Chapter 8

Arabia Adquisita: the Romanization of the Nabataean Cultic Calendar and the Tannur ‘Zodiac’ Paradigm

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Abstract One of the most fascinating and enigmatic pieces of evidence of Nabataean ingenuity is the so-called Zodiac of Khirbet et-Tannur (Jordan), found in a temple built at the mountain summit close to Djebel Tannur in the first half of the second century CE, possibly when the ancient Nabataean Kingdom was already under Roman rule. However, Nabataean traditions and cults persisted during the Roman period and even survived well into Byzantine times. But one important change was the imposition of a Julian-like calendar, of Egyptian inspiration, instead of the original lunisolar calendar of the Nabataeans—earlier inherited and adapted from the Babylonian one—whose month names were however preserved under a solar perspective and a new time framework entitled *Era Provincia Arabia*. An analysis of the dates reported in the foundation inscriptions of the first century CE rock-carved tombs at the southern Nabataean city of Hegra, and other dated inscriptions of the Nabataean Kingdom period, has given some clues for us to look at the Tannur Zodiac with a different perspective. This new way of thinking has allowed a completely different approach to this masterpiece of art which is substantially different to most previous interpretations (see e.g. McKenzie et al. 2012). According to our hypothesis, we consider that it should be formally named the ‘almanac’ or ‘parapegma’ of Khirbet et-Tannur hereafter.

8.1 Introduction: A Nabataean Cultic Calendar?

In March 106 CE the Nabataean Kingdom was annexed by Emperor Trajan to the Roman Empire creating the new province of Arabia (Petraea). Ancient Nabataea, and its ancient capital, the rose city of Petra, has been one of our main research objectives since our first field campaign in the region in 1996 (Belmonte 1999). In December 2015 a new visit to the area was arranged that coincided with the Winter Solstice. Several illumination effects were observed and broadcasted at the principal monuments of Petra and new important hierophanies, predicted in previous campaigns (Belmonte et al. 2013), were verified and contrasted in the light of the literary and epigraphic sources and astral symbolism (Belmonte and González-García 2017). This allowed us to conduct a new analysis of every single clue of astronomical relationships in ancient Nabataea, including all evidence in their time-keeping system.

The idea of a Nabataean calendar centered on the cult of their deities and their ancestors in certain time-marks of special astronomical significance along the year has recently been developed. This has included a combined analysis of classical historiography, ethnographic sources, epigraphy and the archaeological record, interpreted in the light of cultural astronomy (Belmonte and González-García 2017). This was framed within the Babylonian lunisolar calendar of the Seleucid Empire, but not fully restricted by it since the Nabataean calendar seems to have started in Nisan, although most of the calendars of Asia Minor and the Near East in the Hellenistic and Roman Periods began the year in autumn (Stern 2012). According to this proposal, the principal astronomical milestones of this calendar would have been:

- (1) New Year's Eve on 1 Nisan. This could happen either before or after the Spring Equinox (see below).
- (2) The Full Moon after Spring Equinox (14 Nisan), in a clear parallelism to Jewish Passover.
- (3) The First Crescent after Spring Equinox (1 Nisan—New Year's Eve—or 1 Iyyar otherwise)
- (4) With some doubt, since evidence is not strong: the First Crescent of the lunar month including Summer Solstice (1 Tammuz).
- (5) The First Crescent after Summer Solstice (1 (B)ab)
- (6) The heliacal rising of Sirius (Isis) in c. 20/7 Julian. Hence in (B)ab. This could be related to the cult of Isis-Al Uzza as clear evidence of Hellenistic Egypt influence.
- (7) The First Crescent after Spring Equinox (1 Tishri), not reflected, however, in the epigraphy.
- (8) The pilgrimage festival of Aggathalbaeith in the 1st Lunar Month after the Spring Equinox (most likely Tishri).
- (9) The Winter Solstice and the Birth of Dushara, as celebrated during the Epiphany in late Roman times.
- (10) The First Crescent or Full Moon of Thebet, the lunar month after—or including—the Winter Solstice.

These dates would have been the times for the main festivals and celebrations which on at least three occasions—the two equinoxes and the Winter Solstice—would have been performed in the form of ritual pilgrimages to attractive sacred spots in Nabataea and indeed in the capital city of Petra. These spots included Ad-Deir (and the Lions' Triclinium), the high-places at Jabal Madbah and Jabal Khubza and the summit of Jabal Hārūn, all of them in Petra and its vicinity, or the imposing temple of Khirbet et-Tannur, further north, which will be the nucleus of this essay.

As argued, the Nabataean Kingdom had a lunisolar calendar of Babylonian type inherited during the Seleucid period (Alzoubi 2016), but in CE 106 the Kingdom was annexed by Emperor Trajan. As implied by Babatha's Archive, a new era was soon initiated 'according to Provincia Arabia' with New Year's Eve at 1 Nisan/Xandikos, corresponding to 22 March in the Julian Calendar and with a fully solar structure (length of 365 days with a bissextile after each four years, Samuel 1972). Nabataeans needed to adapt these lunar dates to these new circumstances, and they did it very well as the analysis of Khirbet et-Tannur 'Zodiac' will show.

Petra, the ancient Nabataean capital, has been one of our main research objectives since the first field campaign at the site in 1996 (Belmonte 1999). In December 2011, a large field campaign was mounted at sites of the Nabataean Kingdom belonging to nowadays Jordan, including Khirbet et-Tannur and Khirbet edh-Dharih, which offered further clues to the relevance of cultural astronomy in sacred building design and orientation (Belmonte et al. 2013). Last, but not least, in December 2015, a new visit to Petra was made to coincide with the Winter Solstice. Historical, ethnographic, epigraphic and archaeological records have been deeply analysed and compared in order to gain an insight into the Nabataean land- and skyscape relationship. From this multidisciplinary analysis two main points were evident: (1) the importance of both equinoxes and Winter Solstice as time-markers within the lunisolar calendar, and (2) the relevance of some processions and pilgrimages. One of these examples is illustrated in Fig. 8.1.

Illumination effects have been observed and recorded at the principal monuments of Petra. These strongly suggest the relevance of these dates at the time of the Nabataeans. The Winter Solstice was an important event in the Nabataean cultic calendar when a festival of the main deities of the city, the god Dushara and his partner the goddess Al-Uzza, was commemorated. This probably took the form of a pilgrimage, and related cultic activities, such as ascending from the temples at the centre of the city (presumably from Qasr el Bint and the Temple of the Winged Lions) to the Monastery (Ad-Deir) through an elaborated stone-carved processional way (see Fig. 8.1 and below). The relevance of spring and the Spring Equinox within the cultic calendar is also emphasized in relation to other sacred sites in Petra, such as the Zibb Atuff obelisks, and additional Nabataean sites (Belmonte and González-García 2017). It is worth explaining in detail one such pilgrimage route, but before we do this a short reminder about Nabataean religion and related ethnohistorical sources is certainly warranted.¹

8.2 Inspiring Astral Deities in the Nabataean Realm and their Festivals

The Nabataeans had a religion that was a strange mixture of elements from pre-Islamic Arabs and Hellenistic, Egyptian and Middle Eastern influences. Divinities were often represented by stone blocks or betyls (*neshebet* in Nabataean) although in the late period and notably under Roman rule, human or quasi-human forms were developed (see Healey 2001, for a thorough discussion on this topic). The main male

¹ This information has already been published in Belmonte and González-García (2017) but for the sake of clarity and completeness of the present essay we consider that it is appropriate to repeat it here.

divinity was the god Dushara, or Dushares, most likely an astral god. His name means ‘He of Shara’, Shara being the mountain range bordering Petra to the east where the neighbourhood of Gaia, or Al-Ji (today Wadi Musa) was located. The area of Al Madras, to the south of Wadi Musa was especially sacred to him. On certain occasions, he seems to be a form of the god Al-Kutba (‘the one who writes’), although this is much debated. Dushara was identified by classical writers either as Zeus, Ares or Dionysos. Triclinium no. 17 in Bab es-Siq at Petra has an inscription dated 96/95 BCE devoted to Dushara: this is the oldest dated Nabataean inscription and probably the oldest dated betyl of the god (Wenning 2001). According to Suidas [Theus Ares]

... the god Dushara is worshipped by them for him they honour above all others. The image is a black stone square and unshapen, four feet high by two feet broad – one foot in thickness. It is set on a base of wrought gold. (Hoyland 2001: 183).

Dushara’s presence in Nabataea both during the Kingdom and under Roman rule (*Provincia Arabia*) is overwhelming.

Fig 8.1 The proposed pilgrimage route—mostly carved out of the rock—from the city centre (temples of Al-Uzza and Dushara) up to the mountain plateau where the Monastery (Ad-Deir) was sculpted on the sandstone cliffs. The route passed by the Lions’ Triclinium where a nice light and shadow effect happened at Winter Solstice sunrise (below). Winter Solstice sunset light and shadow effects happened both in the interior of Ad-Deir and at the horizon as seen from it (upper left and right respectively). This could be the most important Nabataean pilgrimage route in Petra relating to Dushara’s birth festival from his mother *cum*-consort Al-Uzza (diagram by the authors upon an image courtesy of Google Earth)

On the contrary, there has been much discussion regarding the head female divinity of the Nabataean pantheon (Healey 2001). In Bosra, the northern Nabataean capital during the reign of Rabel II (CE 71–106) and the capital of the Roman province, the main goddess was Allat (or Al Lat), meaning simply ‘The

Goddess'. With a hypothetical solar character (*As Sams*, the Sun, was a female divinity in pre-Islamic Arabia), she has been identified with Athena and Atargatis (the Syrian Goddess). Her name has also been found in Palmyra (Syria), in Iriam (Wadi Rum, Jordan), and in Hatra (Iraq) and she is indeed mentioned in the Quran. She is identified with the Alilat of Herodotus (History III.8).

Interestingly, in Petra, this name is never found. Instead, inscriptions refer to the goddess Al-Uzza. Her name means 'The Most Powerful' and she was the personification of the planet Venus—often specifically assigned to the Evening Star (Hawting 1999), identified with Aphrodite and the Cananaean Astarte and also with the Egyptian goddess Isis (Merklein and Gerger 2001). In inscriptions in Petra and Iriam (present day Wadi Rum), she is mentioned together with Al-Kutba, the 'Master of the House', and of course Dushara, of whom she could have been his partner or even his mother-consort. It has been argued that Al-Uzza was possibly an alternative manifestation of Allat—e.g. the lion was the totem animal for both deities. Interestingly, she seldom had a double nature, being known as Al-Uzzatan, so that, according to many scholars, Allat and Uzza could go in tandem, being two faces of a same coin (Hawting 1999). However, the Holy Quran reports in Sura 53: "Have thou seen Al Lat, Al-Uzza and the other, Manat, the third one. These are only names that thou and thine ancestors had given to them. Allah has not put any power in them." Apparently, according to these verses, these three goddesses were different personalities, who have been identified as the daughters of Allah. However, this does not necessarily apply for Nabataean and even Roman times several centuries earlier. The controversy still continues (Gawlikowski 1990).

What seems to be a completely different female personality is Manatu, a deity (or deities, since the word is a plural) who joins Dushara in several funereal inscriptions at Hegra (Median Saleh, Saudi Arabia; Healey 1993). She was the goddess of fortune and the numen of that southern city and is usually believed to be Dushara's daughter. Manatu as Fate was conceived as a trio of goddesses in Antiquity (Hawting 1999). It is possible that the Moon was one of her manifestations and she could have been represented as three adjacent betyls in several niches across Petra and Hegra. Finally, stars were also very important in pre-Islamic Arabia and bright stars and asterisms such as Sirius (Sira'), Canopus (Suhail) and the Pleiades (An-Nijm) were broadly used for guiding the caravans, establishing the dates of pilgrimages, regulating calendars or making weather forecasts (Forcada Nogues 1993). This could have been so in ancient times. In this line of argument, it is worth mentioning that Nabataean Queens were often assimilated with Isis-Al-Uzza and that Sirius, in her name of Sopdet, was the main celestial aspects of Isis in ancient Egypt (Belmonte 2012).

The Nabataean deities are often mentioned in the writings of ancient sages of Antiquity. Strabo (Geo 16, 4, 26) informs us that the Nabataeans "... worship the sun, building an altar on the rooftop of their houses, pouring libations on it every day and burning frankincense." This sort of domestic cultic practice presumably had its official counterpart in the numerous high-places still standing in Petra and elsewhere. Some of them are of a size fit for a family group or clan; others have a much larger monumental character and often are located at mountain and hill tops, and possibly relate to important festivals. Among these, the outstanding temple at Khirbet et-Tannur can certainly be included.

Historical sources for cult practices in the Levant in the Hellenistic and Roman periods are scarce but most relevant. Lucianus (Dea Siria 49) reports that in the city of Hierapolis-Mambij, in northern Syria, "... the greatest festival they celebrate is that held in the opening of the spring." But it is in slightly later sources where information is paradigmatic. For example, Procopius (2, 16) informs us that the time for festivals "... was the season of the Vernal Equinox and at this season the Saracens always dedicated about two months to their god." The 'Saracens' was the name given by late Roman sources to the Arab-speaking tribes who inhabited the ancient lands of the Nabataeans and still used, among others, the Nabataean Aramaic alphabet for their inscriptions. Probably, they were somehow related to the Nabataeans of the Kingdom period, if not their direct descendants. This information can be further extended with the text of Protheus (3) who argued that the grammarian Nonnius reported that most of the Saracens gather at a certain sacred place—not explicitly mentioned—twice each year. The text continues:

... the first of these assemblies extends over a whole month and takes place about the middle of the spring, when the sun passes through the sign of Aries, while the other lasts two months; this they celebrate after the Summer Solstice.

The arrival of the New Moon marked the time for these festivals (Hoyland 2001). To judge from the evidence of pre-Islamic northern Arabia, annual spring festivals are likely to have been held with aspects of pilgrimage attached (Healey 2001).

Another clue to the identity of the Saracens and their close ties with the Nabataeans is that of the Christian apologist Jerome (Vita Hilarionis, 42–43) who reported that they

... arrived at Elusa on the very day that the solemn festival [which] had brought all the people of the town to the temple of Venus; for the Saracens worship this goddess as the Morning Star and their race is dedicated to her cult.

Early scholars already argued that the name of the city of Elusa was actually a Greek spelling for Al-Uzza and that the name of the city actually honoured the greatest Nabataean goddess, reinforcing the idea stated above. Indeed, festivals dedicated to the greatest female divinity were amongst the most important in the Levant.

In this line of argument, the texts of the Christian apologist Epiphanius of Salamis (fourth century CE, who was born at Eleutheropolis, modern Bayt Jibrin, a locality in ancient Edom and was hence a native of the region) are very important and among the most elucidating. This is so even considering the time passed from the Roman annexation of the Nabatean Kingdom and that his arguments were written to support his assertions and to show that the cult of the virgin had its pagan equivalences (Mordtmann 1875). Epiphanius reported that

... in the idolatrous temple at Petra ... they praise the virgin with hymns in the Arabic language and call her khaabu ... in Arabic; and the child who is born of her they call Dusares. And this is also done that night in the city of Elusa, as it is there in Petra ... on the very night of the Epiphany. (Contra Haereticos, Panarion, 51, 22).

Hence, according to this text, written ca. CE 374–376, the celebration of the birth of Dushara from the womb of the Virgin Mother (almost certainly his mother-cum consort Al-Uzza, or Allat if they are to be identified) took place on 6 January in Petra at dates close to the Winter Solstice, supporting Dushara's solar character. In the same line of argument, it has been suggested that

... all these evidences may well point towards a solar character of the Nabataean chief god and incline us to consider the 'very great festival on the very night of the Epiphany', mentioned in Epiphanius, as a survival of an earlier celebration of the Winter Solstice among the Nabataeans. (Janif 2006-2007: 345).

Lastly, Epiphanius also informs us that the fourth century Arab tribes of southern Palestine and Transjordan performed a pilgrimage during the month of Aggathalbaeith to a major sanctuary—'al baeith', The House—in the region (Panarion 51, 24). This could have been Petra, since Dushara is often called *mr' byt*, Lord of the House in Nabataean inscriptions, or any other relevant sanctuary, perhaps Khirbet et-Tannur. The time of the pilgrimage corresponds to the month of Tishri, the first lunar month after the Autumn Equinox in the Nabataean lunisolar calendar. The central day of the festival was on the 22nd day of Aggathalbaeith, corresponding approximately to 8 November in the Julian calendar. This cult strongly resembles the later Muslim tradition of pilgrimage (*hajj*) in the month of Dhu al Hijja to the 'House of God' in Mecca, the Ka'aba (Janif 2006-2007).

8.3 Land- and Skyscape in Petra: the 'Winter Solstice' Pilgrimage

As clearly shown, Nabataeans certainly celebrated religious festivals and performed pilgrimages to sacred shrines at the time of these celebrations. However, direct evidence on the terrain has so far been very scanty if it were not for the imposing ascending routes to several sacred sites at various spots within the city of Petra (El Khoury, 2006-2007; see e.g. Fig. 8.1) and elsewhere, certainly including Khirbet et-Tannur as we shall shortly demonstrate. The question is how, why and when these pilgrimage routes could have been used. It is perhaps useful to return to our earlier results (Belmonte and González-García 2017) and analyse in certain detail how, why and when one such route was possibly in action: the pilgrimage to Ad-Deir in Petra.²

Petra city centre is spread over a vast area of *circa* one km wide between the slopes of Jabal al Khubza and the cliffs of Umm al Biyara. Here, three large free-standing structures were erected by the Nabataeans in the first century CE. Among them are the Qsar al Bint, dated to ca. CE 40, and the Temple of the Winged Lions, dated to CE 27/28, presumably the temples of Dushara and Al-Uzza, respectively (Alpass 2010; Browning 1989). As shown in Fig. 8.1, one of the most important pilgrimage ascending routes of Petra was the one departing from the area of these temples, at the city centre, and marching up the mountains to a high plateau open to the western horizon where the most imposing monument of the city was built: Ad-Deir. Here a possible astronomical orientation related to the time of the Winter Solstice was discovered two decades ago (Belmonte 1999).

² Although fully described in Belmonte and González-García (2017), we believe that it is worth repeating [this](#) description so that the reader [can](#) get a first-hand impression of how a Nabataean pilgrimage route would have worked in the Kingdom period, and certainly later during [the](#) Roman dominion.

As the processional way goes up to Ad-Deir there are several attention foci. One of them is the Lions' Triclinium which is located in a narrow chasm beside the path (see Fig. 8.1). Nicely carved into the sandstone, it has a reworked niche for a cult statue in its back wall. Data obtained in 2011 (Belmonte et al. 2013) clearly predicted that an interesting light and shadow effect could be produced at the niche at the moment of the Winter Solstice thanks to the light entering across a—now worn—oculus in the façade. During the Winter Solstice of December 2015 the effect was observed in all its splendour at that precise moment. This hierophany is only produced at sunrise in dates close to the Winter Solstice since the triclinium would be in darkness for the rest of sunrises throughout the year, as was experienced by McKenzie's team in late January when the effect was hardly visible (McKenzie 2013). Still more, considering the variation in the obliquity of the ecliptic, the effect must have been still more spectacular in Nabataean times (see Fig. 8.1, extreme bottom right image). So, either on the way up during the early morning of the day of the pilgrimage, or on the way down at dawn, after a night of celebration at the Ad-Deir plateau, the procession could stop at the Lions' Triclinium to glimpse a nice spectacle, which certainly related to the rituals associated with the Winter Solstice and the birth of Dushara.

However, the final objective of the pilgrimage was obviously Ad-Deir. Is this the temple of one of the Nabataean divinities or the unfinished burial place or cenotaph of one of their last kings? Its use as a church in the Byzantine period and its internal structure strongly support Browning's (1989: 190-5) assessment: Ad-Deir was "... a prominent festival venue, with an elaborated staged ascent to it and a vast court in front of it." Its astronomical orientation and the light and shadow effects produced at the moment of the Winter Solstice both at the môtâb for the cult betyls and at the nearby western horizon seem to ratify this line of argument (see Fig. 8.1). The Nabataeans worshipped the môtâb (*mwtb*'), the podium on which the stele/betyl was erected, the equivalent of the seat or throne of the deity. Actually, slight traces of a rock-carved cult betyl, with Dushara's block proportions—possibly destroyed when the site was converted into a church—could still be discerned at the centre of the môtâb. The light and shadow effect of the double sunset phenomenon produced at Ad-Deir reaches its maximum precision and beauty at this position precisely. Interestingly, a very important fact is that the vaulted niche with the môtâb was carefully positioned slightly off-centre relative to the doorway (McKenzie 2013). This asymmetry allowed the effect to occur, which was hence included in the architectural design.

The hierophany is spectacular and would have been observable for nearly a week before and after the Winter Solstice. Winter Solstice sunset, as observed from the môtâb itself, is produced in a peculiar way on a modified rock with the aspect of the head of a lion—the sacred animal of Al-Uzza. At the present time the Sun sets at least twice, first in the axis of the monument and then re-appears in the northernmost corner of the rock before its final disappearing. It should be noted that the anthropic modification of this rock in the area where this phenomenon occurs, as seen from the môtâb of Ad-Deir, allows for such observation and it would also have been part of the design of the complex (i.e. a modified horizon). 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 $-23\frac{1}{2}^{\circ}$ (Belmonte et al. 2013).

Undoubtedly, this ensemble of solar hierophanies confirms the idea that the Monastery was one of the most important sacred enclosures of the Nabataean realm and that Petra was the goal of one of the most important pilgrimage routes, and this happened not only during the Nabatean Kingdom but also under Roman rule. Ad-Deir possibly was the ideal place to celebrate 'on the very night of the Epiphany'—in dates close to the Winter Solstice—the birth of Dushara from his own mother-cum-consort Al-Uzza, the goddess of fertility, reflected in Epiphanius's writings. Echoes of this ancestral ritual might still be alive in the area of Petra as shown by the surviving tradition of the *Amm al-Gaith* procession (see e.g. Al-Salameen and Falahat 2009; Belmonte and González-García 2017 and references therein). It is now the time to turn to the main objective of this essay, the temple of Khirbet et-Tannur and the noteworthy 'Zodiac' discovered at this site.

8.4 The Twin Temples of Tannur (Hurawa) and Dharih (Ain Al-La'aban)

The deep gorge of the Wadi Al-Hasa marks the limits between the ancient lands of Edom and Moab. Precisely at the place where the King's Road (later followed by the *Via Nova Traiana* after the Roman annexation of Nabataea) passes close to an impressive topographic marker, the blackish stone behemoth of the Djebel Tannur—the Mountain of the Oven, the rest of the nucleus of a long-extinct volcano (see Fig. 8.2). Close to it, across the riverbed to the south, there is a high hill that also constitutes a landmark in the territory (Fig. 8.2, Panel a). On the very top of that hill a huge, noteworthy and conspicuous shrine was built: the so-called temple of Khirbet et-Tannur. The sanctuary was fully excavated in the 1930s by Nelson Glueck and his team and the extraordinary findings, including sculptures and high-reliefs, were brought down the mountain and distributed between the Museums of Amman and Cincinnati (the best pieces) where they can still be admired today (unfortunately completely out of context). Glueck never

published the excavations in full and eight decades have elapsed until the extraordinary work of Judith McKenzie and her team has brought back the temple, at least on paper, to all its lost glory (see McKenzie 2013).

Fig. 8.2 The region of Wadi Al-Hasa north of Petra, showing the proposed pilgrimage route that would have been followed by pilgrims to the temple of Khirbet Tannur, possibly ancient Hurawa, located at the top of a hill south of wadi Al-Hasa (a). They eventually departed from the main temple at Khirbet edh-Dharih (Ain Al-La'aban, b). The Djebel Tannur (c) is the dominant topographic feature of the area but neither of the two temples was orientated in its direction. Hurawa was, however, orientated towards New Year's Eve sunrise of the *Arabia* province calendar in Roman times (d). See the text for further details (diagram by the authors)

McKenzie's seminal work offers a complete description of the findings and a full-scale reconstruction of how the temple and its component should have looked like. It is perhaps worth summarizing, following a diachronic sequence, some of her team's major discoveries which are relevant for our purposes:

- (1) The earliest dated objects on site are two Seleucid coins of late third and early second centuries BCE which suggest the earlier construction of certain structures in the second century BCE on this site.
- (2) The discovery of an aniconic stele/betyl dated in the first century BCE dedicated in Nabataean to the Edomite god Qosh at Hurawa (the proper name of the site?). The god Qosh was the main Edomite deity and his presence here possibly speaks of a much earlier sacred character of the mountain.
- (3) In the year 8/7 BCE, there is a dedication of a building (Period 1) on the site by the Head of Ain al-La'aban, presumably the nearby site of Khirbet edh-Dharih (see Fig. 8.2).
- (4) The finding of a typically Nabataean bowl and pottery shows that the use of the site noticeably increased in the first century CE.

- (5) In the first half of the second century CE, the whole complex was rebuilt on a monumental scale (the so-called Period 2). However, it is not clear whether construction began before or after the Roman annexation of Arabia in CE 106. Interestingly, the enclosure wall at Khirbet Edh-Dharrah has a *terminus post quem* in CE 156/157 provided by a coin of Emperor Antoninus Pius found in its foundations.
- (6) The 'Zodiac' was discovered in the sancta sanctorum of the temple. It has a peculiar distribution of zodiacal signs (see Fig. 8.3) and belonged to the late phases of this period of construction when the impressive decorative programme of the site was carried out.
- (7) The plan is unique for a Nabataean temple because of the tall altar platform, with a niche in the front for the statues and steps to the altar on top. Actually, it seems to reproduce in stone a typical rock-carved Nabataean high-place.
- (8) The temple faces East, but "It is unusual for temples to face East so precisely ..." according to McKenzie (2013: 217). However, our data here and elsewhere in Nabataea suggest that this was not so uncommon a practice (Belmonte et al. 2013; Rodríguez-Antón et al. 2016).
- (9) Evidence of feasting and night-time activity have been found. This fact is most relevant for our interests.
- (10) The platform altar was enlarged in a second phase later on (Period 3). Six busts in two columns of personifications of the zodiac were added to the altar (Virgo: Grain Goddess, and Pisces: Fish Goddess the only ones nicely preserved). Their relative position is identical to the 'Zodiac', down below left and right, respectively. This implies a sort of continuity from Periods 2 to 3 and that the order of signs is deliberate and not the result of a Nabataean misunderstanding of classical iconography. This is an important point.
- (11) Finally, the temple was destroyed by the CE 363 earthquake, which was accompanied by a fire that caused so much destruction that worship at the site largely ceased. At that stage, the Zodiac stela was broken and the main fragments were buried under piles of rubble, which contributed to their marvelous state of preservation. They would be separately discovered later on within an interval of twenty years, contributing to the mystery of its interpretation.

Fig. 8.3 The 'Zodiac' of Khirbet Tannur, encircling a Nabatean goddess, presumably the main female deity of the couple worshiped at the hill-top temple. The twelve identified zodiacal signs follow a non-standard ordering dividing the circle into two halves. Aries and Capricorn are personified images perhaps related to certain Nabataean deities. The position of the five dots has been highlighted. See the text for further details (diagram by the authors)

The temple was devoted to a divine couple, a seated god and goddess, framed by bulls and lions respectively, with the Zodiac-Nike slab—described below—presumably located between and above them according to the most probable reconstructions (McKenzie 2013). We have seen that in the first century BCE the god of the sanctuary was Qosh. He was a supreme storm-god, producing rain to ensure a plentiful harvest, good pasture and herds. The surviving cult image of the Period 2 temple (second century CE) is that of a male deity with attributes of Hadad, Zeus and Serapis and hence of a supreme god. Since the supreme Nabataean god was Dushara, the god of the cult statue was possibly a form of this god with the attributes of a storm-god: namely Qosh-Dushara. However, the identification of the female deity is not so clear because few fragments have been preserved. She would apparently be a form of Atargatis but, on the one hand, Allat had a line throne and sometimes wore a mural crown (like a Tyche). On the other hand, Allat—o Al Uzza in Petra—was Dushara's main partner. As Al Uzza is often equated with Aphrodite/Venus and there are no iconographic elements at Hurawa to associate the goddess there with Venus, then it is possible that the broken cult statue of the goddess represents Allat. The temple would then be dedicated to the supreme Nabataean couple Dushara-Allat so frequent in Nabataea outside Petra proper.

The 'Zodiac' is not the only component of the temple decorative programme with a strong astral symbolism (this will be analyzed in details further below). Huge sections of the decoration of the temple also have such a symbolic nature. On the façade, there were seven unframed busts of the celestial deities, representing the visible planets, of which only Helios with a radiate crown, Kronos-Saturn with a reaping hook and Hermes-Mercury with a cap have been well preserved. The portico was framed by the main deities of the temple: a Storm-God with thunderbolt and a Tyche. And in the corners there were the unframed busts of Apollo and a male deity with a crescent Moon behind that are difficult to interpret, perhaps a form of the Semitic lunar god Sin. To further complicate the situation, a female statue of a goddess with attributes of the iconography of the Greek sun god Helios has been found on the site. Does this reflect the female nature of the Sun deity in ancient Arabic culture? Finally, Isis is also represented in a small cult statue.

All in all, given the celestial iconography programme, with personifications of both the visible planets and zodiacal signs, not only in the Zodiac but also in the Period 3 frames, the presence of worshippers overnight at Khirbet et-Tannur, perhaps to watch the night sky or await the rising Sun might be expected, along with night-time rituals, as archaeology seems to prove (McKenzie 2103). Indeed, the hilltop location would have provided a clear and excellent view of astronomical events.

But Hurawa, if this is the correct name for the site, was not isolated. A few kilometres south stands the ruins of Khirbet edh-Dharih, a small village on the eastern bank of the Wadi Al-La'aban which was possibly known as Aïn La'aban in Antiquity thanks to the presence of a permanent spring in the area (see Fig. 8.2). Thamudic inscriptions found on the site and dated ca. CE 32/36 mention the *Bayt li Lat* in relation to the site. This is most probably a reference to a shrine in the area that was converted into an impressive temple (Fig. 8.2, Panel b) almost certainly at the same time that the building of Period 2 occurred at Hurawa due to the extreme similarities of the decorative programme (with the representation of the planets and personification of the zodiacal signs) and the building techniques.

Given the contemporaneity of their construction, and the fact that the busts on the exterior of one depict the planets and on the other the zodiac, with the reverse inside (i.e., in Dharih the personified zodiacal signs are in the exterior façade) this also suggests a relationship between the two temples. Actually, it is highly probable that people normally residing in Aïn Al-La'aban were the same ones who handled the cult in Hurawa at certain key times of the year when pilgrimages and festivals would connect the two sites through the *Via Nova Traiana* (see Fig. 8.2). The hill-top sanctuary could not have permanently housed a great number of people and the daily cult could have been easily handled by a reduced number of priests. The earthquake of CE 363, which destroyed Hurawa, also caused much destruction in Khirbet edh-Dharih but activities on site endured so that it was not deserted until the sixth century CE.

The pilgrimages between the two sites, and the corresponding festivals in Hurawa, were probably performed on certain key dates of the new calendar of the *Provincia Arabia* which was inaugurated in CE March 106, retrospectively. These possibly were a reflection of previous important festival dates of the Nabataean lunisolar calendar. Worshippers could have come at specific times of the week, month or year to make their offerings and celebrate meals together. When were those festivals? To further analyze this possibility we must first discuss the most challenging evidence found in Hurawa, the so-called 'Zodiac'.

8.5 Khirbet-et Tannur's New Paradigm: Zodiac vs. Almanac

Fig. 8.3 shows a close-up of a reproduction of the stela where the two larger fragments have been glued together to show the complete aspect that the piece would have had on its cult site in the temple. The

centre of the representation is dominated by the image of a goddess with a mural crown over her head (a sort of Tyche). She is accompanied by a crescent Moon and a unique object behind her shoulder: two converging sticks, one tipped by an ear of wheat or a small pine cone, and the other similar to a pointed crescent Moon. This symbolism has been found in other representations at Tannur, so she is also the 'Tyche' of Khirbet et-Tannur and thus perhaps another manifestation of Allat. Since the discovery of this masterpiece upper fragment in Glueck's excavation and the serendipitous finding of the lower part of the 'Zodiac' (with the two lowermost signs and the holding Nike frieze) there have been several attempts to interpret the strange distribution of the zodiacal signs divided into two semi-circular sections, one to the left for the spring and summer signs, starting by a personified Aries, and one to the right for the autumn and winter signs, starting by a personified Libra, with the scales to avoid confusion (see Fig. 8.3).

Glueck himself (1952) was unable to offer a satisfactory explanation for this strange distribution apart from a mere reasoning that it would divide the year into two halves starting by the spring and Spring Equinoxes, respectively. He could not find an explanation either for the dots appearing in the signs of Aries (two of them), Gemini, Leo and Capricorn. So he asked for help from one of the best historians of astronomy of the epoch, the Harvard Professor Owen Gingerich who followed a logical pattern. If the image ought to be interpreted as a zodiac, then the dots could be a representation of the position of the five visible planets (excluding the two luminaries) and the whole diagram read as an astrological chart. Gingerich (1966) cleverly thought of an epoch close to the Spring Equinox with the Sun in Aries which would locate Mercury and Venus nearby. He found an apparent solution for 22 March 82 CE with Mercury and Venus located in Aries, precisely, Mars in Gemini and Jupiter in Leo. Saturn would be in Pisces which had not been preserved. This solution left one dot in the personified Capricorn (a young man) without an explanation, but was the best that could be found. When the lowest part of the diagram was found in the 1950s, Gingerich's hypothesis was weakened when a dot was absent in Pisces. Our own analysis, with the most powerful modern celestial charting techniques and programs, has been unable to find any other reasonable alternative for an astrological explanation covering the three centuries that the temple was in use, and even before. To our mind, the diagram is not a sort of horoscope and perhaps not even a zodiac.

Dozens of different hypotheses have been developed to explain what this diagram represents, most of them being sad examples of *vox nihili*. For completeness, we may discuss the most recent of them. Rosenthal-Heginbottom (2001) made an attempt to understand the significance of the 'Zodiac' within Nabataean religion and art. She identified Aries as a female bust that might be identified with Athena. She argued that the distribution was by no means accidental, and that it was the result of an astrological concept and astronomical knowledge, even though its practical and spiritual significance was not fully understood. The peculiar halving was again explained as a calendar year with two beginnings: the civic year in autumn and the religious year in spring. On the contrary, Janif (2006–2007: 348) argued that "... the order of the zodiac constellations at Tannur would therefore respond to some theological and even gnostic concerns, rather than to a method of time reckoning among the Nabataeans ...", but he did not give a clue as to these hypothetical concerns. One of the most reputed scholars on Nabataean religion, Robert Wenning (2009), tried to find a solution fueling his expectancies: in Babylonian mythology the Ram is connected with the Moon, the Scales with the Sun, and both the Moon and the Sun are male deities. If this diagram has a Middle East root, this might explain why Aries is depicted here as a male bust—notice the contradiction. Virgo and Pisces are related directly to the Earth itself and its fertility. Hence, the composition does not follow two calendars but it rather reflects a 'cosmological programme' (sic).

Finally, Judith McKenzie, the person who knows better this fantastic artwork, makes a reasonable assumption: the division of the Zodiac and the orientation of the sanctuary—'facing east precisely'—accord with a major spring festival at Khirbet et-Tannur in Nisan to mark the New Year. Such a festival occurred there in the Vernal Equinox or in the first New Moon after this. Perhaps there also was a harvest festival on the Autumnal Equinox (McKenzie 2013; McKenzie et al. 2012). However, "... the significance of the dots remains a mystery ..." for her (McKenzie et al. 2012: 394) a very wise cautious position.

This was the situation when we decided to change our minds completely in order to find a solution for the peculiar zodiacal diagram and its special characteristics, including the presence of the elusive dots. Two considerations should be taken into account. On the one hand, that the Nabataeans had used the Babylonian lunisolar calendar (with a whole set of festivals of presumably astronomical characteristics; see earlier sections) until the annexation of the kingdom and the creation of the Roman *Provincia Arabia* in 106 CE, which established officially a new dating system in accordance to the Julian calendar. This would imply the need for a completely different way of timing the epoch of traditional festivals and pilgrimages within a completely new chronological framework. The similarity between the new calendar

selected (12 months of 30 days plus five additional days) and the Egyptian time keeping system (Belmonte 2003, 2012) would also be inspiring.

On the other hand, we recall the attention to the way in which the Greco-Roman world used to mark specially signaled days or feast in their calendars—a tradition that in certain aspects has survived to the present day in our home and work almanacs—but that in antiquity took a clear, on occasions monumental, methodology: the *parapegmae*. In these devices, special small holes or plugs were distributed all along the different kind of time markers (days of month, months, weeks, etc.) where wood or metals sticks could be positioned to appropriately mark the timing of special events. One of the most famous, and most relevant for our discussion, was the one found at the Baths of Trajan in ancient Rome (see Fig. 8.4).

Fig. 8.4 The Parapegma table found at Trajan's Baths in Rome. The lower panel shows a reconstruction of this interesting piece where the broken sections have been artistically restored. This device was able to use small pegs to indicate the day of the week, the month (position at either *Calendas* or *Idus*) of a Julian-type calendar, through the equivalent zodiacal signs, and the 30 days of a month (diagram by the authors, on an image by courtesy of the Museo della Civiltà Romana)

This parapegma (Bianco 2017) includes the signs of the zodiac and the faces of the planetary deities (Saturn and Jupiter were erased for unknown reasons but can be reconstructed, see Fig. 8.4) in a complete parallelism to the decorative programme of the temples at Aïn Al-La'aban and certainly Hurawa where

our ‘Zodiac’ was found. The tablet was found in Trajan’s Baths in Rome (i.e. the Emperor who annexed Nabataea), which were constructed in CE 104–109 and operated well into the early fifth century. It cannot be determined exactly when this parapegma was used but the presence of the seven planetary deities representing the seven days of the week perhaps indicates that this masterpiece ought to have a later date within that time interval. It features pegs that were moved from day to day and month to month. Interestingly, the zodiacal signs are represented instead, or in substitution, for the corresponding months, suggesting that in the ancient Roman world, zodiacal signs could have been considered as alternative iconographic representations for the months of the year, which had no proper standardized symbolism for themselves. Interestingly, only the days of the month up to the 30th could be marked in the tablet. Either the months with 31 days operate differently or we are facing a strange arrangement of a solar year, but not necessarily of the Julian calendar.

What is really important for our purposes is that the zodiacal signs were not in representation by themselves but were instead an alternative iconography for the months of the year. Could the diagram found at Khirbet et-Tannur be a peculiar type of parapegma with a similar symbolism? This would mean that the zodiacal signs will not be there representing themselves—and hence the piece would not be a ‘Zodiac’—but would represent the months of the year and hence the diagram is actually a calendar or almanac or, as we shall see, a parapegma in its own right. Which calendar, and months, could be imagined here? Certainly, if Period 2 of Hurawa corresponds to the first half of the second century CE and the decoration programme of the main altar is contemporary with that building phase, then the calendar represented must be that of *Provincia Arabia*, inaugurated in 22 March 106 CE—which was also a New Moon and hence the beginning of the previous lunisolar year, now to be abandoned, at a date nearly simultaneous to the annexation of the Nabataean Kingdom by Emperor Trajan.

Fig. 8.5 shows a schematic diagram of the Tannur Almanac with its zodiacal signs in comparison to a complete year of the calendar of the *Provincia Arabia*. This calendar operated as the Julian calendar—with a bissextile after every four years—but with an Egyptian structure of twelve months of 30 days plus the five epagomenal days at the end of the year. The name of the months were those of the previous Nabataean lunisolar calendar (and their Seleucid alternatives on Greek inscriptions, see Fig. 8.5) which order was respected, but that will not follow the lunar cycle anymore, and their Julian dates counterparts. It started on Nisan or Xandikos 1st, roughly corresponding to 22 March in the Julian calendar. It is worth mentioning that the dates of the vernal and Autumnal Equinoxes and of the Summer and Winter Solstices had been fixed at 25 March, 25 September, 25 June and 25 December in the Julian calendar, respectively (González-García and Belmonte 2006).

Fig. 8.5 A diagram schematically representing the parallelisms between the Khirbet et-Tannur ‘Zodiac’ and the months of the Calendar of the Roman province of Arabia, inherited from the months of the Nabataean lunisolar calendar of Seleucid inspiration. The dates of the solar time-markers (solstices and equinoxes) and of the beginning of the months are specified. The small circles marked the same position of the dots at the ‘Zodiac’ itself. See the text for the corresponding discussion (diagram by the authors).

One thing immediately caught our attention. The dots within the Tannur Almanac are located within those months which are most frequently mentioned in Nabataean monumental inscriptions (Belmonte and González-García 2017) and that in the introduction were identified as those months where the most important festivals—with minor exceptions—ought to be timed. Fig. 8.6, illustrating this fact, is included for direct comparison. The cases of Shiwan, Ab[ib] and Thebet are clear. However, there are two dots in Aries. This sign could stand for Nisan but also for part of the month Iyyar. The parallelism is certainly striking.

Fig. 8.6 Histogram of the months of the year mentioned in dated Nabataean inscriptions in the tombs of Hegra and elsewhere in Nabataea, including Petra, during the Kingdom period. Notice the relevance of the months of Nisan, Iyyar, (B)ab or Ab'ib and Thebet where the number of mentions are statistically significant (numbers indicate the probability of the month not being mentioned by chance). See the text for further discussions (adapted from Belmonte and González-García, 2017)

All in all, if each of these considerations is taken into account, one implication becomes apparent: the dots within the Tannur Almanac could be playing the role of holes and plugs in a standard parapegma. In this particular case, our hypothesis is that these five dots would be marking five most relevant festivals of the old lunisolar calendar to be celebrated in Hurawa, but now conceived within the framework of the new calendar of the Province of Arabia and its New Era. These might be, according to our previous classification: (1) the Full-Moon of Nisan, equivalent to Hebrew Passover; (2) the First Crescent Moon of Nisan or of Iyyar, first one of the yearly calendar depending of which year is considered; (3) the First Crescent of the lunar month including the Summer Solstice, or the Summer Solstice itself; (4) the heliacal rising of Sirius related to Isis-Al Uzza—remember that the calendar has a clear Egyptian inspiration; and (5) Dushara's Winter Solstice festival in dates close to the Epiphany. All these dates could be related to relevant festivals or pilgrimages associated with the divine couple revered on the temple of Khirbet et-Tannur, coming either from Aïn Al-La'aban or elsewhere in ancient Nabataea, now the province of Arabia.

To these, two additional feasts could be associated with New Years's Eve in Nisan 1st, and an additional festival at the beginning of Tishri which could be somehow related to the month of Aggathalbaeith. These might explain the double nature of the almanac divided into two clear halves. It is indeed the moment to change our mind and develop a new paradigm in which the 'Zodiac' of Khirbet et-Tannur should be better known as the Tannur Almanac or, even better, as the Tannur Parapegma.

8.6 Final Discussion and Conclusion

Khirbet et-Tannur (Hurawa) may have been a pilgrimage centre, possibly even a national shrine, during most of its history. This was especially the case during the phase when the splendid temple, with a suggestive astral decorative programme, was in use. This mostly coincided with the Era of *Provincia Arabia*, from its inception in CE 106 through to the earthquake in CE 363 when the place was destroyed, burnt and abandoned. The almanac in the main altar of the temple served as an attractive souvenir of the activities and festivals—and their timing—that ought to be celebrated in the sacred shrine. But this was not all. The temple orientation gives a further clue.

Our investigation of the site (Belmonte et al. 2013) produced an azimuth of $92\frac{1}{2}^\circ$ with an angular height of the horizon in that direction of c. 2° (the temple is not topographically orientated to Djebel Tannur which lies further to the northeast; see Fig. 8.2). Interestingly, this gives a value for the declination (δ) of about $-1\frac{1}{4}^\circ$, corresponding to a date three days before the Spring Equinox (Fig. 8.2, Panel d). This is exactly (with the margin of one day depending on the leap nature of the year) 22 March, i.e. Nisan 1st of the province of *Arabia* calendar. Hence the temple is orientated towards the sunrise at New Year's Eve in the New Era! This fact alone would justify most of the arguments that have been analyzed and discussed in the course of this paper, including the pilgrimages, overnights on site and the need for open skies at the mountain summit, among many others. The rest of the feast to be celebrated on site would be marked by the dots in the appropriate positions on the almanac to be found in the sancta sanctorum of the temple.

Additionally, an orientation three days before the Spring Equinox also reflects a pointing to sunrise three days after the Autumnal Equinox. Fig. 8.5 clearly illustrates that this would mean a date close the Tishri 10th.³ We could recall Epiphanius informing us that his contemporary Arab tribes of southern Palestine and Transjordan performed a pilgrimage during the month of Aggathalbaeith to a major sanctuary in the region (Panarion 51, 24). The time of the pilgrimage would have corresponded to the month of Tishri in the new calendar of Arabia. Was Khirbet et-Tannur the Baeith (of God) the focus of this pilgrimage? While the parallelism is suggestive, we do not have all the clues to arrive at a positive answer. It could easily have been a sanctuary in Petra, or elsewhere in the area, instead.

Interestingly, on our last visit to Petra we learnt that recent excavations at Petra have found the suggestive remains of a small Imperial cult temple beside Qsar al-Bint. It was apparently erected by CE 106–114 and has the same orientation as the city Cardus or colonnade street. This has an orientation of $97\frac{1}{2}^\circ$ directed towards a very high eastern horizon with an angular height of c. 10° . These numbers again render a declination of $-1\frac{1}{4}^\circ$, exactly the same than in Hurawa. Is this a coincidence? We do not think so. The Romanization process of the Nabataean capital is still poorly understood and it is highly probable that, in this jewel of their ingenuity, the Nabataeans' ability to adapt their ancient customs to the new necessities and obligations was fully into operation.

The temple at Hurawa, its orientation and its fascinating decorative programme, together with Petra itself, could simply be the two effective faces of a same coin: to adapt or die!

Acknowledgments This work has been financed under the framework of the projects P/310793 'Arqueoastronomía' of the IAC, and AYA2015-66787 'Orientatio ad Sidera IV' of the Spanish MINECO.

References

- Alpass, P. (2010). The Basileion of Isis and the religious art of Nabataean Petra. *Syria*, 87, 93–113.
- Al-Salameen, Z., & Falahat, H. (2009). Religious practices and beliefs in Wadi Mousa between the late 19th and early 20th centuries, *Al Majaq al Urdunia*, 3, 170–204.
- Alzoubi, M. (2016). The Nabataean timing system. *Acta Orientalia*, 69, 301–309.
- Belmonte, J.A. (1999). Mediterranean archaeoastronomy & archaeo-topography: Nabataean Petra. In A. Lebeuf, & M. Ziolkowsky (Eds.), *Proceedings of the Vth SEAC Conference* (pp. 77–90). Warsaw: Institute of Archaeology of the University of Warsaw.
- Belmonte, J.A. (2003). Some open questions on the Egyptian calendar: an astronomer's view. *Trabajos de Egiptología (Papers on Ancient Egypt)*, 2, 7–56.
- Belmonte, J.A. (2012). *Pirámides, Templos y Estrellas: Astronomía y Arqueología en el Egipto Antiguo*. Barcelona: Crítica.
- Belmonte, J.A. & González-García A.C. (2017). Petra re-visited: new clues for the Nabataean cultic calendar. *Culture and Cosmos*, 21, 131–50.

³ The hajj in the present day lunar Islamic calendar starts of the 10th of Dhu al-Hijja, a month that could be paralleled with Tishri before intercalation was forbidden in the Quran (9, 37).

- Belmonte, J.A., González García, A.C., & Polcaro, A. (2013). Unveiling Petra: astronomy and landscape in the Nabataean lands. *Nexus*, 15, 497–502.
- Bianco, B. (2017). *What's a parapegma?* <http://d'ayology.com/2017/03/24/the-trajans-baths-parapegma/>
- Browning, I. (1989). *Petra*. London: Chatto and Windus.
- Forcada Nogués, M. (1993). *Tratado Sobre los Anwa y los Tiempos de Ibn 'Asim*. Barcelona: C.S.I.C. Fuentes Árábico-Hispanas 15.
- Gawlikowski, M. (1990). Les dieux des Nabatéens. *Aufstieg und Niedergang der römischen Welt II*, 18(4), 2659–2677.
- Gingerich, O. (1966). A note on attempts to date the Zodiac. In J. McKenzie (Ed.), *The Nabataean Temple at Khirbet et-Tannur, Jordan: Final Report on Nelson Glueck's 1937 Excavation* (p. 228, Appendix 3.1). Oxford: Oxford University Press (The Annual of the American School of Oriental Research 67, 2013).
- Glueck, N. (1952). The Zodiac of Khirbet et-Tannur. *Bulletin of the American Schools of Oriental Research*, 126, 5–10.
- González-García, A.C., & Belmonte, J.A. (2006). Which equinox? *Archaeoastronomy, Journal for Astronomy in Culture*, 20, 95–105.
- Hawting, G.R. (1999). *The Idea of Idolatry and the Emergence of Islam. From Plemic to History*. Cambridge: Cambridge University Press.
- Healey, J.F. (1993). *The Nabataean Tomb Inscriptions of Mada'in Salih*. Oxford: Oxford University Press (Journal of Semitic Studies, Supplement 1).
- Healey, J.F. (2001). *The Religion of the Nabataeans: a Conspectus*. Leiden: Brill.
- Hoyland, R.G. (2001). *Arabia and the Arabs: from the Bronze Age to the Coming of Islam*. Oxon: Routledge.
- Janif, M.M. (2006–2007). Sacred time in Petra and Nabataea: some perspectives. *ARAM Periodical*, 18–19, 341–361.
- El Khoury, L. (2006–2007). Nabatean pilgrimages as seen through their archaeological remains. *ARAM Periodical*, 18–19, 325–340.
- Merklein, H. & Gerger, Y. (2001). The veneration place of Isis at Wadi as-Siyyagh, Petra: new research. *Studies in the History and Archaeology of Jordan*, 7, 421–432.
- McKenzie, J. (2013). *The Nabataean Temple at Khirbet et-Tannur, Jordan: Final Report on Nelson Glueck's 1937 Excavation*. Oxford: University of Oxford Press (The Annual of the American School of Oriental Research 67).
- McKenzie, J.S., Reyes, A.T. & Greene, J.A. (2012). The context of the Khirbet et-Tannur Zodiac, Jordan. *ARAM Periodical*, 24, 379–420.
- Mordtmann, J.H. (1875). Dusares bei Epiphanius. *Zeitschrift der Deutschen Morgenländischen Gesellschaft*, 29, 99–106.
- Rodríguez-Antón, A., Belmonte, J.A., & González-García, A.C. (2016). Romans in the Near East: orientation of Roman towns and forts in modern Jordan. *Mediterranean Archaeology and Archaeometry*, 16, 153–160.
- Rosenthal-Heginbottom, R. (2001). A Nabataean Zodiac. In *Measuring and Weighing in Ancient Times* (pp. 51–54). Haifa: Reuben and Edith Hecht Museum.
- Samuel, A.E. (1972). *Greek and Roman Chronology: Calendar and Years in Classical Antiquity*. Munich: Beck (Handbuch der Altertumswissenschaft, 1. Abt. 7).
- Stern, S. (2012). *Calendars in Antiquity*. Oxford: Oxford University Press.
- Wenning, R. (2001). The betyls of Petra. *Bulletin of the American Schools of Oriental Research*, 324, 79–95.
- Wenning, R. (2009). The message of the Khirbet at-Tannur reliefs. *Studies in the History and Archaeology of Jordan*, 19, 577–584.