Mediterranean Archaeology and Archaeometry, Vol. 18, No 4, (2018), pp. 107-113

DOI: 10.5281/zenodo.1472286

EVOLUTION OF ASTRONOMICAL FACILITIES AND PRACTICES IN ANCIENT THRACE

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Received: 28/02/2018
Accepted: 25/06/2018
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ABSTRACT

Evolution of megalithic and rock-cut monuments used for astronomical observations and practices in ancient Thrace are presented in this work. Classificaton is made after independent archaeoastronomical research of the rock-cut monuments and cave sanctuaries.

The discovery and the accumulation of "in situ" material allow to identify the signs of the formation of a number of their parameters - territorial, chronological, functional. One of the promising areas of research, for example, is to distinguish different rock shrines and megalithic complexes associated with long term astronomical observations and astronomical practices. Another area is the specification of the affiliation of individual objects to synchronously existed settlements and tribal communities. This way, reasons for their appearance, function and place in everyday life of citizens and society in Ancient Thrace can be justified.

Here we consider examples of positional astronomical observations, projective systems, and monochrome paintings with calendar records. We present the concept of "dynamic structure of the rock-cut monument", which means that the site is characterized not only with space but also with time parameters as cyclicity and duration of existence connected with various cults and cult practices.

The evolution of astronomical facilities and practices is shown by the suggested typology of the rock-cut monuments according to their locality, landscape of the environment, functional astronomical elements, and accuracy.

KEYWORDS: rock-cut monuments, cave sanctuaries, shapes, spatial relations, meridional and horizon observations, calendar, typology.

1. INTRODUCTION

Copper Age, the Eneolithic age (5000-3000 BC) is one of the brightest periods in Prehistory in the Bulgarian lands. According to experts, in this era very ancient ethnicity and complex culture was born (Fol A., 2009, Popov, 2014). Hundreds Eneolithic settlements were found in Bulgaria - they are well built, with streets oriented according to the cardinal directions, protected by wooden or clay fence. Further, during the Bronze Age (3100-1200 BC) a process of gradually improving of the economy and evolution of the socio-economic life takes place in Bulgarian lands. Mastering the production of metal tools completely changed the lives of native people. The tools of stone and bone were abandoned and replaced by more sophisticated tools and weapons including bronze swords, knives, arrows, spears with metal tip and others (Bailey 1998, Todorova and Vaisov 1993, Stoev and Maglova, 2014). At that time creation of megalithic and rock-cut monuments blossomed. The rock-cut monuments - sanctuaries and tombs are the only almost completely preserved representatives of monumental religious architecture of the ancient people from the Eneolithic to the end of the Iron Age in Ancient Thrace.

Data from archaeological excavations allow us to determine the character of these monuments functioning as sanctuaries, where different ritual activities were practiced. Rituals were connected with the positions of specific heavenly objects in accordance with the natural-geographical environment, economy specificity and social structure of the population. The rock-cave sanctuaries were a unique phenomenon for these civilisations – a material expression of a complicated ritual system naturally added to their philosophical doctrine (Naydenova 1986, Stoev et al. 1990; Dermendjiev et al. 1984; Stoev and Varbanova 1994; Nikolov et al. 1988; Stoev et al. 2001; Stoev et al. 2003; Radoslavova and Stoev 1991).

2. CLASSIFICATION OF ARCHAEOASTRONOMICAL OBJECTS STUDIED IN BULGARIA

Archeoastronomical monuments on the territory of rock-cut complexes arise when the society moves to a sedentary lifestyle. Rock-cut monument or cave sanctuary with astronomical purposes can be defined as a spatial structure of specific relief, rock shapes and cuts connected in a certain functional dependence with the horizon, the sky, the heavenly objects and related phenomena. Such a description gives an idea of the appearance of the monument itself, but does not affect factors associated with its emergence and development over time, which are particularly relevant to its archaeoastronomical context.

The study of the spatial organisation of the sanctuaries and the existence of obvious linear and circular structures offer sufficient and serious data about the existence of orientations, targets and solar-cult architecture. That is why the rock-cut monuments and cave sanctuaries became an object of independent archaeoastronomical research (Polcaro and Polcaro, 2009). It is based on our knowledge about the place of astronomy in the culture of ancient archaic societies who lived on these lands, as well as on registration, analysis and interpretation of their structural elements.

In general, archaeoastronomical objects can be classified as folows:

1. Objects showing ordinary interest in heaven, heavenly bodies and phenomena and their cyclical appearance.

2. Objects testifying to astronomical knowledge and skills and their practical use:

- Megalithic and rock-cut monuments;
- Ancient sanctuaries, masonry and rock tombs;
- Astronomical images and calendar ornaments;
- Ancient calendars and calendar records.

Archaeoastronomical objects allow us to learn about astronomical knowledge, practices, art, belief, custom, understandings, and values of the societies who lived on Bulgarian lands.

3. FORM AND SPACE OF THE MEGALITHIC ROCK-CUT MONUMENTS

Many authors study the problem of recreation of the main features and ways of exploitation of the megalithic and rock-cut monuments and systems that existed in prehistoric times. They, in general, tend to accept that the model should be understood as a system of interactions between cultural relationships, cult activities and astronomical observations, which in turn determine the stable existence and development of human societies inhabiting a given region (Christov , 1999, Fol A., 1986, 1990, Fol V., 2000, Maglova and Stoev, 2014, Stoev and Maglova, 2014, Stoev et al., 2006 a, b, c).

In essence, the different models aim to clarify the ways, in which individual societies use the resources of their area of life and the landscape to ensure their long-term existence. Therefore, the development of a sustainable model of the rock-cut monument must be based on the balance between the available natural resources in the region and the number of observed objects that can be used during the relevant period.

For this reason, it is necessary to carry out a complex study of the "observational purposes" of the

determined number of rock-cut objects and the comparison of these purposes with the available landscape and **relief** in the given region. Assumptions about the size of the effective range of a rock-cut object are based on the distance of the main landscape factors from the structurally identified forms of the rock relief of the monument.

The definition of "form" and "space" categories for the area of megalithic and rock-cut monuments requires a complex approach. Structure of the rock-cut site includes a centrally located body and a platform to which radially oriented chutes and paths are directed.

There are additional elements to every rock-cut monument. The focus of the composition is a visual (or projective) device that allows observation of the Sun in astronomically significant points of the celestial sphere and the horizon. The autochthonous relief structure of the rock - cut monument "Harman Kaya" was used in the Eneolithic Age for positional astronomical observations of the Sun during the summer and winter solstice, and equinoxes (Maglova and Stoev, 2014) through the methods of the so - called vector - horizon astronomy (as shown in Figure 1).

Figure 1. Rock sanctuary "Harman Kaya" with three viewfinders - 1-summer solstice, 2- winter solstice, and 3- equinox.

As another example we can consider is the rock - cut monument Cabile, where the sunrise during the summer solstice can be observed (Stoev and Stoeva, 2016), (as shown in Figure 2). The bas-relief image of the Goddess Cybela is located at the west side of the sanctuary, next to the trench East - West. There are also foundations of an edifice made from large levers stones, which form a square. To the south, at a distance of about 2 km, following the North - South trench, one can see two mounds, almost one behind the other. During archaeological excavations, specialists discovered large quantities of wood ashes. This shows that mounds, which define the meridian line, were probably used as light markers at night observations of bright stars.

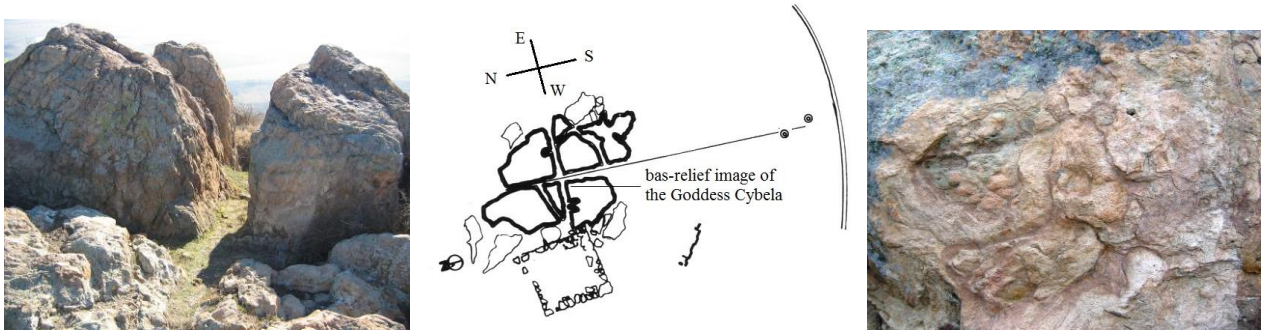

Figure 2. Cabile - trenches oriented East–West and North–South, plan of the sanctuary, bas-relief image of the Goddess Cybela.

Tangarak Kaya rock cave sanctuary can be considered as a projective system of observation of the extreme Sun culminations (as shown in Figure 3). During the winter solstice, once per year solar rays penetrate into the cave and reach the altar, embodying the sacred marriage between the Goddes-mother and the God-Sun (Stoev et al., 2001).

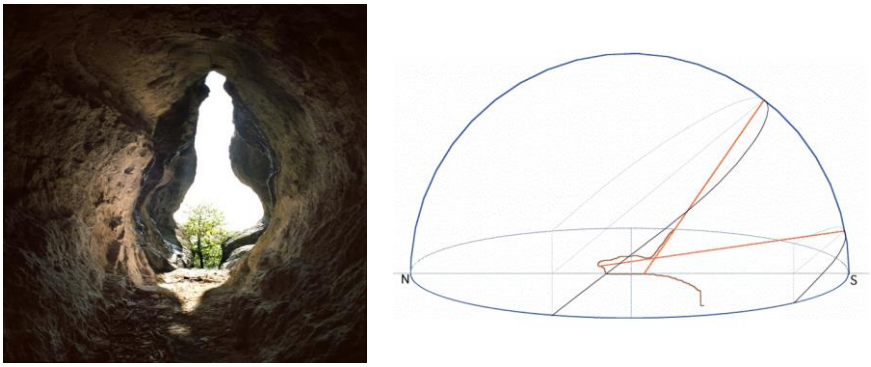

Figure 3. Tangarduk Kaya cave sanctuary. Vertical plan of the sanctuary - solar beam penetrating in the cave during the summer and winter solstice (in red).

The basic rules of shape creation made by ancient builders of megalithic and rock-cut objects are probably based on their knowledge of the organization of forms in living and non-living nature connected with the cult of the Heaven and the Sun.

Last but not least is the process of creating and maintaining a calendar, especially needed in the social organization and religious practices of the society. As an example we can consider the earliest paintings in caves on our lands - the monochrome paintings with astronomical meaning from the Magura cave (about 3000 BC), (Stoev and Maglova, 1999), (as shown in Figure 4).

Figure 4. The Magura cave - monochrome paintings composing solar calendar from the late Eneolithic.

Thus, we can suggest the term "dynamic structure of the rock-cut monument", which means that it is characterized not only with space but also with time parameters - cyclicity and duration of existence of rock-cut monuments connected with various cults and cult practices.

Systematic observations of the positions of the sun's projections during the daily culminations, as well as sunrises at extreme points on the horizon, allowed the days between the winter and the summer solstice to be counted. For those megaliths and rock-cut monuments associated with specific astronomical practices, seasonal occurrences of the observed celestial objects (sunrises and sunsets, culminations, compounds and other astronomical phenomena and events), should be also included in time parameters.

These procedures have greatly facilitated the creation and use of a primitive calendar related to the economic, religious, and domestic needs of the society in this era.

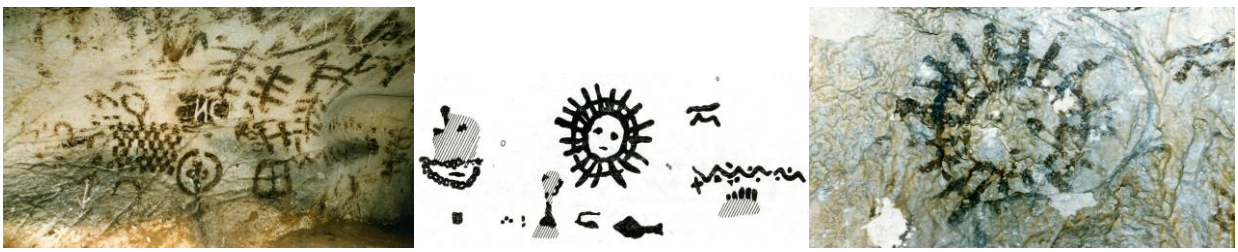

Figure 5. The megalithic complex with caves near the village of Bailovo - monochrome paintings - part of symbolic solar calendar and earlier Lunar images carved into the rock.

Monochrome paintings from the rock cut cave sanctuary near the village of Bailovo (Stoev et al., 1989) represent a finished annual calendar within the tropical solar year, (as shown in Figure 5).

The distinction between the individual rock sanctuaries and megalithic complexes is mainly related to the specific astronomical observations and the existence of long-standing astronomical practices.

Clarifying the affiliation of individual sites to synchronously existing settlements and tribal communities is very important during the research. This gives the opportunity to explore the objects of this type by regions and by chronological boundaries. In this way more reliable conclusions can be argued about the reasons for their appearance, functioning and place in the everyday life of the inhabitants and society in Ancient Thrace.

People of the then society obviously have created and continuously used the powerful solar-chthonic cult united with the cult of the Sun and this to Heaven and Stone. The rock is the personification of the Goddess Mother, who bore and bred the Sun itself. Serving this cult also requires creating and maintaining a precise calendar. This means exact determining of the initial moment of the calendar cycle and its division to equal time intervals connected with seasons. That is why, we suppose that positions of the sunrises and sunsets (during solstice or equinox), which coincide with characteristic points on the local visible horizon were observed.

4. TYPOLOGY OF THE MEGALITHIC AND ROCK-CUT MONUMENTS

Typology of the rock-cut monuments in Ancient Thrace shows the evolution of astronomical facilities and practices.

The typology of rock-cut monuments with an archaeoastronomical meaning is made according to their locality, landscape of the environment, functional astronomical elements, and accuracy of the obtained observational results (Maglova et al., 2007):

Locality:

- On high rocky peaks;
- In natural or artificial caves;
- Accidentally chosen sites with good view towards the local horizon.

Landscape of the environment:

- It almost always include rock, cave and water (springs or water reservoirs);
- Visited by a great many people or only by initiated people;
- It can be used for – astronomical observations, cult practices, time reckoning and time measuring.

Functional elements with an astronomical meaning:

- Astronomically significant azimuth of the basic sight direction (points of the summer and winter solstice, vernal or autumn equinox);
- Presence of equipment for sighting towards astronomical points on the horizon (by using of pillars, grooves, trenches, cave galleries, special sight equipment, near and far relief marks);
- Presence of astronomical objects depicted on the rock (caves, niches and open rock surfaces).

Accuracy of the obtained observational results (on angular dimensions and time) in accordance with the place and manner of observation:

- Observational grounds with a wide scope of vision without requirements for any accuracy (symbolic astronomy weaved into cult and religious practices);
- Equipment for Sun observations with an accuracy of about 5 arc degrees (±10 days – symbolic astronomy with low accuracy);
- Equipment for Sun observations with an accuracy of about 0.5÷1 arc degree (±1 ÷ ±2 days – positional astronomical observations with high accuracy).

5. CONCLUSION

In this work we investigate the evolution of astronomical facilities and practices in ancient Thrace.

Positional astronomical observations, projective systems, monochrome paintings with calendar records are shown as examples. The concept of "dynamic structure of the rock-cut monument" is introduced. This means that the site is characterized not only with space but also with time parameters as cyclicity and duration of existence connected with various cults and cult practices.

Structure of the rock-cut site includes a centrally located body and a platform to which radially oriented chutes and paths are directed. Also, there are additional elements to every rock-cut monument. The focus of the composition is a visual (or projective) device that allows observation of the Sun in astronomically significant points of the celestial sphere and the horizon.

The presented archeoastronomical objects show the mechanisms for observing extreme sunrises and culminations. The accuracy of the solstice and equinox determination is ±1 day and this allows creating and maintaining a calendar with the duration of the solar tropical year. As cave monochrome paintings show, typical holidays related to specific days are also marked in the calendar. The typology of archeoastronomical monuments shows the evolution of astronomical observational technologies and the ways of presenting astronomically significant moments by pictograms.

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