

V. REFLECTIONS OF ASTRONOMICAL AND COSMOLOGICAL KNOWLEDGE IN MONUMENTS, LANDSCAPES AND ARCHITECTURE

ORIENTATIONS AT THE MINOAN PEAK SANCTUARY ON PHILIOREMOS NEAR GONIES (MALEVIZIOU), CRETE

GÖRAN HENRIKSSON, MARY BLOMBERG

Abstract

As part of the Uppsala University archaeoastronomical project to study the Minoan calendar, we have investigated representative examples of their buildings and found on Philioremos the third example of a peak sanctuary related to sunrise at the summer solstice. This is the nineteenth example of an important Minoan building exactly related to a major yearly event of the lunisolar calendar that was remembered in archaic Greek literature. An important achievement of our project is the discovery of cooperation among Minoans at different sites to mark major celestial events and of well-developed methods for maintaining a seasonally correct lunisolar calendar that began in connection with the autumn equinox.

Key words: Aegean Bronze Age, ancient calendars, Bronze Age Crete, Gonies, Minoan culture, orientations, peak sanctuaries.

Introduction

The initial aim of our project was to investigate the orientations of representative examples of important Minoan buildings: the large palaces, the villas, and the peak sanctuaries. We later decided to include all four of the palaces and all of the peak sanctuaries with walls well enough preserved for their orientations to

be measured, as there are only four such palaces and seven such peak sanctuaries (Fig. 1). We were especially eager to include all of the peak sanctuaries, as they are ideally placed for the study of the celestial bodies and we saw a use for the small terracotta objects found around them as aids in this study (Blomberg P. 2000, 2006).

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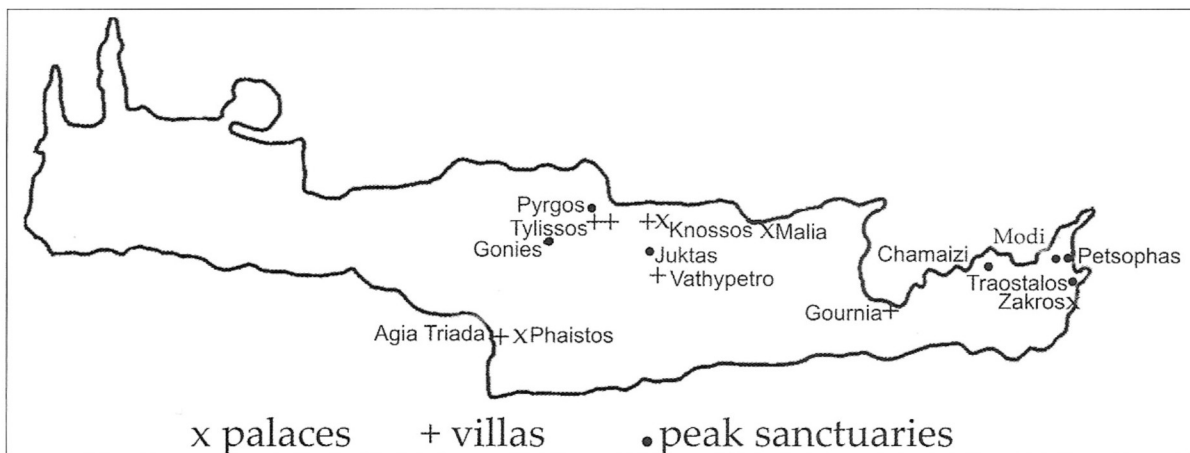


Fig. 1. Minoan sites in the Uppsala University archaeoastronomical project.

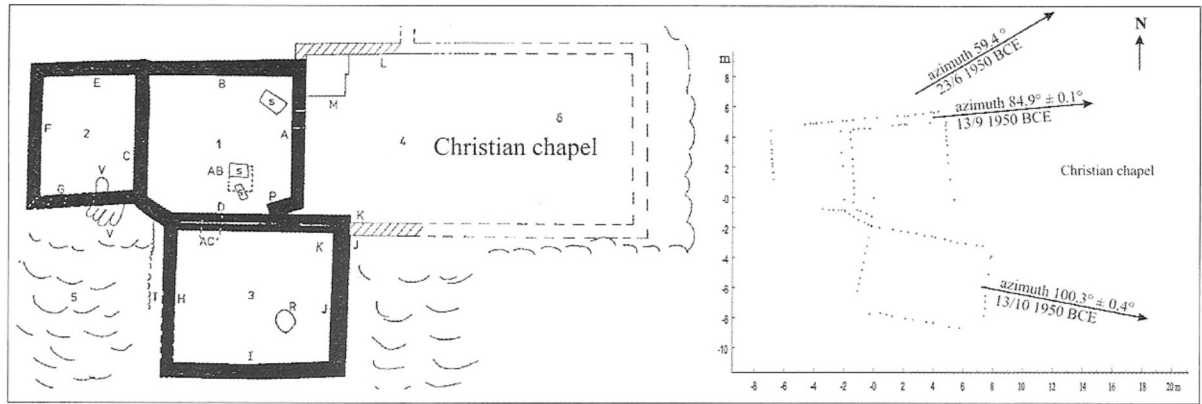


Fig. 2. Peak sanctuary near Gonia. Left: Rutkowski's plan. Right: our measured points and orientations. Sunrise at the summer solstice in 1950 BCE had azimuth 59.4° .

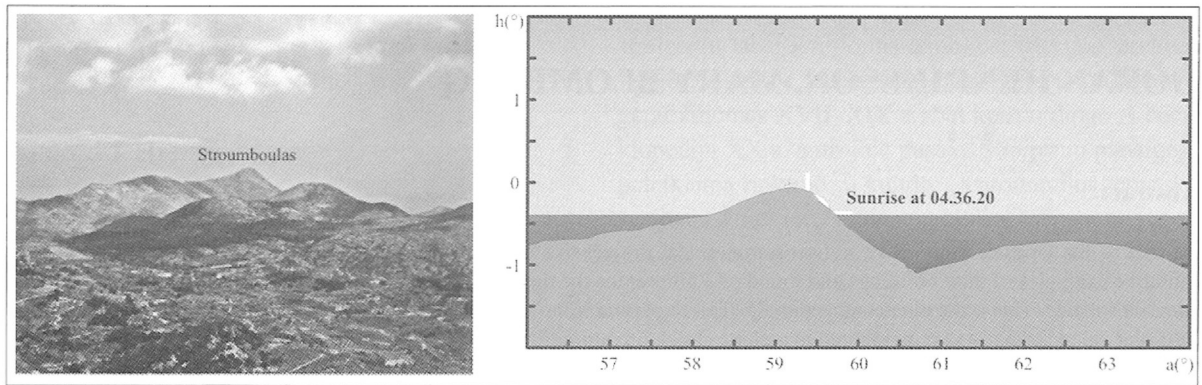


Fig. 3. The peak Strouboulas opposite the sanctuary on Philioremos. Left: photo courtesy of John G. Younger. Right: calculation of sunrise on the summer solstice as it would have been observed from the peak sanctuary, 23 June 1950 BCE, local mean time 04.36.20.

Methodology

Our initial study indicated orientations to major events in the calendar year and we wanted to collect and study these. We use classical archaeoastronomical methods in our investigations (Schlosser and Cierny 1997; Blomberg and Henriksson 2001a): i.e., we measure the orientations of walls and landscape horizons using a total station, we evaluate the measurements by appropriate mathematical calculations and then, using our own computer programs, we compare the results with the positions of the celestial bodies as they were in the Middle Bronze Age, which is the date of most of the buildings. This was from about 2000 to 1650 BCE in the Aegean (Manning 1999, p.339).

The Peak Sanctuary

The site. The sanctuary building is located on the peak of Philioremos (c. 800 m) near the small village of Gonia in north central Crete (Fig. 1). The excavator K. Davaras (1972) dated it to the Middle Minoan I period, ca 2000-1800 BCE. We have no quarrel with the traditional term *peak sanctuary* for these places, as the

study of the celestial bodies most likely had a religious dimension for the Minoans. There is now a Christian chapel at the eastern edge of the site.

The plan. The rooms are not rectangular, a fact noted by archaeologists, but it is not reflected in the only published plan (Rutkowski 1986, p.82). There is no evidence today of any rooms east of the three westernmost ones. The points that we measured on the foundation stones give a more correct view of the original layout of the building (Fig. 2).

The relationships to celestial bodies. From near the building, sunrise on the summer solstice would have been observed to occur behind the conical peak of Strouboulas, which also is about 800 m high and also has a Christian chapel (Fig. 3).

This peak is very prominent on the northern coast of Crete, and there may have been a Minoan peak sanctuary on it also, to judge from the remaining remnants of walls.

If we compare sunrise at the summer solstice with sunrise at the three other major calendar times of the year, the autumn and spring equinox and the winter solstice, we can see the differences. No parts of the building

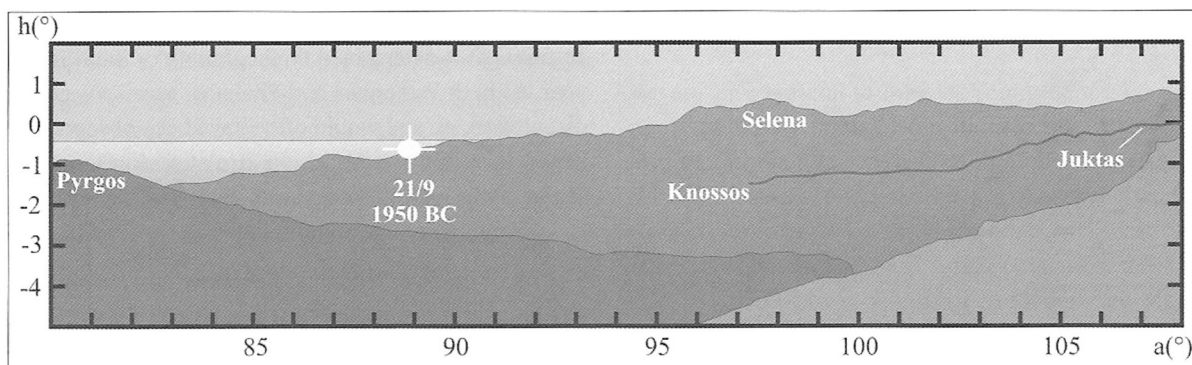


Fig. 4. Sunrise at the autumn equinox in 1950 BCE as it would have been observed from the peak sanctuary. The spring equinox occurs in the same place.

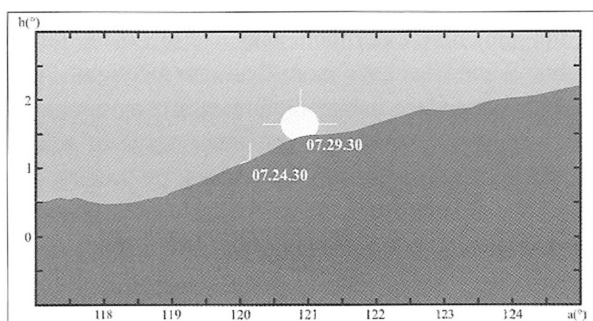


Fig. 5. Sunrise at the winter solstice in 1950 BCE as it would have been observed from the peak sanctuary.

are oriented to where these events occur nor are there any distinctive natural features that mark them (Figs. 4 and 5).

The seemingly indifferent orientations of the north wall and the axis of symmetry of the southernmost room of the sanctuary building may, in fact, have been important in the lunisolar calendar that we have argued was used by the Minoans. The northern wall is oriented to sunrise eight days before the autumn equinox and the axis of symmetry of the southern room is oriented to sunrise twenty-two days after the autumn equinox. These two orientations would have permitted determination in the following way of the years in which the new crescent moon would have appeared on the very day of the autumn equinox and on the earliest possible day of the second month of the year:

1. When the sun rises along the long northern wall and the waning half moon is visible, the next new moon will take place on the day of the autumn equinox, which will therefore be the first day of that Minoan year. This happened, for instance, in the year 1943 BCE. It is probable that years in which the new crescent moon appeared on the very day of the autumn equinox were especially significant for the Minoans.

2. When the sun rises along the axis of symmetry of the southern room and the waning half moon is visible,

the next new moon will take place on the first day of the second month of the year. This also happened in the year 1943 BCE.

These two events will occur in the same year every eighth and nineteenth year. Therefore they indicate the beginning of the eight- and nineteen-year cycles with the new crescent moon on the autumn equinox. These two orientations can thus explain the unusual plan of the sanctuary building.

Discussion

Why the summer solstice? When we asked ourselves why the summer solstice was targeted from the building on Philioremos and not the autumn equinox that was the beginning of the Minoan year, we found that the answer lies in the broader context of the results of our project.

Minoan relationships to major celestial events. In our study of the orientations of the walls of our sites with respect to the horizons opposite, we found many that focused quite exactly on the major times of a calendar year: sunrise and sunset at the solstices and the equinoxes, moonrise and moonset at the major standstills, and also the heliacal risings and settings of the brightest stars to mark significant points of the year. A lunisolar calendar of this type was used later by the Greeks and also had many common features with that of the Babylonians who were contemporary with the Minoans (Cohen 1993). As our research favoured the existence of a lunisolar calendar, the cultural affinities for such a calendar in the eastern Mediterranean supported us in our conclusions (Blomberg and Henriksen, 1996).

Our investigations indicated that orientations were not the only means by which Minoans related their buildings to the celestial bodies. They also chose sites where, from the near vicinity of a building, a major event in the calendar would be observed to occur be-

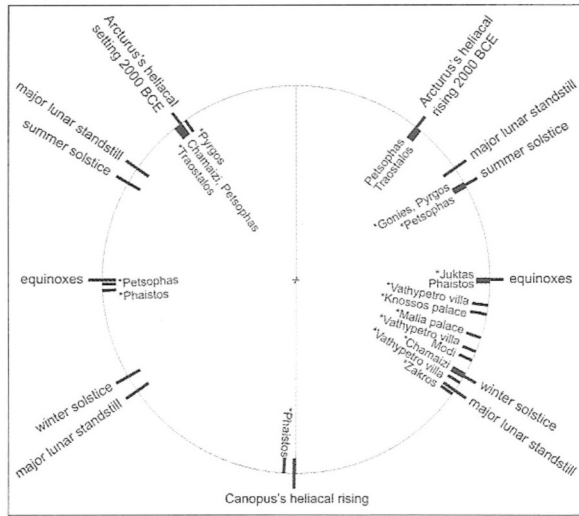


Fig. 6. The Minoan buildings in the Uppsala project. An asterisk indicates a foresight.

hind an impressive natural feature, as in the case of the building on Philioremos. We discovered a number of such examples that mark calendar events in this way for the Minoans.

Our project includes twenty buildings from fifteen sites. We have been able to argue on the basis of their orientations that three were Mycenaean and not Minoan (the small shrines at Malia, Vathypetro, and Agia Triada), and therefore they are not included here. In the case of the seventeen relevant here, we have completed our study of twelve of them (Fig. 6). We found at ten of these one or more relationships to a major calendar event of the year, nineteen in all: four to sunrise at the equinoxes, two to sunset at the equinoxes, three to sunrise at the summer solstice, two to sunrise at the winter solstice, one to the rising full moon at the southern major standstill, two to the heliacal rising of Arcturus, four to its heliacal setting, and one to the heliacal rising of Canopus. The framing of our constellation Orion by the doorway into the Central Palace Sanctuary at Knossos in the days around the autumn equinox should also be mentioned (for earlier studies see Blomberg and Henriksson 2000, 2001b, 2002, 2003, 2005b, 2007a, 2007b; Henriksson and Blomberg 1996, 1997-1998).

The nineteen major times of the calendar measured from our data at ten of the twelve sites is a fair quantitative assessment of their value for the Minoans (Ruggles 1999, p.148). The reason why the azimuths of the relationships in Fig. 6 do not coincide with those of the astronomical events is due to the mountainous character of the horizon in Crete. The azimuths are as measured from the sites.

The Minoans only rarely focused on sunsets and, in the two cases where they did so, it seems to have been for a special reason. We have explained this as being due

to the importance of being able to identify the autumn equinox, as it determined the beginning of the Minoan year. At both Petsophas and Phaistos, sunrise was at a distant horizon and would often have been obscured by heavy mist. Thus establishing a relationship to sunset at the equinoxes at such places increased the chances of knowing when the autumn equinox would occur.

The focus on an event could be marked by a natural or a manmade foresight, by the orientation of a wall, and even by 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 and four of the seven peak sanctuaries have such a foresight. Three of the remaining five monuments had manmade foresights. Some sites have more than one foresight (Fig. 6). Of course some manmade foresights may not have survived. We have discovered other ways of relating buildings to major celestial events, by framing an event in a doorway, for example, and creating light and shadow effects to highlight the event (Blomberg et al. 2002, p.85).

Crete has many mountain peaks that would have been suitable for marking a celestial event. In an area of about 15 kilometres around Philioremos, there are more than 45 peaks higher than 600 meters. This indicates that there may well have been choice available to the Minoans in locating their peak sanctuaries in places that would provide natural foresights for the major celestial events, and consequently there was less need to rely on manmade foresights.

Culture-specific relationships to calendar events. In addition to the relationships to major calendar events, we have found what seem to us to be relationships to other celestial events that had special significance for the Minoans. This may be the case for three that we have found at the palace of Malia, the villa at Vathypetro, and the peak sanctuary on Modi (Blomberg and Henriksson 2005a, Henriksson and Blomberg in press). The axes of symmetry of the major cult area of the palace and of the villa are aligned to sunrise on the first day that could have begun the second month and thus also the sixth, in the lunisolar calendar that we propose for the Minoans. If the new crescent moon rose on that day, then it was the first day of the month. At Modi the axis of symmetry of the sanctuary is oriented to sunrise on the first day that could have begun the third month, and thus also the fifth, of the proposed Minoan calendar. The result from Modi, which seemed very unpromising to us at first, together with the two results from Malia and Vathypetro, provide us with one answer as to why the Minoans created different relationships to celestial events at different sites.

The Minoan calendar. We have argued that the Minoans had a lunisolar calendar that began at the new crescent moon following the autumn equinox. The major evidence comes from the palace at Knossos and the nearby peak sanctuary on Juktas. These were in all probability the most important buildings of their type in Minoan Crete. At each of these places not only was the morning of sunrise at the equinoxes clearly marked, but also the eleventh day after the autumn equinox, which made it easy to know when to intercalate a month in the calendar (Blomberg and Henriksson 2000, 2002).

We think that we now have evidence of a system by which the earliest possible first day of each month of the calendar could have been easily determined, a system deliberately designed to incorporate major cult places of the Minoan culture (Table 1). We think that there probably were also sites with celestial relationships that determined when the remaining months would begin, the eighth, ninth, eleventh and twelfth. We need only two places: X, oriented to sunrise on the earliest possible day of the eighth and twelfth months and Y, oriented to sunrise on the earliest possible day of the ninth and eleventh months. This is an intriguing hypothesis that we hope will be verified in our future work.

Table 1. Minoan sites with relationships to celestial events that determined the earliest beginning of each month

Site	Month
Petsophas, Phaistos, Knossos, Juktas	first month (autumn equinox)
Malia, Vathypetro	second month
Modi	third month
Chamaizi, Vathypetro	fourth month (winter solstice)
Modi	fifth month
Malia, Vathypetro	sixth month
Petsophas, Phaistos, Knossos, Juktas	seventh month (spring equinox)
X (not yet found)	eighth month
Y (not yet found)	ninth month
Gonies, Petsophas, Pyrgos	tenth month (summer solstice)
Y (not yet found)	eleventh month
X (not yet found)	twelfth month

Not all relationships to celestial phenomena were for the purpose of regulating the calendar. The relationships to the bright stars Arcturus, Canopus and the constellation Orion, may have been in order to pinpoint important times in the agricultural year, as they did in the historical period, according to Hesiod, and also times for the sailing season, as we have tried to show elsewhere (Blomberg and Henriksson 1999).

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References

- BLOMBERG, M. and HENRIKSSON, G., 1996. *Minos Enneoros*. Archaeoastronomical light on the priestly role of the king in Crete. In: P. HELLSTRÖM, P. and B. ALROTH, eds. *Religion and Power in the ancient Greek world*. Proceedings of the Uppsala symposium 1993 (= BOREAS. Uppsala Studies in Ancient Mediterranean and Near Eastern Civilizations, 24). Uppsala, 27-39.
- BLOMBERG, M. and HENRIKSSON, G., 1999. Evidence for the Minoan origins of stellar navigation in the Aegean. In: A. LE BEUF and M. ZIÓLKOWSKI, eds. *Actes de la V^{ème} conférence de la SEAC, Gdańsk, 5-8 septembre 1997* (Światowit supplement series H: Anthropology II). Warsaw, 69-81.
- BLOMBERG, M. and HENRIKSSON, G., 2000. Further evidence for the Minoan origins of the Greek calendars. In: A. KARETSOU et al., eds. *Proceedings of the 8th Creteological congress, Heraklion (Crete), Greece, 9-14 September 1996*. Heraklion, 109-128.
- BLOMBERG, M. and HENRIKSSON, G., 2001a. Archaeoastronomy: new trends in the field, with methods and results from studies in Minoan Crete. *Journal of Radio-analytical and Nuclear Chemistry*, 247, 609-619.
- BLOMBERG, M. and HENRIKSSON, G., 2001b. Differences in Minoan and Mycenaean orientations in Crete. In: C. RUGGLES, F. PRENDERGAST and T. RAY, eds. *Astronomy, Cosmology and Landscape*. Proceedings of the SEAC 98 meeting, Dublin, Ireland, September 1998. Bognor Regis: Ocarina Books, 72-91.
- BLOMBERG, M. and HENRIKSSON, G., 2003. The Minoan peak sanctuary on Pyrgos and its context. In: M. BLOMBERG, P. BLOMBERG and G. HENRIKSSON eds. *Calendars, symbols, and orientations: legacies of astronomy in culture*. Proceedings of the 9th meeting of the European Society for Astronomy in Culture, 27-30 August 2001 (Uppsala Astronomical Observatory Report No. 59). Uppsala, 127-134.
- BLOMBERG, M. and HENRIKSSON, G., 2005a. Some problems in Minoan archaeoastronomy. In: M. KOIVA, I. PUSTYLNİK and L. VESIK, eds. *Cosmic Catastrophes: a collection of articles* (Proceedings of the European Society for Astronomy in Culture (SEAC) 2002. Tartu, 15-22.
- BLOMBERG, M. and HENRIKSSON, G., 2005b. Orientations of the late Bronze Age villa complex at Vathypetro in Crete. *Mediterranean archaeology & archaeometry* 5, 51-61.

- BLOMBERG, M. and HENRIKSSON, G., 2007a. The function of the Minoan oval house at Chamaizi. In: E. PÁSZTOR, ed. *Archaeoastronomy in Archaeology and Ethnography* (Papers from the annual meeting of the SEAC (European society for Astronomy in Culture) held in Kecskemét in Hungary in 2004). British Archaeological Reports International Series, 1647, 15-18.
- BLOMBERG, M. and HENRIKSSON, G., 2007b. Orientations of the Minoan palace at Phaistos in Crete. In: I. LIRITZIS, ed. *Ancient watching of cosmic space and observation of astronomical phenomena, 6-10 April, 2006, Rhodes, Greece* (Proceedings of the international conference on archaeoastronomy, SEAC 14th 2006). Mediterranean Archaeology and Archaeometry, 6, 185-192.
- BLOMBERG, M., HENRIKSSON, G. and PPATHANAS-SIOU, M., 2002. The calendaric relationship between the Minoan peak sanctuary on Juktas and the palace at Knossos. In: T. M. POTYOMKINA and V. N. OBRIDKO, eds. *Astronomy of ancient Societies: Proceedings of the Conference "Astronomy of Ancient Civilization" of the European society for Astronomy (SEAC) associated with the Joint European and National Astronomical Meeting (JENAM) Moscow May 23-27. Moscow: Hayka, 81-92.*
- BLOMBERG, P., 2000. An Astronomical Interpretation of Finds from Minoan Crete. In: C. ESTABAN and J. A. BELMONTE, eds. *Astronomy and Cultural Diversity: Proceedings of the International Conference Oxford VI and SEAC 99, La Laguna, 21-29 June 1999. Tenerife, 311-318.*
- BLOMBERG, P., 2006. A new interpretation of the figurines from Petsophas and Traostalos. In: E. TABAKAKI and A. KALOUTSAKIS, eds. *Proceedings of the 9th Cretological congress, Elounda (Crete), 1-7 October 2001. vol. A4. Heraklion, 333-347.*
- COHEN, M., 1993. *The cultic calendars of the Ancient Near East*. Bethesda: CDL Press.
- DAVARAS, K. 1972. Kriti: Modi. *Archaologikon Deltion*, 27 (Chronika), 652.
- HENRIKSSON, G. and BLOMBERG, M., 1996. Evidence for Minoan astronomical observations from the peak sanctuaries on Petsophas and Traostalos. *Opuscula Atheniensia* 21, 99-114.
- HENRIKSSON, G. and BLOMBERG, M., 1997-1998. Petsophas and the summer solstice. *Opuscula Atheniensia* 22-23, 147-151.
- HENRIKSSON, G. and BLOMBERG, M., 2000. New arguments for the Minoan origin of the stellar positions In Aratos' Phainomena. In: C. ESTEBAN AND J. A. BELMONTE, eds. *Astronomy and cultural diversity*. Proceedings of the International Conference "Oxford VI and SEAC 99", La Laguna, 21-29 June 1999. Tenerife, 303-310.
- HENRIKSSON, G. and BLOMBERG, M., in press. Archaeoastronomical study of the Minoan site on Modi. Proceedings of the 10th International Cretological Congress, Khandia (Kreta) 1-8 October 2006.
- MANNING, S. W. 1999. *A test of time*. Oxford: Oxbow.
- RUGGLES, C. 1999. *Astronomy in prehistoric Britain and Ireland*. New Haven and London: Yale University Press.
- RUTKOWSKI, B. 1986. *The Cult Places of the Aegean*, New Haven and London: Yale University Press.
- SCHLOSSER, W. and CIERNY, J. 1997. *Sterne und Steine: eine praktische Astronomie der Vorzeit*. Stuttgart: Theiss.

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MINO KULTŪROS VIRŠUKALNĖS ŠVENTYKLOS ORIENTACIJOS (GONIES PHILIOREMOS VIETOVĖ, KRETA)

Göran Henriksson, Mary Blomberg

Santrauka

Viršukalnės šventykla Philioremos vietovėje buvo tiriama pagal Upsalos universiteto archeoastronominių projektą (1 pav.). Paaikškėjo, kad šventyklos statinys nėra stačiakampis, kaip buvo vaizduojama anksčiau paskelbtame plane. Pagal mūsų atliktus matavimus buvo sudarytas originalus statinių planas (2 pav.).

Žiūrint iš šventyklos vasaros saulėgrįžos dieną galima matyti Saulę tekant iš už Stroumboulas kalno keteros. Nė viena šventyklos statinio dalis nėra orientuota lygiadienio arba žiemos saulėgrįžos saulėtekio kryptimi, taip pat nėra jokių išskirtinių natūralių reljefo ypatumų, galėjusių žymėti šias saulėtekio kryptis (4 ir 5 pav.).

Neįprastą statinio planinę struktūrą galima aiškinti tuo, kad šiaurinė jo siena yra orientuota į Saulės tekėjimo kryptį likus 8 dienoms iki rudens lygiadienio, ir pietinio kambario simetrijos ašis yra nukreipta kryptimi, kuria Saulė teka 22 dienas po rudens lygiadienio. Šios kryptys galėjo būti naudojamos metams, kuriais jaunas Mėnulis pasirodo pirmą pirmojo mėnesio dieną pagal minojiečių Saulės-Mėnulio kalendorių, nustatyti, taip pat pirmajai antrojo mėnesio dienai ir kartu 8-erių ir 19-os metų kalendorinių ciklų pradžia nustatyti.

Kalendoriniams stebėjimams naudoti ne tik specialiai orientuoti statiniai, – ir pačių statinių statybos vietos buvo parenkamos taip, kad svarbių kalendorinių datų metu stebimas dangaus šviesulys projektuotųsi į išsiskiriančius horizonto darinius.

Beveik kiekvienoje tirtose vietovėse mes aptikome statinių, orientuotų į vieną ar daugiau reikšmingų kalendorinių astronominių kryptų (6 pav.). Be šių kryptų, buvo aptiktos ir trys kitos labai svarbios minojiečiams orientacijos. Modi šventyklos, svarbios Malia rūmų kulto vietos bei Vathyperto vilos simetrijos ašis yra nukreipta į Saulės patekėjimą pirmąją keturių mėnesių periodo minojiečių kalendoriuje dieną. Šios orientacijos leidžia iškelti vieną prielaidą, kodėl minojiečiai skirtingus statinius siejo su skirtingais dangaus reiškiniais. Galbūt turime reikalą su specialia sistema, skirta anksčiausiai kiekvieno mėnesio kalendorinei dienai nustatyti, naudojant apgalvotai suplanuotą pagrindinių Mino kultūros kulto vietų tinklą (1 lentelė).

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