanies*), which could bring awe, creature feeling and a sense of mysterious personal contact with the powers of the universe.

5.7 Conclusions: Calendar and Worldview Complement Each Other

Ancient calendars in China and Mesoamerica were not merely technical devices based on purely astronomical observations but were intertwined with religion and symbolism. It is even difficult to distinguish whether the astronomical or the religious aspect was dominant in the formation and use of the calendars.

There are many commonalities between the calendars from both civilizations, mainly:

1. Structure

Both calendar structures use the combination of several cycles. The Chinese took the Heavenly Stems and Earthly Branches to create a Calendar Round of 60 years; the Mesoamerican calendar formed a 52-year Calendar Round by combining four year-bearer signs with the numbers 1-13.

2. Dates have cosmological connotations

In both calendars the names of days and dates have symbolical connotations (connected to cosmological ideas) and contain (implicit) references to the duality of light (hot) and darkness (cold).

3. Religious dimension

Both calendars were not only a tool for measuring time but also were deeply connected to religious and cosmological ideas as well as ritual practices. As such the calendars were important in the construction of a community.

4. Connection with sacred architecture

In both cultures, astronomical alignments were to establish a symbolic link between architecture and the (ritual) calendar, in close connection with celestial phenomena to create a *hierophany*. At the same time, calendar numerology was used in the construction and proportions of buildings so that architecture would have a connection to the numinous world and would be experienced as sacred.