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SKYSCAPE IMPACT TO CULTURAL ASTRONOMY

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ABSTRACT

Since the early days of mankind, humans have looked to the stars for answers to their biggest questions, expecting the fulfillment of the most basic need to comprehend the universe they inhabit, both from a scientific perspective and from other cultural standpoints. The skyscape has been the source of inspiration, imagination, for science and philosophy. The dual interaction between man and the skyscape, so-called cultural astronomy and/or archaeoastronomy, concerns with cultural, artistic, everyday perceptions and understandings of astronomical phenomena, and forms a rich cross-disciplinary field. The determination of time and identification of human or animal images from the starry configurations has exerted a strong influence on the human cultures throughout the millennia. The four solar stands, the lunar phases, the planetary orbits, the rise and setting of bright stars and the constellations have triggered past societies to determine the time for daily works. In essence, the determination of time was deemed necessary for many daily aspects. World examples from the five continents on these aspects are outlined, focused on the determination of time with solar stands in daylight, the lunar periodic movements, and bright stars and associated configurations (constellations). Seven broad categories are recognized: Cat. 1: Religion, Rituals and Funeral Rites; Cat. 2: Mythology; Cat. 3: Art (Music, Painting, Rock Art, Poetry & Literature); Cat. 4: Travel (Maritime & Mainland long distance voyages); Cat. 5: Agriculture; Cat. 6: Observation/Measurement of Time; Cat. 7: Daily life. These all have intimate relationships with the orbits, appearances, directions of rising and setting of bright celestial bodies. Together with the constructed devices for the determination of time and geographical location (sundials, hydraulic and portable devices, topographical markers), including intangible oral documentation of cultural astronomy of aboriginals, led humans to the development of portable devices and monumental (natural or intentionally made) constructions and orientation marking (archaeoastronomical orientations). A compressed overview on this dual relationship shall be critically reviewed.

KEYWORDS: archaeoastronomy, stars, calendar, time, ancient cultures, continents, religion, sundial, constellations, orientation

1. INTRODUCTION

Since the dawn of hominids, but certainly from the Homo sapiens around 30,000 years ago, the humans privileged by curiosity, capable of processing consciously whatever their senses were subjected to, studying the landscape and skyscape and patiently and by painstaking observation of celestial phenomena, tamed many environmental issues, in conjunction to mastering the determination of time – the seasons, the years, the day & night hours. According to Orphics the human and/or Chronos (=time) are "Γῆς παῖς εἰμι καὶ Οὐρανοῦ ἀστερόεντος", which translates to "I am a child of the earth and of the starry sky" (gold Orphic tablet from Petelia, Magna Grecia) (Passas & Khasapis, 1984). Indeed, both the humans and the meaning of time is inextricably attached to both the earth and the sky (Magli, 2009a).

The skyscape has been a source of inspiration and thus affected many aspects of development throughout the ages, from religious rituals and mythology to exploration and art. The echo of this multi-faceted influence and its effects are still felt to this day. Even before man determined how to measure time, the celestial bodies and phenomena were a thing of wonder and worship. With time measurement introduced, the ancient societies advanced in many ways, both in scientific fields and everyday life. The solar stands, lunar phases, planetary orbits and rise and setting of bright stars gave birth to a multitude of myths and legends, while helping societies advance in ways they could not expect (Ruggles, 2015). In the cultural skyscape environment, stars and star configurations, the sun and the moon, planets, and meteorological phenomena inspire concepts that successfully build a romantic relationship with the past and stimulate an imagined sense of sharing the experience, viewpoint, and wisdom of antiquity (Magli 2009b).

The exotic character of landscapes that mirror the celestial tholos have motivated romantic conceit to the rulers, yet this fascinating attractive image of the night sky leads to contemplation and inevitably detailed observation of the stars, something which continues to thread through perceptions of prehistory and antiquity in contemporary scientific progress and popular culture.

The investigation that cultural astronomy, and more specifically archaeoastronomy, is interested in is why they were looking at the sky, what they were watching and how it affected them (Krupp, 2003; Heggie 1982).

Archaeoastronomy can also be described as cultural astronomy or skyscape archaeology. The differences in naming are attributed to the methods, tools and disciplines used in each case (Brown, 2016; Hannah 2015; Castro 2015; Liritzis et al., 2020).

A brief global review of the subject is presented aiming to prove the intimate relationship between the skyscape and human curiosity, an intimate relationship that triggered and established the realization of the uniqueness of humans in the realm of the animal kingdom. Such connection is outlined which has essentially led people to increased knowledge, development, and progress in every aspect of life. Here we introduce seven categories of skyscape impact on people.

2. ASPECTS OF CULTURAL LIFE AFFECTED BY THE SKYSCAPE

Ancient civilizations were directly affected by their observations of their respective skyscapes. Some also had an impact on others in turn, such as timekeeping which had an enormous overall effect. We consider seven (7) broad categories of skyscape impact on people, summarized below for some case studies:

Cat. 1: Religion, Rituals and Funeral Rites.

The stellar objects were worshipped as deities both on their own and as representations of a civilizations' pantheon. Their movement was also considered important and integrated into religious practices. This worship also directly affected the religious rituals, as well as their funeral rites. A prime example is Ancient Egypt, where the Pharaohs were the intermediaries between the people and their deities. They also officiated religious ceremonies and their tombs were elaborate, displaying their deification. Rituals such as divinations were also linked to astronomical phenomena, such as the heliacal rising of Cygnus and Lyra that signified the time for consulting the Delphic Oracle (Liritzis & Castro, 2013).

Cat. 2: Mythology.

Many stars and constellations were named after mythological figures or creatures, that either existed there or were placed among the stars by the gods. The ancient people believed that the bright lights in the sky were indeed some hero or monster that lived in the world long ago. This was quite prevalent in Ancient Greece. An example of such practice comes from the myth of Perseus and Andromeda. We know of the constellations of Perseus, Andromeda, Cepheus, Cetus, Pegasus, and Pisces, all of which had some role to play in the myth. Another example is the hunter Orion, who was killed by a giant scorpion sent by Gaia, after which the goddesses Artemis and Leto asked Zeus to place him in the sky (by Eratosthenes, Aratos, Hyginus and more) (Hard 2015). Yet ancient myths throughout the world are surprisingly similar. Either derived from terrestrial catastrophic events or from skyscape changes (Sluijs, 2021).

Cat. 3: Art (Music, Painting, Rock Art, Poetry & Literature).

Many aspects of Art were directly affected or even directly depicted the ancient skyscape. In the Lascaux Caves, the Palaeolithic rock art on what is known as "The Well" (Rappenglück, 2015) is believed to depict the position of constellations on the night sky. The Greek lyric poet Alcaeus speaks of the swans that bring Apollo back to Delphi from the land of the Hyperboreans, just as the constellation of Cygnus followed by Lyra appear on the night sky (Liritzis & Castro, 2013).

Cat. 4: Travel (Maritime & Mainland long distance voyages).

It is quite evident how any long-distance voyage at those times would be quite difficult. When navigators realized they could use a certain rising star as a direction marker, their travels became easier, which in turn led them to attempt even longer voyages (Liritzis et al., 2018). An example is that of Polynesian navigators who would set a heading according to star positions, or Pytheas of Massalia who travelled to Britain and the Baltic using astronomical measurements (McLeod, 2010).

Cat. 5: Agriculture.

The movement of constellations and the timing of that movement during a year did offer a way for ancient people to prepare for their sow or harvest. The Egyptians, for example, knew when the Nile would flood, thanks to the heliacal rising of Sirius (Lawson, 2004).

Cat. 6: Measurement of Time.

The movement of stellar objects is what gave birth to the idea of measuring time, sundials being the prime example of such devices. These devices in turn affected other aspects of peoples' lives, for example in medicine, where the physician Herophilos employed a water clock to measure his patients' heartbeats (Landels, 1979).

Cat. 7: Daily life.

All the above also had an impact on peoples' everyday life, even in the simplest of ways. From determining when to meet according to a shadow cast by an obelisk or the time on a sundial, to deciding the best time to travel, to determining how long an event would last.

It is obvious that celestial observation had a deep and resounding impact in ancient cultures. It helped societies advance in many ways, from science and travel methods to agriculture and trade. Examples from various continents, time periods and civilizations will be presented by area, beginning with the civilizations that flourished around Europe, then Africa, Asia, the Americas and finally Oceania. We also briefly mention the Innuit people of the Arctic circle, before the discussion of our findings and conclusion.

3. SELECTED EXAMPLES PER CONTINENT

3.1 Europe

The effects the skyscape had on civilizations are evident in Europe, even in very early examples. We focus first on northern and mainland Europe, eventually turning towards the Mediterranean and the ancient civilizations that developed there. Indeed, moving to the Mediterranean, and Ancient Greece, the effect of the skyscape is even more evident. Ancient Greece had a significant impact on astronomy. Even today, many of the names for stellar objects are the same or derived from the names the astronomers gave them at that time. The word planet comes from the Greek word «πλανήτης», which translates to wanderer, describing the movement of celestial bodies across the sky. Astronomy itself, in turn, had quite an effect on Greek civilization as well. Religion and mythology were intertwined and the impact the skyscape had on both is significant.

Even before we consider Ancient Greece, however, the stars and constellations were of great importance in the Minoan civilization. In both art and religion, many symbols were linked to the primary solar Minoan goddess.

Figure 1. Ales Stenar, or Ales Stones, longitudinal view. Photo by Bengt A Lundberg/Riksantikvarieämbetet.

Cat. 1 (Religion, Rituals and Funeral Rites): In Sweden, the Ales Stenar or Ale's stones have had multiple theories as to their use, be it calendrical, religious, or ritualistic (Fig.1). They are oriented towards sunset on summer solstice (Sparavigna, 2016). The Giant's Churches in Finland, several Neolithic stone enclosures, were found to be oriented towards sunrises and sunsets of the solstices, though some smaller ones could have been oriented towards the moon (Ridderstad, 2015). The Goseck circle, a Neolithic structure in Germany, is circular, with the larger entrances aligned towards sunrise and sunset on the winter solstice, while the smaller entrances are aligned to the summer solstice (Boser, 2006). It is possible it was a site of worship, while other theories mention a solar or even lunar calendar. In Rome, the Pantheon was rebuilt in its current form by Hadrian in 125 A.D., in such a way that it allows sunlight in through the ocular opening on the roof (Fig.2). The disc of light moving around the room as the sun moves on the sky creates an effect reminiscent of a spherical sundial, though with light rather than shadow. During the winter months the disc will stay above the cornices, while during summer it will be below the cornice, reaching the floor only on the summer solstice. The entrance is illuminated always at true local noon. (De Franceschini, 2014). At noon on the 21st of April, the sunlight will pass through the oculus and illuminate the entrance and the porch beyond it, so that whoever is walking in at the time appears in a halo of light (Hannah, 2019.). The Basilica of Porta Maggiore is built in such a way that during sunset on the summer solstice, the sun will illuminate one specific scene in the vault, known as the "Rape of Ganymede" (Polcaro et al., 2019).

We can also see such effects in funeral rites and customs in even prehistoric sites. Rock-cut tombs, of approximately 4th to 3rd millennium BC, with specific orientations relative to the sunrise or sunset are found in Roccazzo and Tranchina, in Sicily. The two dolmens in Cava dei Servi were built towards the sunrise at the summer solstice, while the Campanaru in western Sicily has a hole oriented in such a way that the sun rises through it over the local horizon (Orlando, 2016). Extensive studies were also performed in the Iberian Peninsula, as to the orientation of megalithic tombs, during the 1990s. Hence, hundreds of megalithic tombs in Granada, Almeria, Malaga, Catalunya, and Andalusia were studied. Most were found to be facing the sunrise or moonrise, though on some occasions it was shown to have been during the sun's movement across the sky or even sunset (Hoskin et al., 1998). The Praileaitz I cave, a Magdalenian era site, was found to be aligned towards the summer solstice sunrise (Sims & Otero, 2016). The Newgrange tomb in Ireland, is a Neolithic passage tomb, the main site in the Bru na Boinne complex that includes the sites at Knowth and Dowth (Magli, 2018). The site predates Stonehenge by approximately 1000 years. It is aligned towards the winter solstice, so that the rising sun

shines into the inner chamber, through a roof box above the entrance (Fig.3). At the time it was built, the sun would illuminate a three leafed spiral figure on the back wall (Ray 1989).

The Phoenician goddess Astarte has been linked to Aphrodite/Venus through her cult, though her symbol, a star inside a circle, also links her to the Mesopotamian Ishtar. Seven temples of Astarte found in the Mediterranean, were examined as to their orientations. They were found to be either sunrise or moonrise oriented, but three had a western alignment, towards Venus. A similar alignment has been found in some Iron Age sanctuaries, in the southern Iberian Peninsula. The authors interpret this as an indication of Phoenician colonization, though they recognize the possibility that the alignment was towards the moon rise at northern major standstill (Esteban and Pellin, 2016).

Figure 2. The Pantheon, Rome, with the ocular opening on the roof shown. Image from Google Earth Pro.

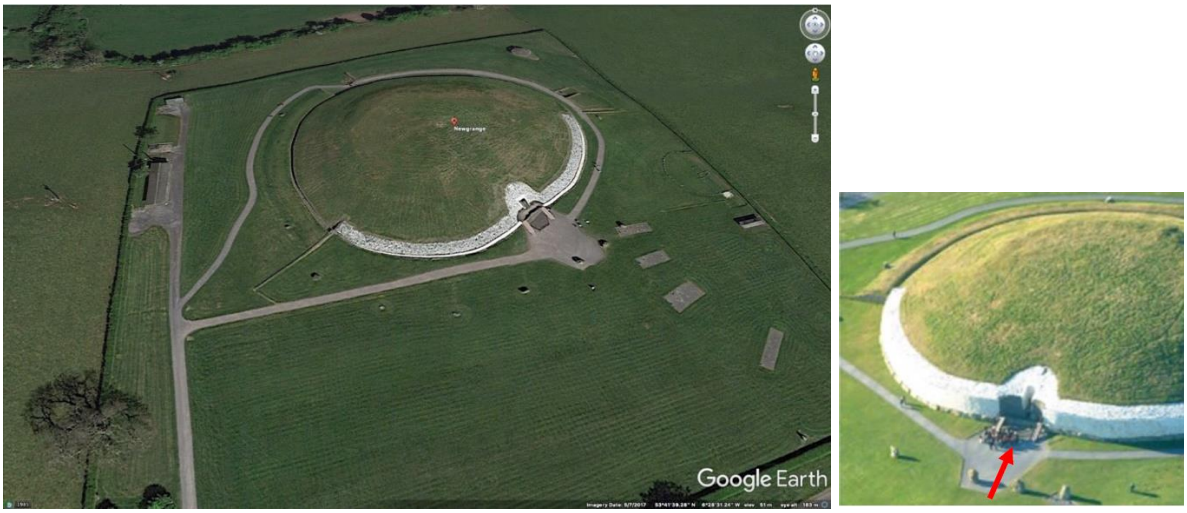

Figure 3. Newgrange site, Ireland (the passage to the Celtic world). The rising sun shines (red arrow) into the inner chamber, through a roof box above the entrance (Images from Google Earth Pro).

Figure 4. Lyra, Cygnus and Delphinus on the Delphic skyscape. Personified images composed from the star configuration (seen faintly here). Image from Stellarium.

Of course, in any such discussion, we need to mention Stonehenge, which is aligned towards sunrise on the summer solstice and sunset on the winter solstice (Stukeley, 1740), though other alignments have been theorized but none is accepted yet.

The Greek temples and their construction were heavily affected by both religion and mythology, and therefore the skyscape. Most Greek temples seem to be built in alignment with a specific purpose. Vitruvius states that the temples were aligned so that when the visitor entered near sunrise, the sun would shine onto the statue of the god, thus impressing the populace and reinforcing the aspect of divine presence on Earth (Morgan, 1914). Other studies show that each temple was so aligned as to have such an effect on the day of the god's major festival (Dinsmoor, 1939). It has been proven, at least until 2008, however, that approximately 58% face towards the east (Boutsikas, 2009). This brings into question whether the temples were aligned to stars and their risings, such as is the case with the temple of Apollo in Delphi, where the risings of Lyra, Cygnus, and Delphinus in front of the Temple (see Fig. 4) and above the Faedriades cliffs, at the vernal equinox marked the proper time for consulting the oracle (Liritzis & Castro, 2013). At the same time, this has been connected to Apollo's absence in the land of the Hyperboreans, when the sunrise at winter solstice illuminated the Apollo's statue at the sanctum of the Temple in Delphi to symbolize the spiritual presence of Apollo in Delphi who had been away. This orientation introduces the possibility of architectural structural interventions for the windows in the temples, which through sunlight enters the sanctum at specific times in the year, just as has been reported by Vitruvius (Vlachos & Liritzis, 2018). The temples of Demeter and Persephone at Akragas (Fig.5) were aligned to the moon, at the northern standstill, which again shows how solar alignments were not the standard, but the patron god of each temple had a role in its construction (Hannah et al., 2017).

In the case of places of worship, such as the Akragas complex, the temples of Demeter and Persephone have been shown to be oriented towards a lunar standstill, rather than the rising sun, a rare phenomenon in Greek temples (Hannah et al., 2017). The temple of Diana in Cephalu, northern Sicily, is oriented towards the sunset during the equinoxes and is believed to have been used as a temple since approximately the 1st millennium BC (Orlando & Gori, 2017). Though it was built much later, we should also note St Edward the Confessor's Church in Leek, England, is known to a double sunset (Kilburn, 1999). Etruscan temples are believed to have been oriented towards the sun, though focused on the movement rather than sunrise or sunset (Pernigotti, 2019).

Figure 5. The Akragas complex, with a red pin on the church that sits above the Demeter temple. Image from Google Earth Pro

The temple alignments mentioned above link directly into the rituals in Ancient Greece. As explained, in the case of the oracle of Delphi, stellar movements dictated the time for oracular consultation and were also directly linked to mythology, geophysics and religion. Rituals performed in the night were also significant, such as the Arrhephoria taking place during the Eleusinian Mysteries (Boutsikas and Hannah, 2012).

Orion tentatively has been assumed to have been targeted in two small sized pyramidal constructions in Argolid, Peloponesse, Greece. The entrance corridors of these pyramidals are aligned directly with the rising of three stars in the constellation of Orion, as seen on the sky at the time of their construction, which is proposed to date from 2500 to 1800 BCE (Liritzis 1998). Apart from being archaeoastronomically important structures, indirect dating via this method reinforces the results of the thermoluminescensce dating method used at least for the lower stone blocks of the buildings (Theocaris et al., 1997).

Cat. 2 (Mythology): With the close relations between religion and mythology, it comes as no surprise that many of the myths were linked to stellar objects. As mentioned previously, in Section 2, Cat.2, the mythological Andromeda and Perseus were placed on the sky after their deaths (see Fig. 6). Arcturus is named after the myth of Arcas and Callisto, where Zeus transformed the boy Arcas into the constellation Bootes and his mother, who was transformed into a bear at the time, into Ursa Major.

The Pleiades were named after the seven daughters of the titan Atlas, who were transformed into stars by Zeus. Orion was an amazingly strong hunter, who angered Gaia after threatening to kill all the animals on Earth. She sent a scorpion after him and Zeus placed both the scorpion and Orion in the night sky after the latter's death, though they are never to appear at the same time, since one disappears from the night sky when the other is rising, thus explaining stellar movement through mythology and vice versa (in Eratosthenes, see Hard 2015).

Figure 6. Andromeda, Perseus and Cetus on the Greek night sky (image from Stellurium).

Cat. 3 (Art): When looking at rock art, the most famous example is that of the Lascaux caves, which are estimated to be about 19,000 years B.C. (Ducasse & Langlais 2019). The caves contain almost 6000 figures of humans, animals, and other signs. Some of the patterns in the artwork have been interpreted as having astronomical content, specifically depicting constellations. For example, one of the aurochs seen in the Hall of Bulls has some spots carved on the face of the animal, around its eye, and another group above it. The first group is interpreted as representing Aldebaran and the Hyades, while the second group matches the Pleiades (Rappenglück, 2015). At any rate, such a hypothesis should be considered cautiously until further irrefutable evidence is produced. In the Magura Cave in Bulgaria, several monochrome figures of humans, animals, the sun, and stars exist on the walls. Studies claim that some of these paintings could be a calendar from the Late Eneolithic. In Topchicka Cave (Bulgaria), 14 pictures found on a boulder represent the stars and sun, on top, and animals and plants below (Stoev & Maglova, 2014).

As mentioned above, in Section 2, Cat.3, the lyrical poet Alcaeus from Lesbos, describes the rising of Lyra and Cygnus over Delphi "*… travels with his lyre on the chariot drawn by many Cygnus …*". Alcaeus speaks of the swans, represented by Cygnus, bringing Apollo back from the land of the Hyperboreans to Delphi, at the appointed time of his ephiphany (Treu, 1952) (Farnell, 2010).

These is also evidence in pottery of how the sky was a source of inspiration. On the Attic red-figure hydria seen in in Fig 7, painted by the "painter of Berlin", the god Apollo is depicted playing his lyre while sitting on a tripod (reminding us of Pythia, his oracle, and the oracular process) that incorporates a swan and, below that swan, two dolphins. This image is a placement that responds to the placement of the constellations on the sky (Liritzis & Castro, 2013).

Ovid wrote his poem *Fasti,* based on the Roman calendar. He goes through each day of the year, mentioning the notable days and events, such as festivals or rituals, while also offering historical context. He also mentions the heliacal rising and setting of some constellations and the mythology surrounding them. He is believed to have used Eratosthenes' *Catasterismi* as a source of inspiration (Robinson, 2013).

Nine solar and lunar eclipses, in the Middle Ages, occurred between 713 and 894 AD. A study has interpreted this barrage of stellar phenomena as the possible cause behind the lack of imagery depicting Ragnarok, the Norse end of the world, before the 9th century AD, and the amount of such imagery found later. These eclipses occurred close to the Hyades cluster, that is linked in the study to Fenrir, the Wolf that swallows the world. In essence, the authors posit that the feeling of impending doom is what caused the latter depictions of some events in the mythological Ragnarok. In the same study, Norse iconography for unknown phenomena is mentioned, specifically fire-dragons. The same is then found in the *Anglo-Saxon Chronicle*, at the time of the first raids on England. The authors mention how aurora borealis was recorded in Ireland on that date, a possible interpretation of the phenomenon during the attack (Langer, 2018).

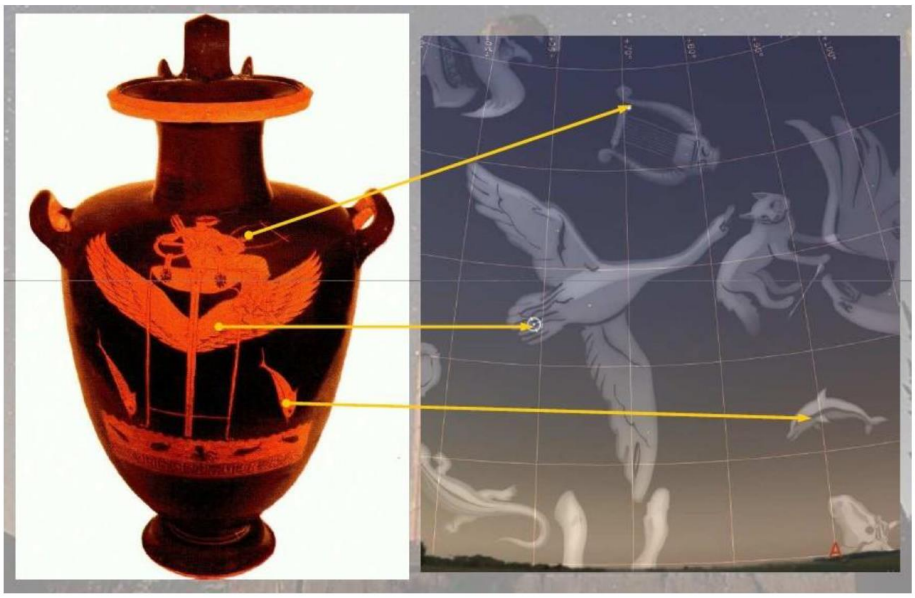

Figure 7. The hydria related to Hyperborean Apollo (Museo Gregoriano Etrusco 16568, Vatican). Image from Liritzis & Castro (2013).

Cat. 4 (Travel): Travel was also greatly affected by astronomy. Navigation with the help of stellar objects was very important, especially in earlier ages. The Vikings are known to have used sun compasses, like the one found in Uunartoq, Greenland. When the weather was not good enough for the gnomon to cast a shadow, they instead used sunstones, such as the one found in Alderney in 2013. The use of these sunstones is also mentioned in the saga of King Olaf the Holy (Ropars et al., 2014). This offers a possible explanation of the navigation methods used to reach as far as the Americas (Ropars et al., 2012).

As mentioned in Section 2, Cat. 4, records of navigation can be traced back to Homer. The first mentions of stellar objects in Ancient Greece appear in Iliad and Odyssey, where he refers to Sirius, the Pleiades, Orion and Ursa Major, among others, as being used for navigation (Mastorakou, 2015). One explorer that reached distant places was Euthymenes of Massalia, who is mentioned by Plutarch as having explored the coast of West Africa and reaching a large river. The explorer apparently believed that this was the beginning of the Nile, though the river mentioned was probably Senegal. The Carthaginian Hanno the Navigator, who lived in the 5th century BC, was also mentioned to have sailed through Gibraltar and around Africa, though there is no consensus on how far he managed to travel (Branigan, 1994). In later years, one of the most important travellers was Pytheas of Massalia. Although a direct record of his travels doesn't survive, we can glean from other writers that he reached as far as the Arctic, travelled to Britain and the Baltic, and was the first to meet the Celtic and Germanic tribes. He was also the first to introduce the concept of Thule, though he is believed to have meant Iceland, and the first to describe the Midnight Sun and polar ice. Strabo, who bases his discussion on Hipparchus' writings, mentions how Pytheas measured latitude in various ways: according to the sun's altitude, the elevation of the north pole or by length of the longest day and the sun's elevation on the shortest day (Bunbury & Beazley, 1911). Another theory claims that Thule was, in fact, Norway (McPhail, 2014). Pytheas is also said to have described the Aurora Borealis (McLeod, 2010). Another long naval voyage took place after Alexander's expedition in India. Plutarch, in this book *On the Apparent Face in the Orb of the Moon*, essentially describes a long voyage to a great continent, past the Atlantic Ocean. Examined and interpreted through modern scientific data, this expedition is believed to have been possible at Plutarch's time, through the use of the rise, set and directional orbits of known bright stars and constellations as navigational markers and by taking advantage of beneficial currents and excellent sailing abilities, as has been explained by Liritzis et al., (2018).

Cat.5 (Agriculture): The Minoans' religion, agriculture, and ritual practices were closely linked to the movement of stellar objects. The Minoan palaces were oriented according to the rising of the moon and sun, while a Minoan religious festival took place close to the heliacal rising of Spica, in the constellation of Virgo, which also marked the grape harvest (Ridderstad, 2009). Minoans had both a lunar and solar calendar, and possibly a star calendar that assisted in agriculture and navigation (Blomberg & Henriksson, 2015).

A study in 1997 on, mostly southern, Iberian archaeological sites, found that a group of those sites, that were dedicated to a fertility goddess, had a solar alignment to the sunrise or sunset on equinoxes. This is similar to other Mediterranean cultures, such as the Minoans mentioned above, mostly in their agricultural fertility rituals. The study also mentions other similar sites, such as the temple of Apollo at Maktar, Tunisia or the temple C of Selinunte (Esteban, 2016).

The Greeks relied heavily upon astronomical observation for their agricultural needs. The rising and settings of stars were important event markers for the appropriate times for sowing and harvesting, while the lunar months were used for their regular calendar, used mostly for civil and religious needs. This lunar calendar did include agricultural festivals (Hannah, 2015).

Hesiod, in his *Works & Days* (West, 1996), as well as Homer in the *Iliad* and *Odyssey* (Fagles, 1996), describe how astronomical observations were vital to agriculture and everyday life. They helped people keep a precise calendar that, while valuable for daily life, travel, and festivals, was vital in agriculture and animal husbandry.

Cat. 6 (Measurement of Time): Pliny in *Naturalis Historia* describes contemporary sundials and water clocks. He mentions that the first sundial was created approximately at 304 BC, though his source, Fabius Vestalis, did not mention any more details. He mentions Varro's description of the first sundial intended for common use, placed in Rostra. Scipio Nasica brought the first water clock and installed it in the Basilica Emilia del Foro, dividing the hours of day and night equally for the first time, thus changing the Romans everyday life (Bostock & Riley, 1855). The Obelisk of Montecitorio, known as the Solare, was transported to Rome from Egypt by Emperor Augustus, and used, along with Ara Pacis, in the construction of the Horologium Augusti. The obelisk was used as the gnomon for a large sundial, while it also pointed onto the steps and into specific features of Ara Pacis on the 23rd of September, the date of the emperor's birthday (Frischer et al., 2017).

In Greece, Anaximander (610-546 BC) is mentioned by Pliny as possibly the first to realize the obliquity of the Zodiac (Bostock & Riley, 1855). He was also said to have built a celestial sphere and is linked with the creation of the gnomon in sundials, in Greece. He is also believed to have participated in the construction of sundials in Sparta (Thibodeau, 2001).

In the lyrics of Orphic poems, man is mentioned as "a child of the Earth and of the starry sky". More details can be gleaned from the poems, such as the rotation of the earth around its axis and its spherical shape (Passas & Hasapis, 1984). In approximately 300 BC, the idea of a heliocentric system was first suggested by Aristarchus of Samos, even though such ideas existed previously, in the Orphic Hymns (Theodossiou et al., 2009).

There are multiple sundials that survive in Greece, in various states. While many exist, the most impressive example is the Tower of Winds in Athens, the earliest surviving clock tower and weather - horometric station (Fig.8). It incorporates eight different sundials, one for each cardinal direction and one for each segment in-between, at a 45° angle from either cardinal. There are also theories of a water clock that might have existed inside the tower, serving as a timekeeping device during the night or cloudy days (Noble & de Solla Price, 1968). Other theories consider an orrery that predicted stellar movements.

Greek calendars varied by city, which makes detailed study and comparisons quite difficult. While the best-preserved calendar is that of Athens, others have survived to a certain extent. These calendars are believed to be lunar, though there is evidence for lunisolar or even lunisolar-stellar calendars (Liritzis & Castro, 2013). Calendars were very important at the time, which is evident by the advances and construction of timekeeping devices such as sundials.

Another one of the most important timekeeping devices of Ancient Greece, contemporary to the Tower of Winds, is the Antikythera mechanism. This intricate orrery was hand operated and could be used to predict stellar movements for years ahead, thus enabling the user to know exactly when important events, such as the Olympic or Pythian games were to take place (Freeth at al., 2008; Efstathiou et al., 2022). It is considered the first analogue computer (Efstathiou and Efstathiou, 2018).

Similar devices made by Archimedes, called astrariums or simply astrological clocks, are mentioned by Cicero in *De re publica* as having been brought to Rome after the siege of Syracuse. However, these devices more closely fit the description of an orrery. Cicero also mentions yet another similar device which showed the movements of the close stellar objects around the Earth (Yonge, 1877). Water clocks were also used in Ancient Greece. Vitruvius also mentions other water clocks that occasionally incorporated sound, in the form of a small gong that indicated the time every hour (Morgan, 1914).

As mentioned in Section 2, Cat. 6, Herophilos was a Greek physician, who lived in Alexandria in the 3rd century BCE. He became interested in the heartbeat and how it could indicate what ailed his patients. He started using a water clock and empirically measure his patients' pulse, categorizing those measurements by age group. Eventually, he began taking his water clock with him on visits to patients' houses, where he measured their pulse to see the severity of their ailment (Landels, 1979).

Figure 8. Frieze on the Tower of Winds, with the sundial plate markings coloured for visibility. The shadow of the current gnomon is also visible. Image drawn by the authors (Vlachos & Liritzis 2022, in submission process for publication) Inset: Tower of Winds, Athens. Photo by Liritzis I. ©

A Minoan device in Crete found in Palaikastro is believed to have served as an eclipse calculator but is also theorized to have been used both as a sundial and for the determination of latitude (Tsikritsis et al., 2013) (Fig.9). Thus, for architectural urban planning, and determination of time for every day's activities and travelling Minoans seems to have devised a system to define time from the material culture unearthed and studied meticulously so far. This could explain how the Minoans, considering the means at their disposal, dominated the Aegean islands.

Studies have posited that the Minoan one-year solar calendar, with twelve solar months, derived from the Egyptian one (Henriksson & Blomberg, 2011). This opinion, however, has recently been challenged in a study, where the Minoan *kernoi* are interpreted as being a form of lunar, lunisolar or solar calendar, according to the appropriate configuration. The study also suggests two possible configurations of one Minoan solar year (Pliakos, 2021).

Other prehistoric cave complexes in Bulgaria have also been found to include images of stellar objects or astronomical phenomena, such as the caves in Tsarevets and the caves near the villages of Baylovo and Lipnitsa. In a recent study comparing methods of observation, two groups of observatories were identified, ones that used the horizon line, from approximately 5000 BCE, and ones that used meridional culminations, from approximately 7000 BCE (Stoev et al., 2022).

Figure 9. Imprint of the Palaikastro plate. Image from Tsikritzis (2013). This mould was used to create the calculator. In the middle is the central disk, with the lines on the right that served as gnomons.

3.2 Africa

Moving on to Africa, we find many examples as well. A special case worth discussing separately, rather than in Cat. 1, are the Dogon people of Mali, in West Africa. According to the writings of Marcel Griaule in 1931 to 1956, their belief system incorporates knowledge of Sirius' two companion stars, as well as the rings of Saturn and moons of Jupiter. Griaule also mentioned that the Dogon had built a model granary oriented to the cardinal directions, but specifically made with a stellar connection in mind (Griaule & Dieterlen, 1965). The real issue was how these people, without any astronomical instruments, knew of such stellar objects. They also did know of Saturn's rings and the Galilean moons of Jupiter, which are difficult to see without instrumentation, though as mentioned later in the Ancient China section, there is a record of such a case. Noah Brosch explains this as a knowledge exchange between the Dogon and an earlier expedition in the area, in 1893, to observe a total solar eclipse. This expedition would possess the necessary instrumentation to observe the celestial bodies mentioned and effectively be the reason behind the Dogon knowledge (Brosch, 2008). If that is indeed the case, it means that stellar objects they knew nothing about and were invisible to them, entered and were incorporated in their belief system in a matter of years. This provides a resounding example of the effect the skyscape can have on a civilization.

Cat. 1 (Religion, Rituals and Funeral Rites): In ancient Egypt, just like in ancient Greece, mythology and religion were closely linked. Religion was a part of everyday life and the people believed that the phenomena of nature were of divine origin. Thus, the Egyptian gods directly represented stellar objects. A list of the deities linked to stellar objects is presented in Table 1 below.

Table 1. List of Egyptian deities linked to stellar objects (Hart, 2005).

Aten	A solar deity
Atum	A solar deity
Bennu	A solar deity
Hathor	Linked with the sky and the sun
Horus	Linked with the sky, sun, and moon
Khepri	A solar deity
Khonsu	A lunar deity
Montu	A solar deity
Nut	A sky deity
Ra	A solar deity
Sopdu	A sky deity
Thoth	A lunar deity

There are, of course, minor deities also linked to stars and constellations. For example, Sothis (Sopdet), was the personification of Sirius, Sah represented Orion – Lepus and Seret represented Capricornus (Lull & Belmonte, 2015). There is also evidence of the existence of astral cults in the Old Kingdom, that worshipped Star-gods who personified the circumpolar stars (Hart, 2005).

The fact that the deities were directly linked to stellar objects affected the way Egyptians built their temples. The most comprehensive study on Egyptian temples and their orientations questioned whether they were oriented astronomically, geographically or in some other way. Approximately 400 temples and shrines were tested in total, as part of that study. Three types of orientation were found to be present, cardinal, solar and stellar. It is worth noting that the

cardinal orientations were performed by stellar observation. The temples of the Nile valley and delta were found to be orientated according to the Nile, where the axis of the building was perpendicular to the course of the river, but they were also astronomically orientated. Overall, most temples were indeed found to have astronomical orientations, whether it was fixed or seasonal, such as temples having equinoctial orientation (Belmonte, 2015). Orientation was also functional at times, as is the case of the Abu Simbel temple (Fig.10). This is built in such a way that the sun shines directly into the back of the temple and the sculptures of the deified Ptah, Amun Ra, the deified Ramesses II and Ra-Horakhti on only two dates a year: February 22, which was the king's birthday and October 22, which was the date of his coronation. The statue of the god Ptah, a chthonic god linked to the underworld, is the only one not illuminated at this time (Magli, 2018). The great pyramids have been shown to be aligned to the pole star, which at the time was Thuban (Ruggles, 2005). Pyramidions, the capstones at the top of the pyramids themselves might have been covered in gold, to reflect the sun (Wilkinson, 2008).

The burial rites of Egyptians were also directly affected by their beliefs and, therefore, stellar objects. In some cases, the figure of Nut, the mother goddess that gave birth to the morning sun, would be painted on the inside of coffin lids, to assist the deceased in his rebirth (De Young, 2000). In the tomb chapel of Senenmut TT71, the oldest surviving star ceiling, from approximately 1500 BC, includes a list of planets with their associated divine entities as well as portrayals of constellations (Pogo, 1930). Solar ships buried alongside the Pharaohs were also an effect of the deification of stellar objects, as the Egyptians believed the gods used ships to travel across the sky, therefore the Pharaoh, a representative of the Sun god on Earth, would also require a ship to reach the afterlife (Abubakr, 1955). The oldest solar ships found are at Tomb S 3357 in Saqqara, dating back to approximately 3000 BC (Ward, 2006). Some solar barges were found to have sailed on water therefore it is possible they were also used as funerary barges. An example of a possible funerary barge is known as Khufu ship, found at the Giza Great Pyramid (Jenkins, 1980).

The oracles in Egypt were also affected by stellar events. An example is the temple of Amun in Siwa which is linked to Alexander the Great as the site where he was proclaimed the son of the deity Amun (Fox, 1973). The temple was recently found to be aligned precisely to the sunrise during the equinoxes. A window in the temple's outer wall is aligned in such a way with yet another window in the inner wall of the sanctum and illuminated the sanctuary of the god on those two days (De Young, 2000).

Figure 10. Sunrise at Abu Simbel inner sanctum. Photo by World History Encyclopedia (License: GNU Free Documentation License).

The Pharaohs themselves were also considered to be linked to the gods and deified after death, and thus to the stars, being called "essence of all the gods" during the Pyramid Age (Hart, 2005).

The Mamprusi in Ghana build their homes facing west, to have the setting sun illuminate the area where the family elder sits. The Batammaliba people perform a ritual in honour of their solar deity when

they build their homes, which are on an east to west axis (Snedegar, 2000).

Cat. 2 (Mythology): Mythology in ancient Egypt was directly linked to their deities, and the ones figuring prominently in it were the solar gods. Atum, the solar deity, was the focus of one of the oldest creation myths (Hart, 2005). Ra, representing the sun, travels across the sky daily on the Atet and passes into the underworld when the sun sets (Abubakr, 1955). Overall, Egyptian religion directly referenced their mythology, and the rituals were supposed to recreated various mythic events (Tobin, 1989). Horus, who competed with Osiris over the crown of Egypt, is a sky god whose wings were the sky, and his one eye was the sun, while the other was the moon (Hart, 2005). The moon is thus explained to be not as bright as the sun, since Set tore out one of Horus' eyes.

In other African cultures, while lunar, solar, and stellar calendar systems have been documented (Peek and Yankah, 2004), the biggest impact the skyscape had in everyday life can be seen in oral traditions and mythology. Rulers tended to be linked to the sun, even taking up a name like "Blazing Sun". The reign of Jjuuko, king of Buganda, is remembered especially because of an eclipse. There was also significant lunar symbolism, such as in ascension rituals in the Shambaa kingdom in Tanzania, where a new king had to walk over the path of the first, founding king, from the east to west, thus symbolizing the rising moon (Snedegar, 2000).

Cat. 3 (Art): The Eye of Horus features prominently in Egyptian art and jewellery and was also believed to be used in healing rituals (Pinch, 2006) (Fig. 11). Colours in art were also linked to the stars. Red, for example, was used in amulets, representing the fiery sun god. While blue symbolized the Nile, it also seems to have had solar links, through the link to the god Amun-Re. Yellow was always linked to the sun and its everlasting nature. There is also an effect in artwork themes, for example, when a crocodile faces the morning sun and hunts for fish, who were the enemies of the sun god. Jewellery materials had specific meanings. Gold was a symbol of the sun and considered divine, since it was believed to be what gods bodies were made of, while silver was a symbol of the moon. Quartzite was linked to Atum due to its colours, while lapis lazuli represented the sky and heavens. Metal was overall preferred for mirrors, due to its reflective nature (Wilkinson, 1999).

Figure 11. An Egyptian protective amulet, the Eye of Horus, of the 6th - 4th century BCE (Louvre Museum, Paris) World History Encyclopedia. License: GNU Free Documentation License

Cat. 5 (Agriculture): The flooding of the Nile, as mentioned previously, was an important event in agricultural terms. The ancient Egyptians believed that it was caused by Isis' tears over the death of Osiris. They realized that the heliacal rising of Sirius (Fig. 12) was directly before the annual flooding, therefore helping them predict the time of the event, if not it's extent (Hart, 2005).

The Pleiades were a popular marker in Africa, their rise marking the beginning of June's rains, though others did exist in various areas, such as the four stars that marked the flooding of the Omo river in Ethiopia (Snedegar, 2000). The Nuer of South Sudan regulate all seasonal, agricultural, and pastoral activities according to the moon. In Fezzan, such activities are

governed by the movement of the Pleiades, Capricorn, Betelgeuse, Canis Major, and others (Oxby, 1999).

Cat. 6 (Measurement of Time): Ancient Egypt also has the only surviving ancient calendar that is this close to the current one, consisting of a 365-day long year. Timekeeping in ancient Egypt was performed using sundials, the oldest of which dates to approximately the thirteenth century BCE (De Young, 2000). There is an equally old surviving water clock (Pogo, 1936), though it is not as precise as latter ones and was probably the result of experimentation rather than mathematics (De Young, 2000). Obelisks of the time have not been confirmed to serve as gnomons for sundials. Later, the Romans have, at least in the case of the Obelisk of Montecittorio, moved an obelisk from Egypt and used it as such (Frischer, 2017).

The Nabta Playa, near Abu Simbel, is home to a circle of stones that is believed to have served as a ritual site or observatory, though they are commonly called calendar stones (Castro, 2015). UNESCO describes the site as having "hypothetical solar and stellar alignments" (Belmonte, 2010). They do have an approximate alignment towards sunrise during the summer solstice (Malville, 2015). Another hypothesis mentions the possibility of the stones being a star map, for the time of their construction, approximately the 6th to 5th millennium BCE (Brophy, 2005).

The Kalokol Pillar Site, also known as Namoratunga II, in Kenya, is believed to have served as a calendar or star map, while the pillars themselves seem to be aligned to specific star systems (Robbins & Lynch, 1978). This interpretation has been challenged (Hildebrand et al., 2013).

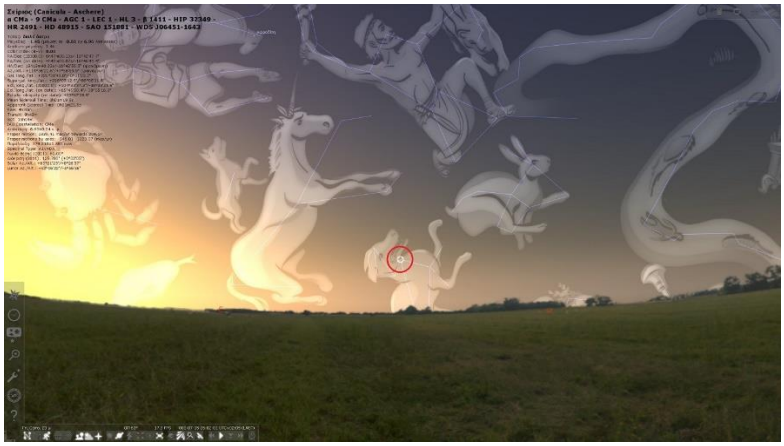

Figure 12. Heliacal rising of Sirius (circled). Image from Stellarium.

Cat. 7 (Daily life): Egyptian society also included hour watchers, observers of the heavens who were tasked with timekeeping and the motion of stellar objects, to ensure that temple rituals took place at the intended times (De Young, 2000). Sometimes these priests attained high status, which can be attested by the fact that statues or even tombs were built for them. An example is TT52, the tomb of Nakht, an Egyptian astronomer - astrologer (Davies, 1917). Another is the statue of Harkhebi, an astronomer, snake charmer and priest of Serket, the back of which contains an inscription that gives details on the tasks of the hour watchers, explaining their duties, observation of the stars and risings and settings and others (Clagett, 1995).

3.3 Asia

Cat. 1 (Religion, Rituals and Funeral Rites): The prehistoric site of Carahunge in Armenia has been called the Armenian Stonehenge. It was suggested by Paris Herouni that it served as an ancient observatory. Though that theory is not accepted, due to various problems in the precision of alignments, further research is warranted to determine any archaeoastronomical potential of the site (Gonzalez-Garcia, 2014).

The Early Bronze Age II megalithic structure Rujm el-Hiri, in Golan Heights, is considered to have been used as a ritual site (Aveni, 2001), a calendar or an observatory (Freikman & Porat, 2017).

In Mesopotamia, astrology preceded astronomy, with its primary use being in predicting the future via omens. The stellar objects represented the Babylonian gods (Koch-Westenholz, 1995). Priest-scribes were the mathematicians and therefore astronomers, with the Chaldean Nabu-rimanni considered to be the first astronomer (Olmstead, 1938). The Enuma Anu Enlil are a surviving series of tablets dealing with astrology, which was the main inspiration behind the priests' divinations (Hunger, 1992).

Astronomy in India is believed to have been a matter of study since approx. 4300 BC (Ashfaque, 1977). The site in Udayagiri, which translates to sunrise mountain, is believed to have had a Sun Temple (Dass & Willis, 2002). The Sanchi Stupa, built to house the relics of the Buddha, at approx. 250 BCE, has a railing

that represents the sun's path on the sky. The megalithic sites in Brahmagiri and Hanamsagar, in Karnataka, both have distinct astronomical orientations (Kak, 2010). In the temple complex of Khajuraho, in Madhya Pradesh, the Lakshmana temple is oriented towards sunrise on Holi, while the others are believed to have also been orientated to specific sunrises (Singh, 2009). Of more recent construction, the Jantar Mantar in Jaipur, completed in 1734-8, is a collection of 19 astronomical instruments built by the Rajput king Sawai Jai Singh II, the founder of Jaipur, Rajasthan. It hosts the Samrat Yantra the world's largest stone sundial of 27 m long and hypotenuse 39 m long parallel to the earth's axis. It is an equinoctial sundial and measures time up to the precision of two seconds. This is an UNESCO World Heritage site, and it houses various astronomical instruments, for more accurate observation of the sky (UNESCO World Heritage List) (Fig.13).

In Japan, the stone circles of Nonakado and Manza, are believed to have been large sundials. The royal tombs of king Kongmin and his wife, in Korea, have constellations painted on the walls and ceiling. In China, this practice began sometime in the Han dynasty. Astronomy and astrology were linked, as they were used for omens that revealed the will of Heaven. (Xiaochun, 2000). In a study on the Guo cemetary of Ancient China (770 BCE to 665 BCE) it's the dominant orientation was examined, in order to identify the local religious belief of the afterlife at the time. In that case, most burials were found to be aligned with their heads towards the north, with a slight eastern deviation. This northern placement was common practice of the Xia, Shang and Zhou dynasties. The change of deviation from west to east was found to be caused by the change of the Polar Star, from Thuban to Kochab (Zhang, 2020)

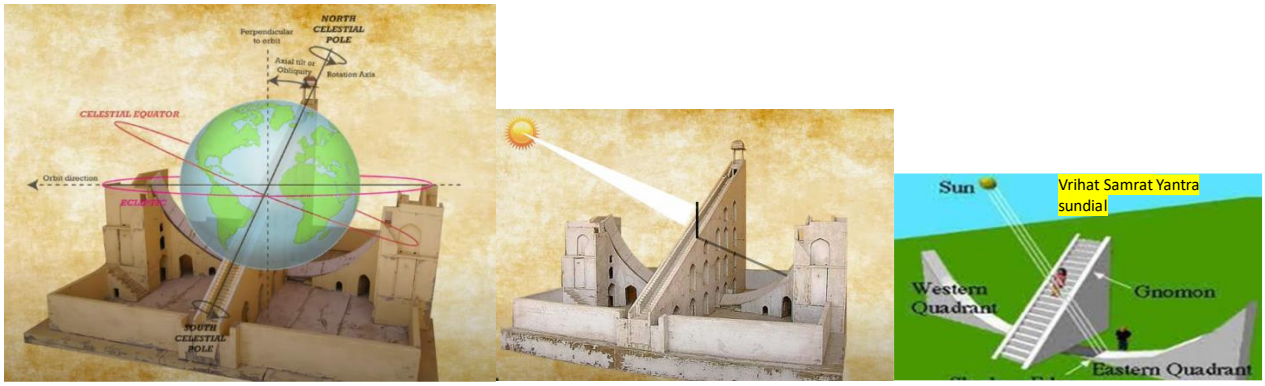

Figure 13. The Jantar Mantar in Jaipur hosts the Samrat Yantra sundial. Left: The edge of the gnomon points towards north pole. It measures local time, sun's declination and right ascendance of celestial objects. Middle & Right: Between the two quadrants (eastern and western) the shadow hits upon a graduated sundial in simple equal hours, minutes and seconds. (Based on Sources: https://www.youtube.com/watch?v=FCZ4bLzNgkM & https://www.bordersundials.co.uk/).

Cat. 2 (Mythology): A Sanskrit treatise in astronomy written in approx. 800 CE, the Surya Siddhanta, is believed to have been based on an even older text of the same name, possibly written in the 4th century CE. In this treatise, the Sun speaks to an asura, a demon-like being, and imparts the knowledge of the stars that the being seeks (Burgess, 1935). The astrologers in Ancient India were very highly regarded to the point where kings did not dare to not employ one, believing it would bode ill for themselves and their kingdom (Dallaporta and Marcato, 2017).

One of the earliest texts found in China, details the mythological king Yao's commission of Hsi and Ho to calculate and delineate the movements of stellar objects (Kelley & Milone, 2011).

Cat. 3 (Art): The hymns of Rigveda and other Vedic literature has references that point towards much earlier observation. The nakshatra lists found in the Vedas also point towards a fascination with lunar observation (Kak, 2010).

Cat. 4 (Travel): In this category, we should mention the Silk Road, which began as early as the 2nd millennium BCE. Trade on the Steppe Route in Asia, which extended for a total of 10.000 km, was common even earlier (Christian, 2000). It expanded into the Royal Road in Persia, in approximately 500 BCE, according to Herodotus, which added another 2800 km (Young, 1963) and expanded and developed even further during Alexander the Great's campaigns (Prevas, 2004).

Cat. 5 (Agriculture): Agriculture in ancient China relied heavily on astronomy for the prediction of floods (Kelley D.H. & Milone E.F., 2011).

Cat. 6 (Measurement of Time): The Babylonians had an early interest in calculating the duration of day and night, the risings, settings, and culminations of stars, as well as the movements of the moon and Venus. Their measurements of astronomical movements were incredibly precise (Magli, 2009). Among important surviving astronomical records are the Babylonian astrolabes, cuneiform tablets on astronomy,

the mul.apin, a star catalogue dating back to the seventh century BC, and the Venus tablet of Ammisaduqa, part of the Enuma Anu Enlil, which is the oldest astronomical text, from the seventh century BC. The Hilprecth Text is also important in its difference from the other texts, in that it deals with calculating the distance between celestial bodies (Rochberg-Halton, 1983). The Pleiades were of great importance as well, being one of the few stellar objects that had a cult. They were also vital for calendrical use (Verderame, 2016). The ivory prism found in the ruins of Nineveh was initially considered to be describing the rules of a game, but was later found to be a calculator, converting units to be used in determining the movements of stellar objects. The Babylonians had also developed a system of zodiacal signs, which is theorized to have been the basis for the one developed by the Greeks (van der Waerden, 1951). They knew when to look for eclipses, both lunar and solar and had developed a 12-month calendar of 354 days, with the necessary 13th month added in some years, that might have been the concept behind the Hebrew, Greek and Roman calendars (Olmstead, 1938). The Chaldean astronomers also discovered the eclipse and saros cycles, near the end of the Empire (Leverington, 2003). A recent study focused on Assyrian astrological reports, dating back to the 8th and 7th centuries BCE, that describe a red glow in the sky. These reports were determined to be the earliest historical observational reports of aurorae and solar activity. (Hayakawa et al., 2019).

The earliest reference to a calendar in Japan, is in the Nihon Shoki or The Chronicles of Japan, believed to date back to 720 BC, in which the emperor requested calendar makers from Korea (Xiaonchun, 2000).

In ancient China, evidence of a luni-solar calendar exists as far back as the 14th centuries BCE (Xiaochun, 2000). The Chinese astronomer and astrologer Gan De is believed to be the first to have compiled a star catalogue, after the Babylonians. He is also considered the first to describe one of the Galilean moons, normally invisible to the naked eye, except on certain days. Though it is yet uncertain which one Gan De observed, it is believed to have been Callisto (Hughes, 1982).

Cat. 7 (Daily life): Omens were of great importance to Babylonians. Their belief in them could cause a king to switch places with one of his poor subjects, who would rule just for the one day predicted to be harmful to the king, and then be killed (Magli, 2009).

3.4 The Americas

In the Americas, there are again many civilizations to look upon for influence in their development by the skyscape. The most well-known ones are the Inca, Aztec, and Maya, who have left us with impressive structures, with the Native American tribes having similarly rich oral tradition and beliefs (see examples in Iwaniszewski 2018; Pérez-Enríquez & Trejo 2016; Hans Martz de la Vega 2018; Moyano 2016; Corado et al 2018; Malville 2014).

Cat. 1 (Religion, Rituals and Funeral Rites): The Inca rulers were believed to be children of the sun god Inti and venerated as such (Dearborn, 2000). The Temple of the Sun, Coricancha, in Cusco and the Torreon in Machu Picchu are believed to have been used as observatories, as was the Maya solar observatory at Uaxactun (Aveni, 2003). In the case of the Torreon, the proposed alignment refers to two windows, called the Solstice and Qullqa windows. One faces towards the sunrise at summer solstice, while the other at the Qullqa constellation at sunset. Other constellations are also visible from this window (Dearborn & White, 1983). This alignment has been disputed in part, as in only certain cases was stellar observation found to be possible. The solar alignments of the building were confirmed, however, and accepted in the same study (Ziolkowski, 2020).

The Mayan city of Chichen Itza contains the Temple of Kukulcan, a deity known as the feathered serpent, which has a unique effect, much like the Pantheon mentioned previously. The Temple is aligned in such a way that the rising sun at the equinoxes, along with the shadows by the pyramid and its steps, and the serpent head carvings, create the now famous serpent effect on the stairway, where a large serpent representing the deity is seen coming down the steps of the pyramid (Mendez et. al, 2005).

A Native American tribe of either the lower Mississippi river or Ohio Valley regions, the Lakota, had a ceremony where they would travel for three months, from the spring equinox to summer solstice, from Dried Willow to the Bear Lodge. This long journey was said to represent the first journey the sun took (Kelley and Milone, 2011).

Cat. 2 (Mythology): As mentioned before, one of the most important Incan gods was Inti, the sun god. In one of their origin stories, the Inca claimed their direct origin from the birth of the sun. (Dearborn, 2000). They believed that before the time of the humans, there were four more periods or suns. These periods each represented one vital aspect of the world, the animal energy, air, fire, and water. These are now combined in our world, though it might not last forever, and it was the Incas duty to appease the gods, so as not to let this sun die (Bierlein, 1994).

The Lakota have a rich oral tradition. A series of stories in their belief system concern a hero called Fallen Star, believed by scholars to be a planetary hero, whose father-in-law had lost his arm. The arm

is essentially formed by stellar objects. The wrist, for example, is the Belt of Orion, while Rigel is the end of the index finger (Kelley and Milone, 2011).

Cat. 3 (Art): Maya pottery has been determined to contain references to eclipses (Kelley and Milone, 2011). An Algonquin origin song begins "We are the stars which sing…", which reminds us of the Orphic Hymns. Navajo blankets have stellar patterns on them, which are sometimes also found on canyon walls. A crescent shape in rock art is also believed to have been identified as representing a supernova (Chamberlain, 2000).

Cat. 5 (Agriculture): The Picchu pillars were a group of pillars mentioned as standing on a hill to the northwest of Cusco. They are described as having been set in a way that the sun would set in-between the pillars for only one week in the middle of August. This might have been a dual use effect. It could have been used in a ritual that marked the beginning of the planting season, with a week being enough time to account for weather that made observation difficult. It could also have been a way for the regular people to witness that observation along with the ruling class (Dearborn, 2000). Generally, the calendars of the Inca and Maya, while symbolic and ritualistic, were closely aligned to agricultural cycles (Broda, 2000).

Cat. 6 (Measurement of Time): The Aztec and Mayan calendars are the more detailed ones remaining. Calendars from other ethnic groups in the area are not well documented at this time, but it is generally believed they were similar in many ways. The calendars consisted of a 365-day year, with a 260-day ritual calendar and a Venus cycle of 584 days (Broda, 2000). The Dresden codex is a Maya book, believed to be the oldest text in the Americas. In it, the 260-day ritual calendar of the Maya has been linked directly to the movements of Venus and Mars (Ruggles, 2005).

The Pawnee have also created star maps, which are found to be some of the most accurate than any other tribal group, though there are reports of similar Lakota maps and a ceremonial tradition more than 2000 years old. There are also mentions of Siouan star maps, though one has been lost and the other remains unpublished (Kelley and Milone, 2011).

Cat. 7 (Daily life): In many ancient cultures in Mesoamerica, an ancient custom was to extinguish all the fires when an important astronomical event, such as an eclipse, would occur and relight them afterwards in a New Fire ritual (Kelley and Milone, 2011). In the sacred ritual calendar of the Aztecs, each day in it had specific designations of mostly animals. Each symbol in the calendar would have a good, bad, or neutral meaning. This calendar was essential in the Aztecs' lives, as before any important action the people would consult the priests, who in turn would look to their sacred calendar and determine the most likely outcome of said action (Broda, 2000).

The Skidi Pawnee peoples' everyday lives were greatly affected by stellar observations. They used their houses as observatories, while symbolism was evident in many aspects, such as the four posts of the house, that represented four stars that maintained the heavens (Chamberlain, 2000).

The Incas, being a Heliocentric culture, the one that is in charge of the adoration and ritualization of the Sun in the practices of their daily life, it was a population that always looked at the sky, looking for any kind of message or a sign that their most important God could give them (Leibowicz et al 2017; Astete et al 2017)

3.5 Oceania

Australia and the Oceanian people in general have a rich history of astronomy, though it is mostly through oral tradition that we find evidence of it. We look upon the Aboriginal Australian people, the Maori of New Zealand, and the Polynesian and Hawaiian navigators as examples.

Cat. 1 (Religion, Rituals and Funeral Rites): Various Australian groups believed that the sky dome was held up by various beings (Haynes, 2000), and some believed the sky was where spirits went after death (Kelley and Milone, 2011). Kane was the creation spirit that, according to the Hawaiian people, created the sun, moon and stars (Chauvin, 2000).

Cat. 2 (Mythology): The Boorong people believed that the sun was created by one of the old spirits, before mankind appeared on the earth. The Needwonee believed a star created the sun and moon. (Haynes, 2000). Aboriginal Australians, mostly in the southern parts of the continent, as well as the Maori of New Zealand, believed that the Aurora Australis was a bad portent. They linked it with fires in the spirit world, or believed it was an evil spirit itself, or even old spirits that would talk to the people. Generally, it was an ill portent, linked mostly with fire, blood and evil spirits (Hamacher, 2013).

Cat. 3 (Art): Rock art in Oceania, dating back to approximately from the 6th to the middle of the 4th millennium BCE, in the form of cup-like holes and grooves, has been linked with constellations, in particular Orion, the Pleiades and others. Another group of rock art has been identified with either the supernova of 1066 or the Vela supernova (Haynes, 2000).

Cat. 4 (Travel): Polynesian navigators have been confirmed to have used naked eye astronomy since ancient times to navigate, having learned how to determine their general direction and latitude. These techniques, passed down from one generation to the other, work even today, as evidenced by a trip per-

formed in 1969 by Hipour, a navigator from the Caroline Islands, during which he successfully crossed 700km of ocean (Kelley and Milone, 2011). In 1768, Captain James Cook was about to leave from Tahiti on the HMS Endeavour, when he let on a Polynesian navigator. This navigator, called Tupaia, navigated without instrumentation, all the way to Rurutu island, 572 km south of Tahiti (Magli, 2009). The Hawaiian people travelled from Tahiti to Hawaii using their knowledge of astronomy and star compasses, along with observations of local phenomena such as currents or bird movement (Penprase, 2011).

Cat. 5 (Agriculture): The Meriam people of the Torres Strait Islands linked the movement of their grand constellation Tagai, which includes Sagittarius, Scorpio, Lupus, and other Western constellations, with the changing of the seasons, which directly affected fishing and gathering (Haynes, 2000).

Cat. 6 (Measurement of Time): In Hawaii, as well as Polynesia, the new year was heralded by the return of the Pleiades in the sky (Chauvin, 2000).

Cat. 7 (Daily life): Astronomy affected even the legal system, where punishment of criminals had to be performed ritually at specific times (Kelley and Milone, 2011).

3.6 The Innuits in the Arctic circle

The Inuit people are mentioned separately, due to the unique circumstances of their skyscape, when above the Arctic Circle. The Qilak, the celestial sphere of the Inuit, was quite unique due to the long absence of the Sun and the fact that, at this latitude, many stars are not visible.

Cat. 1 (Religion, Rituals and Funeral Rites): The Aurora Borealis played a vital role in their mythology and religion, as they believed the light was the spirits of those who died of blood loss (MacDonald, 2015).

Cat. 2 (Mythology): The star mythology of the Inuit was teaching, through the narrative, the relative positions of the stars in the sky. Stars were sometimes believed to be mythological people, transformed into lights in the sky after death (MacDonald, 2015).

Cat. 4 (Travel): Navigation was primarily based on local markers, such as unique terrain, and though the stars did play a vital role sometimes, this effect was not as pronounced as in other regions (MacDonald, 2015).

Cat. 6 (Measurement of Time): They used the rising of Lyra and Aquila as a marker for the end of that absence and the light returning to the region. The moon was used to track their calendrical year, in 13 moon months (MacDonald, 2015). During the time the Sun was missing, the Inuit used the stars to keep track of time, for all their activities (Penprase, 2011).

4. DISCUSSION & CONCLUSION

We have presented some selected examples, but by no means an exhaustive list, from almost every category, across all continents, of how the skyscape has impacted peoples' lives in the past. Some cultures had more prominent and numerous examples than others, which is expected when discussing a global landscape, as each culture had different geographical and astronomical features to contend with, that affected growth and civilization. In all cases, the effect astronomical observation had in humanity's past and the interest and imagination it sparked is evident. Archaeoastronomy, cultural astronomy, skyscape archaeology, are subject coined names describing the interdisciplinary topics from social sciences-humanities and natural sciences, in particular archaeology, history, ancient literature, mythology, tangible and intangible cultural heritage, astronomy.

This impact is still present to this day. One example are the Christian churches. Most Byzantine churches in Europe have been found to be oriented towards the sunrise at the equinoxes, with some orientations being on the solstices and others on specific important days, such as the saint's name day (Liritzis & Vassiliou, 2006). Catholic churches have also been found to be oriented towards sunrise or, sometimes, oriented to the east in such a way that the light of the rising sun will illuminate the altar, on the patron's day (Lauzikas, 2015). This brings in mind what we discussed above, in section 3.1, Cat. 2, about the temple of Apollo in Delphi (Vlachos & Liritzis, 2018) and the orientation of Greek temples in general, as mentioned by Vitruvius (Morgan, 1914). This effectively shows that the Ancient Greek practice of temples, built with orientations towards the first rays of the sun over the perceptible horizon, on a day important to the temple's god, is a practice that lives on to this day in the Christian church. Even if we put aside the churches oriented thus, we still have many that are built on orientations towards the sunrise on solstices or equinoxes, like many examples previously mentioned.

Bright stars, the lunar phases, other planets, constellations, are time markers and consequently regulators and stimulus of people's intellectual activities, throughout the human presence on earth and perpetually shall guide humanity to beyond our planet exploration; much like todays spaceships do.

The brief review indicates how astronomy changed the ancient peoples' lives and still affects ours in ways we do not yet fully comprehend.

The seven broad categories put forward encompass all types of effects the skyscape could have on humans, not just in the past but also to this present day. The examples mentioned are not all inclusive but

presented to ascertain the credibility of the categories determined.

The cultural impact of the skyscape is an interesting subject for present and future study. If many such examples across the world could be catalogued and categorized accordingly, the research value and academic research potential is enormous. Cross-culture comparisons could be made, that could even lead to more details on contact between ancient people, thus giving a clearer indication of their travels or spheres of influence. Similarities between religions (intangible culture) based on stellar movements would be easier to comprehend and offer ideas on the interpretation of practices, that might seem culturally isolated but turn out to be common, albeit in a different form.

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