The pillars of the Earth and the Sky: Capital cities, astronomy and landscape

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Abstract

Some cities were built with the idea of establishing cosmic order. The sky used to be a very important component of the landscape that has been lost completely in our modern, overcrowded, and excessively illuminated, cities. However, this was not the case in the past. Astronomy actually played a most relevant role in urban planning, particularly in the organization of sacred spaces which were later surrounded by extensive civil urban areas. Today, archaeoastronomy approaches the minds of our ancestors by studying the skyscape and how it is printed in the terrain by the visualization and the orientation of sacred buildings. The sun was indeed the most conspicuous component of that skyscape and was the primary focus within a large set of very unique cultures of great historical significance. In particular, in this review paper, we will study and compare the case of four ‘solstitial’ cities: Thebes, Hattusha, Carthago Nova, and Petra, capitals of Egypt in the Middle and New Kingdoms, the Hittite Empire, the Carthaginian dominions in the Iberian Peninsula and the Nabataean Kingdom, respectively. We will briefly analyse solar aspects of the religions of these cultures and will scrutinize their capital cities, showing how their strategic geographical position and orography were of key importance. We will also look at how solar benchmarks, and related hierophanies, played a most relevant role in the orientation and/or location of some of their most significant monuments. We will finally incorporate a frame of analysis for these data in order to come to our conclusion that different Mediterranean societies where solar cults or symbolism are strongly substantiated display common characteristics in the orientation and location of these cities connecting them with solstitial orientations.

1. Introduction

Ancient cities could be founded with a single or several objectives in mind. They often reflect the worldview of their inhabitants or of those who originally built them. However, in those cases, such as Carthago Nova, when there was a population replacement after a dramatic conquest, the new population seldom tends to accommodate the space for the new social, political and religious situation, even recycling previous structures. Cordoba, in southern Spain, would be a good example. Originally a Puniced Iberian oppidum, it was transformed by the Romans into an impressive civitas with a Hippodamian grid, perhaps commemorating the day of
foundation of the *Urbs*. Possibly upon that grid, a substantial Christian basilica was built by the Visigoths that was later demolished by the Muslims to build one of the most impressive buildings ever erected by humankind, the Great Mosque, a replica of the Ka’aba, surrounded by a typical Arab *medina*. Later on, re-conquered by the Christians, Cordoba suffered a final rearrangement adapting the cult direction inside the Mosque – now converted into a Christian cathedral – towards the East and Jerusalem. Indeed the city keeps a strong Andalusian flavour where each new invader has left their unmistakable footprint (Belmonte and Hoskin, 2002: 375-79).

However, the four cities we are going to briefly analyse in this essay were the awe-inspiring creation of their builders and thus must be understood in the frame of each society. Hence, they have preserved the essence of the worldview of the people who imagined them.

The four cases presented in this paper develop four examples where solar phenomena were incorporated into the city design. Such solar phenomena were important to the societies who built them either because of the prominence of a solar deity, or due to a symbolic association of political power to the sun, or both. In all four cases reviewed, the solar relationships are mostly incarnated in orientations towards solstice sunrise or sunset.

This synthesis paper will not present a detailed analysis of archaeological, religious and historical aspects relevant to our proposals since these were already lengthily and accurately discussed in the original papers (many of them co-authored with well-trained archaeologists in their respective areas) where the results were first presented. These are: Shaltout and Belmonte (2005) and Belmonte et al. (2009; see also Belmonte, 2012, 232-38) for Thebes; González García and Belmonte (2011, see also 2014a) for Hattusha, Belmonte et al. (2015) for Carthago Nova and Belmonte et al. (2013) for Petra. It is worth noting that, with the exception case of Thebes, where the research already has a long history dating back to the 19th century (see below), ours is the first detailed archaeoastronomical approach to Hattusha, Carthago Nova and Petra and hence our works stand out in this respect, being the only reference sources – to our knowledge – so far.

We direct interested readers to these publications (and references therein) should they be interested in more detail on the particular archaeological and anthropological contexts. Here, for reasons of rationality and comprehensiveness, we will concentrate on the cultural astronomy aspects of the analysis although archaeological and historical facts will indeed be discussed when the ongoing discussion requires it.

In this essay a diachronic perspective will be followed, starting with Thebes and finishing with Petra. This approach should allow the reader to understand how these unique artistic creations of natural beauty – all the four enclaves under discussion were located within or close to awesome topographical features – were transformed into some of the nicest cosmic landscapes on Earth. As we will show, the time-marks of the solstices would have played a determinant role in this game. The solstices have always been, and still are, the most important stations of the yearly cycle, as the moments when the sun stands still in its annual motion across the horizon. The diachronic perspective will allow us to use the data detailed here to build the interpretative scheme within the framework of the Structural Ladder as defined by Criado-Boado (2012: 209-14) and used in an archaeoastronomical context by González-García (2013), afterwards. In this framework, we carry out a first investigation on a determined aspect of the material culture, a common form of the archaeological record.
For the sake of illustration, take the orientation of a temple. It must be remembered that the choice of a particular axis is already an interpretation, as indicated by Hodder and Hutson (2003: 50). After inspecting the data, the facts may prompt the researcher to propose a first hypothesis with regard to such orientation. This is usually where we end our investigations and perhaps jump to conclusions regarding meaning of the archaeoastronomical records whilst incorporating anthropological methodologies. However the method above proposes a number of steps before taking that leap.

A second step would be to research other characteristics of the archaeological object we are investigating, for example, in our case, the topography and landscape relations of the monuments. Such further investigations and comparisons allow the expansion of our first hypothesis to a new level: an ideal model encapsulating all the information collected so far. We must bear in mind that such a model is still not complete and is not giving a ‘meaning’ to the archaeological object we are investigating; but by proceeding in this way we are accumulating different layers of significance (García Quintela and González-García, 2009).

The third step involves comparing our regional investigation to how that object appears in other geographical areas: how the orientation, topography and other characteristics of the object under study (the cities) appear in other areas. If a common pattern arises, our ideal model could be expanded to a generic hypothetical model, something that could be applied on a general level to a variety of similar objects.

To finally attain a proper level of understanding, Criado-Boado proposes comparing such archaeological characteristics from different chrono-cultural contexts. By so doing, the orientation of temples – or the internal organization of a city – may, for instance, indicate the persistence and/or changes derived from the action of time and culture; under a structural code we could then postulate an ideal generic model. Up to now all steps are based on data, and thus we may term this approach as mainly positivistic.

The final step is that of trying to identify some sense out of that archaeoastronomical problem. To do so we could have recourse to any of the current anthropological methodologies but we must always do it based on our previous steps on the proposed procedure; thus, subjectivity would be much more constrained than if we tried to jump into the fifth step without going through the previous steps.

2. In the realm of Amun-Re: Thebes, landscape and astronomy in essence

Let us start our essay in Thebes. Thebes was the city of Amun-Re, the deity representing the hidden power of the solar divinity and as such – and religious capital of Egypt for uncountable generations – it was embellished with some of the most appealing temples ever built by Egyptian ingenuity. Many of them were aligned to the winter solstice (see Table 1). In particular, the Amun temple of Karnak shows an impressive axis of symmetry.

Ipet Sut, the name of Karnak in ancient Egyptian sources, forms part of a relevant chapter in the history of cultural astronomy. At the end of the 19th Century, Norman Lockyer argued that the main structure of the complex, the temple of Amun, would have been orientated towards sunset at the summer solstice at the moment of construction, as the alignment of the main axis suggested (Lockyer, 1894). However, when he asked for this hypothesis to be checked on site, Lockyer learnt that the hills of Western Thebes precluded such an alignment (see Figure 1 and Table 1), and that the light of the setting sun never actually reached the interior chambers of the temple, unless
the building had been constructed 56 centuries before, i.e. around 3600 BC. When older chronologies were abandoned and a new one proposed at the turn of the century, his hypothesis was severely questioned. Apparently, despite Lockyer being still alive and in his seventies, he never made the necessary effort to accommodate his proposals for the new chronology. Consequently, the potential solstitial alignment of Ipet Sut was forgotten for three quarters of a century.

Table 1. Egyptian temples and chapels in Thebes orientated, or nearly orientated, to sunrise at the winter solstice. The table shows for each temple the location, the identification of the temple (either the most common name, owner deity or builder), the historical period of construction (i.e. dynasty), the latitude and longitude (L and l), its azimuth (a) from inside looking out, and the angular height of the horizon (h) in that direction, and the corresponding declination (δ). The last column contains some additional comments. The datum of the Amun temple at Karnak, open to the west is offered for comparison. Adapted from Belmonte and Shaltout (2009, Appendix II, 349).

<table>
<thead>
<tr>
<th>Place</th>
<th>Temple</th>
<th>Dynasty</th>
<th>L (º')</th>
<th>l (º')</th>
<th>a (º)</th>
<th>h (º)</th>
<th>δ (º)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karnak</td>
<td>Amun (Main)</td>
<td>11th-12th-13th</td>
<td>25/42</td>
<td>32/39</td>
<td>296½</td>
<td>3½</td>
<td>25½</td>
<td>Ammon precinct</td>
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<tr>
<td></td>
<td>Sun High Place</td>
<td>18th</td>
<td>116½</td>
<td>0½</td>
<td>-24</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Hatshepsut</td>
<td>18th</td>
<td>116½</td>
<td>0½</td>
<td>-24</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Re-Horakhty</td>
<td>19th</td>
<td>116½</td>
<td>0½</td>
<td>-24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nectanebus II</td>
<td>30th</td>
<td>114½</td>
<td>0½</td>
<td>-22¼</td>
<td></td>
<td></td>
<td>Mut precinct</td>
</tr>
<tr>
<td>Deir Bahari</td>
<td>Mentuhotep II</td>
<td>11th</td>
<td>117</td>
<td>-½</td>
<td>-24½</td>
<td></td>
<td></td>
<td>Main axis</td>
</tr>
<tr>
<td></td>
<td>Hatshepsut</td>
<td>18th</td>
<td>115½</td>
<td>0</td>
<td>-23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hathor chapel</td>
<td>18th</td>
<td>116</td>
<td>0</td>
<td>-23½</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qurna</td>
<td>Mentuhotep III</td>
<td>11th</td>
<td>25/44</td>
<td>32/36</td>
<td>118½</td>
<td>0</td>
<td>-25½</td>
<td>(<del>24° for h</del>3°)</td>
</tr>
<tr>
<td></td>
<td>Amenhotep III</td>
<td>18th</td>
<td>117</td>
<td>0½</td>
<td>-24</td>
<td></td>
<td></td>
<td>Memnon colossi</td>
</tr>
<tr>
<td>Deir el Medina</td>
<td>Amenhotep I</td>
<td>18th</td>
<td>115½</td>
<td>0</td>
<td>-23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Votive chapel</td>
<td>19th</td>
<td>120½</td>
<td>6½</td>
<td>-24</td>
<td></td>
<td></td>
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Six decades later, Barguet (1962) reviewed the idea of the solstitial alignment. Although the main temple entrance is opened to the west and the river, Barguet argued that the inscriptions of the walls of the complex supported the idea that the temple was somehow connected to the east and especially to sunrise, presumably at the winter solstice. These ideas were later explored by Hawkins (1973), who firstly reported on the winter solstice alignment of the 19th Dynasty temple of Re-Horakhty, but particularly called attention to the so-called ‘high-room’ of the sun, probably built by Thutmose III as an ‘observing’ site connected to his ‘Hall of Festivals’ (the Akh-menu).

In a more recent work (Carlotti, 2005), it was demonstrated that the complex of the Amun temple at Karnak was surrounded during the Middle Kingdom by a village organized through an orthogonal network whose main axis was that of the dromos connecting the temples of Mut and Amun. This was also the orientation of the axis of Mut temple. However, the E-W axis of this network diverged by more than 7° to the main axis of the Amun-Re temple (109½° vs. 116¾°, respectively). This fact suggests that the orientation of this temple was deliberately chosen and not at all restricted by local urban necessities. This is related to a couple of additional important facts pointed out below.
Fig. 1. (a) The main axis of the temple of Karnak facing west. The hills of Thebes located at the western horizon with an angular height of $3\frac{1}{2}^\circ$ preclude the visibility of sunset at the summer solstice in the axis of the temple as might have been anticipated by studying the plan of the monument. (b) This has given rise to the suggestion that the opposite direction (winter solstice sunrise) might have been the most relevant one (see Table 1): the image shows sunrise at the winter solstice at the main axis of the temple of Karnak as seen from the quay. The phenomenon would have been more accurate 4000 years ago (dot-circle) when the temple was first aligned – perhaps to Wepet Renpet (hieroglyph within the image) as well. Photographs by G.F. Dodwell (prior to 1911, when the temple was restored) and J. A. Belmonte.

2.1. Solstitial temples

In the first half of the 15th Century B.C. something extraordinary happened in Egypt. A woman, the royal wife Hatshepsut, proclaimed herself dual king of Egypt. To do so, she had to proclaim that her father had been none other than the god Amun-Re himself, who had elected her for royalty. At this time, the great temple of Ipet Sut had been standing for at least half a millennium since the time of the early Middle Kingdom, when, according to Gabolde (1998) it had been precisely orientated towards sunrise at the winter solstice. However, it is worth noting that the Middle Kingdom temple – presumably orientated using winter solstice sunrise – and the later enlargements of the temple made by the first kings of the 18th Dynasty, notably Amenhotep I, Thutmose I and Thutmose II, had all of them faced west, towards the hill of Thebes. It would be ‘King’ Hatshepsut who first built a new temple to Amun-Re-who-hears-the-prayers exactly on the same axis but open to the east, thus being the earliest structure at Karnak actually facing towards sunrise at the winter solstice, the most common pattern of orientation of Egyptian shrines in Upper Egypt (see Figure 2).

It is important to notice that sunrise at the winter solstice may have had important mythological and/or calendrical implications. To be precise, because of the wandering nature of the civil calendar across the seasons, there have been two occasions after the creation of the calendar when New Year’s Eve or I Akhet 1 has fallen at the
moment of the winter solstice: the first one was in a four year period centred on 2004 B.C. This was a very interesting moment in Egyptian history. Mentuhotep II from Thebes had just re-unified the country and new buildings, on a large monumental scale, were constructed for the first time in the very south of the country, including Karnak, where the most ancient register – a polygonal column possibly of a door jamb – is dated from the reign of his father Antef III (c. 2050 B.C.). The most significant of all was Mentuhotep II’s mortuary temple at Deir el Bahari and the temple of Horus at the summit of Djebel Thoth (see Table 1), the highest of the Theban Hills, built by his son Mentuhotep III (see Figure 3). A few years later, the temple of Amun, indeed a new aspect of the solar god, was re-erected by Senuseret I in Karnak, also on a larger monumental scale. Not surprisingly, all these monuments were orientated to the rising of the sun at the winter solstice and thus, for a few years, some of them were pointing to the rising of the sun at the first day of the civil year, I Akhet 1 or Wepet Renpet (Shaltout and Belmonte, 2005). This fact can hardly be ascribed to chance.

Fig. 2. Declination histogram of 165 temples of Upper Egypt obtained from the data measured by the Egyptian-Spanish Mission on Archaeoastronomy of ancient Egypt. The most significant peaks are identified by a Roman numeral referring to the seven families of astronomical orientations (Belmonte, 2012: 103-68). The highest is the one related to winter solstice (II), the alignment present at Karnak. Long-dashed lines stress the positions of the sun at the solstices and equinoxes. The lines for Sirius (dot-dashed) and Canopus (short-dashed) straddle the extreme declinations of these stars, the brightest ones of the skies of ancient Egypt.

Finally, on the death of Hatshepsut, the actual legitimate sovereign, her nephew Thutmose III erected a new structure in front of his step-mother’s temple. The main focus of this new building was a single huge obelisk, the highest ever to be erected in Egypt – but only by his grandson Thutmose IV – and which today adorns the Roman square of Saint John Lateran (Wilkinson, 2000: 154-66). This granite monolith was located exactly on the main axis of Ipet Sut. We could speculate with the idea that, at the same time, the two Thutmose gained credit for this new impressive work of engineering because, thanks to its height, the top of the obelisk could be seen from the opposite extreme of the complex, so that anybody located at the main entrance (e.g. on
the quay) could have seen the rising sun of the winter solstice appearing behind it (see Fig. 1).

Now, applying the first step of the methodology outlined above, we may propose that Karnak temple was indeed built with that axis so that it encompasses a solstitial alignment filled with solar symbolism due to the character of Egyptian religions but also with highly mythological, calendrical and political implications. It appears as a logical outcome in such a deeply solar religion framework as the Egyptian.

Fig. 3. Mentuhoptep III’s Horus temple at the summit of Djebel Thoth, the highest peak of the Theban Hills. It is built upon the foundations of an archaic period temple with a slightly different orientation. This is an early example of a winter solstice rising temple in the area of Thebes. Photograph by J.A. Belmonte.

2.2. Astronomy and landscape in Thebes

To apply the second step we look at other characteristics of the temples and the city itself, as it relates to the topography of the site. Ipet Sut, and most of Thebes, is located at the only site in the Nile Valley, downstream the first cataract, where the river flows – and has flowed for most of the last millennia as registers demonstrate (Belmonte, 2012: 236-8) – in such a way that the perpendicular direction to the water course roughly corresponds to the solstitial line connecting winter solstice sunrise and summer solstice sunset. The first author is especially keen on the idea, previously outlined by Krupp (1984), that this natural accident may have been discovered by the Egyptians and may have helped to establish the sanctity of Thebes, and above all, the area of Karnak. New data, recently analysed by Luc Gabolde (2013), so suggests (see also Belmonte, 2015). We would then be facing an extraordinary case of a combination of topography and astronomy; a singular case of what has been called the archaeology of landscape, understanding by ‘landscape’ not only the earthly one but also the heavens (see e.g. García-Quintela and González-García, 2009).

In conclusion, the religious enclosure of Karnak – and by the way Thebes, Egyptian Waset, the capital to be developed around it (see Figure 4) – was constructed at a very singular place in Upper Egypt where the axis of the temple is at the same time perpendicular to the Nile and also orientated to winter solstice sunrise, a date that, apart for its intrinsic value, was extremely close to Wepet Renpet during the reign of Senuseret I, founder of the first monumental temple on site. The coincidence between
winter solstice and Wepet Renpet happened c. 2004 B.C. when one of the Mentuhotep kings was on the throne and solstitial temples were already being erected in Thebes (see Table 1).

Thus, Thebes can certainly be interpreted in a context where astronomy combines with religion, history and landscape to produce one of the most sacred traditional spots on Earth. The combination of the local course of the Nile, a solstitial orientation, the wandering aspect of the civil calendar and the nature of the deity worshipped in the temple can be considered as a paradigm of witnesses for the correct interpretation of the complex (Belmonte et al. 2009: 264-8).

Fig. 4. Today, as 3350 years ago, the colossi of Memnon, erected across the Nile in Western Thebes, still face sunrise at the winter solstice as did the Million Year temple of King Amenhotep III behind them. Photograph courtesy of M. A. Molinero and N. Delgado.

The ideal model emerging from these data is that Egyptian religion – with a unmistakable solar flavour shown in several deities and the different solar symbolism found in iconography, the temples, and cities formed around them –, tends to incorporate such solar meaning, especially the most conspicuous solar milestones such as the solstices, into the design (orientation, decoration, etc.) and placement, so that the material culture is imbued in that landscape, including both topographic and celestial features. As amply demonstrated especially by the work during the last decade by the first author and his collaborators (Belmonte et al. 2009), this solar flavour is not the only driving force of orientations in Egypt, but it might be argued that it is possibly the most important one to fully understand the development of temples in ancient Egypt since the Old Kingdom to the maximum splendour of Egyptian culture under the 18th and 19th Dynasties.

3. Under the shadow of the Goddess of Arinna: Hattusha and the Hittites

In order to expand our ideal model of Egyptian religion to other realms we now turn to other geographic, but mostly contemporaneous society – at least for the New Kingdom – to try to see if we can derive our third step in the ladder described in the introduction.

The possible astronomical or topographical orientations of the Hittite monuments of the Bronze Age have remained unexplored until recently. González-
García and Belmonte (2011) performed an analysis of a statistically significant sample of Hittite sacred enclosures that demonstrates that ancient Hittite monuments were not randomly orientated as previously suspected. On the contrary, there were well-defined patterns of orientation that could be interpreted within the context of Hittite culture and religion. This provided an important insight into how the temporality was imprinted by this culture both in the sacred spaces and the landscape.

The Hittite Empire controlled Anatolia and large areas of the Levant from the 16th to the 13th centuries B.C. (Bryce, 2002). Hittite religion has been considered a syncretistic system as it included different traditions from a mixed population: Hittite and Luwian creeds, with Assyrian influences, were imposed over an original substrate of more ancient Hattian beliefs, and a notable influence of Hurrian religion (Taracha, 2009).

Several divinities had celestial manifestations, notably the sun. In the ancient Hattic language, the sun, Eshtan, had a female character personified in the Sun-goddess of Arinna, Lady of the Land of Hatti. Together with the Storm-god of Hatti, they formed the supreme couple of Hittite religion. However, there was a male aspect of the deity: the Sun God of Heaven, called Ishtanu in Nesili, the official language of the Hittites, and Tiwad in Luwian. Hittite kings referred themselves as “My Sun”, while a winged solar−disk was used to crown the royal names in monumental inscriptions and royal seals. Furthermore, an implicit recognition of the solar movement on the horizon and consequently of the solstices might be hinted at in certain hymns to the solar deity where we can read: … ‘thou stridest through the four eternal corners’ (Güterbock, 1980). The Moon, called Arma in Luwian, and Kushuh in Hurrian, was represented as a winged human figure with a tiara crowned by a crescent. Besides, goddess Shausga enjoyed a double nature that equated her to the Assyrian Ishtar and the Sumerian Inanna (Burney, 2004). She was a personification of the planet Venus displaying a double male and female nature. Shausga is represented in this double character in the reliefs of the open-air sanctuary of Yazilikaya, to the north-east of Hattusha. There is hardly any other evidence of stellar cults although there is a brief mention of the Pleiades within the context of the rituals of the purulli festival, which might suggest an interest in this asterism (Kellerman, 1981).

The Hittites paid attention to uneven solar and lunar phenomena. In this respect, a prayer of Mursili II (c. 1321-1295 B.C.) reports a solar omen that occurred while he was on campaign in the land of Azzi in his 9th or 10th regnal year. Often identified as a solar eclipse, it has allowed the dating of Mursili’s 10th year in 1311 B.C. thus offering a perfect time bench for ancient Middle East chronology in this controversial period (Collins, 2007; Belmonte, 2013).

3.1. Sacred space and time

Hittite temples were normally planned around a central courtyard where the adyton and several other chambers opened. Actually, the holy of holies in most of the temples was off-centre, deliberately so designed to ensure there was no direct view into it from the entry portal (Bryce, 2002: 241; Burney: 2004, 278). Most Hittite cities had monumental gates that certainly served objectives other than a mere defensive purpose. Some were profusely decorated with ritual scenes (see, for example Figure 5) and others, like the monumental gates of Hattusha’s Upper City followed a symmetrical layout that has been interpreted within a ceremonial and ritualistic context (González-García and Belmonte 2014).
The monumental gate of the sphinxes in Alaca Hüyük. This certainly was a most important cultic place of the Land of Hatti. The sacred character of the gate can be envisaged from the images of divine adoration to the Sun-goddess of Arinna (right) by a procession of worshippers, and to a bull, standing for the Storm-god of Hatti, by the king himself (left). These ruins have alternatively been identified with the sacred cities of Arinna or Zippalanda. Photograph by César González.

The Hittites possibly counted their time by lunar months (the existence of the ‘festival of the month’ would be a trace of this, see Belmonte and González-García, 2014) but we ignore the precise organization of this calendar and how they accommodated the lunar year with the cycle of the seasons. The celebration of special festivals to specific deities at their proper time was essential for maintaining the order of the universe and some priests were responsible for the celebration of festivals in due-time.

In particular, the so-called SANGA-priest of the Sun-goddess of the Earth slept ‘under the stars’ at the temple courtyard regularly and it is possible that one of his duties were astronomical observations for the appropriate timing of the festivals (Taggar-Cohen, 2006: 117). Such festivals have been identified in several inscriptions where it is clear that the sacred time was governed by a yearly cycle, certainly connected to the agricultural activities, with crucial times at the moments of the sowing and the reaping. These were the moments, spring and autumn, of the two most important Hittite feasts, AN.TAH.SUM and nuntarriyashas, respectively (Bryce, 2002: 188). A detailed analysis of the characteristics and timing of these festivals can be traced in González-García and Belmonte (2011).

3.2. Astronomy and landscape again: the Hattusha paradigm

There are data on the orientation of more than 60 religious structures from the Hittite Lands, the vast majority of them from the area of the capital, Hattusha (González-García and Belmonte, 2011; Müller-Karpe et al. 2009). Figure 6 presents an absolute declination versus normalized frequency histogram for the data of the city of Hattusha. A few main peaks have a degree of confidence higher than 99%. The highest one is at a declination of ±24º, which could be correlated with the sun at the solstices. A second one, close to 0º, could be catalogued as ‘equinoctial’.

Fig. 5. The monumental gate of the sphinxes in Alaca Hüyük. This certainly was a most important cultic place of the Land of Hatti. The sacred character of the gate can be envisaged from the images of divine adoration to the Sun-goddess of Arinna (right) by a procession of worshippers, and to a bull, standing for the Storm-god of Hatti, by the king himself (left). These ruins have alternatively been identified with the sacred cities of Arinna or Zippalanda. Photograph by César González.
Fig. 6. Declination histogram of monuments at Hattusha, the Hittite capital. The value of the declination for each temple is considered in its absolute value only. The vertical dashed line indicates the extreme declination of the moon, while the vertical solid line indicates the solstices and thus the solar range. The frequency is normalized by subtracting the mean and dividing by the standard deviation. Notice the absolute singularity of the most significant peak related to the solstices.

Hence, the most significant peaks of the histogram certainly represent solar alignments, in agreement with the importance of Hittite solar cults and solar rituals. The solstices seem overwhelmingly dominant (winter solstice was possibly the most important one, although summer solstice alignments have also been reported as shown in Figure 7a; see González-García and Belmonte, 2014b, for further examples). An explanation for such importance, at least for the winter solstice, could be a festival devoted to the Sun-goddess of Arinna mentioned in ancient Hittite sources. The ‘equinoctial’ peak would be an indication of an interest in sunrise or sunset in dates close to the fall and spring equinoxes, perhaps heralds of the main festivals: AN.TAH.SUM and nuntarriyashas. Hence, the archaeoastronomical data confirms the textual evidence and have shown the relevance of solstitial and ‘equinoctial’ orientations that could be explained within the context of ancient Hittite cult necessities.

There is, however, a case study of much interest and this is the main sanctuary at Hattusha, Temple 1. This is the largest sacred structure of the Hittite capital and the only one built in the so-called Lower City. The temple lies within a walled-in holy area, usually termed as temenos (see Fig. 7b). The temple has a main gateway and at least one and possibly two side entrances. This temple is one of the rare examples of a double temple with two sanctuaries, one devoted to the Storm-God of Hatti and the other to the Sun Goddess of Arinna (Zimmer-Vorlaus, 2011).

The main entrance to this temple has an orientation such that it could be related to the southernmost setting of the moon or even perhaps Venus, which as has been shown were prominent figures in Hittite religion. However, from the central courtyard of this building – or from the temple ceiling, where the king often appealed to the solar deities – and along the temple minor axis to the east, the sun-disc would have been seen at dawn climbing the northern rim of Hattusha acropolis – where a small temple of the
goddess was located – on dates close to the winter solstice (see Fig. 6), possibly the moment of one of her festivals. Curiously, the opposite direction heads towards the mountain top where the sun sets on summer solstice as observed from Yazilikaya (see Fig. 7a). Interestingly, Hittite divinities were supposed to rest in sacred mountains in the ‘surroundings’ of the temple before actually entering their shrines.

Beside the temples, other parts of Hattusha might be connected to the solstices. To this regard, Müller-Karpe (2013) has argued that sunrise and sunset on winter solstice could be witnessed from the portern of the South Gate (Yerkapi) towards the King’s and Lion’s gates, respectively, but, as pointed out by González-García and Belmonte (2014a), this hypothesis ignores the differences in angular heights between the three elements and the respective background horizon. However, an interesting possibility is that the alignments worked in the reverse, i.e. that winter solstice sunrise could be spotted on top of Yerkapi as seen from the Lion’s gate, while sunset on the same day could be seen happening on top of the same structure as seen from the King’s gate, in an impressive example of a landscape created for the occasion of the winter solstice, an epoch when the king was always in his capital city (Taggar-Cohen, 2006: 118). Hence, it is fairly obvious that, as in the case of Thebes, city of the sun god Amun-Re, Hattusha as the seat of the divine couple formed by the Solar Goddess of Arinna and the Storm God of Hatti, also shows paradigmatic relationships between local orography and the sky – i.e. among land- and skylscapes – with the solstices once more playing a dominant role.

Thus a common pattern arises: solar religions, notably in the eastern Mediterranean shores, did tend to produce capital cities that incorporated solar phenomena, particularly the solstices, not only in the orientation of their temples, but also in the place selection of those temples and perhaps in the location of the cities themselves as living sanctuaries of the deities.

4. A stronghold in the western Mediterranean: the rise of Carthago Nova

Now searching for a completely different chrono-cultural setting, we move to the city of Carthago Nova, present day Cartagena, in the southeast of Spain. The city was
founded over a previous minor Iberian settlement by Hasdrubal, the brother-in-law of Hannibal Barca, c. 229 BC as a twin to Carthage and capital of the Carthaginian domains in the Iberian Peninsula. Actually, it shared the name with its African motherland, *Qart Hadashat*, which curiously meant New City. The site was a very peculiar one with a local orography similar to that of the African metropolis. The town was founded on a small, well-protected peninsula, only connected to the mainland on its east side, and included a series of five hills (see Figure 8). These were devoted to the principal Punic divinities and to the legendary earlier founder of the city, Aletes, according to Polybius (see Noguera Celdrán, 2013, and Belmonte et al. 2015, for a thorough description and analysis of the texts).

**Fig. 8.** The peculiar topography of Cartagena in antiquity. The diagram shows the location of the five main hills within the urban area: *Arx Hasdrubalis* (1), *Mons Cronos* (2), *Mons Aletes* (3), *Mons Hephaistos* (4) and *Mons Aesculapii* (5). Either by chance or by deliberate selection, Mons Cronos, where the sanctuary of the main Punic deity Baal Hammon was presumably located, may have acted as a node of selective astronomical alignments (meridian, equinoctial or solstitial) with the other hills. A Punic ‘agora’ has been proposed by local archaeologists in the area of the latter Roman forum. The position lately occupied by the Roman theater and amphitheater, and the Via Augusta are also sketched. Adapted from Belmonte et al. (2015), from an original map by courtesy of Ramallo Asensio (2012).

Preliminary landscape archaeology approaches on site had shown the relevance of the local topography for the placement of the most sacred and relevant buildings in the different areas of the city (Noguera Celdrán, 2012) where visibility played a most relevant role. Our research team is now conducting a pioneering project to analyze the orientation of Roman settlements in Hispania (see, e.g. González-García et al. 2014), while a first diachronic study was conducted at ancient Emerita Augusta (today Mérida, González-García and Costa-Ferrer, 2011). Ancient Carthago Nova was our logical next step and a further and detailed archaeoastronomical analysis of the city was hence conducted in autumn 2013 (Belmonte et al. 2015).
4.1. A historical snapshot

Luckily, we have a description by Polybius of Qart Hadašt a short time after its conquest by Scipio Africanus the Elder in 209 B.C. This description indicates that when Hasdrubal chose and organized the site, he knew very well what he was doing. The highest spot dominating the site and the port was devoted to Eshmun (Aesculapius according to Polybius), as in Carthage itself. Another hill located on axis to the north of that one was devoted to Cronos/Saturn, the Punic Baal Hammon, where a temple to this deity was presumably erected. This probably served as the node for a series of curious astronomical alignments. The most significant was the solstitial relationship to the sacred area of the Arx Hasdrubalis (Cerro del Molinete) to the west-south-west, where a sanctuary presumably dedicated to a female divinity was erected. Towards the end of the 2nd century BC, the Phoenician sanctuary was transformed and furnished with a mortar pavement with inscriptions, including a large tesserae-made dedication to Atargatis (Dea Syria).

In the Republican era, a sanctuary was built next to the Phoenician one, devoted to an unknown deity, and with a monumental access, a splendid view and an orientation which fully justified the new Roman dominion over the city and its port, one of the best of the Mediterranean (see Figure 9). The construction of this sanctuary at the top of a prominent orographic feature of the acropolis clearly indicates the status attained by the city. The temple, the staircase and the terraces were a monumental façade presiding over the town, which was clearly visible to the ships entering the harbor (see Fig. 9).

![Fig. 9. A tentative infographic reconstruction of the temple of Republican era at the top of Cerro del Molinete (ancient Arx Hasdrubalis). It was located in a dominant position, facing the city and its port and could have served as a perfect topographic reference. Images by courtesy of José Miguel Noguera Celdrán and María José Madrid.](image)

Later on, the city was re-founded under the title of Colonia Urbs Iulia Nova Carthago and especially under Caesar and Augustus a new orthogonal grid, with strong astronomical connections (see below), was applied to the city. The urban plan even included Mons Aletes, the hill devoted to the legendary city founder to whom Augustus was perhaps assimilated to. The new project included the forum and associated buildings, a hypothetical porticus duplex that was built to the southeast of the forum –
this is the source of a series of antefixes representing Capricorns, a symbol of the winter solstice –, the theatre with its peristyle, and the *Collegium Augustalís* or *Augusteum*. The position of these structures clearly demonstrates that they were planned in unison in order to conform to the new urban orthogonal layout. Hence, at the beginning of the 1st century A.D., Carthago Nova reached its apex in organic structuration and planning. This planning actually reflected an interest in both the local and the celestial landscapes.

4.2. Sky- and landscapes of Carthago Nova: a fruitful relationship

In the autumn of 2013, the authors and their team performed a detailed archaeoastronomical analysis of the ancient remains discovered across the city in the last couple of decades (Belmonte et al. 2015). In this, they were helped by archaeologist José Miguel Noguera Celdrán who has been excavating in Cartagena for more than a decade (Noguera Celdrán, 2012). His advice was going to be fundamental for a best approach to the problem (see Belmonte et al. 2015).

*Qart Hadašt* was erected as a minor scale replica of its mother town and with Monte Sacro (‘Sacred Mountain’, perhaps a recall of a very ancient tradition) serving as the axial point for a series of possible astronomical alignments as shown in Fig. 8. As already mentioned, the most significant one was the solstitial relationship to the sacred area of Arx Hasdrubalis, where a sanctuary presumably dedicated to a female divinity, perhaps Tanit the supreme goddess of Carthage, was erected. Exactly at the same place, a small *sacellum* dedicated to Atargatis was going to be built in the early Roman period.

Figure 10 shows a series of images obtained at the summer solstice of June 2014 which illustrates how the sun climbed the northern slope of Monte Sacro, finally abandoning the horizon on top of a modern building (a 19th century water deposit) located at exactly the same spot where the Cronos temple should have been located in Punic (and Roman) times. This phenomenon is quite similar to others of similar construction we have already described in other places throughout the Mediterranean such as Hattusha (see Fig. 7), and could indeed have been relevant in the Iberian Peninsula during the Phoenician period (Esteban and Escacena Carrasco, 2013). Finally, Monte Sacro may have had an equinocial relationship to Cerro de San José, consecrated to Aletes, the mortal hero deified for his discovery of the silver mines responsible for the wealth of the city. Mons Aletes could also have acted as a reference point for the establishment of the *agora* of *Qart Hadašt* in the valley between the hills at a place where summer solstice sun would have risen upon this hill, in a certain parallelism to the pair Arx Hasdrubalis-Mons Cronos. As we will see later, the Roman forum followed a similar pattern.

After the conquest by Scipio in 209 BC, the Romans reorganized the Phoenician city erecting a series of important monuments the remains of which can be contemplated (and indeed measured) today. On the acropolis of the city (the Arx Hasdrubalis), the citizens of Carthago Nova erected at least two sanctuaries. The first was the *sacellum* of Atargatis and the second the so-called Republican sanctuary built on the Italic tradition. The former of these buildings was with high probability the refurbishing of an older structure, perhaps of Phoenician origin, for which two (east and south) main accesses have been archaeologically reported (Noguera Celdrán, 2012). One of the main entrances – the one facing the inscription mentioning Atargatis – opened to an area where a masonry altar was presumably located in the wall opposite the entrance. From this altar, an open view of the eastern horizon would have been obtained through the gate ranging from summer solstice sunrise (over Monte Sacro and Baal Hammon
temple, see Fig. 10) to sunrise at the Equinoxes. These relationships could have been significant for the rituals taking place on the site. The building had another gate oriented to the south, perhaps to the area of the port although, within the error of $\sim 1^{\circ}$, an alignment to Canopus, a star allegedly related to sea fearing, cannot be ruled out (see Belmonte et al. 2015).

Fig. 10. Summer solstice sunrise from the gate of the sanctuary of Atargatis, a sector where the sacred area of a female Punic deity was possibly located since the foundation of Qart Hadašt, over a water deposit presumably built upon the foundations of the temple of Baal Hammon at Monte Sacro. This sequence strongly suggests a nice astronomical relationship between two selective sacred areas of the Phoenician, and later Roman, town: Arx Asdrubalis and Mons Cronos. Image series courtesy of Andrés Ros.

At the end of the Republic, presumably in year 44 B.C., Cartagena was re-founded under the title of Colonia Urbs Iulia Nova Carthago and first under Caesar and especially during Augustus’s government a new urban grid was applied to the city (Ramallo Asensio, 2011: 78-89). This was orthogonal in the western sector of the city and possibly followed a solstitial axis linking sunrise and sunset at summer and winter solstices, respectively (see Figure 11). This axis could easily have been established by solar observations at the eastern horizon, perhaps in a line of sight passing through the main eastern gate of the city as stressed in the diagram. The western horizon was mostly obscured by relatively high nearby mountains presenting a large angular height and would have been useless for such a purpose. Later on, this solstitial alignment was extended, possibly via a varatio procedure, to the north, to the area of the forum, and to the south to the sector of the impressive Roman theater built under Augustus and dedicated to his adopted sons Lucius and Caius Caesar. The frons scenae of the theater followed the solstitial axis at $0^{\circ}$ of angular height. This alignment could only work if the orthogonal grid had been artificially extended to the south, considering that the eastern
horizon is obscured by Mons Aesculapius and the western one by the hills encircling the port.

![Colonia Urbs Iulia Nova Carthago](image)

**Fig. 11.** The principal buildings and part of the recovered street grid of Roman Carthago Nova over imposed to a modern city aerial view. A general solstitial arrangement (SS and WS stand for summer and winter solstices, respectively), relating important buildings and sacred spots, can be ascertained. Adapted from Belmonte et al. (2015).

However, on the opposite side of the urban grid, the area of the Forum presents an interesting peculiarity. This sector of the city was re-arranged so that it could fit the pattern despite the local orography. The data of the temple of the forum, and the maps provided for the excavations of the Curia and the Augusteum show that sunrise at the summer solstice occurred on top of Mons Aletes (see Figure 11), the hill devoted to the legendary local hero of the city to whom Augustus was perhaps associated after his radical reform – nearly a second foundation – of the city (Cesar was so promptly killed that most reforms must certainly be assigned to Augustus).

Summarizing, Carthago Nova reproduces the scheme presented so far in our ideal scheme as an astronomical and topographic materialization of sacred space – with again a dominant role of the solstices – as is the case for several other cities in the ancient world where a strong solar cult (in our particular case possibly related to the Phoenician-Punic god Baal) is strongly related to their founder such as, for example, Alexandria (see e.g. Ferro and Magli, 2012).

5. **A pink city as old as time: Petra and the Nabataeans**

The final case we want to analyse in the scheme of our ladder is that of Petra. The Nabataeans, a people of presumably Arab roots, developed a singular and sophisticated culture in the harsh lands of Arabia Petraea at the frontiers of the Hellenistic World from the early first century B.C. to the annexation of their kingdom by Emperor Trajan at the beginning of the 2nd Century AD, and even later (Markoe,
2003). Petra was the capital of their kingdom for generations and represented the highlight of their civilization although the Nabataean genius was also present in many other sacred buildings scattered across their lands (see Wadeson, 2013, for a recent diachronic analysis of Nabataean constructive techniques). Among these, the nearly contemporaneous temples at Khirbet et-Tannur and Khirbet ed-Dharih showed a collection of elements of undoubted celestial symbolism which might be traced in the nature of Nabataean religion (Healey, 2001). Nabataean inscriptions mention a set of divinities with a possible celestial nature such as Dushara, Al Kutba, Allat and Al Uzza. All these deities were often represented by stone blocks (baetyles). In the area of Petra, Dushara and Uzza undoubtedly were at the head of a pantheon with many levels of comprehension (Zayadine, 2003). It is interesting to analyse how this pantheon could be reflected in the monuments, their location and indeed their orientation

5.1. Skyscaping in Arabia Petraea

Recently, the authors, in collaboration with the Levant specialist Italian archaeologist Andrea Polcaro (Belmonte et al. 2013) have presented an extensive pioneering archaeoastronomical analysis of Nabataean monuments in the region (notably Jordan and the Negev). Data collection was deliberately planned to coincide with the winter solstice. The goal was to analyse a statistically significant sample of temples and other sacred buildings, which could permit archaeological confirmation of previously suspected astronomical activities by the Nabataeans relating to religious practice (Belmonte, 1999).

Fig. 12. Images of different kind of monuments of Petra analysed in our work: (a) City centre with the extant temples; (b) Highplace at Djebel Khubtha; (c) The ‘Crecent’ shrine; (d) The Monastery; (e) the Obelisks or Zibb Attuf at Djebel Madbah; (f) The Treasury; (g) The Urn Tomb at the cliffs of Djebel Khubtha; (h) Madbah excavated highplace; and (i) the Treasury at Little Petra. Photographs by J.A. Belmonte.
The data samples 90% of the temples known so far in Nabataean lands, including those in Petra and a few additional ones in other settlements of the Nabataean kingdom such as el Qsar, Tannur, Dharih or Wadi Ramm. In Petra, data includes the temples, a great majority of the so-called accessible highplaces and a few of the most architecturally significant and representative monuments excavated and sculpted in the sandstone walls (see Figure 12). In total, fifty temples and other cultic structures from all over the ancient Nabataean kingdom were measured. This has been estimated to be a statistically significant sample of all known religious Nabataean structures discovered up to date. A detailed description of the data and their analysis can be gained in Belmonte et al. (2013).

Figure 13 illustrates the main outcome of this analysis, showing the astronomical declination histogram. This is strikingly similar to the one discovered for neighbouring cultures with a strong celestial component in their religion (González-García and Belmonte, 2014b). The histogram shows a series of significant peaks. Some of them, of a probable celestial – presumably solar – character, might be interpreted at the light of Nabataean beliefs, considering, among other sources, that Strabo (Geographia XVI, 4, 26) reported that this people worshipped the Sun on the roof of their houses.
relevant in Nabataean religion: the winter solstice sun for Dushara (according to Epiphanius’s *Panarion*), Venus for Al Uzza or Mercury for Al Kutba. Finally, Peak IV, centred at $60\frac{4}{9}$, is certainly connected with the large number of monuments which were northerly orientated, including the main temples at the colonnade avenue in Petra, and could be interpreted as an interest in the northern skies. Hence, the most significant peaks in the histogram can be interpreted at the light of Nabatean beliefs reinforcing the celestial character of the religion and perhaps showing that the equinox and the solstices were important for their time-keeping system as will be discussed later on.

The Nabataeans used the Assyrian lunisolar calendar amply spread in the Levant since the epoch of Assyrian, Babylonian and Persians rule on the Levant, and which was still in use during the Hellenistic and Roman periods. This is particularly certain within the texts in the Aramaic language used by the Nabataeans in private and official inscriptions, a fact which has been demonstrated (Wadison, 2013, and references therein) by the funeral dedications inscribed in the façades of several tombs in Hegra – Al Hijr, in present day Saudi Arabia –. A nice example of this could be the tomb of Raqush, (nº 41), the construction of which was commanded by Qa’ab Ibn Haritha in the month of Tammouz. Curiously, the few inscriptions found at the tombs of Petra never included dates. The calendar started by the month of Nissan with the first Crescent after the Spring Equinox but had a sort of secondary New Year’s Eve at the beginning of Tishrin, after the Autumn Equinox – a characteristic still preserved nowadays in the modern Hebrew calendar –. This fact could also be reflected in Nabataean celestial symbolism.

![Fig. 14. Detail of a plaster copy of the portrait of Tyche (i.e. Nabataean Manat) discovered at the temple of Tannur surrounded by the zodiacal signs but in a peculiar order with an intrinsic symbolism. On top, both Aries (represented by a goddess, perhaps Uzza) and Libra are located. Capricorn is substituted by the figure of a young male god, possibly Dushara. The original fragment is today at the Museum of Cincinnati. Photograph by Juan A. Belmonte, courtesy of the Amman Archaeological Museum.](image)

Figure 14 shows the well-known ‘zodiac’ of the temple at Khirbet Tannur, a masterpiece with a couple of peculiarities which permit a speculative exercise. On the
one hand, the signs associated with the two equinoxes (Aries and Libra) are located at the top of the image as if they were representing two halves of the Nabataean year, but with Aries being substituted by the image of a goddess. This might be Al Uzza (or perhaps Allat, according to Gibson, 2011: 131-5) as a personification of the double nature of the planet Venus, since the image is embraced by two small disks. However, another possibility is that the zodiac would actually be a horoscope since five discs, perhaps for the five planets (plus the moon close to Tyche), were sculpted in Aries (two), Gemini, Leo and Capricorn. On the other hand, the standard goat-form representation of Capricorn – the sign housing the winter solstice – is absent and in its place an image of a young male divinity, perhaps Dushara, suggests the importance of the winter solstice: this will be most relevant below when discussing the suggestive findings at the Monastery.

5.2. Beauty in sandstone: astronomical paradigms

Our 2011 campaign in Nabataea intended to observe the effect of the winter solstice phenomena at some of the most impressive monuments of Petra. Belmonte (1999) had suggested a phenomenology related to the solstices for some of the most singular monuments in the city which needed further verification. Direct observation could enable us to directly witness light and shadow effects that may have been of significance to the ancient Nabataeans.

The most impressive light and shadow effect at winter solstice occurs at Ad Deir (the Monastery, see Figure 15). It is unclear if this is the temple of one of the most important Nabataean divinities, Dushara or Uzza, a heroon for one of their deified kings such as Obodas I or the unfinished burial place or cenotaph of one of their last kings, such as Rabbel II (see Alpass, 2013, for a recent review on the possible usages of Ad Deir). Its use as a church in the Byzantine era and its internal distribution suggests that, originally, this was a sort of monumental cella or biclinium with a cultic podium (a môtab) on its back (Wenning, 2003).

Fig. 15. Winter solstice sunset at Ad Deir. The left image shows the light and shadow effect in the innermost sacred area of the structure, the môtab. The right image demonstrates the accurate solstitial phenomenology associated with the site. Dotted line corresponds to the path followed during winter solstice sunset by the upper limb of the sun for the 1st century BC. Adapted from Belmonte et al. (2013).
Indeed, Ad Deir would have been a prominent festival venue, with an elaborated staged ascent from the centre of the city, a vast court in front of it and a series of related monuments. The orientation of the structure strongly suggests a winter solstice relationship. The left image of Fig. 15 shows the light and shadow effect produced at the interior of the monument at the moment of winter solstice sunset. The light of the setting sun entering through the gate of the monument perfectly illuminates the sacred area of the deep interior of the building where the mótab for the installation of the sacred baetyles is located.

The winter solstice sun, as observed from the mótab itself, sets in a most interesting way on a peculiar sandstone structure, perhaps in part man-made but difficult to actually confirm considering erosion, as shown in the right panel of Fig. 15. The phenomenon would have been still more impressive two thousand years ago when the northern limb of the disk of the sun had a declination close to $-23\frac{1}{2}^\circ$. We believe that this extraordinary ensemble of solar hierophanies, perhaps in combination with the visibility after sunset of other celestial bodies such as Venus, in its capacity as ‘Evening Star’ – the astral manifestation of Al Uzza –, clearly reinforces the idea of the Monastery as one of the most important sacred enclosures of the Nabataean realm. Ad Deir would have been the ideal place to celebrate, in dates close to the winter solstice, the birth of Dushara from his own mother-cum-consort Al Uzza, the goddess of fertility (Belmonte et al. 2013).

As previously discussed, the knowledge of the equinoxes possibly was of particular importance to the Nabataeans, and would have been a key element for the control of the lunisolar calendar. Interestingly, our new data (see Belmonte et al. 2013) confirms the equinoctial alignment of the impressive Zibb Attuf, the ‘Pillars of Merciful’ (see Fig. 12, panel e) popularly known as the Obelisks. These carved out behemoths could have been used to control time by the use of shadow cast at sunrise. However, according to Belmonte (1999), the most inspiring equinoctial relationship would have been found in the Urn Tomb – the most impressive and better preserved of the so-called royal tombs (see Fig. 12, panel g) – in relation to the impressive sacred mountain of Umm al Biyara. The well-preserved gate of the Urn Tomb was centred at equinox sunset over the central part of that particular mountain, a result which has been plainly confirmed by the new data but to a much larger degree of sophistication.

This is shown in Figure 16. The Urn tomb has a quite elaborate design, suggesting that it was used not only as a tomb but also as a place for other religious activities or festivals, possibly related to the cult of the dead. On December 21st 2011, sunset at the winter solstice was observed from the court in front of the Urn Tomb. During the sunset, the sun passed behind a conspicuous landmark in the distant western horizon. Most important, the last rays of the sun illuminated the northeast corner of the inner hall after crossing the main gate of the tomb. The phenomenon, in combination with the confirmed equinoctial alignment, proved quite astonishing.

Sunset at the equinox took place between two distinct features – presumably natural although perhaps with some human alteration – on the summit of Umm al Biyara. Surprisingly, the data also indicated that sunset at the summer solstice occurs in between another couple of this kind of ‘natural’ features further to the north in the distant western horizon. This new alignment completes the symmetry of the main hall of the tomb (see Fig. 16). This impressive set of three alignments within the plan of the monument in combination with significant features in the distant horizon can hardly be ascribed to a random effect.
We argue here in favour of a deliberate attempt to convert the hall of the Urn tomb, whatever its actual purpose – certainly a religious one –, in a kind of time-keeping device that would have been very useful in controlling time and the calendar, be it sacred or profane. This probably was the result of an original Nabataean design. Interestingly, Bishop Jason converted the Urn tomb into the cathedral church of Petra on June 24, 446 AD (Fiema, 2003). Perhaps, this formidable enclosure was selected as the new cathedral of the city because it included such a notable grouping of astronomical alignments, so useful for the Christian worship. They would have offered markers, of an excellent and precise nature, for the determination of Christmas, on December 24, Easter (through the observation of the spring equinox), and Saint John, on June 24, precisely the date of consecration of the new cathedral.

![Fig. 16. Sunset phenomenology in the western horizon (a) related to the solstices and the equinoxes as seen from the Urn tomb enclosure (b). Our data suggests that the location and the internal distribution of the monument (c) were deliberately chosen with an astronomical objective in mind. Adapted from Belmonte et al. (2013).](image)

The analysis of a statistically significant sample of Naabataean data, together with the study of the light and shadow effects confirmed in several monuments of Petra related to the consistent use of the equinoxes and the solstices (once more), certainly points towards the importance of celestial elements in Nabataean religion, posing new evidence for cultic worship centred on the celestial sphere.

Thus, we may finally find a coherent picture in the four elements we planned to analyze in this essay. The suggestive connection between them and the sun has been exposed, either because they were centres for the power-sustained cult of a prevalent solar divinity, such as Hattusha or Thebes, or because solar hierophanies played an undoubted dominant role in the design or location of conspicuous buildings within the local landscape. This certainly is the case of Carthago Nova and Petra. They were capitals of states with a strong solar component in their ritual sphere. All four incorporated solar events – particularly the solstice sunrises or sunsets into their design – and even in their location, searching for the best spots to highlight such particularly inspiring moments.
6. Conclusion

Michael Hoskin (2001) has shown that data on the orientation of buildings, whether connected to the sky or simply the landscape, may have a strong intrinsic interest as a new perspective of archaeological studies and that an orientation, an alignment or a celestial hierophany is a fact in itself that was most probably relevant to the society that produced it, either for prosaic reasons such as the control of a calendar or for a more symbolic meaning presumably related with political, sociological and religious aspects of their worldview − or most probably for a combination of all of them.

In the previous sections we have shown how astronomical alignments and solar hierophanies − with a common interest in the solstices − were substantiated in the landscape of four formidable capital cities of antiquity that really behaved as pillars of contact between the earth and the sky: Middle and New Kingdom Thebes, Hittite Imperial Hattusha, Punic *Qart Hadasht* (Roman Carthago Nova) and, finally, Nabataean Petra. The present paper shows that the four cities treated here incorporated solar phenomena or solstitial orientations in their design. This does not appear as a random relationship since, in all cases, this interest can be linked to each other either in the orientation of paralleled ritual structures or to more prosaic calendrical or cultic expressions.

The four cases under discussion, being relatively isolated culturally and chronologically (although they all share the common Mediterranean cultural milieu) could be seen as clear cases of cultural convergence in the construction of cities, where the solstice apparently is a key element of their design. A most interesting issue in a cross-cultural comparative topic is the inference of cross-cultural patterns. In this line, an important point could be the preeminence of solstice alignments in cases different from Egypt, which indeed is the best case study analyzed so far.

This fact has allowed us to extend our initial hypothesis to other areas, and thus find a common thread in all four cases, that might be interesting to test in other areas. Mediterranean cultures with strong solar symbolism in their ritual lives, either directly in the realm of religion (strongly attested for in the case of Egypt and perhaps in the land of Hatti), in their calendar or in the justification of power (as might be the case in Hatti – remember the titles of the kings – and other regions), tend to incorporate such symbolism by orientating and locating certain structures. In particular, their capital cities tend to incorporate the solstices within the context of a conspicuous celestial symbolism. This has been shown preliminary in a statistical approach to the problem where the four cultural contexts under discussion have proven to be extremely close in the probability space independently of the statistic procedure applied such as the dendrogram or a K-means approach (González-García and Belmonte, 2014b).

Certainly, different societies when confronted with similar problems found similar solutions when using similar tools to face them, in this case probably the recourse to a common solar cult (which is pretty obvious in the case of Thebes and Hattusha) or to a close relationship between a main male (solar) deity, and his mother-cum-consort, both represented as celestial aspects of the reality (as might be the case in Carthago Nova and Petra). The regularities of the solar movements are thus conjured with the local landscape in a peculiar way. In the four cases under study, the religious architecture is integrated within the corresponding landscape, and at the same time with the solstice – through the selection of certain relevant alignments –, to finally create a true skyscape.
Solstices, both summer and winter ones, seem to be the most conspicuous common features, a fact hardly surprising considering the relevance of these particular solar milestones in Mediterranean cultures even today. Indeed, the role of local landscape should also be taken into consideration thus implying an interaction between astronomy (skyscape) and local topography (landscape). Sun-watching certainly contributed to convert those cities into places of awe-inspiring crystallization of beauty (both natural and created), and into unique artistic creations of their people’s will as a gift for their deities, holding a holy meaning that our work has helped to unveil.

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7. References


