

# An archaeologist's comments on prehistoric European astronomy

## *Comentarios de una arqueóloga sobre la astronomía europea prehistórica*

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### ABSTRACT

*The study of prehistoric astronomy still has difficulties. Its academic discipline, called archaeoastronomy is still contending for high scientific value. As archaeoastronomy is the study of the astronomical practices, celestial lore, mythologies, religions and world-views of all ancient cultures, results of archaeological research are essential to its investigations. In prehistoric Europe the surveys of the megalithic monuments have enhanced the interest in prehistoric sky and stimulate archaeoastronomical research. The archaeological material remains can always offer novel notions to be developed in order to enrich the general picture of prehistoric astronomy. The purpose of the study is to present case studies on prehistoric sky lore and its impact on societies, in addition to emphasise the essential role of archaeology in archaeoastronomical investigations and interpretations.*

**KEY WORDS:** *Carpathian Basin. Megaliths orientation. Sky lore. Cosmological symbols.*

### RESUMEN

*El estudio de la astronomía prehistórica todavía presenta algunos problemas. Su disciplina académica, llamada arqueoastronomía, continúa esforzándose por alcanzar una categoría científica alta. Como la arqueoastronomía es el estudio de las prácticas astronómicas, las tradiciones sobre los fenómenos celestiales, mitologías, religiones y visiones del mundo de todas las culturas antiguas, los resultados de la investigación arqueológica son esenciales para sus propios trabajos. En la Europa prehistórica los estudios sobre megalitos han fomentado el interés por el cielo durante la Prehistoria y estimulado la investigación arqueoastronómica. Los restos arqueológicos materiales siempre pueden ofrecer nuevas ideas que enriquecen el cuadro general de la astronomía prehistórica. El propósito de este trabajo es presentar casos concretos de tradiciones sobre el cielo prehistórico y su impacto sobre algunas sociedades, además de resaltar el papel esencial de la arqueología en las investigaciones e interpretaciones arqueoastronómicas.*

**PALABRAS CLAVE:** *Cárpatos. Orientación de los megalitos. Tradiciones sobre el cielo. Símbolos cosmológicos.*

**SUMMARY** 1. Introduction. 2. Initial steps. 3. Late Neolithic enclosures of the Carpathian Basin. 4. Comments on attitude to megalithic astronomy of prehistoric Europe. 5. Orientation of construction other than megalithic monuments. 6. Evaluation of prehistoric astronomical knowledge. 7. Beyond orientation. 8. Conclusion.

## 1. Introduction

Working with artefacts and detectable traces of structures on ground, an archaeologist investigates the remains of the activities of past people and attempts to retrace the construction of their life and reveal their knowledge and beliefs. Given the lack of written records in prehistoric societies, the latter aim is rather difficult. Thus archaeoastronomy - an interdisciplinary research field investigating how people of past cultures have perceived and responded to celestial phenomena - however much it is discussed, it plays an important role as a subdiscipline to archaeology.

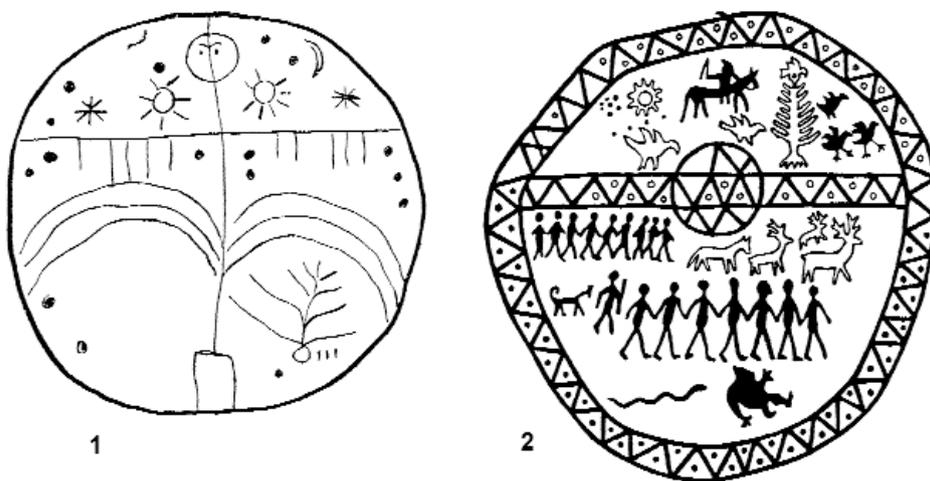
In this paper I would like to prove that to elucidate prehistoric sky lore and its impact on societies needs very complex investigations, in which astronomy plays an important but not exclusive role. The cultural background is essential. As archaeoastronomy also works with material remains of past monuments, archaeological research is fundamental to it. Archaeoastronomical themes need real interdisciplinary research as they may require not only astronomers and archaeologists but other specialists such as social anthropologists, historians of religion.

## 2. Initial steps

The sky lore of a community must be detected in the material culture as well but it can be very

well hidden. In order to reveal the relation to sky some initial points need clarifying.

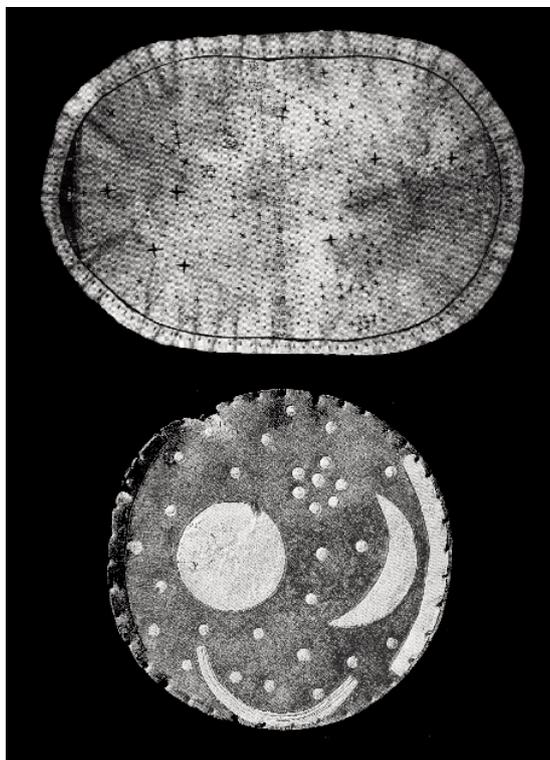
**First:** ethnoastronomy involves not only pure astronomical events but atmospheric phenomena as well (Chamberlain 1982). They are also considered to be the independent elements of the sky. This belief can be tested and proved not only by the ethnographical written reports but by objects as well, such as the shamans' drums or the Skidi Pawnee Indian star map. The Saami and the Siberian shaman drums often depict the cosmos with its important parts and participants. Sun, Moon, some constellations, and the rainbow are the most depicted symbols (Figure 1) (Pentikäinen 1987; Hoppál 2002). The unique Indian star chart is a perfect example of how the religious worldviews transform the reality into a specific representation of the world. The size of the stars depicted on the chart depends not on their real brightness (magnitude) but on their powers on the earth. The pronounced groupings roughly follow the virtual clustering of the stars in the sky but their identifications with the real sky were only possible with the help of written texts (Chamberlain 1982: 184-205). They also pictured the purple arc visible before sunrise and the deep red arc visible at sunset on the horizon named the *Dawn* and the *Golden sunset* respectively as separate celestial entities (Chamberlain 1982: 189). These ethnographical analogies helped with interpreting the famous Nebra disc as a possible depiction of Bronze Age cosmologic notions (Pásztor and Roslund 2007), in which these atmospheric



1: Anohin 2003. 92. ábra

2: Hoppál 2005. 111. pp.

**Figure 1.-** Cosmological representations on shamans' drums. 1: After Anohin 2003: 92. 2: Hoppál 2005: 111.



**Figure 2.-** Upper: Skidi Pawnee Indian star chart, after Chamberlain 1982: 184. Lower: the Nebra disc.

phenomena caused by the solar light and the rainbow beside the sun, moon and the Pleiades cluster might have had significant roles (Figure 2).

**Second:** we should know what kind of celestial phenomena could be observed by naked eye in the region and in the period investigated as they are determined principally by the geographical location (especially the latitude) but the climate, the weather also have impact on them. In the Carpathian Basin, for example, the climate, the weather, and even the environment were very similar to the present one during the Bronze Age (Juhász *et al.* 2005), thus mostly the same celestial phenomena could have been visible. The topographical features can cause a noticeable difference in the sky lore even in such a small territory as the Carpathian Basin. The interest and the cognition of the sky are richer and more colourful among the people living on the Great Hungarian Plain than those of the mountains (Zsigmond 1999).

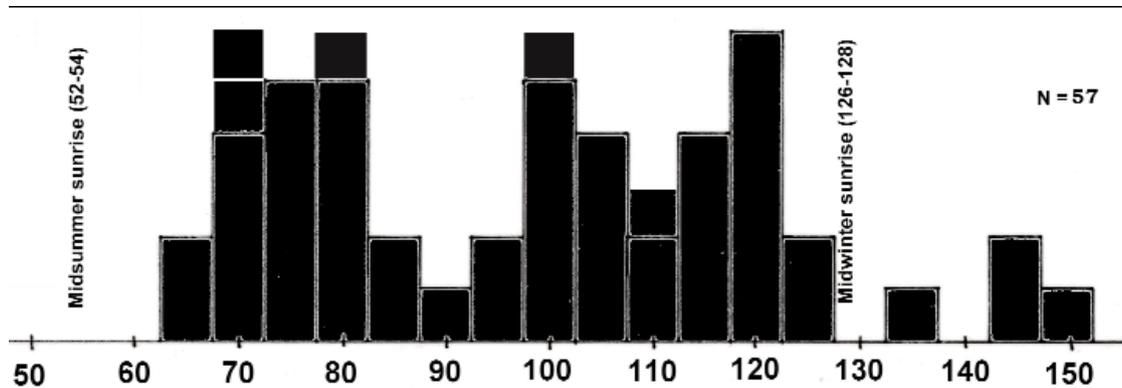
**Third:** prehistoric people were most likely not to have *l'art pour l'art* knowledge. Their needs were ruled by their living. Anthropological research proves star lore is much influenced by the activity

for the living (Amades 1994). The development, the frame of a society has a decisive impact on the necessities and consequently on the sky lore as well. As for the Carpathian Basin, remains of temples or sacred structures have not been uncovered yet in the Bronze Age. Nor do the sacral deposits show the existence even of a possible regularly used sacral area either. Their finding locations, however, indicate specific world views (Pásztor 2009f). As the archaeological finds do not show the presence of a hierarchical or organized religion, the belief system might have been similar to traditional folk beliefs, which considered the surrounding world as the natural unification of animate and inanimate nature (Pásztor 2009b). This argument, however, needs some corrections as in the prehistoric Carpathian Basin there are cultures owning constructions like cult space and possible different belief systems supported by artefacts.

### 3. Late Neolithic enclosures of the Carpathian Basin

The circular earthworks called rondels in Central Europe are the most discussed structures of the Late Neolithic period. They have a repeated form highly suggestive of deliberate design and symbolism. The often empty space inside the enclosure is generally surrounded by one or more (often two or three) circular ditches. The concentric ditches are interrupted by two, three or most often four causeways at (close) right angles. The investigation of possible common set of rules in geometry and in orientation of the earthworks of the *Lengyel* culture might have revealed some time and space concepts of the late Neolithic people (Pásztor, Barna 2009).

The near symmetrically arranged causeways often face the main cardinal points. The study of their orientations supports the argument that the sun or rather the sunrise might have played such an important role in the life of the population that this belief was integrated into their communal/cultic earthen architecture. The first step in constructing the rondels might have been setting out the direction of the eastern causeway, which might have been determined by the rising point of the sun at the horizon on the day when the construction was initiated. All except three investigated rondels have their eastern causeway in the direction of the rising sun during the year (Figure 3), however, the rest



**Figure 3.-** Distribution of the orientations of the eastern causeways of the Neolithic Lengyel rondels. After Pásztor, Barna and Roslund 2008: fig. 4.

may have also been aligned to the sun but later than sunrise. The vertexes of the diagram might signal certain days or time periods connected to important festivals for *Lengyel* people.

This is only an assumption as the positions of the vertexes cannot be identified with exact dates in the calendar but it would be natural to initiate the construction of their common cultic structures on an already consecrated festival date/period in order to make the event more memorable for the community. The idea of a solar worship receives some corroboration from the sitting of the monuments on the sun facing slopes of gentle hills; from the patterns, colours on contemporary pottery and the burial custom in which the sun path orientation might be the leading (Pásztor *et al.* 2008). Another interesting feature of the rondels is the proportions of their dimensions. For 47 of 58 monuments the rates of the diameters can be marked with whole numbers and the most can be characterized with 3:4 and 5:7. This means that the size of the rondels depended on the size of the population or there might have been common set of rules in designing the communal space. The ground plan and the location of the entrances prove the builders preferred symmetry in creating the circular causeway enclosures. If the monument has four causeways their axes are almost exactly perpendicular to each other. As a practical means to obtain right angles numerical triads are referred, among which the triad 3-4-5 is the simplest, the oldest and the most well-known. It comes from empirical experiences (Ranieri 1997). The use of ratio of 3:4:5 proves *Lengyel* people of the late Neolithic period employed this practical geometrical role about 7000 years ago (Pásztor and Barna 2009).

#### 4. Comments on attitude to megalithic astronomy of prehistoric Europe

Archaeoastronomy has been widely known for its research of astronomically orientated alignments. It was obvious that the huge standing stones arranged in regular geometrical forms captured the interest very early and their investigations raised the question of prehistoric astronomy (Baity 1973).

Alexander Thom's measurements and his theory have launched an 'avalanche' (Thom 1966). Megaliths all over Europe started to be investigated and their orientations to be interpreted. The enthusiastic searching for prehistoric astronomical lore, however, has had some side effects. Archaeoastronomical measurements can basically be interpreted using astronomical concepts, methods and knowledge. The archaeoastronomers often displayed finding astronomical explanation for almost any orientation, which was viewed with high scepticism by archaeologists. Prehistorians became most upset by the extreme claims of prehistoric man's intellectual achievements, made by researchers who had no formal training in archaeology. It often happened that investigators moving into archaeoastronomical research over-interpreted the evidence of the archaeological records (Roslund *et al.* 1999). Fortunately the attitude has changed considerably from both parts. Archaeoastronomical research has gained to be an official subdiscipline of archaeology. There are also session themes involving prehistoric sky lore at regularly organized archaeological conferences. The megaliths, however, still tempt researchers to forget about alternative interpretations supported by archaeology as the majority of archaeoastronomical investigations and interpreta-

tions are carried out by astronomers and it is less common to have archaeologists that are also interested in interpreting the role of the astronomical observations in cult practice. I would like to mention just two examples to demonstrate how the research or the interpretation of the orientation of monuments could be improved by comments from archaeology when there is little solid evidence for the reason of orientation.

#### 4.1. The archaeoastronomical investigations of Sardinian 'nuraghi'

Civilization of Nuraghic people developed from 2000 B.C. to 500 B.C. Its lifetime is divided into two periods. The prehistoric phase is between 2000 and 1000 B.C. (during the Bronze Age). *Nuragi* and *tombe di gigante* are assumed to have been built only in this period. The proto-historic phase is between 1000 and 500 B.C. (during the Iron Age). No new buildings are supposed to be built but the old ones were still in use (Melis 2003). Around 7000 nuraghi have until now been detected. The structures of the nuraghi can be very complex, from a simple tower to a so-called multi-lobulated monument. The monuments are argued to show a highly sophisticated astronomical way of thinking especially the tri-lobulated nuraghi with their solstitial and lunistical orientations (Zedda 2007). Extensive fieldwork has been accomplished to investigate the orientation of the entrances of the single tower nuraghi (272 items) and the central towers of the complex nuraghi (180 items) (Zedda and Belmonte 2004).

The authors have concluded that the entrances are oriented in the arc of the horizon comprised between the midwinter sunrise and the southern direction (120°-180°) for northern Sardinian monuments and 120°-210° for southern ones. The difference between the two peaks may mark the chronological difference between the nuraghi types. As targets, the midwinter sunrise, the moon at its southern major lunistic (turning point) and the stars of the Centaur-Southern Cross were offered. Studying the complex nuraghi, the orientation of the tangent lines of their peripheral towers (the outer walls of poli-lobulated nuraghes, 50 items) has also been interpreted with astronomical targets. The orientations of the tangent lines are argued to concentrate around the solar and lunar rise or sets at solstices and lunistics (Zedda and Belmonte 2004).

Visiting the sites in Sardinia we have raised arguments against the overstated importance of astronomy in the construction of the complex monuments of Nuraghic civilization (Dimitriadis and Pásztor 2009). Some of them are the followings:

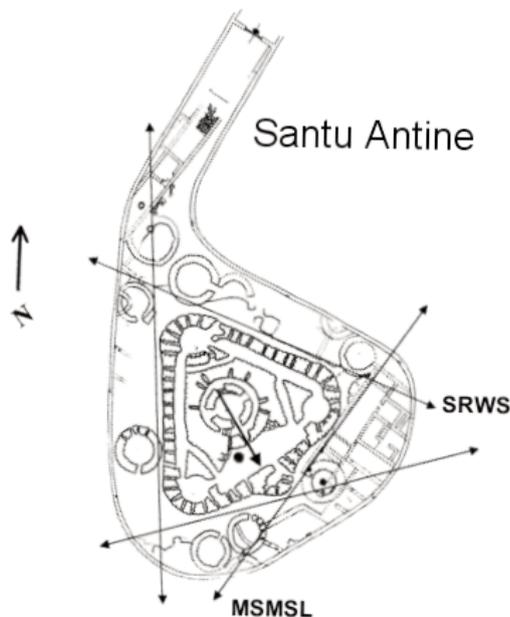
- Hardly any of them have been excavated; hence one has to be very careful with putting arguments forward. There is no agreement even among the Sardinian archaeologists about the function and the periodization of these monuments (Lilliu 1997 and his followers, Laner and Saturno 2005).

- There is not much sense of orientation of the central tower as they are "closed" inside the surrounding buildings, one cannot often look through the gates from the centre of the towers, as there is another wall blocking the sight from the inner space, or there is another monument outside, in front of the gates (e.g. Losa of Abbasanta) or the entrance is so low that one has to duck in order to be able to enter (e.g. Arrubiu).

- We have investigated the tri-lobulated monuments, which are generally triangular monuments with equal sides. As one of the side-walls often has north-south direction, the orientations of the other walls fall possibly unintentionally towards the directions of the solstices in Sardinia. As coincidentally, the azimuths for the solstices on Sardinia are also about 60 and 120 degrees – these angles stand for the equilateral triangle. This means that if the builders just wanted one side of their symmetrically built tri-lobulated monuments towards north-south, the other walls point at the solstices without the builders' knowing about it (Figure 4).

The preference of north-south direction in house orientation is a known phenomenon in early prehistoric Europe. It is not so unusual in the prehistoric Carpathian Basin either. In the early Neolithic it is considered partly the surviving Mesolithic heritage, and partly the result of the interaction with the western-Balkan region (Bánffy 2004: 66-69). This custom did not disappear in the Bronze Age either. As this direction does not belong to the environmental factors ruling house building, it may have had a non-environmental, perhaps social/ritual reason, which had its root in cosmology (Pásztor 2006).

- If astronomy/sky role played such important role for Nuraghic culture as it is stated, one can rightly expect some astronomical reflections also in the archaeological material. The ceramic finds, however, hardly show any astral/solar/lunar mo-



SRWS= Sun Rise Winter Solstice  
MSMSL = Moon Set Major Southern Lunestice

**Figure 4.-** The ground-plan of the tri-lobulated Santu Antine nuraghe with the assumed astronomical orientations. After Zedda-Belmonte 2004: fig. 5.

tifs, there are some *pintaderas* with possible solar symbols exhibited in the museum of Cagliari, but they come from the early Iron Age which is the late period of the Nuraghic culture and there is no new nuraghe supposed to be built in this period. This statement is also valid for the small famous bronze statues too. From the late period of the culture there is a boat type having a bird with a circle (solar symbol?) but this motif belongs to the Late Bronze Age/Early Iron Age sun-bark type motifs which might indicate a communication with the Central European Urnfield Culture.

- The archaeologists argue there are 'other' cultic places such as *Santa Cristina di Paulilatino*, belonging to this culture, but what about their orientations? The prehistoric cultic monuments on Sardinia seem to have strong connection with water. Water cult was widespread in the Mediterranean region during the classical times (Eliade 1958), which is quite understandable. The importance of wet places, springs, streamlets, might have had an effect on orientating the monuments. This topographic centred orientation was discovered in Malta when the dolmens were investigated. Measurements of the orientation of Maltese dolmens

show that they are aligned so as to run parallel with landscape contours and in particular with the flow of streams in the valleys below them (Pásztor and Roslund 1997).

This result indicates that these early Bronze Age monuments served purposes in connection with the water which is an essential element of life and the islands might have had shortage of it. This may also strengthen the orientation parallel or perpendicular to the Jordan River, of dolmens in the Jordan Valley rather than the astronomical (Belmonte 1997: S41). The significance of water in the belief system of prehistoric Europe is also supported by the hoarding ritual which is the most characteristic feature of the Bronze Age. It can generally be stated that 60% of the sacred deposits comes from wet places. Although it does not exclude the worship of other elements of nature as ethnographical research reports on sacrifices to the sky god performed on riverbanks (Pásztor 2009f).

#### 4.2. Some comments on the interpretation of the orientation of Menorca taulas

The megalithic monuments on the two Balearic Islands, Majorca and Menorca, belong to the most particular in the western Mediterranean. Among them are the *taula* precincts on Menorca with their peculiar high T-formed standing stones in their centres. *Taula* precincts together with cyclopean towers *talayots*, and *naveta* tombs are the visible archaeological remains of the Talayotic culture on the islands. The active lifespan of this culture is supposed to have started around 1700 BC during the Bronze Age and to have ended about 123 BC during the Iron Age (Service *et al.* 1996: 128-139; Kolb 2005: 169-170). A *taula* is formed by two great blocks of limestone in the shape of a huge letter T. It is normally set in the middle of a horseshoe-shaped shrine wall of stones with entrance opposite the front face of the *taula*. The inside face of the wall is usually broken up at intervals by large vertical pillars (Service *et al.* 1996: 134-137).

Although both islands Majorca and Menorca were inhabited by Talayotic people during this period, their archaeological heritage has some differences. *Taulas* and *navetas* are unique to Menorca. A striking feature of most *taulas* is that their fronts face south. This is especially true for those situated on the southern part of the island (Hoskin 2001: Table 4. 1).

As the monuments of Talayotic period are very distinct from those of earlier times, their origin is still on debate. Many cultural influences must have reached the Balearics from the surrounding lands, including Africa. It is possible that their impact was continuously enriched and changed the islanders' beliefs. Thus the Talayotic culture is assumed to have developed locally out of the pre-Talayotic culture (which already had boat-shaped houses and megalithic tombs), although the material shows a clear connection to the Iberian mainland and the architecture demonstrates certain similarities with those of Sardinia and Corsica (Kolb 2005: 170-172).

The orientation of *taulas* has been investigated and an interpretation has been offered by Michael Hoskin. According to his measurements the orientations are well concentrated within a few degrees of due south (Hoskin *et al.* 1990: fig. 3). According to Hoskin: "Around 1000 BC, a Centauri and the preceding stars of the Cross-Centaurus group would have been seen framed by the precinct entrance of a south-facing *taula*; but only if the site commanded a wholly uninterrupted view to the south." (Hoskin 2001: 42). The reason for this orientation was the *taulas* precincts' function or role. According to Hoskin's hypothesis the *taulas* were places of healing devoted to the manifestation of medicine and hence orientated towards the celestial representation of Chiron i.e. Centaur. Hoskin built up his hypothesis based on the result of measurements of the orientations of *taulas* on the southern part of Menorca (Hoskin 1989). Among these orientations there is one, at Torralba, which is pointing more easterly than the rest. This anomaly is believed to strengthen his idea by its being orientated towards the rise of Sirius/Orion. In his travel guide Heraclides Criticus gave the description of a ritual that had taken place on Mount Pelion in Thessaly, Greece, where Chiron had lived, and which was performed at the heliacal rising of Sirius. This ritual may have been a sacrifice to Chiron or Zeus. The animals whose bones were found at the site of Torralba might have been sacrificed at the heliacal rising of Sirius (Hoskin 2001: 45).

This influence had to reach Talayotic people's islands before building the first *taula*, that is to say at least 1400 BC or earlier. However, according to Hoskin's hypothesis the Menorcan islanders may have taken up the custom when they got into contact with the Sea Peoples who returned from Egypt to Sardinia after the famous battle of ca. 1176 BC.

Many attempts have been made to determine the origin of the various groups of Sea People and the role of the Mycenaen but the picture is still not clear (Wachsmann 2000: 103). The Greek sailors, i.e. the Mycenaean sailed their ships to the west Mediterranean in search of ore in around the 9th and 8th century BC (Levi 1991: 66). Calabria, Etruria, Sardinia and South Iberia could offer large deposits of copper. After reaching the western tip of Sicily, the Mycenaean learnt to go directly to Sardinia, which was a necessary stage on the western tin route and quite rich in copper, silver and lead deposits. In order to organize the exploitation of the Sardinian mines better, the Mycenaean brought with them extremely experienced Cypriot miners and smiths, who, *inter alia*, taught the inhabitants of the *nuraghi* the art of casting small human and animal figures in bronze in the way normal at that time in Syria and Anatolia. This was a form of production that flourished for several centuries in Sardinia and often achieved very high standards of artistic excellence. The presence earlier than the 8th century BC of the first Greek colonies in Sardinia is not supported by the archaeological finds (Levi 1991: 66). Finally the Greeks, sailing from Sardinia, most likely via the Balearics, reached the southern coast of Spain supposedly not earlier than the 6th century B.C. These events are much later than the building period of the *taulas*.

Using Hoskin's measurements (Hoskin *et al.* 1990: Table 1) for making a diagram on the orientation of *taulas* (Figure 5) it can be seen that they are closely facing due south with a mean azimuth of 180 degrees and a dispersion of  $\pm 15$  degrees, which is indeed low. This means that the sun, or the full moon might have also been likely targets for the orientation of the *taulas*.

The sun at that time would have traversed the Hellenistic watery signs of Capricornus, the Sea-goat, in December, Aquarius, the Water-bearer, in January and Pisces, the Fishes, in February when it rains at the most on Menorca. The fact that the full moon would have appeared in these signs in June, July and August, when the moon is at its lowest position at the southern horizon, and when it is the driest season on the island, at a lowest altitude of 21 degrees in the 18.62 year cycle might have made the *taula* a probable object for calling for rain.

Strabo wrote in his well-known book that the Celtiberians and their northern neighbours worshipped some unnamed god at full moon outside the

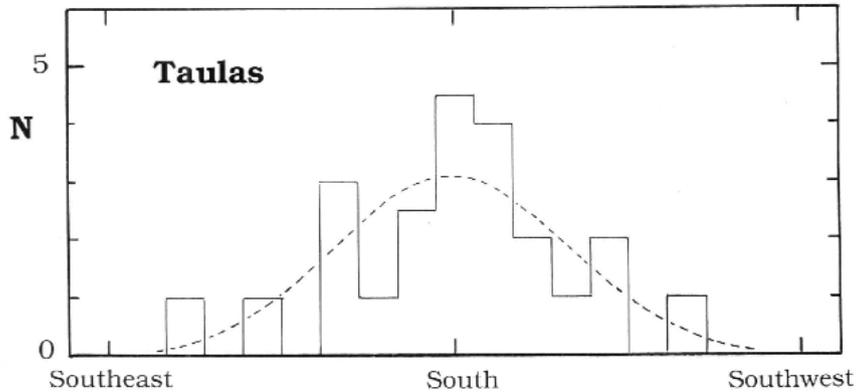


Figure 5.- Chart of distribution of orientations of the Menorcan taulas.

gates. A night ceremony dancing there with the whole family, was observed (Strabo, *Geography*, 6. 164.16). The concave front facades of the *taula* precincts may have served to define this sacred area in front of the monument. It can also be imagined that the flat upper slab of the *taulas* served as a stage or a tall altar for the ‘priests’ performing the rituals. Every participant of the small communities standing outside the gates could have seen the ceremony well. An additional light effect might have enhanced the atmosphere of the ritual. The front surfaces and sides of the vertical components and more especially the sides of the horizontal components of the *taulas* were furnished remarkably compared to their backs which were sometimes left crude (Hoskin 2001: 39). The flat surfaces reflecting the light of the full moon transformed the lifeless stones into the bright symbol of their divinity or enhanced the atmosphere of the ceremony with the mystic reflection. The worship of moon goes far back on the Iberian peninsula and continued through to the later periods (Oliviera and Da Silva 2006).

The relation of *taulas* to a possible bull-cult as Pasarius argued (Pasarius 1969: 117-26) is not in contradiction with a possible moon-festival as in the early time the bull with shining horns was also associated with the moon (Azara 2003) The numerous bronze bulls that have been found at various sites strengthen his proposal, that the *taulas* may have been symbols for bulls’ heads. In Torralba the excavator found a little bronze image of a bull. Beautiful bronze bull heads of almost natural size were found at the sanctuary of Son Corro, near Costitx on Majorca. Even to this day, the Patroness Virgin of Menorca is Our Lady of the Bull and her

sanctuary is in the highest peak of the island called El Toro. Although her legend has a Christian origin it is likely that this has a much earlier source (Martí 2003: 20-22). A calculation of the moon’s location in the constellation Taurus, the Bull, at the vernal equinox around 1000 B.C. as seen from Menorca can be seen on Figure 6. The drawing shows a stunning sight in the west with the 2.5 day old moon between the horns of the Bull when the sun is 10 degrees below the horizon.

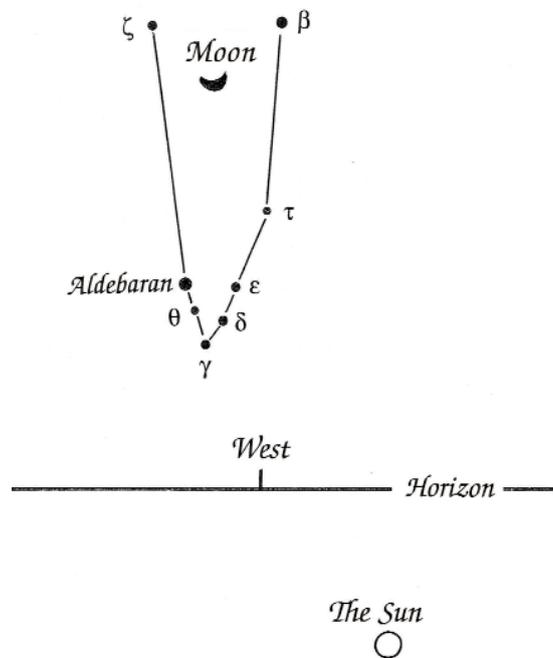


Figure 6.- The moon’s location in the constellation Taurus, the Bull, at the vernal equinox around 1000 B.C. as seen from Menorca. The drawing shows a stunning sight in the west with the 2.5 day old moon between the horns of the Bull when the sun is 10 degrees below the horizon (drawing by Curt Roslund).

As for a non-astronomical interpretation, despite the above-mentioned attractive ideas it should also be admitted that the full moon may have had nothing to do with the events taking place at Menorca *taulas*. The cited Strabo reference regarding the strong indication of moon worship seems rather Celtic unless the Celts inherited that from the local populations (Dr. Selleslagh's personal comment).

The *taula* precincts are considered sanctuaries (Kolb 2005: 170), although they do not suggest the shrine patterns known from the Aegean, Italy, or even from Sardinia at the end of the Bronze Age. As a cult place, they might have served burial rites and had a strong relation with ancestor cults. Richard Bradley has accomplished a study on the orientation of the long houses in Neolithic Europe and associated orientation with origin. He argues that the buildings in Linear Pottery settlements were generally orientated towards the areas of the origin of the communities who lived there (Bradley 2001). The *taulas* as altars may have also faced the direction where some of the ancestors of the Talayotic cultures came from, settled down on the islands, and became the leaders of the community. Travelling was a characteristic feature of the Bronze Age and the travellers might often have come to a ruling position in a community by esoteric knowledge acquired during journeys (Kristianssen and Larsson 2005). Beside these assumptions, the north-south direction could also have been a heritage of native cosmology as I noted above for early Europe.

Although this interpretation is not more supported by archeological finds than the astronomical ones, it does not mean that the other interpretations are valid. One has to list all the possible alternative solutions as the final word is in any case declared by archaeological excavations.

When interpreting the orientation of a monument an alternative is to redirect the attention from the observation of the actual sunrise (or sunset) to its effect on the *edifice* itself. Thus the purpose of the orientation could have been to obtain natural light in order to illuminate the monument at a special occasion or just to get the light in a special way in order to enhance the atmosphere of the ceremony taking place inside the monument (as did the master builders through the history of architecture). The megalithic monuments are perfectly suitable for such testing (Newgrange, Maes Howe, Loughcrew, etc). Investigating such a light and shadow interaction for the unique building of Stonehenge at mid-

summer sunrise, the result was surprising. Such a light interplay could not only have enhanced the mystic feelings of the participants (like inside the renaissance churches), but in addition have offered an explanation to the creation of the Trilithon Horseshoe (Pásztor 2009c).

## 5. Orientation of constructions other than megalithic monuments

In the Carpathian Basin there are no megalithic monuments. Still, it is possible to investigate the orientation of structures in order to form an understanding of possible astronomical knowledge. Unlike the Neolithic period (see above) the Bronze Age does not offer sacral buildings or enclosures to be studied. However, there are the groundplans of houses which can be measured.

Investigations on the orientations of houses in the Neolithic show that the possible reasons for orientation were first of all environmental, such as the prevailing wind - which is northwest-southeast in the Carpathian Basin - or solar radiation, direct absorption of the heat by aligning the axes roughly east-west, to get the largest possibly roof area facing the longest period of the sun's path in the sky and light penetration through the location and orientation of the doorway (Topping 1996). In the case of the Neolithic Linear Pottery Culture in Central Europe, Anick. Coudart called attention in that house orientation was probably not chosen to minimize the effects of wind and adverse climatic conditions. There was certainly a link between the orientation of houses and prevailing summer winds but this does not apply to all the areas occupied by the Danubian groups (Coudart 1998: 84-89). The ethnographical research also argues that the non-environmental factors have had significant impact on house building activities involving the layout of a house. Thus the belief system may have had greater influence on the orientation of buildings than the topographical and climatic factors.

This may also be the ruling factor for the orientation of 13 Bell Beaker houses at a Hungarian site if they celebrated the turning points of the sun (solstices) as people did in the later periods. The mean orientation of the houses at the site is close to the direction of the midwinter sunrise at the latitude of Budapest. There is another effect which can strengthen the hypotheses of the importance of the sun.

During the time around the winter solstice the sun fills the houses with light through the open gables at about 9 a.m. Some other features such as ritual pits inside some houses support the argument that rituals could have been taken place inside the domestic area, and archaeological finds such as golden discs and vessels decorated with possible sun symbols strengthen the important role of the sun in the belief system (Pásztor 2005).

Another case study of a Late Bronze Age Tumulus culture settlement has been studied with 60 houses, which offers a good opportunity for a statistical calculation as well. The longer axes of the houses show a very good correlation with the north-south direction. This means that the same can be argued for the main entrances in connection with the east direction, as the main doorways detected often as a two-swing door, was generally found on the eastern side of the houses, close to its southern end. The statistical dispersion for the direction of the main axes is 13,5 degrees. It signals that the possible target for the orientation might have been a celestial but not a topographical one as in the latter case the parallaxes would be noticeable. Two interpretations have been argued, a cosmological one for the north-south axis, and an astronomical one for the entrances aligning around true east, i.e. vernal equinox sunrise. This does not mean however, that the spring equinox sunrise had a significant role in the beliefs. It is possible that the people built most of the houses around the middle of March and they only wanted to orientate the entrance to the rising sun (Pásztor 2006). Beside these sky elements, however, there may have been many other reasons for the orienting customs of a community.

Anthropological research shows some interesting examples, such as the traditional Japanese houses facing south, or rather aiming at avoiding the north in their façades (Hendry 1981: 217); the houses of the Indonesian Toraja village face north, where the rivers flow from (Waterson 1994: 97). Even these two examples prove that there may also have been such factors controlling the building activities that are impossible to establish without the help of written sources. The investigation of all houses available of the Bronze Age in the Carpathian Basin show quite wide choice of directions with a slight preference to the north-south and southeast-northwest directions. A survey of ground plans of houses belonging to 47 sites, indicates that

the orientation may have been intentional; there are cases with clear clusters of orientation and the dispersion from the mean value is often lower at a site used by different cultures than for different sites of the same ancient culture. This means that one cannot expect a uniform custom in orientations even within the same cultural group. This actually harmonizes with what can be read in ethnographic reports on ceremonies and rituals of traditional societies (Vértes 1990; Pásztor 2009f). At the same time, however, they warn us not to overemphasize the significance of orientation. The datum of the orientation is just a piece in the puzzle of prehistoric sky lore.

The study of the orientations of cemeteries of the Carpathian Basin in the Neolithic and Bronze Age cannot even offer information of a scientific value on prehistoric astronomy even if there was a strict burial ritual. The grave orientations can be taken into account just as an element of the belief system on death (Pásztor 2008a).

## 6. Evaluation of prehistoric astronomical knowledge

Interpretations based on a single site may be misleading, if they are not corroborated by the results from other sites. Only a consistent and coherent pattern of directions shared by a representative sample of closely related monuments can be accepted as evidence of astronomical origin for their orientations (Roslund *et al.* 2000). With this in mind, what can one say about the real, observational astronomical knowledge in the Neolithic (including also the megalithic monuments) and the Bronze Age? Not as much as is still generally assumed by non-professionals. Even early communities must have been familiar with the regular motion of the sun, its cyclical movement. This is easily confirmed through the presence of farming activities. They may have also noticed the summer and winter solstice; however, there are no satisfying, clear evidences of them. Available evidence gives little support on certain ideas concerning astronomy in prehistoric Britain and Ireland. The assumption that a calendar involving eight-fold divisions of the year was in use during the Neolithic and Bronze Age and this is why solstices and equinoxes were the most important targets for orientations of megalithic monuments has not been

proved to be strongly supported (Ruggles 1999: 133).

The investigation of the megalithic monuments indicates that the observation of astronomical events does not need such complex structures. It has made Douglas Heggie conclude that the motivation behind megalithic astronomy was not purely practical (Heggie 1982: 216). As anthropological research always argues that even in one single cultural group uniformity in customs and rituals cannot be expected, this can also be established from the orientation of megalithic monuments. Systematic studies of patterns of orientation amongst regional groups offered more persuasive evidences and also revealed some regional trends (Burl 1983: ch. 5; Ruggles 1999: ch. 8.). Unfortunately, not all local groups used the same orientation even within a region and often an alternative interpretation cannot be excluded either. However, one of the significant problems about megalithic (prehistoric) astronomy is that it is impossible to make distinctions between the lunar and solar possibilities. Quite often the alternative explanation might be that it was desirable simply to keep within the range of horizon where the sun rises at any or certain part of time of the year (Ruggles 1999: 130).

Given the ecological background, the requirements for survival are the most decisive in the knowledge of traditional and supposedly also prehistoric people. These factors also have a strong influence on the relation to nature. In Northern Europe there is a shortage of sunny, warm days, thus the worship of sun may have been stronger and more easily detected (Green 1991). The Mediterranean people however, may have been more devoted to water than the sun, as drought can be a killing power in summer. This assumption may be supported for example in the orientation of Maltese and Jordanian dolmens. In the Mediterranean, people were still active at early night, thus a possible moon cult seems also supportable. The most fitting orientations for the moon have been found on the Iberian Peninsula. A group of passage graves around Évora in central Portugal show a remarkable similarity in orientation, the statistical dispersion is only  $\pm 11$  degrees from their mean value. The grave finds could be seen to argue in support of the idea that the orientations were aimed at the rise of the first full moon after the vernal equinox that is the Easter full moon (Roslund *et al.* 2000). This argument can be further supported through

the orientation of other megalithic monuments of southwest Iberia, and particularly Central Alentejo. It is also noticeable that moon worship or its participation in later rituals has long tradition in Iberia (Oliveira and da Silva 2006). There are however, reasonable convincing examples for intentional lunar orientations also in the British Isles (Ruggles 1999: 131).

To sum up, the most that can be argued about prehistoric astronomy is that generally, shared astronomical knowledge did not exist even in the areas with megalithic monuments. Throughout Britain and Ireland there is a strong preference of chambered tomb entrances to avoid north direction. It is also clear that the predominant overall trend in tomb orientation is eastward, the rising areas of the celestial bodies. There are only some exceptions which face westwards. The stone circles and henges often show low precision astronomical alignments thus the astronomy was very much part of a ceremonial tradition in the Late Neolithic. At least so in certain places at certain times, although there are examples which prove that astronomy is unlikely the only symbolic influence upon the location and orientation (Ruggles 1999:131-133). The archaeoastronomical investigations on the archaeological material of the prehistoric Carpathian Basin argue the same or a very similar level of astronomical lore detected (see chapters above).

Indirect deduction from historical and ethnographical sources can, however, argue that the Bronze Age sky lore must also have involved the cognition of the regular change of the moon's phases for possible magic purposes or early calendars, the creation and use of constellations and the observation of certain atmospheric phenomena necessary for weather lore and maybe for magic. There are finds from other parts of Europe with possible atmospheric phenomena such as rainbow, or sky colour (Pásztor and Roslund 2007), but such finds from the Carpathian Basin have not been discovered yet. To sum up, it can be stated that the astronomical knowledge of Bronze Age Carpathian Basin was like most folk astronomy and, seemingly, hardly more than the Neolithic.

## 7. Beyond the orientation

The archaeoastronomical investigation of prehistoric Europe should be quite complex and per-

haps it needs different methodology for south, especially southeast Europe, because of their connection with complex state cultures of the Near and Middle East. As in searching for the astronomical or rather sky lore one cannot be confined to surveying merely the orientation of the megaliths. In exchange we often know very little about their archaeological background since many have not been excavated yet or in most cases no-culture-bound features have been detected during archaeological fieldwork. 'Megalithic' astronomy is certainly not equal to prehistoric sky lore of Europe. The History of religion and social anthropology can prove the strong impact that celestial phenomena may also have on traditional communities. Their interest about the sky is, however, hidden in the artefacts and their context in a different way. To reveal it, astronomical measurements and calculations are hardly needed. Instead, an archaeological approach complemented by ethnoastronomy is essential (Pásztor 2008b). The ethnographic researchers argue that the nature lore can be characterized by a certain duality. Beside the empirical, practical knowledge, the nature lore of a traditional society also shows many irrational features (Vajkai 2004: 120-123). Studying the archaeological material of the Bronze Age in the Carpathian Basin, the results indicate that the real sky role may have been similar or hardly more than what ethnoastronomy carried out about 150-200 years ago. This argument may also be valid for the whole of Central Europe. The influence of the celestial bodies or phenomena on belief systems, as it appears to me, may however have been stronger and gone through significant changes during the Bronze Age. I would like to present the results of some case studies to support this.

### *Cosmology*

Studying and discovering prehistoric cosmological ideas is a challenging research task. In the lack of written and oral material one is forced to use 'silent sources', such as special archaeological finds, iconography, symbols of decoration motifs, and the orientation of houses and graves. These 'building units' argue that archaeological methods should have a primary role in revealing prehistoric cosmologies. One cannot expect a unified, detailed description of the universe but some essential/fundamental elements of prehistoric teachings on the cosmos can be revealed. Focusing on the Carpa-

thian Basin, without the use of megalithic monuments and rock carvings I have tried to develop a methodological approach by applying my results on orientations of houses and cemeteries, and the comparative study of celestial symbols (Pásztor 2009a).

Two ancient cosmologic constructions have been used for comparative studies to hunt for artefacts, the Proto-Indoeuropean and the Proto-Uralic. By the Bronze Age, Indo-European peoples are assumed to have been present in the Carpathian Basin. However, the heritage of the native, or the influence of belief systems other than the Indo-European must also be taken into account. The Proto-Uralic is a good example for a hunter-gatherer worldview and these people lived partly in Europe and partly in Western Asia. Some decoration motifs have been argued to have a cosmological rather than solar meaning, such as the well-known sun-cross symbol. Its spread in Neolithic and Bronze Age Europe indicates a possible interaction with Proto-Indo-European beliefs (Pásztor 2009e). There are other finds which could indicate nature worship with a shaman-like mediator between the human and the supernatural worlds involving the sky (Pásztor 2009b). The worship of nature/natural spirits may have been a fundamental belief system for some communities (archaeological cultures), as is also supported by the hoarding ritual (Pásztor 2009f). Although archaeological finds cannot assure solid evidences of any kind of celestial worship, there are nevertheless finds such as small clay figurines of celestial entities from the so-called 'sorcerers' graves' which clearly indicate the influence of the sky and its events (Nagy 1979).

However, some warning conclusions have also been drawn from the cosmological studies:

- One cannot expect a unified cosmology either for the whole Bronze Age or the whole Carpathian Basin (or even for one cultural group). Different archaeological cultures show different preferences of using cosmological symbols, house-orientations and grave-orientations.
- There may have been different versions of cosmological ideas even within the same culture.
- The interaction between contemporary, neighbouring cultural groups can create a 'virtual common cosmology' through the exchange of goods.
- The impact of complex societies can be overemphasized.

Thus the Bronze Age cosmology in the Carpathian Basin (but possibly for the whole of Europe) can be said to have been not unified, not homogeneous, not free from contradictions, and altering with time (Pásztor 2009a).

#### *Celestial symbols on artefacts*

Although there is no rock art in the Carpathian Basin, the Bronze Age artefacts are richly covered by abstract decoration among which there may be symbols with some relation to the sky and its events. Investigation of symbols is, however, one of the most difficult themes of cognitive archaeology, as they are easy to be over-interpreted. As it appears to me, no real astronomical event such as eclipse, or conjunctions, or different phases of the moon, or heliacal rising, etc. can ever be interpreted from the symbols. This argument might be valid for the whole of Europe. Many symbols in rock art and on artefacts are called solar, but when they are depicted without rays we cannot even separate them from the likely full moon symbols.

The religious notions/beliefs cannot always be clearly recognized in the material culture. An abstract motif could be used as a pure decoration as well as the symbolic attribute of the sun or the weather or any god. Complex investigations including the symbols of a culture can result however, in valuable conclusions and information. Some conclusions drawn from case studies are (Endrődi and Pásztor 2006; Pásztor 2008a):

- Different sites of an archaeological culture can show different degrees of the use of celestial symbols,
- The influence of contemporary, neighbouring cultural groups can create a 'virtual sun cult',
- To detect the possible impact of sun in the Bronze Age ritual life, comprehensive investigations of the archaeological cultures are needed,
- The number of cosmological, celestial symbols significantly increased—especially on prestige artefacts—at the end of the Middle Bronze Age, which may indicate a mythological/ideological development accompanied with social changes and maybe an increased interest in the sky from the Middle Bronze Age on (Pásztor 2009d).

## 8. Conclusion

Celestial events often exerted a great or even decisive influence on the life of ancient communities. They may provide some of the foundations on which an understanding of the deeper meaning of mythologies, religious systems and even folk tales can be based. These influences may be detected in the archaeological material culture as well. There is good evidence that celestial phenomena played a particularly important role in the worldview of prehistoric Europe (Pásztor, Roslund 1999).

What can be concluded on prehistoric European astronomy after more than a 30 year long existence of archaeoastronomy as a subdiscipline? After having so many general theories on prehistoric European astronomy it is time to go into the details of it. It appears to me that different cultures or regions cannot -or just in very well-founded cases, can - be mixed. As an organized religion such as sun cult or moon cult for the Neolithic and the Bronze Age has not yet been proved, one can get a better picture of scientific value by investigating the possible sky lore of an ancient culture or a certain region. After studying several similar case studies, the general assumption on prehistoric astronomy can be improved once more.

Archaeoastronomical measurements cannot or can hardly be carried out after finishing the fieldwork in the case of such archaeological constructions which have no visible remains. As far as the astronomical potential of the orientations is concerned, the horizon's altitudes must also be taken into account. If these measurements are not taken during the excavation, it is very difficult for them to be carried out later. Taking measurements from ground plans can have a high chance of containing errors.

Closer teamwork between astronomers and archaeologists is desirable in order to make meaningful contributions to our understanding of prehistory. Archaeologists cannot ignore the importance of the sky either. This collaboration should not only apply to the interpretation of measured data, but to all the work carried out, from the formulation of a research strategy and the execution of fieldwork to the final analysis of the information gathered. Their approaches and perspectives can be different but can be fruitfully complementary to the cases investigated. Spanish archaeologists are setting a good example of it with their landscape archaeological research.

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