

The Minoan peak sanctuary on Pyrgos and its context

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Abstract

We report the results of our archaeoastronomical study of the small Middle Minoan building on Pyrgos (Maleviziou), the mountain near the large Minoan villa at Tyliisos. The orientation of the long wall of the building indicates that the major axis was aligned to sunrise at the summer solstice. This is the second example of such an orientation for a peak sanctuary in Crete, the other being that of the major axis of the structure on Petsophas. The short axis of the building on Pyrgos is oriented to where the heliacal setting of Arcturus occurred at the end of the Early Minoan Period. Arcturus is one of the four brightest stars, and we know from surviving texts that it was an important calendar star in the Aegean from very early times. This is the third example of orientations to Arcturus at the Minoan peak sanctuaries, the other two being at Petsophas and Traostalos. At the beginning of the Middle Minoan Period (ca 2000 BC), the heliacal setting of this star as seen from Pyrgos would have occurred directly above the prominent peak of Kako Kefali, which thus could have served as a foresight in the same way that the peak of Modi could have for the heliacal setting of the same star as seen from Traostalos.

Conclusions based on the accumulating evidence from orientations of the Minoan palaces, villas, and peak sanctuaries included in the Uppsala Project are summarized and compared briefly with the differences in grave orientations.

Methods

We apply archaeoastronomical methods to the study of the Minoan archaeological remains; this means measuring the orientations of the buildings and evaluating the data using appropriate tools. These are the basic methods of archaeoastronomy (Hoskin 2001: 7-20; Blomberg and Henriksson 2001b: 609-610) and, as far as we know, they are the only ways of recovering the astronomical achievements of an ancient culture from which no legible documents have survived. It is fortunate that peoples in many places and periods have been strongly motivated to establish physical relationships between themselves and the sky by orienting their settlements and buildings to prominent celestial events, thus leaving this evidence of their astronomical interests.

Crucial to the accuracy of the results obtained using archaeoastronomical methods is reliance on adequate measuring equipment, computer programs, and input parameters. For measuring orientations we use the digital theodolite SOKKIA SET 4C; for the computations of the astronomical data we use the computer programs developed by Henriksson. The parameters for calculating the visibility of bright stars are from Bemporad (1904), Sidentopf (1941), Ljunghall (1949), and Schmidt (1865). It is important to use Schmidt's visibility calibrations for Athens from ca 1850, as his observations were made before modern air pollution. When statistical evaluations are relevant, we rely upon the Department of Mathematical Statistics at Uppsala University (Henriksson and Blomberg 1996: 111; 2000: 307).

Pyrgos in the context of the Uppsala project

Our study of the peak sanctuary on Pyrgos is part of the on-going Uppsala project to collect the evidence for Minoan astronomical observations, to interpret this evidence, and to evaluate its influence on the Minoan culture and on the later Mycenaean and Greek cultures. We have measured the alignments of fifteen Minoan monuments (Blomberg and Henriksson 2001a; 2002; Henriksson and Blomberg 1996; 1997-1998; forthcoming). These include four palaces, five villas, and six peak sanctuaries (Fig. 1). We have not yet completed our evaluation of all sites so that the results presented here are preliminary.

There may have been as many as 25 Minoan peak sanctuaries, but it seems that fewer than ten ever had buildings. The identification of those with no buildings has been made on the basis of the types of small objects found on the sites (Rutkowski 1986: 73-98). The construction of these places probably dates to early in the Middle Minoan Period, which began ca 2000 years before our era. It seemed to us that sites of this type, especially those on the eastern coast of Crete, were ideally placed for the

purpose of observing the celestial bodies, and we therefore studied the orientations of their walls and examined the finds to see if these could support such a function. Our study of the peak sanctuary on Pyrgos is the fourth that we have completed, the other three begin on Juktas, Petsophas, and Traostalos (Blomberg and Henriksson 2002; Henriksson and Blomberg 1996; 1997-1998).



Fig. 1. Minoan sites in the Uppsala University archaeoastronomical project.

The archaeology of Pyrgos

The site of Pyrgos with its small building was excavated in 1962 by the local superintendent of antiquities for the Greek Archaeological Service. It is located in north central Crete on a moderately high mountain (684 m), and this is typical of such places; they are not on the higher mountains of Crete (Rutkowski 1986: 73-74; Peatfield 1990: 119-120). The finds consisted of pottery shards, human and animal figurines, a layer of ashes, and part of a pair of horns (Alexiou 1963; Megaw 1962/1963: 31). In 1997, wall BE of the building was 12.8 meters long, and wall CD measured 5.6 meters (Fig. 2).

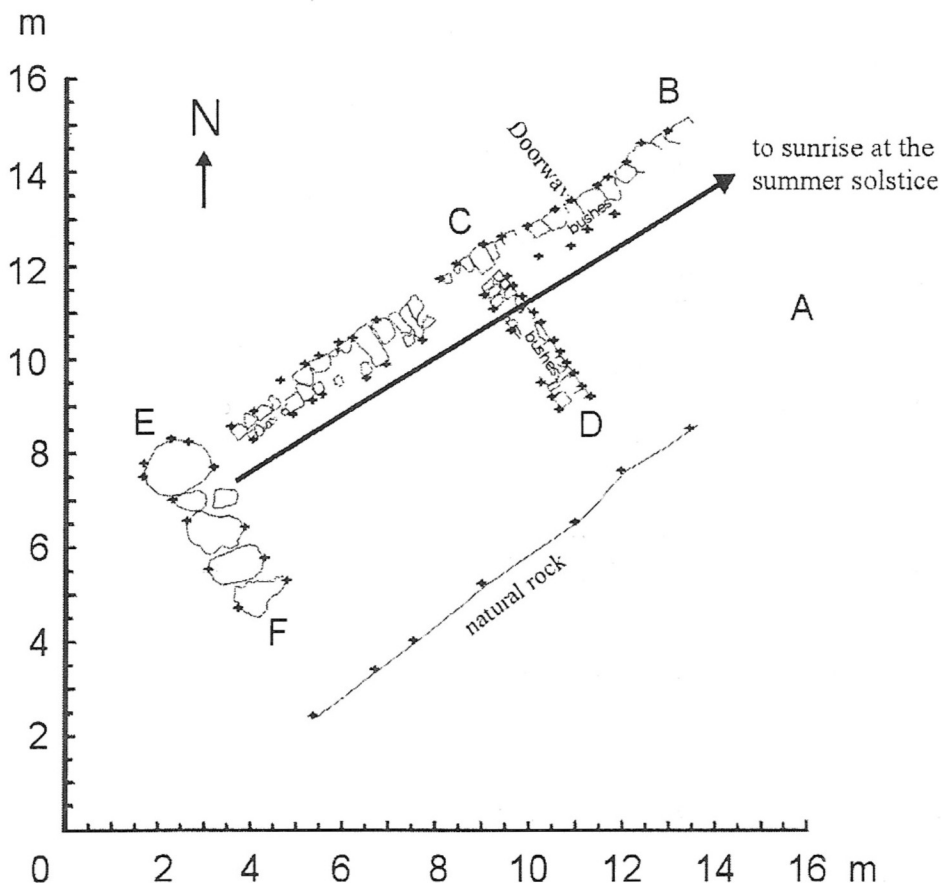


Fig. 2. Plan of the peak sanctuary on Pyrgos, north central Crete. The orientation of the wall BCE is $59.3^\circ \pm 0.4^\circ$ and that of the wall CD is $325.2^\circ \pm 0.2^\circ$.

In the summer of 2000, they were 11.2 and 3.2 meters respectively. This destruction is due to the illegal digging for valuable objects and, unfortunately, is the fate of many Minoan monuments in remote areas, making the documentation of these places urgent. We do not know if there had been a built rear wall or if the natural rock screen served that purpose. The rock seems to have been somewhat smoothed with tools. The peak sanctuary on Traostalos on the eastern coast of Crete clearly had smoothed natural rock as one of its walls. It has been suggested that these structures were, at least in part, open to the air, but we have no proof one way or the other.

The archaeoastronomy of Pyrgos

Using orthogonal regression estimation, we calculated the orientation of the long wall BCE and found it be $59.3^\circ \pm 0.4^\circ$ (Fig. 2). The calculated azimuth of the upper limb of the sun at sunrise at the summer solstice in 2000 BC is 59.2° (Fig. 3). The horizon is the open sea, and the altitude at which the sun will become visible is sensitive to variations in atmospheric refraction and extinction. From Pyrgos sunrise at the summer solstice in the Middle Bronze Age could have been observed as far north as we see it in Fig. 3, but never further north. The computed horizon altitude is -0.39° from a mountain with height of 684 m (that of Pyrgos). The refraction is valid for a temperature of $+17^\circ\text{C}$ and barometric pressure of 760 mm of Mercury.

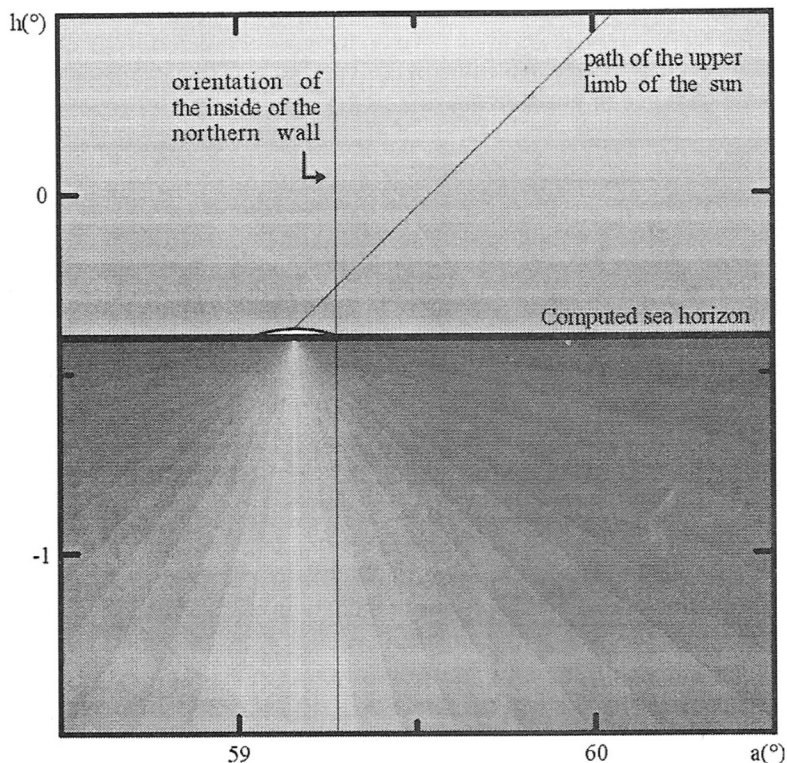


Fig. 3. Sunrise at the summer solstice on 23 June 2000 BC, 04.34.38 local mean solar time, from the peak sanctuary on Pyrgos.

The weighted mean value of the minor axis of the building is $325.2^\circ \pm 0.2^\circ$. This is the orientation to the heliacal setting of Arcturus as it would have been observed from Pyrgos towards the end of the Early Minoan Period (Fig. 4). The last phase of the period began about 2200 BC. At that time the heliacal risings and settings of Arcturus were very close to the limits of the circumpolar stars for the latitude of Pyrgos ($35^\circ 19'$). These stars are important for navigation and they, as well as Arcturus, have figured prominently in early Greek literature, especially in connection with navigation. The hypothesis has been presented that Calypso's reference to the Bear in book 5 of the *Odyssey* is actually a reference to the circumpolar stars as a whole (P. Blomberg this volume), the word for bear in Greek meaning also north ($\alpha\rho\kappa\tau\omicron\varsigma$, compare our 'arctic').

To someone standing near the building on Pyrgos, the most prominent peak opposite the site, that of Kako Kefali, would have been a foresight for the heliacal setting of Arcturus at the beginning of the Middle Minoan Period, ca 2000 BC, when the structure was most probably built.

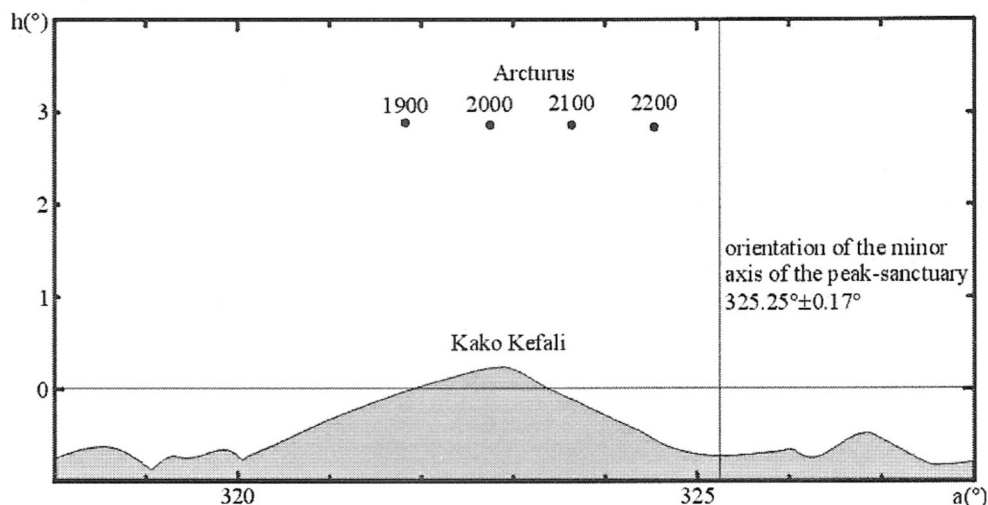


Fig. 4. The heliacal settings of Arcturus during the late Early Minoan Period and the early Middle Minoan Period. The changes in position are due to the phenomenon of precession.

Pyrgos compared with Petsophas and Traostalos

The orientations measured on Pyrgos gain significance when they are compared to those that we found earlier at the peak sanctuaries on Petsophas and Traostalos on the eastern coast of Crete. The long wall of the building on Petsophas was oriented, as at Pyrgos, to sunrise at the summer solstice (Fig. 5), and the highest peak on the island of Karpathos opposite would have been an excellent foresight for this event (Fig. 6). There are also two oblique walls at the site, AA' and AB, that were oriented to the heliacal rising and setting of Arcturus in the same period. The horizon is the open sea in both directions (Henriksson and Blomberg 1996).

At Traostalos (Fig. 7) there are also two oblique walls (AA' and AB) that were oriented to the horizon setting and rising respectively of Arcturus in the same period and there is another wall (BC) oriented to the eastern limit of the circumpolar stars. Traostalos lies about 7 km due south of Petsophas, and the entire eastern coast of Crete can be seen from it in clear weather. The orientation on Traostalos to the setting of Arcturus could have had as foresight the isolated conical peak of Modi. Thus we have a third instance of orientation to Arcturus—the other two being at Pyrgos and Petsophas—and a second instance of a prominent mountain peak that would have made a very good foresight for the heliacal setting of the same star (Henriksson and Blomberg 1997-1998).

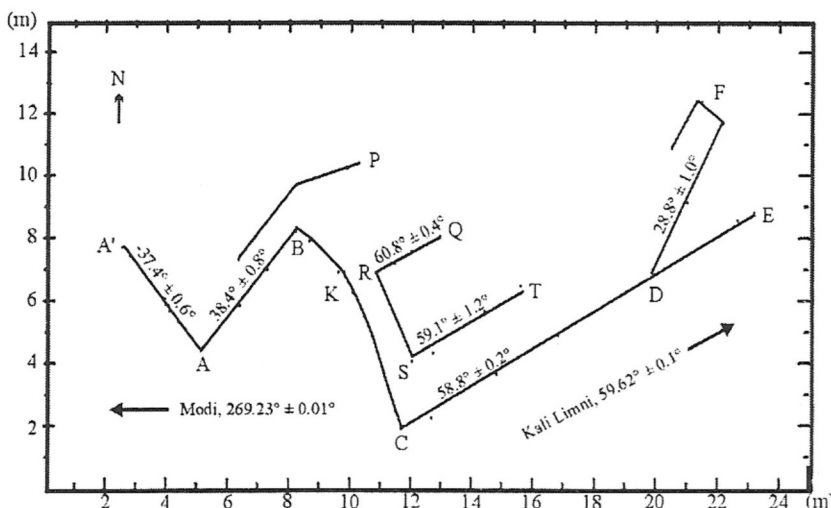


Fig. 5. Plan of the peak sanctuary on Petsophas showing orientations to the heliacal rising (AB) and setting (AA') of Arcturus and to sunrise at the summer solstice (CDE). From the near vicinity of the building sunset at the equinoxes could have been observed directly behind the isolated conical mountain peak of Modi.

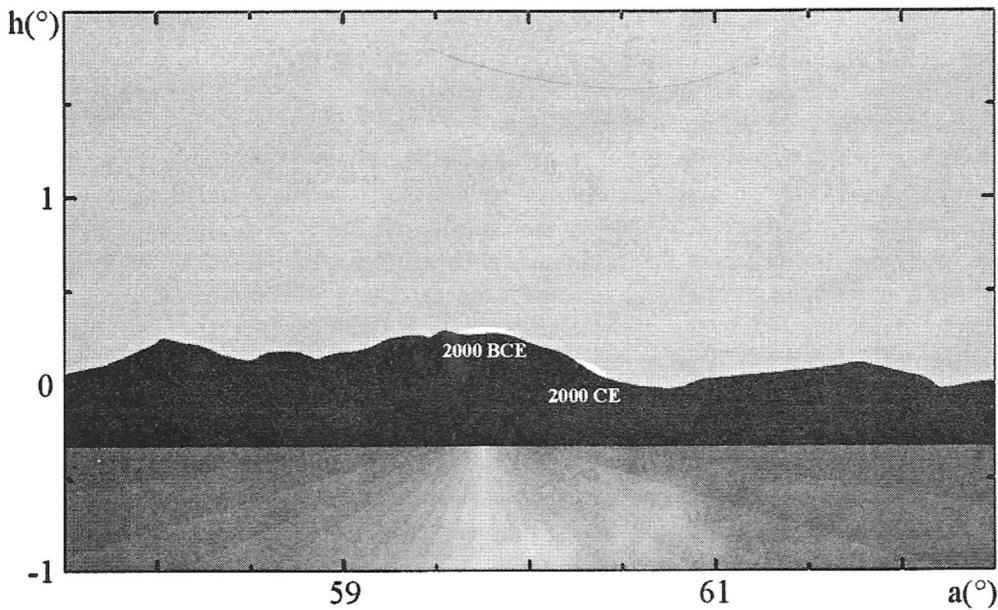


Fig. 6. Sunrise at the summer solstice as it would have been observed along the main axis of the peak sanctuary on Petsophas in the years around 2000 BC. The highest peak of the mountain Kali Limni on the island of Karpathos could have served as a foresight.

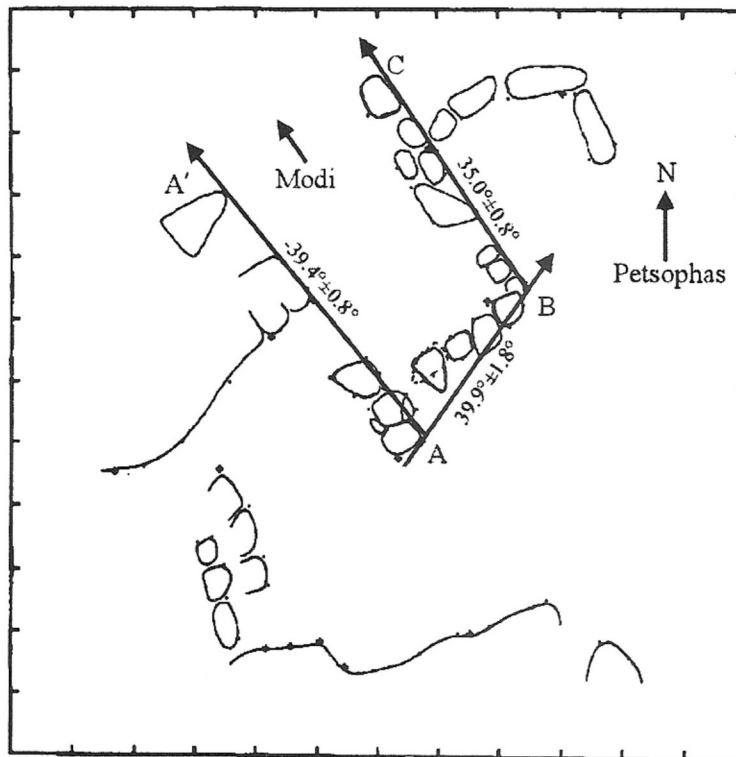


Fig. 7. Plan of the peak sanctuary on Traostalos showing orientations to the heliacal rising (AB) and setting (AA') of Arcturus and to the eastern limit of the circumpolar stars (BC).

Summary of the orientations of sites included in the Uppsala project

We have summarized in Fig. 8 the orientations and other relationships that we have found so far in our study of fifteen major Minoan monuments: the four major palaces, the six peak sanctuaries with adequate surviving walls, and five of the large villas. The term 'relationships' is used because, in a few cases, there is not an orientation of an architectural feature; but the observation of the celestial event would only have occurred in the near vicinity of the building, e.g. sunset at the equinoxes behind Modi

as observed from Petsophas (Henriksson and Blomberg 1996: fig. 2). Also, we must keep in mind that the azimuths of the orientations are in most cases influenced by the mountainous landscape, being shifted southwards due to the altitude of the horizon.

Our study has given striking results. Ten of these fifteen monuments have orientations to major celestial events: sunrise at the summer solstice in two cases, sunrise at the equinoxes in four cases, sunset at the equinoxes in one case, sunset at the summer solstice in three cases, sunrise at the winter solstice in one case, moonrise at the southern major standstill in one case, the heliacal rising of Arcturus in two cases, and the heliacal setting of the same star in three cases, a total of seventeen orientations to major celestial events at these ten sites. It is a striking fact that in the case of eleven of these seventeen orientations there were features that would have made excellent foresights; seven were natural features and four were man-made. The asterisks in Fig. 8 signify the presence of such a feature. Four of the monuments have orientations to more than one major celestial event: two each in the case of the peak sanctuaries on Pyrgos and Traostalos, three in the case of the villa at Vathypetro, and four in the case of the peak sanctuary on Petsophas. Sunrise at the solstices and equinoxes are all objects of Minoan orientations. Sunset at these times seems not to have been as important and those three to sunset at the summer solstice—the oblique building at Mallia, the tripartite shrine at Vathypetro, and the small shrine at Agia Triada—are therefore especially interesting and have been discussed in separate publications (Blomberg and Henriksson 2001a; forthcoming). The peak sanctuaries show a greater number of different relationships and only they have orientations to the important calendar star Arcturus. In the Middle Bronze Age it rose and set at the times later known to have been the limits of the sailing season in the Aegean. Furthermore there are orientations at two peak sanctuaries, Pyrgos and Traostalos, which mark the limits of the circumpolar stars for their latitude. The orientation at Petsophas to sunset at the equinoxes is also unique and is due, we think, to the special function of that site for observing the celestial bodies—for the sake of keeping the calendar, for navigation, and perhaps also for religious reasons (Henriksson and Blomberg 1996: 113). Another unique orientation is that of the palace at Zakros, which is oriented to moonrise and with a natural foresight that could have marked the alignment. The villas are oriented to the east within the limits of sunrise, but we have not completed our study of these places and, aside from Vathypetro, we do not yet know their precise relationships to sunrise.

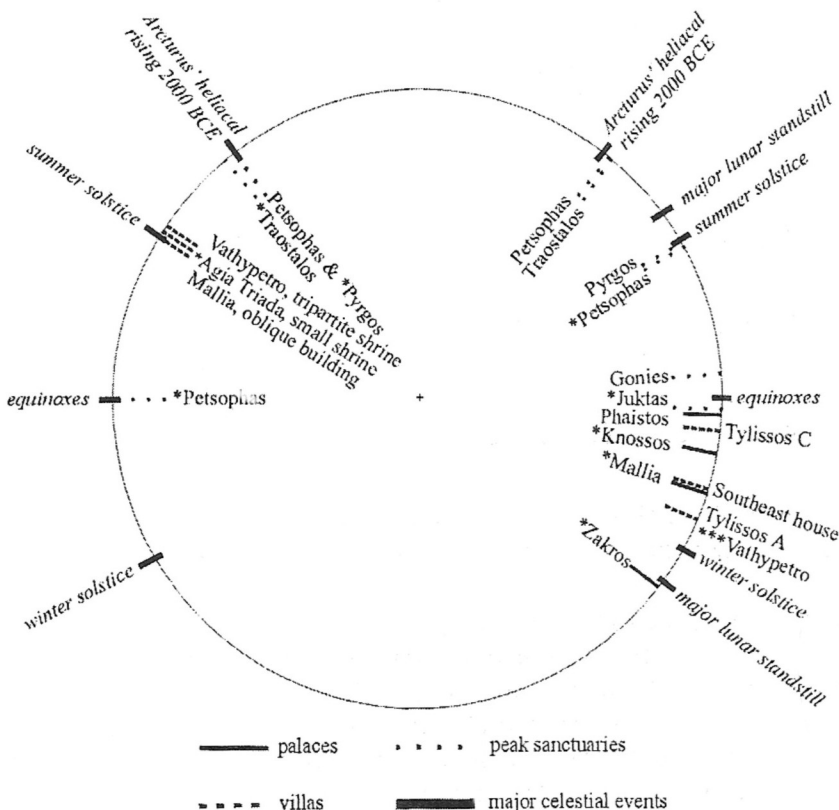


Fig. 8. The Orientations of 15 major Minoan monuments: 4 palaces, 6 peak sanctuaries, and 5 villas.

Grave orientations in Minoan Crete

In our study of 323 graves with passage approaches at 15 sites in Crete (Blomberg and Henriksson 2001a: 77-84), we found an overwhelming number with orientations to the east within the limits of sunrise (Fig. 9): 86% lie within these limits, which is only 18% of the circle, and 40% lie within $\pm 10^\circ$ of due east, which is less than 6% of the circle. From these data it is not possible to tell whether the orientations were determined by religious or other factors, but the insistence on orientation to within the limits of sunrise, or possibly moonrise, is clear.

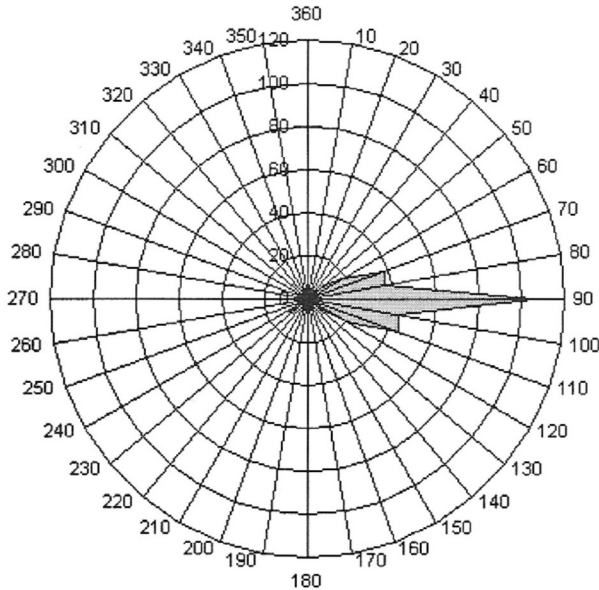


Fig. 9. Frequency distribution of the orientations of 323 chamber tombs with passages from 15 sites in Crete.

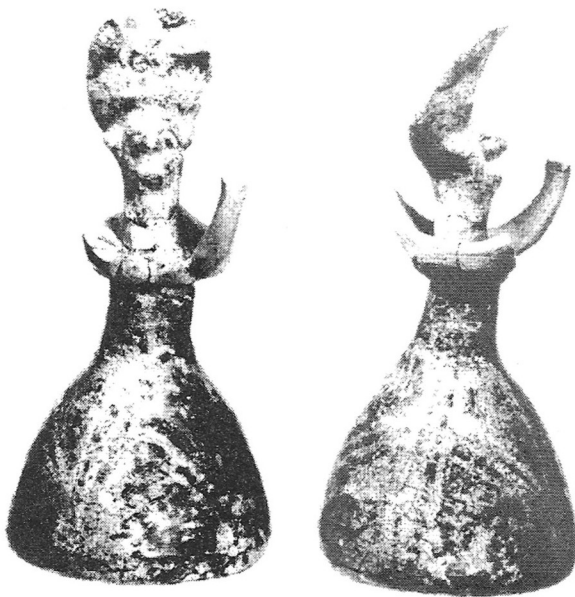


Fig. 10. Female figurine from Petsophas. Archaeological Museum, Heraklion, Inv. no. 3431. Photograph and permission to publish courtesy of the museum.

Conclusions

This fact of the differences in orientations for different types of structures in Minoan Crete should warn us against offering a single interpretation for their meaning, whether religious or practical. We are inclined to conclude from our results that Pyrgos and the other Minoan peak sanctuaries, especially those on the eastern coast, had as an essential part of their function the systematic study of the motions of the celestial bodies and that this was primarily for practical purposes: for regulating the calendar

and for navigation. The figurines found at these sites support such a function, as Peter Blomberg (2000) has shown. The orientations of the four palaces, on the other hand, suggest a religious significance connected with celebrations of important events in the year, e.g. the new year and the harvest. A religious meaning for the orientation to the moon at Zakros is supported by the large number of figurines of women with moon-shaped heads (Fig. 10) found at the nearby peak sanctuaries on Petsophas and Traostalos and elsewhere in the eastern part of the island. The strong concentration to the east for the orientations of graves in Minoan Crete seems to us to have been motivated also by religious beliefs, most likely centering on ideas concerning the regenerative power of the sun.

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