

THE ELITE AT KNOSSOS AS CUSTODIANS OF THE CALENDAR

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Abstract: Among the buildings chosen for our pilot archaeoastronomical project investigating Minoan astronomy were the palace at Knossos, most likely home of the local political leader who also may have been the actual or symbolic leader of all Minoan society, the nearby peak sanctuary on Mount Juktas, and one of the large and stately villas built around the palace and furnished with fine religious equipment, both of the latter probably administered by priests. We found at these places striking similarities in alignments to the Sun, and these suggest to us that the three buildings were part of a system whereby the political and religious elite used orientations to significant yearly risings of the Sun to regulate what became a sophisticated calendar. A corollary is systematic astronomical observations for a long period of time.

Keywords: archaeoastronomy, Bronze Age Crete, Knossos, lunisolar calendar, Minoan calendar, peak sanctuaries, solar calendar

Introduction

The power structure of Minoan society is not completely clear to historians as the script, Linear A, has not been deciphered and its subject matter seems to deal primarily with agricultural accounts. To the archaeologists, despite their long study of the ruins of buildings and communities, and the contents of graves, the members of the Minoan elite are hardly more than shadows. The considerable pictorial remains show no ruler iconography (Davis, 1995). Still, we can assume that there was a political and religious elite.

In our study we employ classical archaeoastronomical methods: using a digital theodolite with observations of the Sun to determine the orientation of the coordinate system and the orientations of foundations to celestial bodies, determining the positions of celestial bodies at the appropriate times in the past using our own computer programs, and calculating the visibility of bright stars. Our study of the 19 buildings selected for our project has introduced us to a group of people who were educated in astronomical knowledge. By piecing together the evidence from 13 of the 15 buildings so far investigated, we have recovered in some detail the advanced calendar developed by this group and understood some of the complex mechanisms involved in its regulation.

Our recent study of the south-east house at Knossos gave us the clue as to the calendric functions that bound the villa with the palace and the peak sanctuary. The palace was the place of political authority, Mount Juktas was, in part, an observatory, no doubt bound to religion, and the south-east house was probably the residence of priests educated in astronomical knowledge. We have published our findings at the palace and on Mount Juktas (Blomberg, Henriksson and Papathanassiou, 2002), but our investigation of the south-east house has thrown new light on the cooperation between these places in evolving and regulating the calendar.

The archaeology of the south-east house

The house was built into the south-eastern slope on the site of the original settlement at Knossos, with many details typical for the Middle Minoan IIIA period (Evans 1902-1903, 3-10; 1921, 425-429). This would have been c. 1750-1680 BC, using the early chronology (Manning, 1995). It is part of the large complex of buildings around the palace and within sight of the peak sanctuary on Mount Juktas (Figure 1).

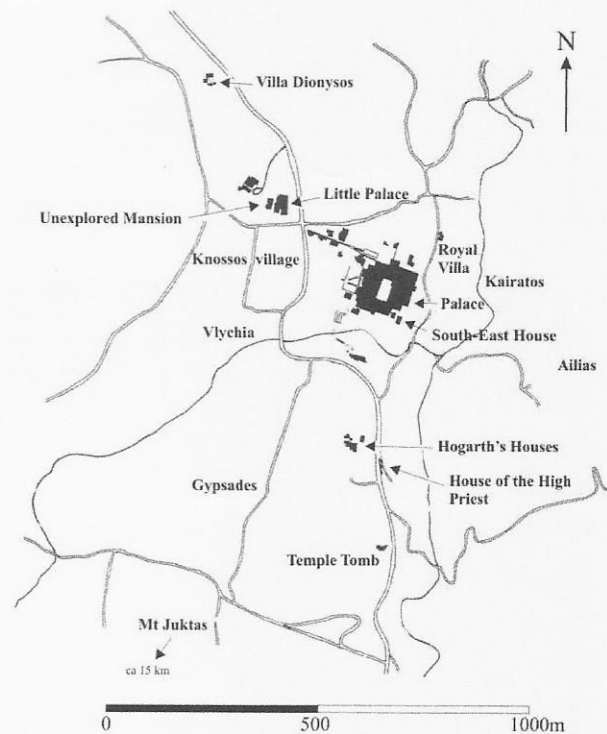


Figure 1. Knossos. The Kephala Hill and surrounding area. Based on Myers, Myers and Cadogan (1992), with permission.

Access was by a staircase descending from the top of the hill to a lower level. Part of the original plan was the pillar crypt just below the stairs (Figure 2). According to the excavator Sir Arthur Evans, 'there is clear evidence that such pillared crypts fulfilled a religious function'. It was built of fine masonry and contained an exquisite lamp of purple gypsum. Evans said of the lamp that it 'exceeds in richness of design any other object of the kind found within the palace'. There was also a libation table and a pyramidal stand, which probably held a double axe, the most common Minoan symbol. The pillar in the centre of the room has an incised double axe, and Evans drew the parallel between this room and the pillar crypts in the so-called central palace sanctuary where 29 double axes were incised into the pillars. Thus we can assume the considerable importance of the house and the small chamber. It was noted that the building is set at a different angle from the eastern wing of the palace, and this was explained as being due to the steep bluff. We propose an archaeoastronomical reason below.

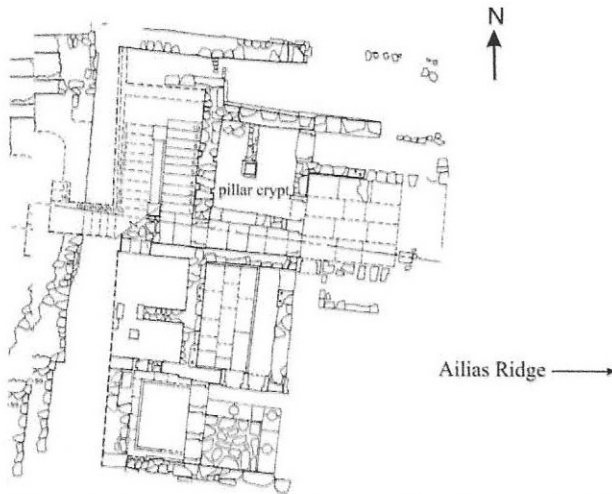


Figure 2. Plan of the south-east house. From Hood and Taylor (1981), with permission.

There is a well-defined niche in the western wall, symmetrical with the northern door (Figure 3). A hole was found below a stone in the south-west corner 'widening below into a cave artificially cut out of the soft rock. It was largely filled with earth that had apparently filtered into it, but, except for a few fragments of the Minoan and Neolithic pottery, nothing was found in it' (Evans 1901-1902, 110; 1902-1903, 3-10). We explain below the significance of the 'hole' in this corner of the pillar crypt.

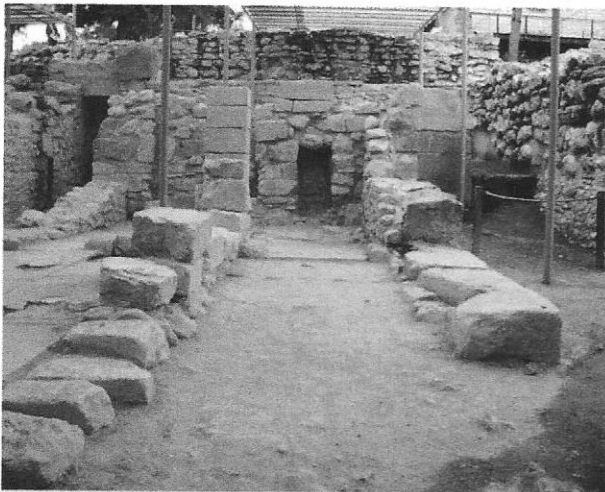


Figure 3. The pillar crypt from the east. Photo, Mary Blomberg 1996.

The archaeoastronomy of the central palace sanctuary and the peak sanctuary

THE PALACE

We present those details of the orientation of the central palace sanctuary and the peak sanctuary that are relevant for the discussion here. The full account has been published elsewhere (Blomberg, Henriksson and Papathanassiou, 2002).

The central palace sanctuary was part of a much earlier building (Catling, 1973-1974). The present arrangement of rooms was probably the work of the Mycenaeans who

converted the western part into a corridor for access to the well-known storerooms beyond (Hallager, 1987), thus accounting for the worn condition of the concave stone (Figure 4), the importance of which is explained below.

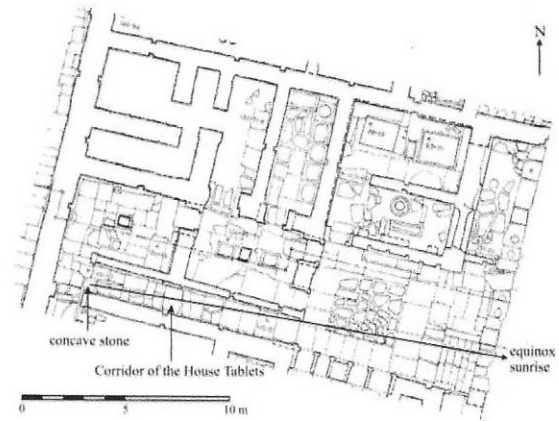


Figure 4. The plan of the central palace sanctuary as excavated. From Hood and Taylor (1981), with permission.

The sanctuary was originally one room (Driessen, 1990) and was orientated so that the upper limb of the Sun at sunrise on the equinoxes appears at the intersection of the Alias ridge and the northern jamb of the southernmost door (Figure 5).

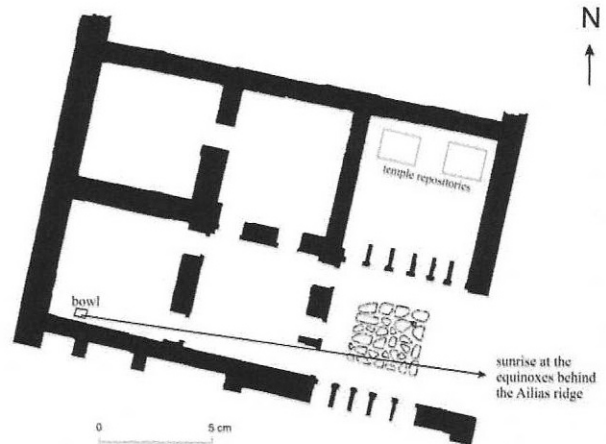


Figure 5. The reconstruction of the original sanctuary (Driessen, 1990). With permission from the author.

Eleven days after the autumn equinox the upper limb of the Sun at sunrise appears at the intersection of the ridge and the southern jamb of the door (Figure 6). The Sun does not appear in the doorway again until 11 days before the spring equinox. In the 11-day interval the rays of the rising Sun strike a much worn concave stone near the western wall (Figure 7). The stone is the remnant of a shallow bowl, the function of which was to cast a reflection on the west wall at the equinoxes (Figure 8). The 11-day interval is crucial for regulating a lunisolar calendar since the lunar year is 11 days shorter than the solar year. If the relevant phase of the Moon appeared in the 11-day interval, this would indicate that it was time to intercalate a lunar month into the calendar so that the lunar and the solar years would have concurrent cycles

beginning at regular intervals. This indicates that the Minoans had such a calendar. Months were added three times in eight years and, more exactly, seven times in 19 years.

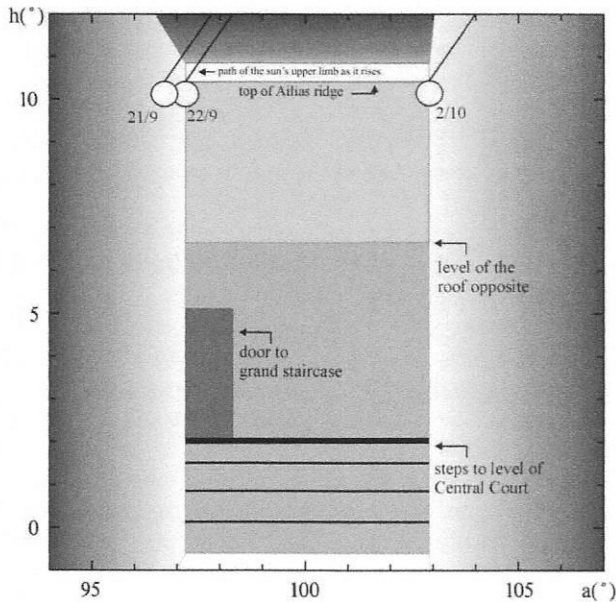


Figure 6. Autumn equinox sunrise from the sanctuary. Reconstruction by Göran Henriksson.



Figure 7. The bowl which casts the reflection. Photo, Göran Henriksson 1996.

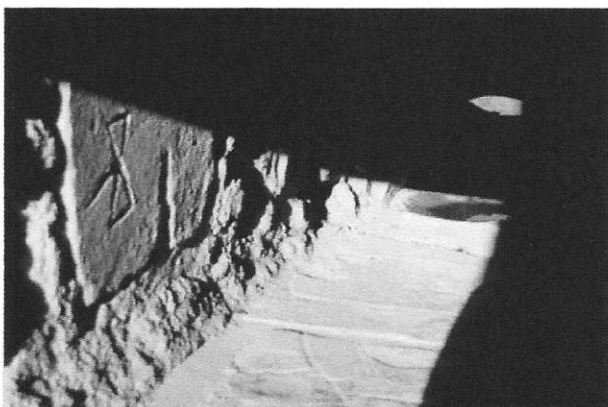


Figure 8. The reflection from the Sun's rays. Photo, Mary Blomberg 1996.

The beginning of the year was set with respect to the autumn equinox by the heliacal rising of Arcturus at Petsophas, which was marked by the orientation of one of the walls of the peak sanctuary (Henriksson and Blomberg, 1996). The heliacal rising occurred one lunar month before the autumn equinox so that the rising of the relevant phase

of the Moon in the 11-day interval after the heliacal rising would indicate that it was time to intercalate a month. It is this relationship at Petsophas that signifies most clearly that the Minoan new year began at the autumn equinox rather than at the spring equinox. We have evidence of this calendar also at Mount Juktas and at the south-east house (below). The fact that the Hellenistic calendar at Knossos began at the first crescent Moon after the autumn equinox may be a survival of the Minoan calendar (Guarducci, 1945).

The size of the reflection varies each year due to the relationship of the Sun's coordinates at the true equinox. It is larger the closer the Sun is to the true equinox, and the largest reflection, in 1998, was made when sunrise took place two hours from the true equinox (Figure 9). The orientation is dictated by the altitude of the Ailias ridge to the east, which also is responsible for the orientation of the pillar crypt in the south-east house. The nearly horizontal ridge faces the Kephala hill, on which the palace and villas were built.



Figure 9. The size of the reflection on the equinoxes in four consecutive years. Photos, Göran Henriksson.

Mount Juktas

Mount Juktas is about 15km southwest of the palace and is a prominent landmark for the whole area. On it is the largest Minoan peak sanctuary, which was built at some time in the late Early Bronze Age, c. 2300-2000 BC. There is a magnificent view towards the sea to the north and the mountains to the east. Such sanctuaries are considered by Minoan archaeologists to have been religious cult places and this is no doubt the case. Relationships between them and celestial phenomena were very important. On the basis of our investigations at all of them that have surviving foundations, we found orientations to the equinoxes, a solstice, the rising or setting of a bright star, or the beginning of a solar month. Some of the sanctuaries had orientations to more than one significant celestial event. Petsophas on the east coast had four. There is no specific orientation from the palace to the peak of Mount Juktas, as is sometimes maintained, although it is prominent on the southern horizon.

The placement of the peak sanctuary on Mt Juktas was such that from the altar the upper limb of the Sun at the equinoxes could be seen to rise in a saddle of the mountain Selena, and 11 days after the autumn equinox it rose where two mountains intersect. Sunrise 11 days after the spring equinox did not occur at a well-marked place (Figure 10). There is also a so-called ramp, the orientation of which is such that the morning of the equinox and the 11th day before and afterwards are indicated in a similar manner as in the central palace sanctuary. The walls of the ramp are related to sunrise in such a way that the ramp is completely illuminated only in the 11-day interval. As at Knossos this interval and its relationship to the autumn equinox would have provided an easy method for regulating a lunisolar calendar, just as it did also at the peak sanctuary on Petsophas.

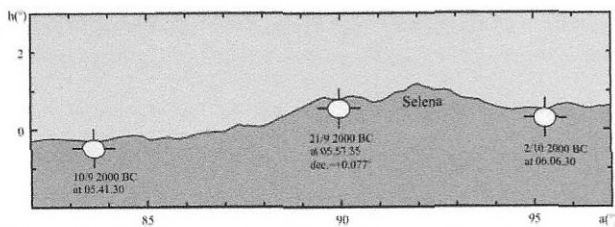


Figure 10. Sunrise opposite Mount Juktas on the autumn equinox and 11 days before and after the equinox. Reconstruction by Göran Henriksson.

The small terracotta figurines of animals and humans, separately made parts of bodies, and other objects found on the peaks can be connected to stars and constellations as we see them used in Aratos' poem *Phainomena*. This would confirm us in our view that the sanctuaries were also used as observatories and astronomical schools where the centuries-old activity of building up knowledge of the motions of the celestial bodies had laid in the hands of a group of learned persons on the most suitable observation places of the island. Future generations were educated there to continue after their teachers. A detailed presentation has been published explaining how these small objects could have been used in teaching the motions of the stars and constellations (Blomberg, 2006). To us it is clear that these sanctuaries were intimately connected to the study of celestial phenomena.

The archaeoastronomy of the pillar crypt in the south-east house

When we measured the orientations of the pillar crypt, we found relationships to the Sun at the equinoxes that are the same as those in the central palace sanctuary. The upper limb of the Sun at sunrise appears at the intersection of the top of the Ailias ridge and the northern door frames of the two doors of the room and illuminates the hole in the southwest corner and the southern corner of the niche (Figure 11). We think that the hole was originally the site of a similar kind of marker as the bowl in the central palace sanctuary for recording the Sun's rays on equinox morning. The Mycenaean successors to the Minoans may have destroyed it, perhaps thinking that it concealed the sanctuary treasure.

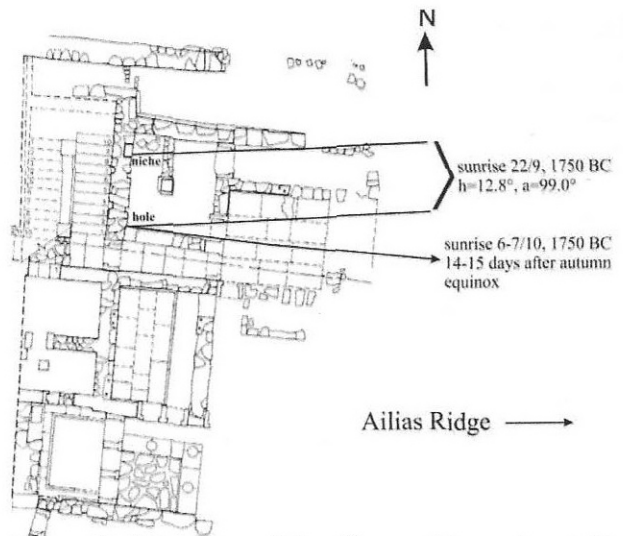


Figure 11. Orientations of the pillar crypt to sunrise on the autumn equinox. Orientations by Göran Henriksson

The position of the house on the slope in relation to the Ailias ridge opposite is responsible for the relationship of sunrise on the equinoxes to the pillar crypt, just as the alignment of the central palace sanctuary to the ridge is responsible for the phenomena to be observed there. The Sun appears at the intersection of the Ailias ridge and the northern door frame of the southern door (Figure 12), just as it did at the central palace sanctuary (Figure 6).

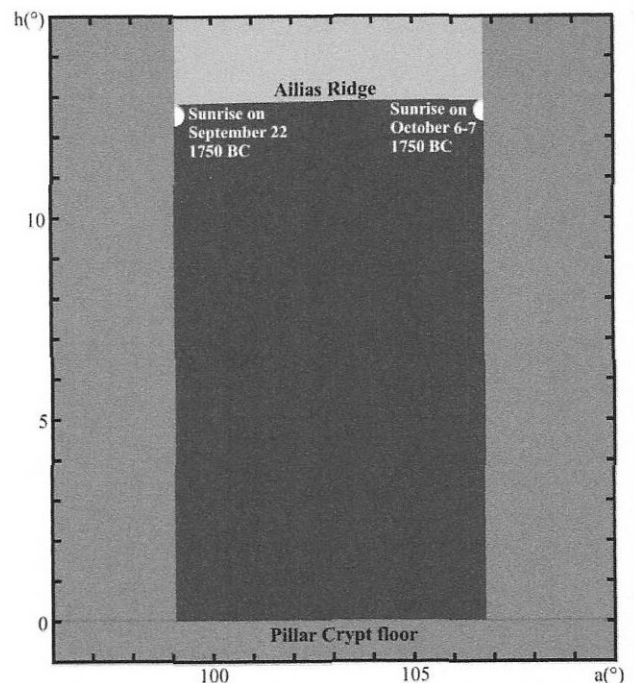


Figure 12. Sunrise at the autumn equinox from the pillar crypt. Reconstruction by Göran Henriksson.

Fourteen or fifteen days later it appeared at the southern side of the door opening. The results of the orientation of the south-east house are thus somewhat different than in the central palace sanctuary. If the new crescent Moon, for example, appeared on the equinox then the full Moon appeared on the 14th or 15th day. This could have been due to the different symbolic meanings of the days of the

calendar or another possibility of calibrating the calendar in bad weather.

Discussion

The fundamental basis for good relations between humans and the divine world was honouring the gods in the proper ways. Paramount among these were the annually recurring monthly and seasonal festivals devoted to the gods. It was therefore essential that the calendar be correct, with the months occurring in their proper seasons. Learned members of elite political and religious groups with control over the calendar would have inspired deep awe. In turn their elite status may have been significantly supported by their knowledge of the heavens. We have in the area of Knossos three prominent buildings with different functions connected to the Minoan calendar, the palace as residence of the political elite, the sanctuary on Mount Juktas and the south-east house both presided over by priests. Despite the paucity of written documents these three monuments give us insight into the existence of an ancient and advanced astronomical knowledge shared by the highest elite of Minoan political and religious spheres, knowledge used to regulate the calendar. We can surmise the different calendar functions as follows.

At Knossos there was the installation of a reflecting bowl in the central palace sanctuary perhaps as early as the late Early Bronze Age whereby the morning of the equinox was clearly marked by the reflection cast by the Sun's rays as they fell in the liquid-filled bowl exactly at sunrise. The reflection was, and still is, cast on the western wall every morning for 11 days after the autumn equinox and then does not appear until 11 days before the spring equinox. In a consecutive series of three years, the rays of the Sun appear on the morning of the equinox after 365 days. However, on the fourth year the rays do not appear after 365 days but, as we all know today, after 366 days. This method of using reflections was not only a way of clearly and dramatically marking the moment of the equinoxes, but it also marked the cycles of the Sun with respect to the equinoxes and indicated when a day should be added to form cycles of whole days for the solar year (Figure 9). The knowledge of the lunisolar calendar probably also meant that the political elite knew of the 8- and 19-year lunar cycles. There is a tradition of the 8-year cycle as the period of rule for King Minos (Blomberg and Henriksson, 1996). The political leaders probably had ceremonial roles in connection with the beginning of the year, the beginning of cycles and the time for festivals.

At the peak sanctuary on Mount Juktas, the most impressive and probably the oldest one in Crete, sunrise on the equinoxes and on the 11th day after the autumn equinox were well marked from the altar (Figure 10) and also the ramp. This, together with evidence from three other sites, means that the Minoans had a lunisolar calendar beginning in connection with the autumn equinox by the end of the Early Bronze Age (before c. 2000 BC). The sanctuary, as the place for the observation and teaching of celestial phenomena, would most likely have been a focal point of important cultic activity.

At the south-east house the variety of relationships to the Sun from the pillar crypt may indicate the working base for the priests, where observations were recorded and contemplated, a theoretical framework constructed over time, and models for the calendar devised with methods of calibration. The priests working here and on the peak may have had a deeply esoteric role in mapping out the larger cycles for the motion of the Moon and the Sun.

Our results show that 10 of the 12 solar months were pointed out by orientations at 13 of the 15 Minoan buildings which we have so far evaluated (Figure 13).

Sites	Months
Petsophas, Phaistos, Knossos, Mt Juktas, Vathypetro	first (autumn equinox)
Malia, Vathypetro	second
Modi	third
Chamaizi, Vathypetro	fourth (winter solstice)
Modi	fifth
Malia, Vathypetro	sixth
Petsophas, Phaistos, Knossos, Mt Juktas, Vathypetro	seventh (spring equinox)
Gournia	eighth
Gonies, Petsophas, Pyrgos	tenth (summer solstice)
Gournia	twelfth

Figure 13. Solar months marked by orientations.

The publications of the buildings are given below in the references. Thus we have good indications that the Minoans used not only a lunar calendar but also a solar calendar and had methods for calibrating both of them. We do not have such clear evidence for any neighbouring culture.

Acknowledgment

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