Minoan Astronomy 125

Mary Blomberg and Göran Henriksson

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Abstract

Of the three great cultures of the ancient eastern Mediterranean — the Babylonian, Egyptian, and Minoan — we have considerable knowledge of the astronomy of the first two through their documents (see relevant sections of this Handbook). Very little written material, however, has survived from Minoan Crete, but the evidence of other impressive archaeological discoveries implies that the inhabitants were on a par with their neighbors and had made similar advances in astronomy. In lieu of written sources, we have used the methods of archaeoastronomy to recover as much as possible about Minoan astronomy. In short, these are measuring the orientations of walls and their opposite horizons at a representative selection of monuments, analyzing the measurements statistically, and comparing the results with digital reconstruction of the positions of significant celestial bodies for the time when the walls were built.

M. Blomberg (✉)
Department of Archaeology and Ancient History, Uppsala University, Uppsala, Sweden
e-mail: mary@mikrob.com

G. Henriksson
Department of Physics and Astronomy, Uppsala University, Uppsala, Sweden
e-mail: goran.henriksson@astro.uu.se

C.L.N. Ruggles (ed.), *Handbook of Archaeoastronomy and Ethnoastronomy*,
DOI 10.1007/978-1-4614-6141-8_141,

Introduction

Our knowledge of Minoan astronomy is based on the study of a selection of the different types of Minoan buildings dating from Middle Minoan I to Late Minoan I (ca 2000–1450 BCE). There are problems in assigning later monuments to either the Minoans or the Mycenaeans due to the complex problem of the role of the Mycenaean population in the island (Driessen and MacDonald 1997). The florescence of Minoan culture was Late Minoan I (ca 1650–1450 BCE) and by that time, Minoan astronomy, being centuries old, would have reached its apogee. The following monuments were selected: the six peak sanctuaries with foundation walls (Petsophas, Traostalos, Modi, Juktas, Philioremos, and Pyrgos), the four large palaces (Zakros, Malia, Knossos, and Phaistos), five villas (the Southeast house at Knossos, Vathypetro, Tylissos A, Tylissos B, and Agia Triada), two small houses with cult equipment at the village of Gournia, and the unique oval house at Chamaizi – 18 buildings at 15 sites (Fig. 125.1). The comprehensive *Aerial atlas of ancient Crete* (Myers et al. 1992) has 26 Minoan sites with Middle Minoan and Late Minoan I foundations, including 16 non-attached villas. The remaining 18 entries in the *Atlas* are later than Late Minoan I or are graves and Greek sites. The peak sanctuaries are not included in the *Atlas*, and a few other sites are excluded for technical reasons. The monuments we have selected are a good cross-section of those available, and all of those chosen turned out to have a precise relationship to one or more celestial bodies useful for constructing calendars. This makes them reliable as contributors to Minoan astronomy. It is not possible to present the details for each of the investigations here, but an index of the relevant publications can be found on the webpage (http://minoanastronomy.mikrob.com/?page_id=2), which is under construction.

Discussion

The peak sanctuaries, located on mountain tops near Minoan settlements, would have made excellent observation places and all with remaining walls were chosen. The term “sanctuary” has come into use because of vague similarities to later Greek cults, but the role of peak sanctuaries as vantage points for sky watching could have made them sacred places for the Minoans. There may be some indication of this on the inscription in Linear A on a small libation bowl found at Petsophas with the name or attribute of a goddess derived from *mena*, the Indo-European root for moon (Blomberg and Henriksson 1996, p. 35). The peak sanctuaries all look out over the sea, and the many small, roughly made terracotta figurines found in and around them remind us of Aratos’ descriptions of the constellations as they became visible during their risings and settings (Kidd 1997). His account of the positions of a number of the stars was valid for the Minoan period and is believed to belong to a tradition dating back to that time (Henriksson and Blomberg 2000). It is probable that the peaks were used as observatories by Minoan astronomers, and that the figurines were used as teaching aids in the construction of a mental map of the sky (Blomberg 2007).

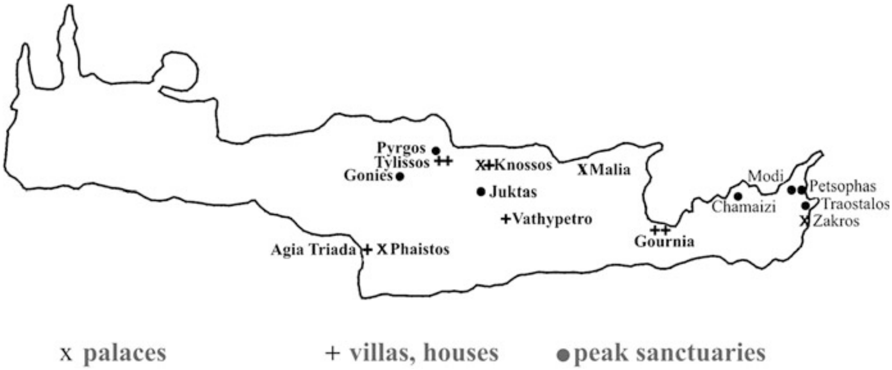

Fig. 125.1 Minoan sites in the Uppsala University archaeoastronomical project

From the investigation of the peak sanctuaries, a number of features were recognized as characteristic for Minoan astronomy:

1. The great majority of the main rooms of buildings were oriented to a horizon position of the sun or moon that is important in a solar or lunar calendar: seven to sunrise or sunset at the equinoxes, three to sunrise at the summer solstice, one to sunrise at the winter solstice, one to moonrise at the southern major standstill limit, and five to the first day of the 8 months of the solar year not signified by sunrise and sunset at the equinoxes and the solstices. Four buildings have orientations to more than one major calendar horizon position and five had orientations to the heliacal rising or setting of Arcturus or Canopus (Tables 125.1 and 125.2).
2. The buildings were closely aligned to the celestial bodies intentionally and not to a geographical feature. For example, at Petsophas, the sun had risen directly behind the highest peak on Karpathos in the Early Bronze Age, but when the present building was built in the Middle Bronze Age (ca 2000 BCE), the orientation of the axis of symmetry of the room was to the sun, which rose south of the peak (Fig. 125.2).
3. Orientations were usually marked by a natural or an artificial foresight, i.e., a prominent natural feature such as a mountain peak or a manmade construction such as a column (Table 125.1 below). This indicates that the alignment of buildings to the celestial bodies was of vital importance in Minoan cosmology, connecting their world to the celestial sphere.
4. The 11-day difference between the 12-month lunar year and the yearly cycle of the sun was known and used (orientations at three sites: Petsophas, Knossos and Juktas). For example, if the new moon occurred in the 11 days following the heliacal rising of Arcturus at Petsophas, which occurred one moon month before the autumn equinox, then a moon month should have been added that year in order to keep the cycles of the sun and the moon commensurate within the larger cycles of 8 or 19 years. This 11-day difference was well marked in the calendar regulator found at Knossos (see below).

Table 125.1 Orientations of Minoan buildings

Site	Orientation	Foresight
Agia Triada, villa	Sunset equinoxes	
Chamaizi, peak sanctuary?	Sunrise winter solstice	Artificial
	Arcturus' heliacal setting	Artificial
Gournia, MM IA house	Sunrise 1 month before and after equinoxes	
LM I house	Sunrise 1 month before and after equinoxes	
Juktas, peak sanctuary	Sunrise equinoxes	Natural
Knossos, palace	Sunrise equinoxes	Artificial
Southeast house	Sunrise equinoxes	Artificial
Malia, palace	Sunrise 1 month before and after equinoxes	Natural
Modi, peak sanctuary	Sunrise 2 months before and after equinoxes	
Petsophas, peak sanctuary	Sunrise summer solstice	Natural
	Sunset equinoxes	Natural
	Arcturus' heliacal rising	
	Arcturus' heliacal setting	
Phaistos, palace	Sunrise equinoxes	
	Sunset equinoxes	Natural
	Canopus' heliacal rising and setting	Natural
Philioremos, peak sanctuary	Sunrise summer solstice	Natural
Pyrgos, peak sanctuary	Sunrise summer solstice	Artificial
	Arcturus' heliacal setting	Natural
Traostalos, peak sanctuary	Arcturus' heliacal rising	
Traostalos	Arcturus' heliacal setting	Natural
Tylissos, villa A	Sunrise summer solstice	Artificial
Tylissos, villa C	Sunrise 1 month before and after solstices	Artificial
	Sunrise 1 month before and after equinoxes	Artificial
Vathypetro, villa	Sunrise equinoxes	Artificial
	Sunrise 1 month before and after equinoxes	Artificial
	Sunrise winter solstice	Artificial
Zakros, palace	Moon southern major standstill limit	Natural

The orientations to important calendar points that existed between all Minoan buildings that were investigated reveal that the construction of calendars was a primary goal of Minoan astronomy. This presupposes a longstanding tradition of sky watching and recording with respect to the sun, the moon, and the bright stars that began probably as early as the beginning of the third millennium BCE. The orientations to Arcturus at four sites reveal also the Minoan use of this important calendar star for the agricultural year, as it was later used by the Greeks. There is no evidence of interest in the planets.

By the end of the third millennium BCE, the Minoan astronomers had acquired a deep understanding of the motions of the sun and the moon and were able to construct both a lunar and a solar calendar that could be kept accurate through time by simple methods. There are the archaeological remnants of a calendar regulator

Table 125.2 Orientations of Minoan buildings to the beginning of a solar month

Site	Months
Petsophas, Phaistos, Knossos (2), Juktas, Vathypetro, Agia Triada	First (autumn equinox)
Malia, Vathypetro	Second
Modi	Third
Chamaizi, Vathypetro	Fourth (winter solstice)
Modi	Fifth
Malia, Vathypetro	Sixth
Petsophas, Phaistos, Knossos (2), Juktas, Vathypetro, Agia Triada	Seventh (spring equinox)
Gournia (2), Tylissos Villas A and C	Eighth
Tylissos Villa A	Ninth
Gonies, Petsophas, Pyrgos, Tylissos Villa A	Tenth (summer solstice)
Tylissos Villa A	Eleventh
Gournia (2), Tylissos Villas A and C	Twelfth

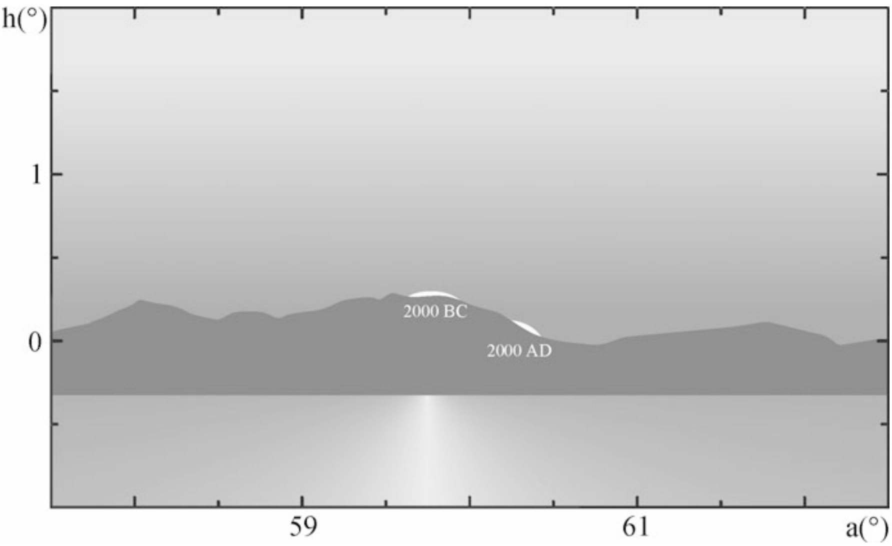

Fig. 125.2 Theoretically calculated position of sunrise at the summer solstice above Kali Limni (elevation 1215 m), Karpathos in 2000 BCE and 2000 CE

that had once functioned – and still functions – in the most sacred part of the old palace at Knossos (Henriksson and Blomberg 2011). It consisted of an alabaster bowl embedded in the floor in the darkest part of the Central Palace Sanctuary (Fig. 125.3). The stone was placed such that sunrise on the morning of the equinoxes shone through the northern side of the door and struck the bowl. 11 days after the autumn equinox, the sun's rays reached the bowl for the last time until 11 days before the spring equinox.

Fig. 125.3 The alabaster bowl in the Central Palace Sanctuary at Knossos

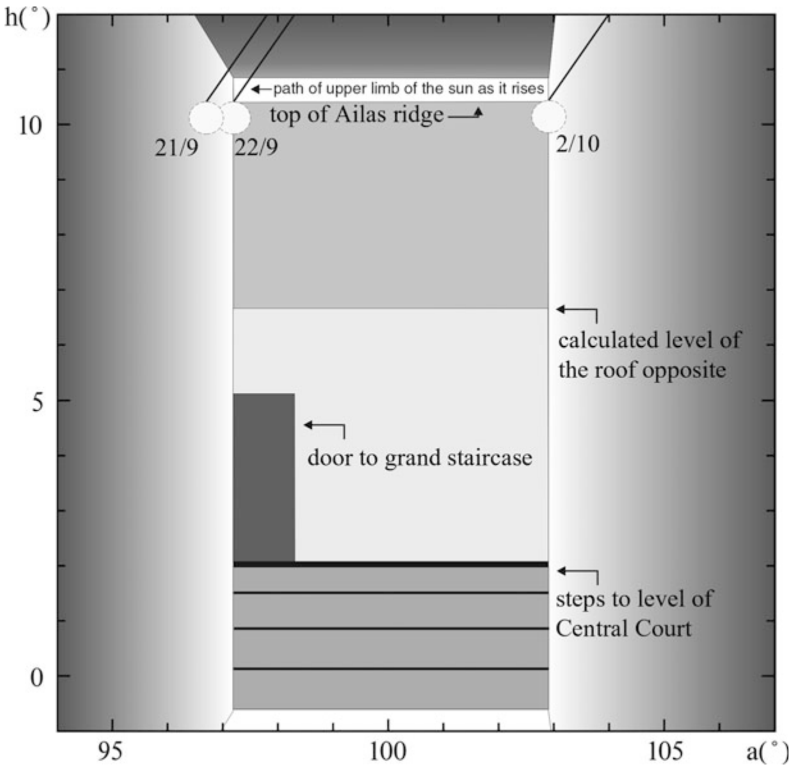

Fig. 125.4 Sunrise at the autumn equinox and 11 days later at Knossos

Fig. 125.5 The size of the reflection at sunrise on four consecutive autumn equinoxes in a cycle of 365 days in 3 years and 366 days in the fourth year

There are the natural foresight of the Ailias Ridge and the artificial foresights of the north and south door frames (Fig. 125.4). When the bowl is filled with a liquid, a reflection is cast for about 10 min on the west wall of the Sanctuary on the 11 days after the autumn equinox and before the spring equinox when the sun strikes the bowl at sunrise. The reflection becomes lenticular in shape as the sun rises higher, and it reaches its largest size after about 4–5 min. There is a somewhat worn lenticular depression of similar size in the wall exactly at the site of the reflection. It was probably incised to indicate its place after future refurbishing of the stucco, which was the usual covering of Minoan walls.

The stone is now much worn, as the Sanctuary in which it was placed was altered by the Mycenaeans when they took over the palace (ca 1450 BCE), and a corridor was built in the area of the stone leading through a newly cut door into the storage magazines to the west.

The reflection at sunrise on the morning of the equinoxes is larger when the sun is closer to the true equinox and it is cast in a cycle of 365 days for 3 consecutive years, but not until the 366th day in the fourth year (Fig. 125.5). The Minoans must have realized that an intercalary day should be added every fourth year to maintain

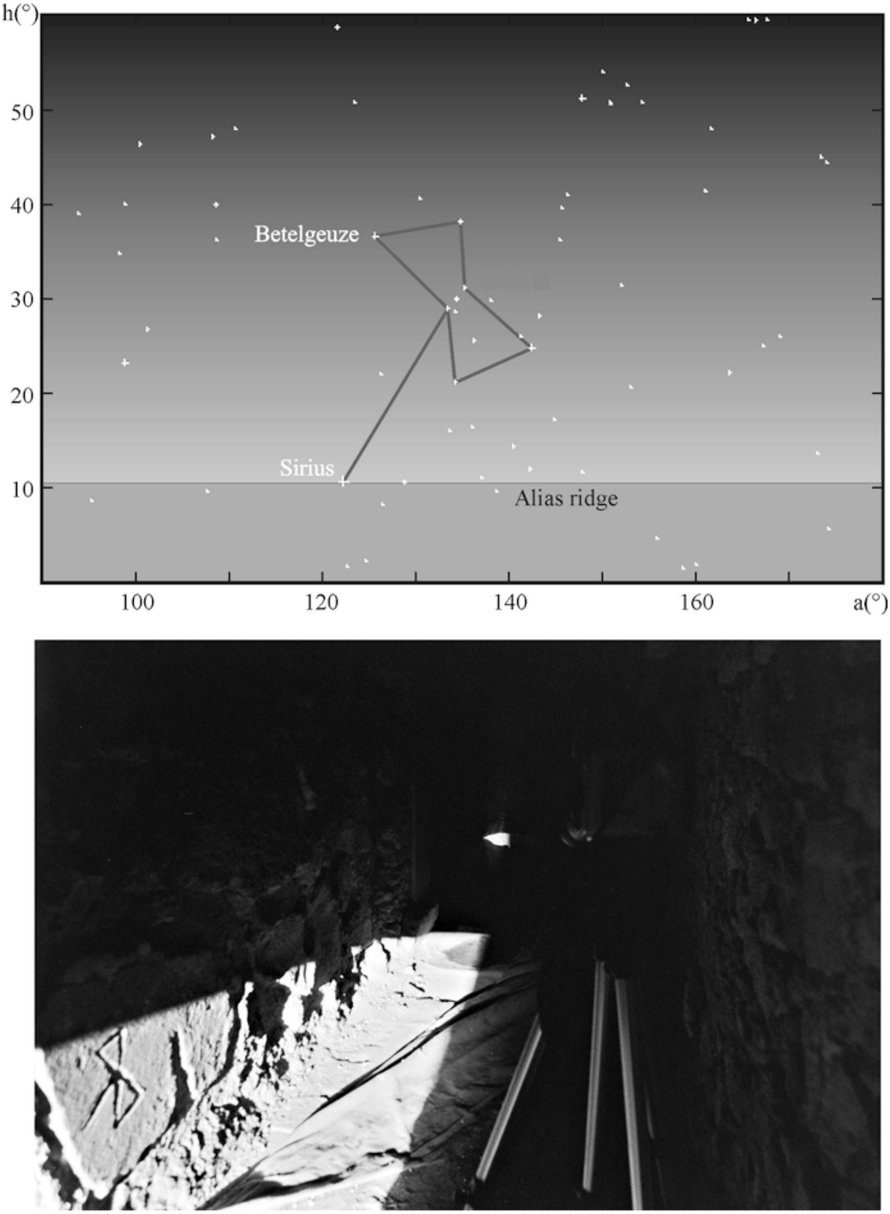

Fig. 125.6 The hypothesized Minoan double axe constellation would have dominated the sky opposite the Central Palace Sanctuary at the autumn equinox, 23:38 local mean solar time, 21 September 2000 BCE

a calendar that always started at the autumn equinox. The reflection differs in size from year to year due to the varying distance of the sun from the true equinox and is larger, the closer the sun is to the true equinox. This is a calendar regulator for both a lunar and a solar calendar and is located in what was probably the most sacred room in Minoan Crete. The orientation on the 11 days before or after an equinox was a method for knowing when a moon month should be added to the lunar calendar (Henriksson and Blomberg 2011). The autumn equinox, rather than the spring equinox, is indicated not only at Knossos but also at Petsophas and at Juktas (Blomberg et al. 2002). The Southeast house at Knossos shows some similarities to the arrangement at the Palace, but it is not so well preserved.

Our constellation of Orion dominated the eastern sky opposite the Sanctuary at the autumn equinox in the Middle Bronze Age, and it is probable that its brightest stars formed the constellation of the double axe – the most important Minoan symbol. The double axe is engraved in the southern wall of the Sanctuary, and the shadow on the wall at sunrise at the equinoxes touches its upper point (Fig. 125.6). This makes it probable that the Sanctuary was not only devoted to the mechanical regulator of the calendars, but also was important in celebrating some aspect of Minoan religion.

The orientation of the ceremonial rooms of the palace at Zakros to moonrise at the southern major standstill limit may reveal that the Minoans understood the importance of the 19-year cycle of the moon, when the moon will recur with the same phase on the same day of the solar year marking a nearly even cycle of 19 solar years and 235 synodic months.

According to the frescos of large sailing ships on Thera, we can infer that Minoan astronomy incorporated the detailed knowledge of the motions of the stars that made navigation possible. Recent research in the eastern Mediterranean pushes the knowledge of navigation back into the Paleolithic period (Strasser et al. 2010). This could lend support to hypotheses that the Minoans had achieved enough knowledge of the motions of the stars to navigate to Crete at the beginning of the seventh millennium.

Summary

Minoan astronomy as recovered from the investigation of the relationships of the buildings to celestial bodies reveals that it had achieved a level to compare favorably with their neighbors the Egyptians and the Babylonians. The important recovery of Minoan economic clay documents found at Agia Triada shows that the Minoans kept detailed accounts of farm produce (Godart and Olivier 1976–1985), and thus, it is probable that their astronomers kept careful records of their observations of the motions of the celestial bodies. Our lack of such texts deprives us of specific knowledge, but we can infer its scope from contemporary neighboring societies and from customs in the later history of the island that are echoed in

Mycenaean and Greek myths and rituals. At some time in the third millennium BCE, Minoan astronomers had constructed both a lunar and a solar calendar that could be regulated precisely. They probably also had a star calendar that could be used for agriculture and navigation. The precise orientation of Minoan buildings to a horizon position of the sun, marking the beginning of each solar month (Table 125.2 above), implies that the celestial sphere had important symbolic meaning in Minoan traditions and religion. Each place may have had its responsibility in celebrating some of the significant events of human life at the right time, for example, celebrations for a god or goddess; rituals for the ruler or priests; times for sowing, harvesting, and sailing; and other local and national religious celebrations. Each settlement would have had its part to play in the wider context of Minoan cosmology by being a link in the chain of months recording terrestrial time and its dependence on the motions of the celestial sphere.

Our archaeoastronomical studies have influenced Minoan archaeologists to measure the orientations of buildings to important calendric, agricultural, and similar positions of the celestial bodies, and thus, the future looks bright for the deepening of our knowledge of Minoan, as well as Mycenaean, astronomy.

Acknowledgments For their generous financial support, we thank the following organizations: the Swedish Council for Research in the Humanities and Social Sciences, the Gunvor and Josef Anér Foundation, the Axel and Margaret Ax:son Johnson Foundation, the Magn. Bergvall Foundation, and the Helge Ax:son Johnson Foundation. We also thank the Greek Archaeological Service for permission to study the sites in Crete and the personnel at the Swedish Institute at Athens for their help in many ways. We are indebted to Peter E. Blomberg for publishing the small finds from the peak sanctuaries.

Cross-References

► Astronomy and Navigation
► Ancient Egyptian Calendars
► Babylonian Observational and Predictive Astronomy
► Egyptian Constellations
► Orientation of Egyptian Temples: An Overview

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