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Archaeoastronomical investigation of the peak sanctuary on Modi (Siteia)

Introduction

The investigation of the Middle Minoan foundation walls on the peak of Modi near the northeastern coast of Crete is part of the Uppsala University archaeoastronomical project (fig. 1). The purpose of the project is to discover the extent and character of the Minoan interest in celestial phenomena by studying the orientations of representative examples of the major types of Minoan buildings: palaces (Knossos, Phaistos, Malia, Zakros), villas (Agia Triada, Gournia, South East House, Tylissos A and C, Vathypetro), peak sanctuaries (Chamaizi, Gonies, Juktas, Modi, Petsophas, Pyrgos, Traostalos), and shrines (Agia Triada, Malia, Vathypetro). We wanted especially to include all of the peak sanctuaries with remaining walls, as they are ideally placed for the study of the celestial bodies and we saw a use for the small terracotta objects found in and around them as aids in this study (Blomberg 2000; 2006). We have no quarrel with the traditional term *peak sanctuary* for such places, as the study of the celestial bodies most likely had a religious dimension for the Minoans.

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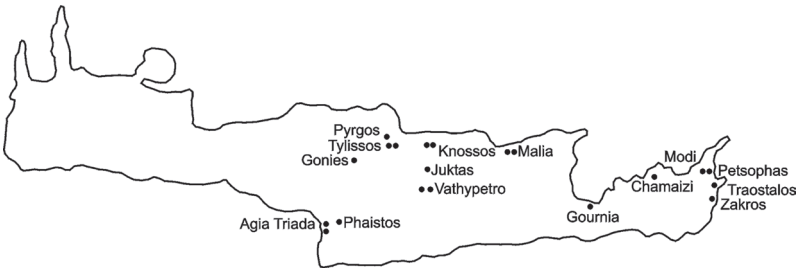

Fig. 1 : *Map of Crete showing the Minoan sites in the Uppsala University archaeoastronomical project*

This was clearly the case in the neighbouring contemporary cultures in Mesopotamia and Egypt.

As we completed our work at site after site, we discovered that orientations were not the only means by which Minoans related their buildings to the celestial bodies. They also chose sites where, from within a building or very near it, a major celestial event could be observed to occur behind an impressive natural feature, such as a prominent mountain peak. Sunrise from the peak sanctuary near Gonies (Henriksson – Blomberg in press) and sunset at the equinoxes from the peak sanctuary on Petsophas (Henriksson – Blomberg 1996) are examples. We found at nearly every site one or more relationships to some major celestial event: sunrise or sunset at a solstice or the equinoxes, the heliacal rising or setting of one of the brightest stars, moonrise or moonset at a major standstill. These have been the focal points for orientations in cultures of all times and places.

The Minoans only rarely focused on sunsets and, when they did so, it seems to have been for a special reason. We have found two examples, sunset at the equinoxes at both Petsophas (Henriksson – Blomberg 1996) and Phaistos (Blomberg – Henriksson 2007b). At these two places the eastern horizon is distant, without distinctive landmarks, and often obscured by mist. But sunset at the equinoxes at both sites occurred behind natural foresights, to use the archaeoastronomical term, and this would have improved the chances that

sunrise or sunset on these two important days in the Minoan calendar would have been observed on those very days. The importance of actual observation of a major celestial event was probably not only practical but also symbolical. We have argued that the Minoan calendar was lunisolar and that the new year began at the appearance of the new crescent moon following the autumn equinox (Henriksson – Blomberg 1996).

A celestial event could be marked by a natural or manmade foresight, by the orientation of a wall, and even by both a foresight and an orientation. The relationships are always clear. It seems that the Minoans sought places where natural foresights could mark the major celestial events. Three of the four palaces (Malia, Phaistos, Zakros) and five of the seven peak sanctuaries (Gonies, Juktas, Petsophas, Pyrgos, Traostalos) have such a foresight. Two of the remaining three monuments (Chamaizi, Knossos palace) had manmade foresights. Some manmade foresights, of course, may not have survived.

It must be stressed that the relationships to the celestial bodies that we have discovered in Crete were the result of long-term systematic observations on the part of the Minoans. This is perhaps most clearly demonstrated by the change in the orientation of the west side of the central court at Phaistos (Blomberg – Henriksson 2007b) when the bright star Canopus became visible in the southern sky as a result of the phenomenon of precession, the slow rotation of the earth's axis that completes one revolution in about 26 000 years. It is shown as well by the retention at Knossos of the orientation of the earlier EM III "palace" for the Old Palace when it was built in MM IB (Catling 1973-1974: 34).

Methods

We use classical archaeoastronomical methods in our investigations (Blomberg – Henriksson 2001b; Schlosser – Cierny 1997), i.e., measuring the orientations of walls and landscape horizons using a total station (an optical instrument that combines an electronic theodolite, an electronic distance measuring device and software running on an internal computer), evaluating the measurements by

appropriate mathematical calculations and, using our own computer programs, comparing the results with the positions of the celestial bodies as they were in the Middle Bronze Age, which is the construction period for most of the buildings in our project. We also study Minoan iconography and any other evidence that may contain information about the celestial bodies in that culture, such as later Greek traditions.

Results from Modi

The conical peak of Modi (H. 539 m) is a prominent landmark on the northeast coast of Crete (fig. 2). It is due west of Petsophas and served from as early as the Middle Minoan Period as a foresight for sunset at the equinoxes as observed from this peak sanctuary. It also was a foresight for the heliacal setting of Arcturus from Traostalos, to which one of the walls of this sanctuary was oriented in the same period (Henriksson – Blomberg 1996). Remains of the foundation walls of two small buildings were found a few meters from the peak (fig. 3). Faure designated the best-preserved building as the sanctuary (fig. 4) and suggested that the building to the north of it was a priests' house (Faure 1962: 37-38). The finds were those typical of peak sanctuaries: ashes, terracotta figurines of animals and humans. The site was excavated by Davaras in 1972 and yielded a large number of votive offerings, including many bronze knives (Davaras 1972: 652; see also Jones 1999: 41, 43, 45, 47, 51, 55, 57, 63, 78).

Fig. 2 : *The peak of Modi as seen from the peak sanctuary on Traostalos*

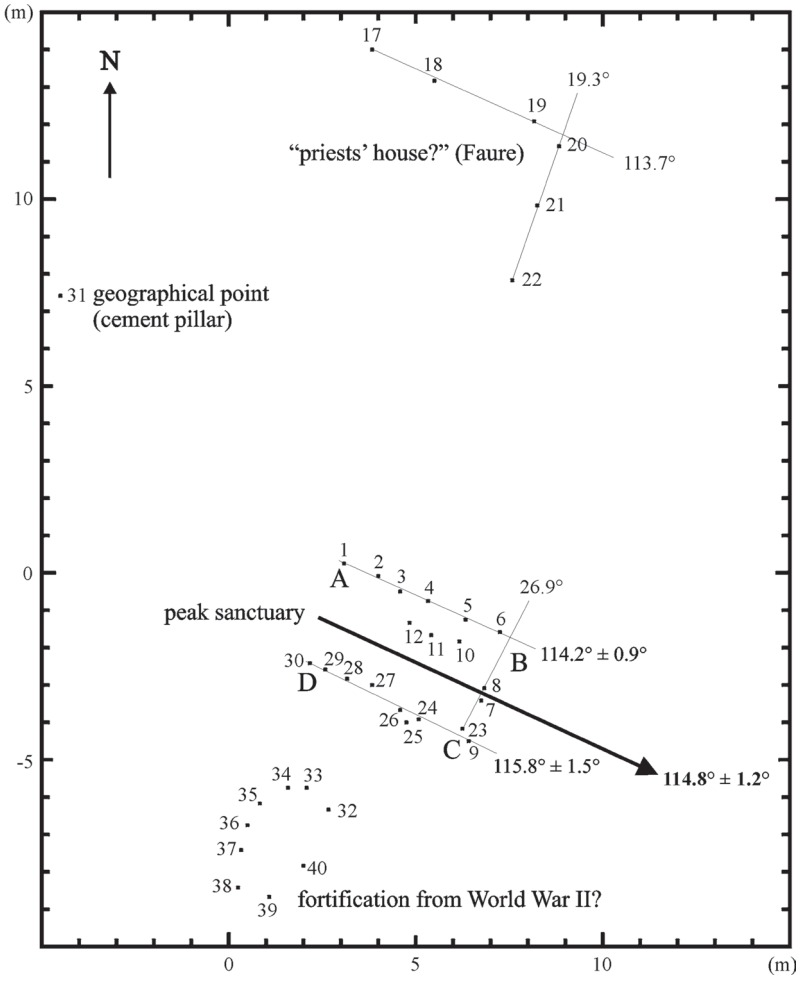

Fig. 3 : *Measurements of the foundation stones on Modi. The axis of symmetry of the peak sanctuary is 114.8° ± 1.2°, which is the direction to sunrise on the day corresponding to our 19 November in 2000 BCE, two lunar (synodic) months after the autumn equinox, and also to the day corresponding to our 18 January in the year, two lunar months before the vernal equinox*

Fig. 4 : *Wall AB of the peak sanctuary on Modi with A in the foreground*

Two sides of the priests' house and three sides of the peak sanctuary could be measured. The axis of symmetry of the long walls of the sanctuary was found to be 114.8° ± 1.2°, that of the surviving long wall of the "priests' house" is 113.7° (fig. 3). As only three points could be measured on the foundation stones of this wall, no standard deviation could be calculated. Nevertheless, the similarity in the orientations of the long walls of the two buildings indicates that they were intended to be the same and aligned to the same celestial event. This is the direction to sunrise two lunar (synodic) months after the autumn equinox (the third month in our proposed Minoan calendar) and thus also to sunrise two lunar months before the vernal equinox (the fifth month). These sunrises are not to major celestial events, and this is a feature that Modi shares with the palace at Malia and the villa at Vathypetro (Blomberg – Henriksson 2005a; 2005b). At Malia and Vathypetro the axes of symmetry of the main cult rooms are oriented to sunrise one lunar month following the autumn equinox (the second month) and thus also one lunar month prior to the vernal equinox (the sixth month).

Project results

From our earliest study, that of the peak sanctuaries on Petsophas and Traostalos (Henriksson – Blomberg 1996), we found evidence that the Minoans had a lunisolar calendar in which the first month began at the new crescent moon following the autumn equinox. An orientation to the equinoxes gives also, of course, the time for the beginning of the seventh month, the month that began at the new crescent moon after the vernal equinox. The discovery of orientations that were not to major celestial events was unsettling until we understood their function in determining the earliest days on which specific months in the Minoan calendar could begin. All of our studies in Crete have confirmed our conclusions about the Minoan calendar.

The results of our investigations so far are summarized in Figure 5. Our project includes twenty buildings from fifteen sites. We have completed the measurements of all twenty buildings and have evaluated the data from fifteen: the four palaces, the villa at Vathypetro, the seven peak sanctuaries, and the three shrines. The shrines do not appear in Figure 5, as we have argued on the basis of their orientations that they were not built for Minoans, but for Mycenaeans (Blomberg – Henriksson 2005b: 53, 50; 2001a: 75). There is also archaeological evidence to support our arguments. The three shrines were all oriented to sunset at the summer solstice, an orientation that seems to be unique in Crete aside from these small buildings. Of the remaining seventeen buildings, we have completed and published our study of ten: Chamaizi (Blomberg – Henriksson 2007a), Juktas and Knossos palace (Blomberg *et al.* 2002), Malia palace and Vathypetro villa (Blomberg – Henriksson 2005a; 2005b), Petsophas (Blomberg – Henriksson 1996; Henriksson – Blomberg 1996; 1997-1998), Phaistos (Blomberg – Henriksson 2007b), Pyrgos (Blomberg – Henriksson 2003b), Traostalos (Blomberg – Henriksson 1996; Henriksson – Blomberg 1996; Blomberg 2006), and Zakros (Blomberg – Henriksson 1996; 2000). Our results from Gonies are in press (Henriksson

– Blomberg in press). The eleven buildings, including Gonies, have nineteen relationships to what we call major celestial events (fig. 5): four to sunrise at the equinoxes (Juktas, Knossos palace, Phaistos, Vathypetro villa), two to sunset at the equinoxes (Petsophas, Phaistos), three to sunrise at the summer solstice (Gonies, Petsophas, Pyrgos), two to sunrise at the winter solstice (Chamaizi, Vathypetro), one to the rising moon at the southern major standstill (Zakros), two to the heliacal rising of Arcturus (Petsophas, Traostalos), four to its heliacal setting (Chamaizi, Petsophas, Pyrgos, Traostalos), and one to the heliacal rising of Canopus (Phaistos). Thirteen of these nineteen orientations are marked by a foresight — nine by a natural foresight and four by a surviving manmade foresight. Six of the eleven buildings have more than one relationship to a major celestial event, with Petsophas having four. It is possible that there were additional relationships to celestial events that were culture specific for the Minoans. We think that this is the case for the peak sanctuary on Modi and also for the palace at Malia and the villa at Vathypetro. The small differences in azimuth for buildings oriented to the same celestial event, as in the case of Gonies, Pyrgos and Petsophas to sunrise at the summer solstice, are due to the mountainous horizon opposite most sites in our project.

We have also published a number of articles on what we call spin-off results of our studies. In these we present the deductions concerning the calendar, navigation, and religion that can reasonably be drawn from the long term astronomical observations made by the Minoans (Blomberg – Henriksson 1996; 1999; 2000; 2003a; Henriksson – Blomberg 2000; 2005).

The orientation at Modi, placed in the context of the orientations that we have measured at other Minoan sites, indicates the existence of a system for identifying the earliest day on which specific months in the calendar could begin (Table). For example, the first month never began earlier than the day of the autumn equinox and it would only begin then if the new crescent moon appeared on that same day. Not only do we know of this type of lunisolar calendar from many

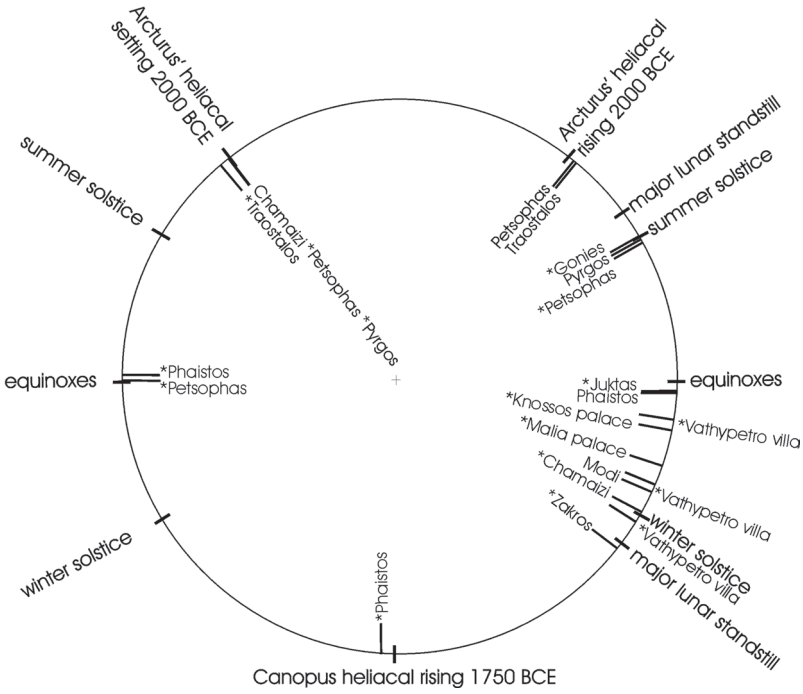

Fig. 5 : *Relationships of the Minoan sites in the Uppsala University archaeoastronomical project to major celestial events. An asterisk indicates a foresight for the event*

contemporary cultures in the eastern Mediterranean (Cohen 1993), but it existed in the cultures following the Minoan in the Aegean (Blomberg – Henriksson 2003a). The orientations to the equinoxes at Juktas, Knossos palace, Petsophas, Phaistos and Vathypetro villa gave the time for the beginning of the first and seventh months. The orientations of the axes of symmetry of the pillar room of the palace at Malia and the hall of columns at Vathypetro villa gave the time for the beginning of the second and sixth months, the orientations at Modi gave the time for the beginning of the third and fifth months. The orientation to sunrise at the winter solstice at Chamaizi gave the

time to begin the fourth month, and the orientations to sunrise at the summer solstice at Gonies, Petsophas and Pyrgos gave the tenth month (Table). If we did not have these results from so many important Minoan buildings, in fact from all but one (Zakros) of the eleven buildings that we have completed in our project, we would not have been able to understand the significance of the orientation on Modi. The orientation at Zakros to the rising moon at the major southern standstill could have indicated the beginning of the eight- and nineteen-year cycles, which contain very close to a full number of lunar months and solar years. With the help of these cycles, it is known when to intercalate a month in order to keep the months occurring in the right seasons (Blomberg – Henriksson 1996: 28-29).

months	**sites**
first month (autumn equinox)	Juktas, Knossos palace, Petsophas, Phaistos, Vathypetro villa
second month	Malia palace, Vathypetro villa
third month	Modi
fourth month (winter solstice)	Chamaizi
fifth month	Modi
sixth month	Malia palace, Vathypetro villa
seventh month (spring equinox)	Juktas, Knossos palace, Petsophas, Phaistos, Vathypetro villa
eighth month	site x (not found)
ninth month	site y (not found)
tenth month (summer solstice)	Gonies, Petsophas, Pyrgos
eleventh month	site y (not found)
twelfth month	site x (not found)

Table : *Relationships of Minoan buildings to major celestial events that determined the first day on which a month could begin in the proposed lunisolar calendar*

Conclusions

The results from our study of the peak sanctuary on Modi give us evidence of a system by which the first day of each month in the Minoan calendar could have been easily determined and thus the times for ritual and economic activities correctly judged. The system seems to have been deliberately designed to incorporate major cult sites of the Minoan culture. We think that there probably were also sites with celestial relationships that indicated the beginning of the 8th, 9th, 11th and 12th months. We need only two such sites to complete the system, one giving the ninth and eleventh months and another giving the eighth and twelfth months. Considering how many Minoan buildings, especially peak sanctuaries, have suffered to the extent that there are no longer foundation stones that can be adequately measured for the purpose of calculating their orientations, we think that the surviving evidence for a system such as we have described is astonishing.

Not all relationships to celestial phenomena were for the practical purpose of regulating the calendar. The relationships to bright stars would have been useful for pinpointing important times in the agricultural year, as they did in the historical period, according to Hesiodos, and also the limits of the sailing season, as we know from Aratos. Such dates, of course, would have been crucial also for the Minoans, as we have tried to show elsewhere (Blomberg – Henriksson 1999; Henriksson – Blomberg 2000).

The discovery of the orientations at Modi to the earliest beginning of two additional months of the year has deepened our understanding of how the Minoans used their astronomical knowledge for regulating the calendar. An accurate calendar was of the greatest importance. It would almost certainly have had a ritual function in that, by determining when each month began, the proper times for religious celebrations could be set. It also enabled the Minoans to arrange for the simultaneous occurrence of religious ceremonies throughout the island, as well as indicating the correct times of the year for major

economic activities. For this reason it would have been of the utmost importance that the calendar could be kept accurate with the months beginning at the proper times and in the right seasons. The significance of the relationships established between buildings and celestial bodies, however, points far beyond the practical purpose of calendar regulation for the Minoans. It indicates a deep religious concern to anchor their world in the cosmos by means of temporal and spatial connections between their homes and sanctuaries to the sun, the moon and the brightest stars.

The fact of long-term, systematic observations on the part of the Minoans is very likely to have led also to considerable theoretical understanding of the motions of the celestial bodies and this encourages us in setting as the ideal final result of our investigations the recovery of Minoan astronomy.

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