Jamie Luna

History and Science of Latin America

INDT 262

Mayan (architecture, calendar,) related to science

The ancient Mayan civilization stands as a testament to human intellectual achievement, particularly in the realm of astronomical observation and celestial understanding. At the heart of their scientific prowess lay an intricate relationship with the planet Venus, a celestial body that transcended mere astronomical curiosity to become a fundamental element of Mayan culture, religion, and statecraft. This essay explores the profound significance of Venus in Mayan civilization, tracing its importance through astronomical records, cultural practices, and the groundbreaking work of researchers who have unraveled the complexities of Mayan astronomical knowledge. The Mayans' approach to astronomy was far more than a scientific endeavor—it was a sophisticated system that integrated celestial observation with political, religious, and agricultural practices. The Venus Table in the Dresden Codex, a remarkable document of astronomical precision, exemplifies the depth of their celestial understanding. Through meticulous tracking of Venus's cycles, Mayan astronomers developed a complex calendar system that allowed them to predict celestial events with remarkable accuracy, using these predictions to guide everything from military campaigns to agricultural planning.

In chapter 5 of the book *How to Practice Mayan Astrology: The Tzolkin Calendar and your Life Path* we learn that Venus holds a crucial role in the lives of the Mayans and other Mesoamerican civilizations. They meticulously observed its movements and incorporated its cycles into their calendars and daily lives. The planet Venus was associated with the god

Quetzalcoatl, also known as Kukulcan among the Maya, who was a prominent deity in Mesoamerican mythology. This deity was often depicted as a feathered serpent, symbolizing both the earth and the sky. The Mayans tracked Venus's cycle, which lasted approximately 584 days, and divided it into four distinct phases: the morning star, disappearance at superior conjunction, the evening star, and disappearance at inferior conjunction. Each phase had specific cultural and religious significance. For example, the appearance of Venus as the morning star was often associated with war and conflict. The Mayans believed that this phase of Venus brought about a time when the gods demanded sacrifices and battles. Venus's cycle was so significant that it was integrated into the Mayan calendar system. The Mayans used a complex calendar called the Long Count, which was supplemented by the Tzolk'in (a 260-day ritual calendar) and the Haab' (a 365-day solar calendar). The synchronization of these calendars with the Venus cycle allowed the Mayans to predict celestial events with remarkable accuracy. They used these predictions to plan agricultural activities, religious ceremonies, and even political events.

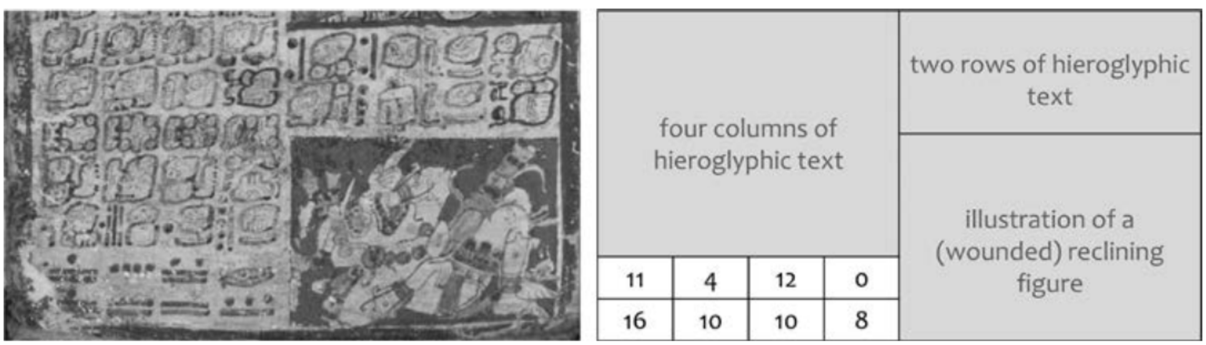
The Dresden Codex, one of the few surviving Mayan manuscripts, contains extensive tables and calculations related to Venus's cycles. These tables were used to predict the heliacal rising of Venus, which was a significant event for the Mayans. They believed that the accurate prediction of Venus’s appearances and disappearances was crucial for maintaining cosmic order and harmony. Venus was also associated with fertility and abundance. The Mayans believed that the planet's influence could bring about prosperous harvests and favorable conditions for their crops. This belief was reflected in their agricultural practices and rituals, where they sought the blessings of Venus for a bountiful yield. Venus played a role in Mayan mythology and storytelling. The planet was often featured in myths and legends that explained natural phenomena and the actions of the gods. These stories were passed down through generations and were an integral part of Mayan culture and identity. Venus was more than just a celestial body for the Mayans and other Mesoamerican cultures. It was a symbol of divine power, a guide for agricultural and political activities, and a central element in their calendar system. The meticulous observation and integration of Venus's cycles into their daily lives highlight the advanced astronomical knowledge and deep cultural significance that the planet held for these ancient civilizations.

Venus is called an "interior" planet because its orbit is closer to the Sun than Earth's. This gives Venus (and Mercury) a different visibility pattern compared to other easily visible planets like Mars, Jupiter, and Saturn. While the exterior planets can be seen anywhere along the zodiac, Venus is only visible near the horizon in the morning or evening. The visibility of Venus changes because the orbits of Earth and Venus are not perfect circles and aren't in the same plane. However, on average, Venus follows a predictable pattern over 584 days. A scientist named Förstemann observed Venus between 1882 and 1884. He noted that Venus first became visible in the morning just before sunrise. Over the next 242 days, Venus rose earlier each morning and slightly north of its previous position. About 198 days after its first appearance, Venus was farthest from the Sun, rising 1 hour and 15 minutes before sunrise. After this peak, Venus started rising closer to sunrise as its distance from the Sun decreased.

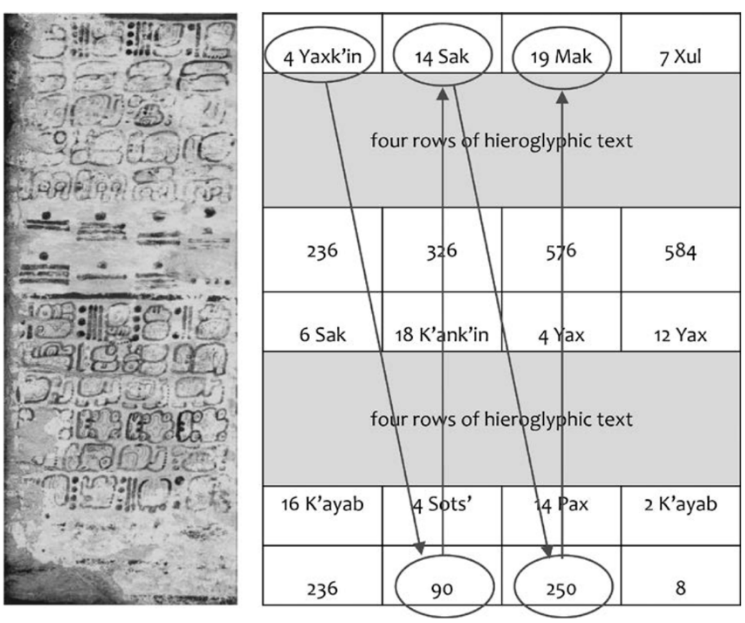
Later in his work, Förstemann thought that the differences in his observations might be due to trying to include either Mercury's or the Moon's periods. What's more important is that the overall logic in his findings was clear. Even though the exact intervals didn't match Venus's movements perfectly, the 8-day invisibility period and the 584-day cycle strongly suggested

Venus was the focus. Better data later showed Venus was visible for about 263 days on average, with invisibility periods of 8 and 50 days, but this didn't change his main conclusions.

Förstemann noticed that the 8-day interval matched the last column of dates on figure 1. The final date in the table, on figure 2 , was 1 Ajaw. He realized that the table was designed to return to the date 1 Ajaw 13 Mak every 104 years when Venus first appeared in the morning. Using the Long Count, the 260-Day Count, and the 365-Day Count, Förstemann was able to explain most of the information on these figures and hypothesized that it all related to tracking Venus. He had figured out the main numerical pattern of the Venus Table.



(Figure 1)



(Figure 2)

4 Ajaw 8 Kumk’u
+ 1 day
5 Imix 9 Kumk’u
+ 1 day
6 Ik’ 10 Kumk’u
+ 9 days
2 Chuwen 19 Kumk’u
+ 1 day
3 Eb Seating of Wayeb
+ 1 day
4 Ben 1 Wayeb
+ 3 days
7 Kib 4 Wayeb

(figure 3)

+ 1 day
8 Kaban Seating of Pohp
+ 1 day
9 Etz’nab 1 Pohp

Seler's timing was influenced by a long history. In the 1830s, after Humboldt had returned from Latin America and gained fame for his work, adventurers John Lloyd Stephens and Frederick Catherwood traveled through Mayan lands. They created popular illustrations and stories about their experiences. Their publications were very popular in Europe and the U.S., but few scholars followed them due to military unrest after the region gained independence from Spain. It wasn't until the late 19th century that Europeans started returning to the Yucatan Peninsula. One such explorer was Alfred Maudslay, who traveled through the Mayan region with Stephens and Catherwood's book, "Incidents of Travel in Yucatan." Maudslay was a typical 19th-century adventurer, exploring the South Pacific and Mesoamerica before becoming a successful Maya archaeologist. Between 1881 and 1902, Maudslay worked at twelve different Mayan sites over seven seasons. By 1888, he had visited famous Classic period sites like Copán, Quirigua, Tikal, and Yaxchilan. Like Stephens and Catherwood, Maudslay made many drawings of monuments and hieroglyphs, but he also took lots of photos. His work, published in "Biologia Centrali-Americana" (1889), included both photos and detailed drawings, which were very important for Maya research.

Maudslay's work convinced him that these sites were from the same time period and were ancient compared to when Europeans first met the Mayans. He noticed that Chich'en Itza, which Catherwood had illustrated, was also mentioned in historical records. Chichen Itza began as a pilgrimage site to the Sacred Cenote, a water-filled sinkhole that later became a major archaeological site in the northern Yucatan Peninsula. The northern Yucatan Peninsula is a limestone plain without rivers, streams, lakes, or ponds. The area has many natural sinkholes, known as cenotes. One of the most notable is the Sacred Cenote, which is 60 meters wide and surrounded by steep cliffs that drop 27 meters to the water below. The exact time when the Sacred Cenote became a pilgrimage site is debated. Some suggest it started as early as the "Maya Preclassic" period (2000 BC – 250 AD). This estimate spans about 2250 years, which is a very broad range and even longer than the entire Christian era. However, another study provides a more precise date for the first occupation of Chichen Itza, which is 495 AD. This means that around or before 495 AD, the founders of Chichen Itza began to use the Sacred Cenote regularly as a pilgrimage site.

This made him realize that connecting Chich'en Itza to other Classic period sites could link the great cities to history. In 1889, he decided to work at Chich'en Itza to figure out its relationship with the other sites he had explored. When Maudslay arrived at Chich’en Itza in the late 1800s, it wasn't a "lost city" because people always knew about it. The name "Chich’en Itza" means "at the edge of the cenote of the Itza," referring to its location next to a big natural well. The Itza Mayans, who came from the southern Peten region, named it. Even after the city was no longer lived in, people still visited the well into the 1500s. Families like Xiu and Cocom made pilgrimages there, and they even had conflicts over access to the sacred well. Although the city wasn't populated anymore, it remained important to local people.

Maudslay also used Landa's description from the 1500s. Landa described a ruined structure called "El Castillo" or the "Temple of Kukulcan" and even sketched it, showing how it looked in his time.

Landa described the stone building at the top of the pyramid, noting a space in the northern room used for burning incense. This building and its features are important in the final chapters of the book. Landa also talked about the area around the Temple of K'uk'ulkan. There were many big, well-built buildings, and the ground between them was covered with cement, which was very strong. In front of the north staircase, there were two small stages with four staircases each, where they performed plays for the public. Landa, likely with Juan Cocom, observed the government, religion, and theater arts that shaped life in the city. As a visitor, he could imagine the city leaders and priests organizing politics and rituals more easily than modern tourists can. However, his interest in the Great Cenote might seem abrupt to today's tourists. He mentioned a wide causeway leading from the stages to a well, about two stone's throws away. Two hundred and fifty years later, Stephens and Catherwood visited the ruins.

When Maudslay arrived sixty years after Stephens and Catherwood, and more than three hundred years after Landa, he started a big project. He and his team cleared a lot of trees and brush, which you can see in his famous photographs. This helped him make a very accurate and detailed map . But the work wasn't easy. At that time, the Yucatecan economy was booming because of henequen, which drew local Mayan villagers to work on plantations. This made it hard to find workers for the archaeological work (Graham 2002, 157). On top of that, both Maudslay and his partner Henry Sweet got very sick and had fevers during their stay (Graham 2002, 163).

Despite the challenges, their efforts were very rewarding. Sweet took a famous photo of Maudslay from the temple on top of the Monjas Structure. Maudslay poetically described the view from there: "To the southward, where no clearing had yet been made, the sea of verdure spread unbroken from our feet. During the lovely tropical nights, when a gentle breeze swayed the tree-tops, and the moonlight rippled over the foliage, it seemed to be a real sea in motion below us, and one almost expected to feel the pulsation of ocean waves against the walls" Maudslay’s map is still very impressive, even compared to newer ones made with better technology. His detailed photos of the architecture and inscriptions are still valued today

Förstemann and Teeple believe that Tawiskal Uwoojil created the Venus Table to track Venus’s appearances in the morning and evening skies accurately. John Teeple found that the Venus Table's precision suggested it was like the ephemerides used in ancient Greece or Mesopotamia. However, unlike those cultures, Mayan astronomers used a calendar-based algebraic model instead of geometry. This focus on accuracy, along with evidence that Mayan leaders were also involved in astronomy for statecraft, helped solidify the view of the Mayans as scientifically advanced. Archaeological excavations further supported this understanding, showing that Mayan architecture was aligned to track celestial movements. For example, Oliver Ricketson found an equinox alignment at the Caracol in Chich’en Itza, which he called “the Observatory.” The Caracol is a circular tower with doors aligned to the cardinal points and an inner corridor with more doors between the cardinal points. Inside, there is a small spiral staircase leading to the upper part of the building, although the top of the staircase is not preserved.

Although the Mayan civilization never formed an empire like the Aztec Triple Alliance, Mayan cities formed political and economic alliances across large regions. These alliances were typically hierarchical. Maudslay's hypothesis that the southern cities were part of a cultural sphere has been confirmed by hieroglyphic inscriptions, as most Long Count dates on their monuments start with a baktun coefficient of 9.

Epigraphers Simon Martin and Nikolai Grube discovered that the Mayan civilization had a system of 'overkingship,' where a few powerful cities, like Tikal and Calakmul, dominated many smaller kingdoms. This system was common in Mesoamerica and explained the differences in the sizes of the Mayan capitals. Tikal and Calakmul, the two main 'superpowers,' were often in conflict.The Mayans used celestial events, like solar eclipses, to legitimize their political power. They aligned their buildings with celestial bodies and recorded astronomical events in their inscriptions. This knowledge was used to plan military campaigns and political actions, believing it would improve their chances of success. The political landscape of the Classic Mayan period was complex, with a hierarchical structure where some cities were more powerful than others. Tikal and Calakmul played dominant roles, often through warfare and alliances. Their society's hierarchy is evident in their inscriptions and monuments, showing a dynamic political environment. In the south, stone roofs often had "roof combs" that looked like decorated billboards, showing historical figures and deities. In the north, Puuc style temples were big rectangular blocks with vertical faces. These buildings had corbeled vaults, but the upper parts were filled in, allowing decorations to be part of the external walls. For example, at Uxmal, architects used stylized masks for different characters and purposes. Maudslay found similar styles at Chich'en Itza and Uxmal, suggesting an "Old Kingdom" in the south and a "New Kingdom" in the north, influenced by Central Mexico's "Toltec."

The Venus Table's modern interpretation was shaped by John Teeple, a chemical engineer with a talent for math and time to explore numerical patterns. Despite lacking formal training in archaeology or Mesoamerica, Teeple made significant contributions to Mayan astronomy. In 1927, after receiving the Perkin Medal in Chemistry, he became known for his work on Maya inscriptions. His articles had a lasting impact on the field. Interestingly, his opportunity to work on the Dresden Codex came about due to historical circumstances related to the production of potash, an important agricultural and industrial chemical. The First World War disrupted the supply of potash from Germany, prompting nations to seek alternative sources. John Teeple's Perkin Medal was awarded for his innovative method of extracting potash from Searles Lake, California. Unlike other methods that became too costly once German production resumed, Teeple's approach remained profitable. The Cornell Alumni News highlighted his success in overcoming scientific challenges and producing cost-effective, borax-free potash. Teeple's ability to turn a problem into a profitable solution demonstrated his exceptional problem-solving skills. The Mayan civilization used a complex system of writing with glyphs, which are symbolic pictures. They also had an advanced understanding of astronomy and timekeeping. One part of their calendar system is called the Supplementary Series, which includes several glyphs that mark different periods of time. Teeple was a researcher who studied these glyphs closely. He focused on a specific glyph known as Glyph A. He noticed that this glyph sometimes had different prefixes (the beginning part of the glyph) and suffixes (the ending part). By analyzing these variations, he discovered that Glyph A could represent either a 29-day month or a 30-day month. This was significant because it showed that the Mayans had a sophisticated way of tracking lunar cycles, which are roughly 29.5 days long. By using different prefixes and suffixes, they could indicate whether a particular month was 29 or 30 days. Teeple's work helped us understand more about how the Mayans recorded time and how accurate their astronomical observations were. It also shed light on the complexity and precision of their calendar system.

During the early part of the Late Classic period, the Mayan civilization started focusing more on celestial events and combining astrology with numerology. This interest was partly due to political competition between different sites. For example, the military conflicts between B'ahlaj Chan K'awiil and Nuun Ujol Chaak happened when Mayan rulers were keen on linking their achievements to astronomical events. B'ahlaj Chan K'awiil often recorded his victories using the "Star War" verb, which was a popular practice at the time. This fascination with astronomy was likely influenced by frequent comet sightings and the numerological significance of certain calendar dates, like the end of 13 winikhaab. These astronomical and numerological tools became established among those interested, but not everyone adopted them. For instance, the 819-Day Count is only found at Palenque, Copán, and Quirigua, and the mysterious Glyphs Y and Z only appear at Yaxchilan. Now, considering the historical date in the Dresden Codex, the question arises whether figures like Tawiskal Uwoojil or K'uk'ul Ek' Tuyilaj had access to ancient records that preserved the date 9.9.9.16.0 1 Ajaw 18 K'ayab since the Middle Classic period. This suggests that some Mayan rulers might have had historical records that informed their astronomical practices. The reinterpretation of the Venus Table at Chich'en Itza indeed raises intriguing questions about the extent of Tawiskal Uwoojil's role in copying versus authoring the content. Given that the Venus section in the Dresden Codex are a copy of an earlier manuscript, it's essential to consider how much of the original content was preserved and how much was modified or authored by Tawiskal Uwoojil himself. The incongruity or "shift" in the lower portions of the columns on figures 1 & 3 relative to the 365-Day Count, suggests that the upper portion was constructed for an earlier period, while the lower portion reflects Tawiskal Uwoojil's own adjustments. This indicates that there were corrections made to align the Venus Table with contemporary understandings or predictions, which scholars like Thompson have used as evidence for further corrections. To better understand how this shift occurred and its implications, it's useful to consider the intellectual environment of Tawiskal Uwoojil's predecessor. This predecessor, likely a member of the royal court or an advisor at Chich'en Itza, would have been deeply involved in the astronomical and calendrical calculations of the time. This context helps us appreciate the complexity and continuity of Mayan astronomical knowledge and its transmission through generations.

The Venus Table in the Dresden Codex indeed holds a fascinating dual role, both as an astronomical record and as an oracle. The way K'uk'ul Ek' Tuyilaj structured the Venus Table suggests a meticulous approach to predict Venus' appearances. By breaking it into canonical periods, each row could predict significant visibility events like the first morning or last evening appearances of Venus. From an oracular perspective, the restriction to using only "even" Day Signs for Venus positions hints at a deliberate choice for divination purposes. This selective use implies that certain days were deemed more auspicious or significant for Venus-related predictions. Moreover, the variability in the predicted dates—where the deviations from the average synodic period of Venus were equally positive and negative—suggests a built-in randomness. This randomness could be seen as a feature rather than a flaw, providing a "random" element crucial for the oracle's function. In essence, while the table aimed for long-term accuracy, the short-term variability allowed for meaningful divinatory interpretations based on observed deviations.

The Tz'iknal structure at Chich'en Itza was dedicated on a specific date in the Mayan calendar (10.3.0.0.0 1 Ajaw 3 Yaxk'in). By the time K'uk'ul Ek' Tuyilaj made her observations, there were more than 25 years of records from this structure. She noticed that a significant event, the first morning visibility of Venus, was approaching on a rare and important date (1 Ajaw), which happens only once every 104 years. She checked historical records and found a previous occurrence of this event on a similar date (9.9.9.16.0 1 Ajaw 18 K'ayab). Using these records, she could calculate and confirm the rarity and significance of the upcoming event.vIn essence, K'uk'ul Ek' Tuyilaj used historical records and her observations to identify and verify a rare astronomical event, highlighting the importance of Venus in Mayan astronomy.

Even though the differences between the north and south parts of the city are clear, scholars have had a hard time agreeing on the overall mural program within the Ball Court complex. The murals aren't fully in the Postclassic “international style” yet, which Tawiskal Uwoojil would have seen. Instead, the artists mixed traditional Central Mexican and Mayan styles, making it hard to figure out who made each mural and who they were for. For example, the mural in the Lower Temple of the Jaguar could show one big event with different groups of warriors, priests, and nobles, or it could show different events happening at different times. The images themselves are also confusing. One mural shows a figure with Teotihuacan-style eye ornaments meeting another nobleman, possibly suggesting a foreigner from Central Mexico bringing Quetzalcoatl ideology to Chich’en Itza. There are also Day Signs next to the central figures, which use Central Mexican symbols. These Day Signs were often part of personal names, so the mural might be showing the arrival of strangers, similar to an event at Tikal centuries earlier.

The story of Mayan astronomical achievement, particularly their understanding of Venus, reveals a civilization of extraordinary intellectual sophistication. Far from being mere primitive observers, the Mayans developed a complex system of celestial tracking that integrated scientific observation with cultural and religious practices. Their Venus Table demonstrates a level of astronomical knowledge that rivals contemporary civilizations, challenging simplistic narratives about pre-Columbian American societies. The work of researchers like Förstemann, Teeple, and Maudslay has been instrumental in uncovering the depth of Mayan astronomical expertise. Their careful analysis of codices, inscriptions, and archaeological sites has shown that Mayan astronomers were not just observers, but sophisticated scientists who used celestial cycles to understand and predict complex natural and social phenomena. The Venus cycle, in particular, emerged as a critical element of Mayan cosmology, intertwining astronomical observation with religious belief, political power, and agricultural planning.

Ultimately, the Mayan understanding of Venus represents more than just an astronomical achievement. It is a window into a sophisticated civilization that saw the cosmos as an intricate, interconnected system—where celestial movements were not just phenomena to be observed, but fundamental forces that shaped human experience. As we continue to study and appreciate their achievements, the Mayans remind us of the extraordinary intellectual capabilities of human societies, regardless of their technological context.