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The Westernization of the Night Sky: A Study of Indigenous Astronomy and Sky Culture

Zoe Kaya Perles

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Professor Raj Pandya

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Abstract: When we examine the night sky and consider the history and progression of science and astronomy, we observe the sky through a specific cultural lens. Contemporary understandings and interpretations of the sky and of science have been distorted by the biases of Western European history and culture. Consequently, indigenous astronomy has been eradicated, depreciated, forgotten, and omitted from the historical record. After thousands of years of colonization and the purposeful destruction of indigenous cultures, much knowledge of indigenous astronomy has been lost. However, the knowledge that has been preserved is extraordinary. A study of the methods and strategies of astronomical observation developed by indigenous civilizations and the roles that astronomy served within indigenous societies crafts a compelling argument about the validity, sophistication, and value of indigenous astronomy and sky culture. With that knowledge, we can then consider the drastic repercussions of the erasure of indigenous astronomy and why it is essential that we incorporate indigenous knowledge into modern understandings of science and astronomy.

Key Words: *Spanish major, Astronomy, Science, Indigenous, Indigenous cultures, Sky Culture, Mythology, Religion, Astrology, Aztec, Maya, Navajo, Mesoamerican, Colonization*

The human consciousness is drawn to the night sky. In all its vastness and mystery, it is a mesmerizing entity that we long to understand. But when we look to the sky, our perceptions of what we see and observe are distorted by a cultural lens. Contemporary perspectives of astronomy and sky culture are tendentious and, at the expense of other cultures, establish the Greco-Roman lens as a norm. Though unrecognized by mainstream Western society, indigenous civilizations across the globe deciphered and interpreted the night sky in their own ways. Astronomy was embedded in their cultures, rituals and belief systems. They developed their own unique methods of astronomical observation and, like the Greco-Roman world, charted the sky and used the stars to tell their stories and conceptualize the universe. These indigenous perspectives have been discarded as tangential to the historical record. But by examining the history of colonization and both the substance and suppression of indigenous astronomy and sky culture, we can integrate indigenous perspectives into contemporary knowledge of the cosmos and acknowledge Western culpability for the suppression or eradication of indigenous knowledge, culture and civilization.

To examine the roots of the destruction of indigenous astronomy and sky culture, we must first study the history of colonization and early colonizers' attitudes toward native peoples. This brutal history set a precedent of dehumanization in the treatment of indigenous peoples. When Spanish conquistadors such as Christopher Columbus and Hernán Cortés arrived in Latin America in the already-inhabited lands of indigenous tribes such as the Maya, Aztec and Inca, they brutalized and decimated the native populations they encountered. Indigenous peoples throughout the Americas were murdered, raped, enslaved, and exploited by the Europeans. As Christopher Minster indicates in his article, "The History of Latin America in the Colonial Era," contemporary historians have estimated that "the population of Mexico's central valleys was

around 19 million before the arrival of the Spanish” but had “dropped to two million by 1550” (Minster). And these statistics refer exclusively to populations around Mexico City; “Native populations on Cuba and Hispaniola were all but wiped out, and every Indigenous population in the New World suffered some loss” (Minster).

Under Spanish domination, indigenous cultures were vehemently suppressed. Many native populations maintained written codices that recorded each tribe’s extensive history and culture. These codices “were burned by zealous priests who thought that they were the work of the Devil” (Minster). Furthermore, conquistadors shattered existing power structures and stripped most indigenous leaders of their power and control. In their place, the Spanish established a structure of governance known as the *encomienda* system. The *encomienda* system granted conquistadors control over certain lands and the peoples that inhabited them. Theoretically, *encomenderos* were supposed to protect the people entrusted to their care. If that initial purpose was not infantilizing enough, the harsh realities of the *encomienda* systems were, in actuality, far worse. The system was essentially legalized enslavement. Indigenous peoples were forced into exploitative labor. Though courts were established so that indigenous peoples could report abuses, they were rigged. They “functioned exclusively in Spanish, which essentially excluded most of the Native population,” making it impossible for Native people to communicate the abuses they were forced to endure (Minster). The *encomienda* system remained in practice until 1721, though it was not officially outlawed until the late 18th century. However, the Spanish colonies that Latin America had been divided into remained under Spanish control and did not gain independence until the first half of the 19th century.

Native Americans of the Southwest region of the United States faced similar treatment. Thrilled with their New World colonies, Spain sought to extend its wealth and power by gaining

“gold, slaves, and converts to Roman Catholicism” (Pauls). Tempted by Spanish explorer Álvar Núñez Cabeza de Vaca’s stories of golden cities rumored to be hidden somewhere within the North American interior, the Spanish government decided to sponsor an expedition to North America led by Francisco Vázquez de Coronado in 1540. On his journey, Coronado and his men “demanded provisions from nearby pueblos,” molested many indigenous women and met indiegnous resistance with brutal force (Pauls). Back in Spain, the Inquisition ensued in full force. Consequentially, the methods of the Inquisition popularized in Spain were transferred to the Americas. During their conquest, “the Spanish executed some 200 Pueblo individuals, many through burning at the stake” (Pauls). Catholicism spread throughout the United States and, as in Mesoamerica, the *encomienda* system was put in place to exploit and gain ownership over indigenous lands and peoples. Native Americans faced heavy punishments for engaging in their traditional religious activities and rituals. Their “rituals were seen by the Catholic priests as abominations, and, in order to stamp out traditional religion, the missionaries destroyed regalia and punished religious leaders severely; reports of tortures such as flaying and dismemberment” were alarmingly common during this period (Pauls).

The Spanish invasion and domination of the Americas gave colonizers the power to annihilate, frame and construct history. Consequently, history was rewritten and retrofitted to justify their invasion and dismiss indigenous peoples as uncivilized and subhuman. According to their version of history, colonizers were white saviors who benevolently civilized the barbaric cultures that they encountered in the Americas. As Minster argues, “What we know about pre-Columbian civilization comes to us in a jumbled mess of contradictions and riddles. Some writers seized the opportunity to paint earlier Indigenous leaders and cultures as bloody and tyrannical. This, in turn, allowed them to describe the Spanish conquest as a liberation of sorts.”

(Minster). The result was the suppression and destruction of indigenous languages, histories, religions, mythologies, art, customs, and traditions. Colonizers tried to blot entire cultures and ways of life from the historical record.

The Western world has demonstrated a widespread resistance -- and even an outright refusal -- to acknowledge and address the atrocities committed against indigenous peoples. While discussion of Western colonization in the Americas has understandably centered on the genocide of indigenous peoples, we must remember that the mass death events of the 15th-19th centuries were also a mass obliteration of indigenous knowledge. For astronomers that were raised to seek Orion or Hercules in the night sky, it is easy to forget that indigenous civilizations throughout the Americas and around the globe had their own complex understandings and interpretations of the night sky. Indigenous civilizations developed their own methods of astronomical observation and used their findings to record and expand their knowledge of the night sky, make precise calculations of celestial movements, and devise systems of timekeeping.

Indigenous strategies for observing and measuring the night sky relied on methods utterly distinct from our own. For example, many indigenous civilizations used fixed locations on the horizon to chart celestial movements. The Hopi-Navajo of modern-day Arizona “denoted important days in the solar year by fixing the position of sunrise and sunset on prominent peaks and notches in their landscape” (Bretcher 63). The ancient Mesoamericans were particularly advanced astronomers and, like the Hopi-Navajo, relied on “fixed locations in temples and other buildings to observe the heavens. They tracked the rising and setting of the sun, moon, planets and stars at the horizon by placing sets of crossed sticks along the line of sight” (Smith 259). In this way, they were able to track celestial phenomena such as solar equinoxes and solstices. Both

the Maya and the Aztec charted sky motion with architectural structures that acted as observatories and aligned with the movements of celestial bodies.

Mesoamerican observations of the night sky were then used to develop calendars and structures of timekeeping. The Maya and Aztec kept annual calendars that kept track of events within the solar year. Numerous “larger cycles of time were developed to keep track of events across the years. Use of these calendars hinged on careful observations of the stars and planets, so astronomy was a well-developed science” (Smith 253). The Aztec civilization, for example, “inherited a rich tradition of calendrics and astronomy from earlier Mesoamerican cultures , and from this tradition they focused their attention on three types of calendars: the ritual calendar, the annual calendar, and the 52-year calendar round” (Smith 253). The 52 year calendar combined the ritual and annual calendar and was known as the “calendar round” in which each day of the year “had a unique combination of entries in the two calendars...Each year within the 52-year calendar round was assigned its own designation of a name with numerals...” (Smith 257). The Aztec used the year-count to record important historical events.

Mayan astronomy was perhaps the most developed of all ancient civilizations. Without any modern technology to observe and measure the night sky, their precise calculations of the movements of celestial bodies is highly impressive. Starting in roughly 900 CE and ending with the Spanish invasion, the Maya

“refined their astronomical techniques, charting the positions of the planets, devising tables for long-term predictions of the movements of these planets, and creating tables to predict eclipses. Their predictions were so sophisticated that they included corrections and amendments, showing that they fully understood that the movement of the planets and precession were complex” (Shuttleworth).

The Maya recorded all of this data in a comprehensive set of written codices. Unfortunately, few of these codices still remain. When the Spanish invaded, they destroyed nearly all of them in an attempt to erase anything they deemed related to indigenous religion. The few codices that still exist, such as the Dresden, Paris and Madrid Codices, are named after the European cities in which they resurfaced (Zorich). Modern scholars have used these codices and other non-written sources such as Mayan art to piece together what we now know of Mayan astronomy and mythology. Much has been lost. However, what we do know is extraordinary.

In the Western tradition, one of the most well-known and celebrated astronomers is Claudius Ptolemy. Ptolemy's feats in the field of astronomy and his calculations of sky motion are world renowned. But a comparison of Ptolemy's calculations to those made by the Maya yields some interesting observations:

| | Modern | Ptolemaic | Mayan |
|---------------------------------------|---------------|------------------|--------------|
| Estimated Lunar Month (Days) | 29.53059 | 29.53337 | 29.53086 |
| Synodic Period of Venus (Days) | 585.93 | 583.94267 | 583.92027 |
| Solar Year (Days) | 365.24198 | 365.24667 | 365.242 |

("Mayan Astronomy," University of Arizona)

These differences in calculation are so close as to confirm the precision of Mayan calculations in the field of astronomy. Moreover, they force us to contemplate why the Maya are not perceived as being central to the history of astronomical observation. When we are exposed to the history of astronomy, it is Ptolemy's name that we learn, along with the likes of Galileo Galilei, Nicolaus Copernicus, and Johannes Kepler. I do not mention these astronomers to diminish their outstanding accomplishments nor suggest that we cease studying and recognizing their contributions to the development of astronomical thought. But these comparisons between

Ptolemy and the Maya expose the limitations of the Westernized version of history to which we have been inured. Erasure of non-Western cultures from the history of scientific development creates the misconception that science originated and was advanced solely in the West.

Studying the uses and methods of indigenous astronomy and the precision of indigenous astronomical calculations must be accompanied by a recognition that astronomy did not serve the same function for indigenous civilizations as it did in the Western tradition. However, that does not refute the tremendous, astronomical achievements made by indigenous populations nor does it minimize the significance of astronomy to ancient cultures. As Krupp argues in his book *Echoes of the Ancient Skies : the Astronomy of Lost Civilizations*, “Just because we regard accurate, precise observation as a component of objective, scientific thought, we should not assume it fulfills the same function in other belief systems or that it can’t exist in them at all.” (Krupp 24). Many indigenous civilizations perceived astronomy’s most important role as being mythological, astrological or religious.

The Maya and Aztec saw an important connection between astronomy and religious deities. Like many ancient cultures, they believed that “the celestial luminaries were gods who influenced human destiny and controlled events on earth” (Milbrath 1). Furthermore, Mesoamerican architects utilized astronomical alignments to lay out and construct cities and buildings, many of which held important religious and ritualistic significance. The Templo Mayor in *Tenochtitlan* (modern-day Mexico City), for example, was designed so that the Sun rose exactly between the *Huitzilopochtli* and *Tlaloc* temples on the date of the spring equinox (Smith 260). The Aztec held an important ritual at this temple called *Tlacaxipehualiztli* that honored *Xipe Totec*, the "Flaying Lord" (Bassett 396). During this *veintana* (twenty-day) ceremony, "Mexica priests honored Xipe Totec...by sacrificing a captive and flaying his corpse.

Ritual participants wore the flayed skins as an act of atonement, and the penitents shared the offerings they received with the captor" (Bassett 396). The New Fire ceremony, or *Toxihuhmolpilia*, as the Aztec called it, was another sacred Mesoamerican ritual that related to the charting of important celestial events. The ceremony was signaled by the passage of the Pleiades star cluster through zenith at midnight (Smith 260). Translating to "The Binding of the Years," the New Fire ceremony was celebrated at the end of each 52-year cycle, as per the 52-year calendar round. Its purpose was to "renew the sun and ensure another 52-year cycle" (Cartwright). It was thought that in the event that the ceremony failed, the Aztec civilization would end (Cartwright). *Toxihuhmolpilia* "was overseen by *Xiuhtecuhtli*, also known as the 'Turquoise Lord', the Aztec god of fire" (Cartwright). At midnight, when the Pleiades reached their zenith, the high priests performed a human sacrifice and removed the victim's heart. A fire was then lit "in the empty chest cavity using the sacred firestick drill, the *tlequauitl*. If the fire burned brightly, then all was well" and *Xiuhtecuhtli* had allowed another 52-year cycle to begin. The fire was then used to light a huge pyre in the center of the city which was then transferred to the Templo Mayor and soon to all the temples throughout the city (Cartwright).

In addition to a connection between astronomy and religion, many indigenous cultures equated astronomy with astrology. Much of Aztec astronomy functioned "in the realm of divination and ritual" (Smith 260). Their 260-day calendar was used to keep track of rituals, forecast the future, and determine whether days were to be lucky or unlucky (Smith 254). Within this calendar, "days were numbered from 1 to 13 and named by a sequence of 20 emblems, or name-day glyphs. Most of the Aztec symbols represented animals, plants, or other things in their environments." (Krupp 186). Aztec calendar priests known as *tonalpoque* used the 260-day ritual calendar, or the *tzolkin*, to personally give names to newborns. They "consulted the ritual

almanac for omens (good or bad) associated with the day of the child's birth. In favorable circumstances the child took the number-name of the ritual calendar day of his or her birth" (Krupp 188).

Lastly, one of astronomy's most critical roles in indigenous cultures was its connection to mythology. Myths are part of how "indigenous people made sense of the world around them—a form of science separate from, but with kinship to, the enterprise of observation, prediction, and questioning built around what we call the scientific method" (Taylor). E.C. Krupp eloquently argues the pertinence of mythology in the introduction to his book:

“Myths are not simple tales, but tales told simply. And these tales are not just idle chatter. The stories are important. They reflect, in symbols, the deepest concerns of our minds. For this reason myths are worth analyzing. The richest myths have multiple levels of meaning. They are networks of thought. Because they link a variety of perceptions and incorporate more than one theme, they endure. Our goal is to understand the use we make of the sky, and here mythology can help. We are hunting descriptions of the world's structure, explanations of natural phenomena, and accounts of the passage of time. We find them all in myth” (Krupp 82).

Mythology serves as a record of cultural values. In studying myth, we can learn about the most essential principles and ethics of a given culture. Thus the value of indigenous sky stories cannot be overstated.

And yet when we look up into the night sky, we see only Greco-Roman stories: the great hunter Orion fighting Taurus the bull; Andromeda chained to a rock by her mother and father, Cassiopeia and Cepheus; the divine son of Zeus, Pollux next to his

beloved brother Castor with whom he chose to share his immortality. But "just as the people of early Western civilizations looked to the stars and told stories about them, so did Indigenous people around the world" (Taylor). Take the Mayan constellations of the Paddler Gods and Primordial Fire, for example. The Maya saw something that appeared like smoke in the night sky--a deep sky object we now refer to as the Orion Nebula. They envisioned the nebula to be smoke from the great cosmic fire of creation, represented by the Primordial Fire constellation, whose three stars encompass the Orion Nebula. Nearby, a line of bright stars along the Milky Way represent the Paddler gods who were tasked with taking the Maize God to that very cosmic fire of creation. There, he sacrificed himself, allowing the creation of the cosmos to commence (Stellarium Astronomy Software). Or take the dual Navajo constellations, Revolving Female and Revolving Male, who were placed in the sky by the Navajo Black God and together symbolize familial values and the creation of a family through the union between husband and wife (Childrey 46-50). Or perhaps the Aztec constellation, Ball Game of the Stars, which represents an important Aztec game and ritual whose movements echo the motion of the Sun and the Moon (Stellarium Astronomy Software). These myths have value. To object to that truth is to imply that only Greco-Roman myths hold significance. But there is no basis to that claim. In studying and understanding the gravity of indigenous mythology, we gain insight into entire cultures with which we may not be familiar. And yet, a fraction of the world's population is at all cognizant of the existence of indigenous knowledge.

After all, the West has constructed a culture that centers Western thought, practice, and ideology. Indigenous astronomer Annette Lee argues that "our very picture

of what science is was shaped by Western European history and the biases of that culture.” (Taylor). Most people view science as value-neutral. However, as Lee contends, what we understand of contemporary science has been fundamentally distorted by a lens that is inclined to accept Western European history as a norm whilst simultaneously neglecting other histories and cultures. And the Western rejection of indigenous astronomy and mythology has not only established Greco-Roman myths as the norm; it has created a disconnect between many indigenous communities and their own native sky stories. Wilfred Buck is a Cree man who has dedicated his life to gathering star stories from indigenous cultures throughout Manitoba, Canada. Buck argues that indigenous communities are losing the stories and myths from their collective memory (Taylor). This loss is a "direct fallout from the ways in which colonizing Europeans killed Indigenous people and weakened links to their culture. After more than 14 years of collecting star stories from Indigenous elders around Manitoba," Wilfred has only managed to gather two dozen (Taylor). Even with attempts to salvage and preserve the astronomical perspectives that colonizers tried to eradicate, generations of people "are fighting to even know their own language. And young indigenous people look up to the sky at night and see only the stories of the Greeks"-- the stories of a culture that has forcibly replaced their own (Taylor).

Wilfred is not the only person aiming to increase knowledge of indigenous astronomy and sky stories. Various successful efforts have been made to integrate indigenous perspectives into science curriculums. A primary school in Australia, for example, adopted the "Indigenous Sky Stories Program" to introduce native sky cultures into the school's lesson plans. Students responded enthusiastically, seeking out additional

sky stories outside of class and observing celestial bodies of the night sky in their own time. An "unexpected outcome of the program was the retelling of personal Sky Stories by some of the students as told to them by their parents," indicating that the introduction of cultural perspectives to school science curriculum enhances students' abilities to draw critical connections across cultures (Ruddell 175). The study was put in conversation with other studies that demonstrate that indigenous students find science curriculums incomplete and unrelatable. In turn, this disconnect reflects "the disparity between Indigenous and non-Indigenous engagement and learning outcomes across Australia" (Ruddell 171). In fact, indigenous students are less likely than non-indigenous students to seek careers in STEM. Overall, the study concluded that "educational outcomes can be strengthened when Indigenous knowledge is given the space to co-exist with the hegemony of current western science concepts" (Ruddell 170). The study presents just a glimpse of what indigenous knowledge has to offer. By centering this knowledge in educational settings, we establish indigenous histories and cultures as essential parts of a well-rounded understanding of the world--an understanding that is more complete, inclusive and multifaceted. But indigenous knowledge is seldom given the space and platform it deserves due to a fundamental disregard for indigenous peoples. And that lack of appreciation for native peoples and cultures dates back to the European invasion and colonization of indigenous populations.

When colonizers arrived in the Americas and encountered indigenous populations, they saw cultures entirely unfamiliar from their own and concluded that "different" conveyed inferiority. Indigenous cultures were deemed antithetical to "civilized" society. That early dehumanization and devalorization of native civilizations

drastically impacts how we have come to understand culture and society. Our values have been Westernized and, consequently, Western definitions for progress, advancement, and civilization are biased. The implications of those early colonizers' attitudes set a precedent of entitlement. Just as conquistadors felt authorized to steal and enslave indigenous lands and peoples, contemporary Western society has deemed it fair and within our right to disrespect indigenous cultures, to mock them incessantly in media with harmful stereotypes, to appropriate their cultures, to push them out of already stolen lands, to build pipelines across their sacred reservations, to take indigenous children away from their families to be "educated" on how to be a "civilized" member of society in native boarding schools, to force them to assimilate into mainstream culture because their own cultures have been deemed not worth preserving and not worth knowing. That lack of value and therefore lack of knowledge with which indigenous cultures were and are perceived, dating back to the arrival of the Spanish in the Americas in the 15th century, has fundamentally distorted modern understandings--or lack thereof--of indigenous cultures. Nowadays, non-indigenous peoples tend to employ cyclical logic: they do not know anything about non-Western cultures and peoples because they do not try to learn. They do not seek insight about that with which they are not already familiar. And they use that lack of knowledge as proof that there is nothing to know. And so they naively believe that indigenous cultures have nothing to add and do not hold their own value. According to that logic, why would we incorporate indigenous astronomy and sky cultures into our collective consciousness if these perspectives are merely peripheral, belonging to cultures on the sidelines that played no real part in the progression and evolution of society and culture? But the simplicity and/or absence of indigenous

astronomy is a myth. Indigenous civilizations around the globe developed impressive techniques for observing the sky and incorporated astronomy into their customs, traditions, celebrations, belief systems, mythologies and methods of recording time and history.

As descendants of colonizers, we have inherited the legacy of genocide. And so it now becomes our responsibility to fundamentally reform how history is framed and taught, through what lens we learn about culture, and through what definitions we have come to conceptualize civilization and society. A precedent of accountability must be set. Integrating indigenous astronomy and mythology into our mainstream perceptions of science and sky culture is just one way that we can begin to do just that. But it is a frightfully important first step.

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