# Development of Celestial Navigation by the Ancient Maya

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This paper discusses the knowledge and culture of astronomy possessed by the Maya civilisation and how this might have been used for marine navigation in the 8th Century. Comparison is made with the European view and use of celestial positioning.

KEY WORDS

1. History. 2. Astro Navigation. 3. Sea.

1. INTRODUCTION. Contrary to current consensus, recent historical research has revealed that the ancient Chontal Maya in northern Yucatan possessed large seaworthy vessels in which they navigated long distances out of sight of land (400–600 nautical miles) to reach the islands of the Caribbean and the shores of Florida (Peck, 1998a and 1998b). Without the benefit of a magnetic compass, these long voyages would have required some form of celestial navigation. The Maya seafarers would have used the rising and setting Sun for orientation in the morning and late afternoon and maintained their course at midday by adherence to wave patterns in the same manner as ancient Polynesian navigators. Maintaining their desired course at night would have required reference to the circumpolar stars and planets with which they were thoroughly familiar. But familiarity alone with the stars and planets is not enough for effective celestial navigation.

Maya science related to the cosmos is tied inexorably to their religion and to their concept that the relationship of the movement and relative position of the planets and constellations (viewed as embodiments of their gods) influenced and even controlled events and fortunes on the Earth. For this reason the Maya developed their science of astronomy so they could predict the movement and relative position of the heavenly bodies accurately on any particular calendar date. In this respect, it is similar to European astrology that gradually moved from folklore art and myth beginning in ancient times and evolved into the science of astronomy around the fifteenth century, which then provided the mathematical data required for the development of celestial navigation. Accurate astronomical data essential to the development of celestial navigation was available to the Maya many centuries before it was available in Europe. Although the same astronomical data was available to both the Maya and Europeans, their basic application of that data took a different approach.

An elementary form of celestial navigation was performed by ancient navigators in Europe, the Middle East, and the Orient long before the introduction of the magnetic compass. These early navigators in the northern hemisphere would have used some of the circumpolar celestial bodies, but their primary reliance was on the North Star

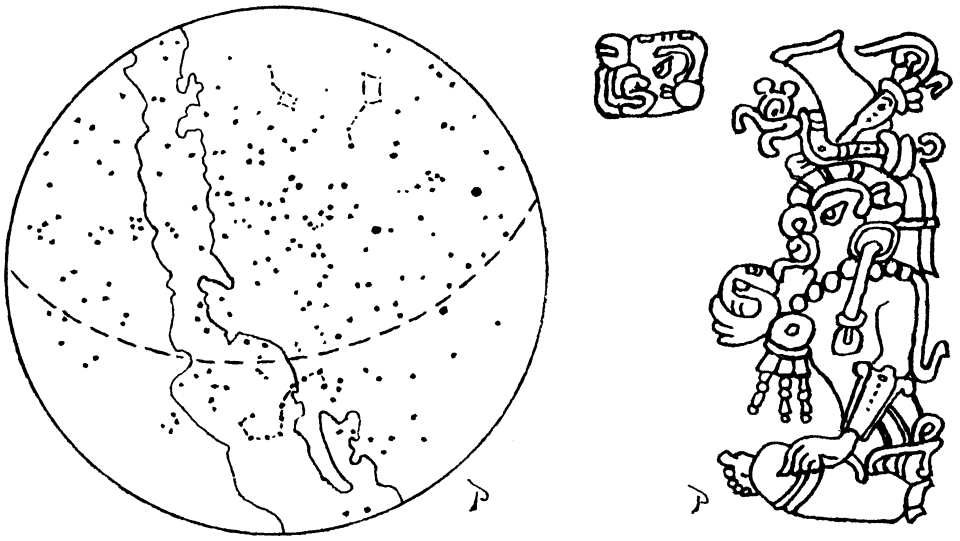

Figure 1. The night sky on the left, at 20 degrees latitude when Scorpius is opposite the north celestial pole, was redrawn from the *Maya Cosmos*. The god of the north on the right was redrawn from the Dresden Codex.

(Polaris) to determine the north azimuth from which they could extrapolate the other cardinal points of east, west, and south. A similar use of the North Star for navigation would have been unworkable for the Maya because of their more southern location. The already weak Polaris would have been much lower on the horizon and more difficult to see with the naked eye because the light from the star must pass through more of the Earth's hazy atmosphere.

There is no mention of the existence, or the significance, of the North Star in the Maya complete lexicon of known stars and planets. The direction of north, or the north celestial pole, was pictured on the Tablet of the Cross at Palenque not as a star, but as a black void, and was revered by the Maya in their creation myth as the heart of heaven from which the gods, Itzamna and the First Father, emerged from the other-world to create the Earth and the cosmos. When the First Father created the sky, he set the crown or heart in the dark north void and gave the stars and planets a circular motion around this dark celestial pole.

The black void at the Maya celestial pole is illustrated in Figure 1 although the void is necessarily shown in white. The weak Polaris and some of its equally weak neighbours would have been barely visible in this north void, but of no consequence to the Maya who considered the bright Venus, Saturn, and other overhead stars, planets, and constellations as the embodiment of their principal gods. Venus was particularly important and its significance varied with its orbital confluence with the Sun as a morning star or an evening star. Venus is associated with the First Father and is thus a male figure rather than female as in the Zodiac of the western world. The god of the north shown in Figure 1 is incorrectly labelled the 'god of the North Star' in most Maya historical reference publications. The Maya had no 'North Star' so this misconception is one more example of how historians and anthropologists try to force accepted western cultural norms and knowledge into the interpretation of Maya mysticism and science.

In Maya religious dogma, the First Father created the sky and divided it into eight partitions consisting of the four cardinal points of north, south, east, and west, with four more intermediate points at northwest, northeast, southwest, and southeast. This partition of the sky can be seen on several works of Maya art and is best illustrated in some detail in the Madrid Codex. The depiction of the partition of the sky in the Madrid Codex is weathered and damaged with some portions missing or indistinct. The drawing in Figure 2 represents my interpretation of how the original

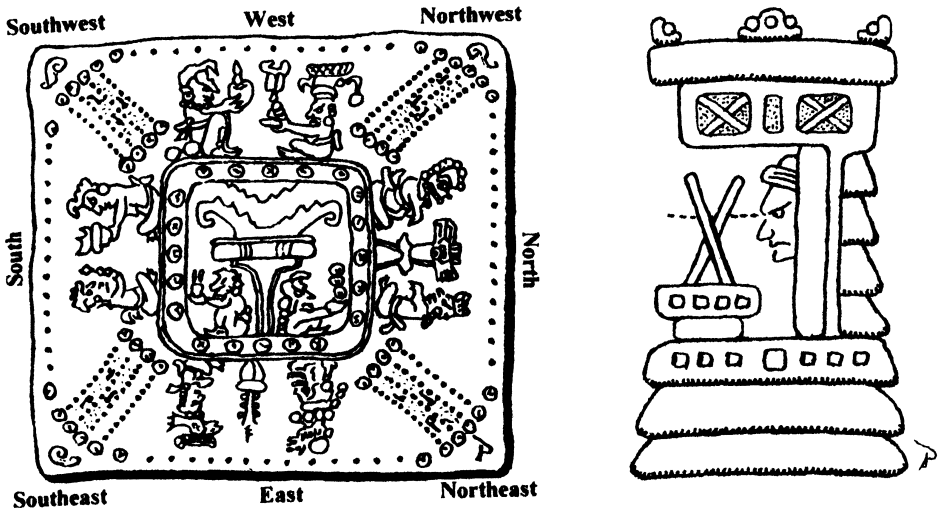


Figure 2. The figure on the left shows the partition of the sky as redrawn from the Madrid Codex and the figure on the right is a stylised drawing of an astronomical observatory as redrawn from the post classic Nuttall Codex.

undamaged illustration would have appeared in the Codex. An analytical examination of the drawing reveals that it is much more than just a depiction of the eight partitions created by the First Father. This detailed drawing from the Madrid Codex has all the elements and mathematical data required for celestial navigation.

The Madrid and the Dresden codices are filled with mathematical tables pertaining to the orbital movement and calendar timing of celestial bodies. It is significant that these documents have been traced to northern Yucatan, the homeland of the seafaring Chontal Maya who made the long overseas voyages requiring celestial navigation. The tall round building with spiral stairs leading to the dome-like room on top found in Chichen Itza, the capital city of the Chontal Maya in northern Yucatan, has now been identified by archaeologists as an observatory for celestial observations (Coe, 1993). This observatory was probably the source for the mathematical tables and data contained in the Dresden and Madrid codices.

The depiction of the sky in the Madrid Codex shows each cardinal point represented by two gods associated with that particular direction. The north void is represented by two gods that appear to be the morning and evening star (Venus) with the world tree or tree of creation between them. The intermediate points of northeast, northwest, southeast, and southwest, are shown by four parallel dotted lines. The space between three of the four dotted lines is filled with numerous mathematical

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numbers separated by a few scattered symbols. The meaning or function of the numbers is unclear, but it could easily constitute a numerical grid of the sky to locate stars, planets, or constellations, giving their angular declination in relation to their azimuth position on a particular date.

The fact that each intermediate point is represented by four lines instead of one is significant. This could very well mean that later Maya astronomers had further divided the original eight partitions provided by the gods into 20 segments (4 cardinal points plus 16 intermediate points) to make their astronomical observations and data more definitive and more accurate. This is quite logical since the Maya vigesimal mathematical system is based on advancing the numbers beyond the decimal by a power of 20 rather than by 10 as in our decimal system. In this regard, it should be borne in mind that the artist's drawing in the codex is meant to be merely a schematic illustration of religious significance rather than an accurate depiction of the astronomer's worksheet. For this reason, the artist felt compelled to show the appropriate gods at the four cardinal points that crowded the four intermediate points into the inappropriate parallel lines shown. The worksheet of the astronomers would not have shown the artwork depicting these gods and so the 20 increments of the sky would have been spaced evenly around the perimeter of the sky as though the viewer was in the middle of the figure looking at the sky overhead with the Index point in the revered black void of the north. The work sheets of the European mathematicians who developed celestial navigation around the fifteenth century used this basic concept, but divided the sky into 32 increments (based on the 32-point magnetic compass of the period) with the index point on Polaris or the North Star. Another difference in the European system was that the mathematical data for computation of declination was shown in separate tables contained in their nautical almanacs or Regiomontanus, rather than on the azimuth document. The mathematical tables in these European almanacs contained many errors as they were based on the error-filled *Almagest* of Claudius Ptolemy (circa 150 AD), and there is every indication that the mathematical data contained in the Maya document was probably more accurate (Brown, 1993).

There is evidence to indicate that the Maya knowledge of the orbital path and timing of the planets was so complete and accurate that they were able to plan and time major events during a conjunction of these bodies to provide a favourable religious augury for the event. The Bonampak murals record a major battle that occurred there on 6 August, 792. The artwork in the mural indicates that the battle was conducted under the favourable signs of Mars, Saturn, Orion, and Gemini. And indeed, when the sky for that date is examined, we find a near conjunction of Mars, Saturn, Orion, and Gemini which are bisected by the Milky Way. The Milky Way was revered as the reptilian celestial monster of creation and would have added to the favourable portent of the event.

This advanced knowledge of astronomy and the sophisticated system of predicting and displaying the orbital path of the stars, planets, and constellations in their relative position in the sky on any one date would have made celestial navigation an easily attained art or science. However, the Maya system of celestial navigation would not have converted the celestial observations to a latitude/longitude line of position (LOP) as in modern (or early) celestial navigation. The Maya concept of the celestial cosmos as related to navigation centred around the city at which the observations were being made, and all points in the sky or on the surface of the Earth or sea were

relative to that point rather than to a numerical latitude or longitude. This concept of navigation in which the position of the vessel is related only to its point of departure is not unique or common only to the Maya. It was the same basic concept, based on dead reckoning navigation, used by early European navigators on their portolan charts for centuries before (and even after) acceptance of the latitude/longitude method of fixing a position on the face of the Earth.

The Maya navigator crossing the open sea seeking new lands would be guided by the Sun and wave patterns during the day, and his celestial navigation at night would not be tied to any particular star such as Polaris or the North Star. Instead he would view the entire sky as a charted and indexed map with which he was thoroughly familiar. His only concern was his spatial relationship with his point of departure and whether he was receiving good omens for the voyage from the gods of the sky.

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