

THE SARDINIAN TYPE UNDERGROUND WELL TEMPLE AT GARLO, BULGARIA: AN ARCHITECTURAL AND ASTRONOMICAL SURVEY

Lyubomir Tsonev

*Institute of Solid State Physics, Bulgarian Academy of Sciences,
72 Tzarigradsko chaussee blvd, 1784 Sofia, Bulgaria.*

Email: ltzonev@abv.bg

and

Dimiter Kolev

*Institute of Astronomy, Bulgarian Academy of Sciences,
72 Tzarigradsko chaussee blvd, 1784 Sofia, Bulgaria.*

Email: dzkolev@abv.bg

Abstract: In this paper we describe a rare but relatively well-preserved Sardinian type underground well temple located at the village of Garlo, in Bulgaria. This dates to the fourteenth or thirteenth century BCE, and contains some unique architectural features. We postulate that the Garlo temple was used during the winter solstice for rituals associated with the 'newly-born Sun', underground water and the start of the new annual cycle of life. Solar and water cults are known from ancient Thrace, but previously they have never been combined in this way.

Keywords: archaeoastronomy, Bulgaria, Garlo, underground well temple, solar cults, water cults, winter solstice





















1 INTRODUCTION

In the second and third millennium BCE specific examples of ancient sacred architecture appeared in the Mediterranean region: well temples devoted to the cult of underground water. Basic data about the most popular and carefully-studied of these restored well temples are sum-

marized in Table 1, but many have yet to be investigated in detail so important questions about them remain to be answered.

The cult of underground water has its origins in Mesopotamia, with the Sumerian god *Enki*, who was the god of underground water, the god of fertility and the keeper of the world order.

Table1: Data on some of the best preserved and intensively-studied sacred springs and well temples in Europe.

No	OBJECT AND LOCALIZATION: Name // Nearest town // Province // STATE	GOOGLE-EARTH COORDINATES	OBJECT TYPE	DATING	DROMOS AZIMUTH "A", OUTWARDS	STAIRCASE SLOPE "h"	OBJECT DIS- POSITION ON THE TERRAIN
1	Underground well temple at Garlo village // W from Breznik // prov. Pernik // BULGARIA	N=42° 47' 14.80" E=22° 50' 52.62"	Undergr. well + tholos 	Middle Bronze Age XIV-XIII cent. BC.	170° 	Originally h=40°; after restor. h=30°	Tangentially semi-dug at a steep hill slope
2	Pozzo di Enki in Cuccuru Nuraxi // Settimo San Pietro // prov. Cagliari, SARDINIA, ITALY	N=39° 17' 10.25" E=09° 10' 36.58"	Undergr. well + tholos 	Middle Bronze Age XIV-XIII cent. BC.	335° 	Damaged. h=60°	On horizontal rock plateau
3	Pozzo sacro di Funtana Coberta // N from Ballao // prov. Cagliari // SARDINIA, ITALY	N=39° 34' 51.76" E=09° 21' 06.17"	Undergr. well + tholos 	Late Bronze Age X-IX cent. BC.	250° 	h=40°	On horizontal terrain
4	Pozzo sacro di Sa Testa // Olbia // prov. Olbia-Tempio // SARDINIA, ITALY	N=40° 56' 04.47" E=09° 32' 45.86"	Undergr. spring + tholos 	Late Bronze Age XII-IX cent. BC.	265° 	h=40°	On horizontal terrain
5	Pozzo sacro di Sant' Anastasia // Sardara // prov. Medio Campidano // SARDINIA, ITALY	N=39° 37' 00.49" E=08° 49' 11.33"	Undergr. spring + tholos 	Late Bronze Age XII-IX cent. BC.	165° 	h=40°	On horizontal terrain
6	Pozzo sacro di Matzanni // W from Vallermosa // prov. Cagliari; (S from Villacido // prov. Medio Campidano) // SARDINIA, ITALY	N=39° 22' 33.10" E=08° 42' 05.19"	Undergr. spring + tholos 	Late Bronze Age XII-IX cent. BC.		h=30°	On horizontal terrain
7	Pozzo sacro Santa Cristina // SW from Paulilatino // prov. Oristano // SARDINIA, ITALY	N=40° 03' 41" E=08° 43' 57"	Undergr. spring + tholos 	Early Iron Age IX-V cent. BC.	155° 	h=40°	On horizontal terrain
8	Pozzo sacro Perfugas // Predio Canopoli // prov. Sassari // SARDINIA, ITALY	N=40° 49' 43.21" E=08° 53' 09.54"	Undergr. spring 	Early Iron Age IX-V cent. BC.	250° 	h=40°	On horizontal terrain
9	Pozzo sacro Santa Vittoria // W from Serri // prov. Cagliari // SARDINIA, ITALY	N=39° 42' 42.61" E=09° 06' 09.02"	Undergr. spring 	Early Iron Age IX-V cent. BC.	210° 	h=40°	On horizontal terrain
10	Pozzo sacro di Noddule // between Nuoro & Orune // prov. Nuoro // SARDINIA, ITALY	N=40° 23' 06.88" E=09° 16' 58.36"	Overgr. spring + tholos 	Early Iron Age IX-V cent. BC.	?		
11	Pozzo sacro Si Tempiesu // E from Orune, NE from Nuoro // prov. Nuoro // SARDINIA, ITALY	N=40° 24' 39.39" E=09° 24' 46.77"	Overgr. spring + tholos 	Early Iron Age IX-V cent. BC.	?		
12	Asclepeion in ancient town of Panticapeion // the N district Adzhimushkay of the modern town of Kerch // Crimean peninsula // UKRAINE	N=45° 23' 50.59" E=36° 32' ±10"	Undergr. well + tholos 	Middle Iron Age V-IV cent. BC. (Other references I cent. AD)	?	h=40°	On horizontal terrain

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Most of these underground water temples are localised to the island of Sardinia (Figure 1) where between 30 and 40 are known. Beyond this island there are only two isolated examples: one is at Panticapaeum (modern-day Kerch) on the Crimean Peninsula, and the other is at the village of Garlo in Western Bulgaria. It is this latter well temple that is the focus of this paper.

Two basic types of Sardinian water temples exist. At smaller sites, comprising sacred pits or *pozzi sacri*, modest above-ground shrines are found around the springs. Contrasting with these are the complex, sophisticated and very impressive sacred well temples, which include several obligatory components: (1) an underground staircase [dromos]; (2) an underground tholos roofed with a spherical or parabolic axially-symmetrical vault; and (3) a suitably-designed underground water source. The water source itself can take the form of a shallow spring, or a deep well that is lined with masonry. In most cases, the tholos has an *opaeon*, a circular opening at the vault's apex which allows light from the Sun, the Moon and the stars to enter the tholos. Archaeologists believe that some of the well temples originally included above-ground architectural elements. It would appear that all of the underground Sardinian wells had religious functions.

The technical development of the Sardinian well temples continued for more than a millennium. The most ancient examples were supposedly created in the Middle Bronze Age, in the fourteenth and thirteenth centuries BCE. They are constructed using crude cyclopic dry masonry, in a technique that is reminiscent of the fortress walls at Mycenae, Tiryns (continental Greece) and Hattusa (the capital of the Hittite Empire in Asia Minor). The Bulgarian well temple dates to this period and its masonry is like that found in the earliest Sardinian well temples. The most sophisticated well temples in Sardinia appeared in the Late Bronze Age and in the Iron Age, between the ninth and the fifth centuries BCE. They were built of high-quality quadrangular blocks, and contained false vaults. The Crimean underground well temple dates to the very end of this period (Atzeni, 1980; 1987; Gaydukevich, 1949; Guido 1963; Lilliu, 1958; 1967; 1980; 1982; Lilliu and Schubart, 1967; 1979; Melis, 2003; Mitova-Dzonova, 2007; Moravetti, 2005; Webster, 1996; Zervos, 1954).

As Table 1 indicates, the sizes and the proportions of the various well temples varied within certain limits, but the length of the dromos was not strongly prescribed by the cult and the depth of the well varied over a wide range of values. However, the dromos was often oriented in a general southerly direction. It is also worth noting the inclination of the dromos staircase.

Published data indicate that the inclination angle of the dromos was $\sim 40^\circ$ in all of the Sardinian well temples. Since the reconstructed well temple at Garlo in Bulgaria has a staircase inclined at 30° it seems to differ from the general rule, but according to Dermendzhiev (2007), the original pre-restored staircase was steeper and had an inclination of 40° . The staircase in the Crimean temple also warrants a mention. The discoverer, E.E. Lyutsenko, lists a value of 45° in his original text, but depicts an inclination of 40° in the plan of the well temple. Unfortunately the dromos at this site was destroyed long ago and the exact value can no longer be checked (Gol'msten, 1941). So, the inclination of the dromos staircase proves to be a curious contructional invariant in all of the Sardinian type water temples.

2 THE MAIN ARCHITECTURAL FEATURES OF THE GARLO WELL TEMPLE

The underground well temple near the village of Garlo in Bulgaria (Figure 2) is 40km northwest of the capital, Sofia, at a latitude of $42^\circ 47' 14.80''$ N, and a longitude of $22^\circ 50' 52.62''$ E. It is probably the most ancient monument of a sacred architectural nature in Bulgaria, and was discovered in 1971 by Dimitrina Mitova-Dzhonova (1983; 1984a; 1984b; Mitova-Dzonova, 2007). The site was investigated and partially restored in 1972, and in 1983 a large protective building with a special shelter and an exhibition platform for the public was constructed around the well temple. At the same time further, but not entirely correct, restoration was carried out. Unfortunately, in 2007 the special shelter collapsed, but at the end of 2010 the well temple was cleared out again. A decision was taken in 2012 to rebuild the shelter and to restore the tholos floor which had been damaged by treasure hunters. Since 2009, the Garlo well temple has been officially recognised as a Bulgarian 'Archaeological Object of National Importance'.

The construction of the protective building and the restoration disturbed the authenticity of the original structure, thereby complicating our analysis and our measurements, so here we will mention briefly some of the changes that were made during the restoration process in order to describe more exactly the situation:

- (a) The diameter of the reconstructed *opaeon* is larger than the original one.
- (b) The west wall of the dromos has been completely rebuilt and the original curb stone in the foundation of the wall has been removed.
- (c) The staircase which was excavated by the archaeologists was rectilinear, consisted of only 13 steps (counting from the tholos upwards), and ended below the ground surface, whereas the restored staircase has 24 steps (the 11



Figure 1: The Mediterranean region and the Black Sea showing localities mentioned in the text, and the Bulgarian underground well temple at Garlo. Other Bulgarian sites mentioned in this paper are shown in Figure 2.



Figure 2: Bulgarian localities mentioned in the text.

newly-added steps forming a 90° turn) leading up to the ground surface.

(d) The original 13 steps were inclined at 40° with respect to the horizon (Dermendzhiev, 2007) whereas—as we have already noted—the restored staircase has a slope of 30°.

(e) The original corridor contained two niches of quite different depths located opposite one another in the walls, but the restored corridor has two equally-shallow niches.

We will now describe the most important architectural features of the Garlo underground

water temple, noting first its extremely-complicated geographical location, on a steep hillside (see Figures 3 and 4). All of the Sardinian well temples were built on flat land, as was the Crimean well temple, but the Garlo well temple is partially dug into a hillside.

Visitors enter the well temple through a covered staircase (the dromos). In the upper section of the staircase it begins as an open-air construction, but its lower part is covered in a quasi-megalithic manner with large rough stone slabs, giving the corridor a trapezoidal cross-section. When the corridor goes deeper into the ground the load on the ceiling increases and the width of the covering stone slabs decreases accordingly (see Figures 5–8). At the lower end the corridor has a triangular cross-section and is crowned with a tapered cotter. The architectural character of the dromos changes significantly from a flat ceiling to a keystone arch along a distance of only 4m in order to adapt to the changing pressure of the stone mass overlay. After its anomalous hillside location, this is the second extraordinary architectural feature of the Garlo well temple.

The core of the structure is the vaulted cylindrical tholos, which has a height and a diameter of about 4m. This vault is the third extraordinary architectural feature of the Garlo well temple. This is not a false vault (constructed with layered square-shaped stone slabs, with the upper layer sticking out a little further inside), but a real vault, where rough stones are ordered in a wedge-like manner. In Figures 9 and 10 we have plotted the precisely-measured tholos profiles in their present-day configurations. The restoration has affected only 0.5m, in the very upper part of

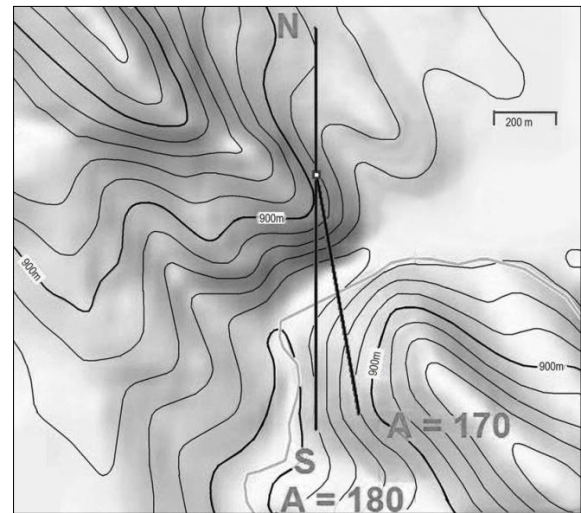


Figure 4: A relief map of the region around the Garlo well temple. NS marks the meridian 180°, and 'A' marks the dromos direction 170° (Google Maps).

the vault. The walls from the tholos floor up to a height of 3m are still preserved in their original state (see Figure 11).

Some important conclusions can be drawn from these results:

- 1) The cross sections in north, south, east and west directions differ from one another. Therefore the question about the general form of the vault (whether it was spherical or a parabolic/ beehive type) cannot be determined.
- 2) The N-S cross section is almost symmetrical, while the E-W cross section is strongly asymmetrical. Probably the asymmetry was intentional and was connected with the different pressures on different parts of the tholos and vault due to the complex location of the building.



Figure 3: A panoramic view of the Garlo area from the northwest, showing the location of the village and the underground well temple (indicated by the white circle).



Figure 5 (top, left): A general view of the Garlo well temple from inside the tholos (photograph: L.Tsonev).



Figure 6 (top, centre): The upper trapezoidal part of the dromos, with the lintel (photograph: L.Tsonev).

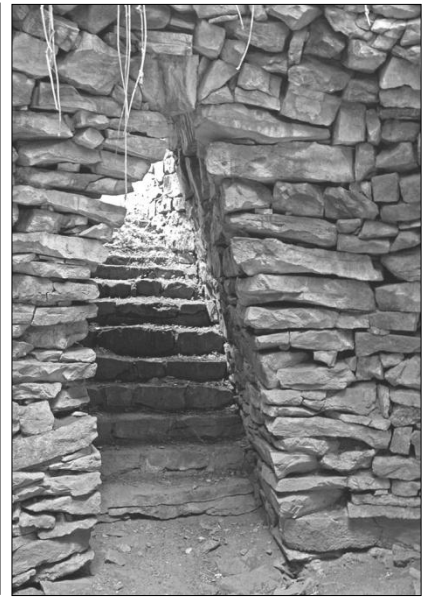
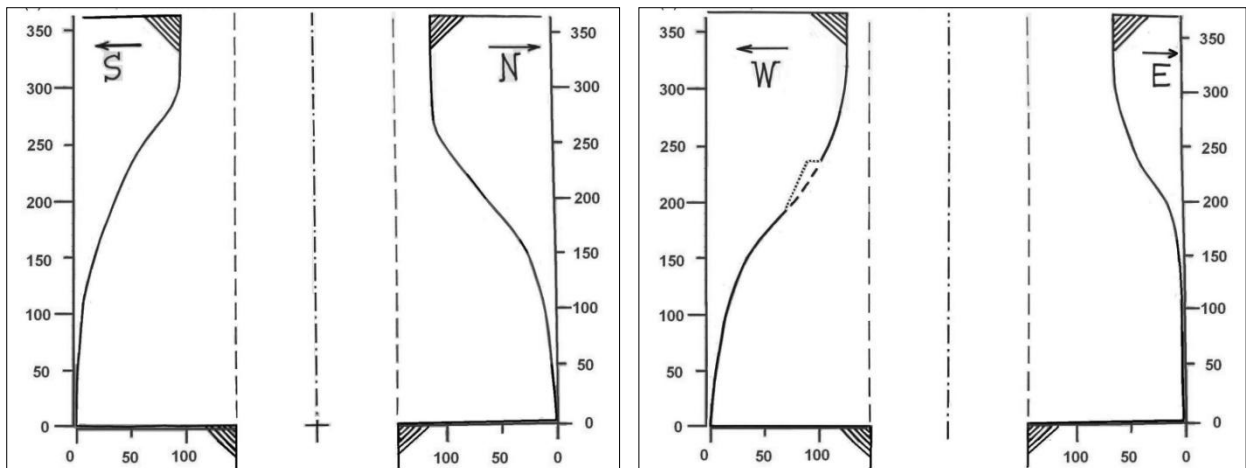


Figure 7 (top, right): The lower end of the dromos with the keystone arch (photograph: L.Tsonev).



Figure 8 (above): The dromos ceiling seen from below, looking upwards. On the left is the exit to the ground surface (the quasi-megalithic roof, and the lintel), and on the right is the transition of the dromos to the tholos (with the keystone arch) (photograph: L.Tsonev).



Figures 9 (left) and 10 (right): Exact profiles of the tholos walls in four perpendicular directions (diagrams: L. Tsonev).

At the vault apex there is a circular opening (*opaeon*), and after restoration it has a diameter of 2.30m. According to D. Mitova-Dzhonova, the original opening was damaged by treasure hunters before the temple was investigated by archaeologists. She supposes that the original *opaeon* had a diameter close to the diameter of the well (i.e. about 1.30m)—similar to most of the temples of this kind.

The sacred well is situated in the center of the tholos floor, and has a diameter of 1.3m and a depth of approximately 5m.

The concept of a real vault is only supposed to have been invented during Roman times. Therefore, the dating of the Garlo well temple to the fourteenth or thirteenth century BCE by its discoverer, D. Mitova-Dzhonova, on the basis only of some stone and clay artifacts does not seem very convincing from an architectural point



Figure 11: The west (left) and east (right) walls of the tholos (photograph: L.Tsonev).

of view. This unique structure therefore needs to be dated by some more objective physical method, such as by optically stimulated luminescence (OSL). In order to check on the possibility of carrying out OSL dating we have to get a realistic picture of the original terrain before the restoration and before the creation of the protective building around the temple. For this reason we measured for the first time the vertical profile of the mountain slope at the following three different places, which are shown in Figure 12:

- 1) Profile 'B' crosses the well temple exactly through the center of the *opaeon* where the change in the original terrain was most considerable, not only in the remote past but also in the years 1972–1983;
- 2) Profile 'A' crosses the hill 50m south of the temple, where the terrain has retained its original slope for more than three thousand years;
- 3) Profile 'C' crosses the hillside 50m north of the temple, where the road necessary for the restoration of the temple in 1983 was formed.

The result of the profile measurements is exceptionally interesting as it recreates an authentic picture of the slope of the hillside prior to the construction of the underground well temple. In the course of the building process a large 15m deep pit shaped like an inverted cone was excavated in the hillside. Stone masonry was used from the deepest point up to the ground surface: first the well was formed, then the tholos and finally the vault with the *opaeon*. The

entire mass of excavated stones and earth removed from the artificial cavity was then piled up on the slope below the level of the well temple's *opaeon* (on what then was the original ground surface). The excavated material was then irradiated by solar UV radiation over a long enough period for the geological luminescence signal accumulated by the quartz grains on the stone surface to be totally bleached away. Then the last layer of rock and soil covered the bleached material and the accumulation of the new archaeological luminescence started. So it would seem that we have here the necessary and sufficient conditions for the application of the OSL dating technique, which has been described by Aitken (1998), Liritzis et al. (1997), Liritzis (2000; 2011) and Theocaris et al. (1997). An independent means of dating the Garlo well temple is critical, and at this stage OSL seems to offer the best possibility.

3 AN ARCHAEOASTRONOMICAL SURVEY OF THE GARLO WELL TEMPLE

3.1 Introductory Remarks

Archaeoastronomical research began in Bulgaria in the second half of the twentieth century by which time it had already been known that a solar cult was widely represented by sacred monuments across the territory of ancient Thrace (i.e. the northern and central part of the Balkan Peninsula).¹ Archaeological sites mentioned below are shown in Figures 1 and 2.

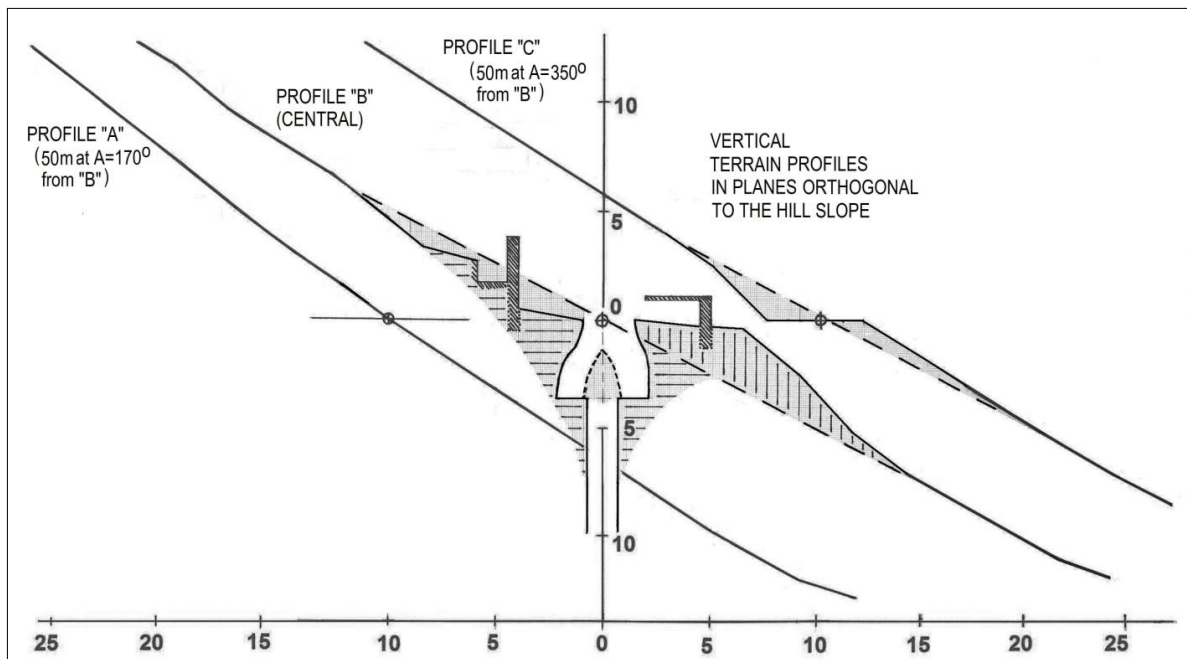


Figure 12: 'A', 'B', 'C' are exact vertical cross-section profiles at the Garlo well temple site. Horizontal hatching indicates the pit excavated into the hillside at the beginning of the temple-building phase. The vertical hatching shows the excavated material piled up on the slope below the temple *opaeon*. The walls of the protective structure erected around the temple are also partially shown. Coordinates are in meters (diagram: L. Tsonev).

Artifacts dating to the fifth and fourth millennia BCE that have been interpreted as showing the use of solar and lunar calendars at this time are the decorated clay figurines from the village of Ovcharovo near Targovishte in northeastern Bulgaria (Koleva, 1991; Nikolov, 1991), and the gold plates with symbolic scenes from the village of Letnitsa near Lovech in central northern Bulgaria (Dermendzhiev, 2007).

Traces of practising solar cults have been detected in rock-cut shrines dating to the second millennium BCE at Belintash (Stoev et al., 1991); Harman-kaya (Stoev et al., 2003) and Angel voyvoda (Ivanova, Koleva, and Kolev, 2013) in the Rhodope Mountains, and the ritual complex in the Sliven region in the Balkan Mountains (Banov and Demirev, 1991).

Sites associated with solar cult activities dating from the first millennium BCE until Roman times in the fourth century CE include the Thracian cult buildings described by Gocheva (1991), rock-carvings near Burgas on the southern Black Sea coast (Georgiev, 1991) and rock tombs near Kavarna on the northern Black Sea coast (Toptanov, 1991).

Dolmens in Thrace date from the twelfth to the fourth centuries BCE and have recently been studied from an archaeoastronomical perspective by González-García et al. (2009), Kolev et al. (2008) and Tsonev and Kolev (2012). Although they do not demonstrate a strongly-defined orientation preference, they are directed predominantly towards the south, where the Sun god reached his maximum power (see the left

hand histogram in Figure 13). Classic Thracian temples found under tumuli and dating to the period from the fifth century BCE to the third century CE demonstrate the same predominantly southerly orientation of the dromos (Russeva, 2000; 2002), as shown in the right hand histogram in Figure 13.

Lunar and/or stellar observations are not noticeably represented in ancient cult monuments found in Thrace, with the curious exception of the Baylovo Cave near Sofia (Stoev and Stoychev, 1991).

A good review of the astronomical knowledge found in classical Thracian society from the middle of the first millennium BCE up until Roman time, as described by ancient authors, is presented by Gerassimova-Tomova (1991).

A water cult also is known to have existed in Thrace in pre-Roman times, but it was never found in association with sacred underground pits or wells. This cult was expressed by honoring numerous small ground-level springs in their natural state, and without any significant accompanying architecture (Nekhrizov, 2005).

Two Bulgarian shrines associated with sacred springs that do have impressive architectural features, but dating to Roman times only, are the sanctuary of the three nymphs at the village of Kasnakovo near Haskovo (Aladzhov, 1997; Nekhrizov, 2005; Venedikov, 1950) and the sanctuary devoted to Asclepius at the village of Batkun/Patalenitsa near Pazardzhik (Tsontchev, 1941; Zontschew, 1940).

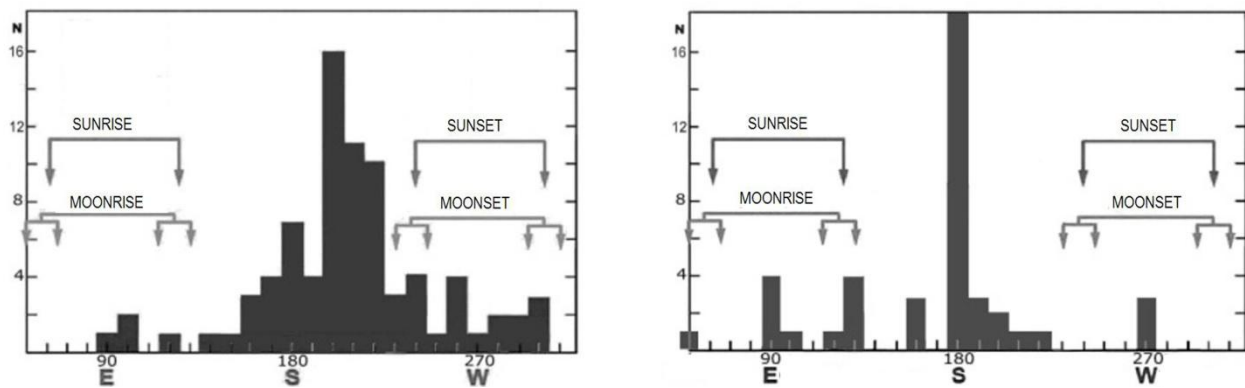


Figure 13: The orientation of 80 dolmens (left) compared with 47 classic Thracian temples under tumuli (right) found in Bulgaria (diagrams: L. Tsonev).

It is clear from the foregoing review that the overall design and the architecture of the Garlo well temple is atypical of the Thracian Culture that developed on the Balkan Peninsula between the fifteenth century BCE and the fifth century CE. The Garlo well temple is unique to this region. At the same time its similarity to some of the Sardinian well temples is obvious and it is because of this that D. Mitova-Dzhonova interpreted the site as a temple of the underground waters, deriving its tradition from the Sumerian god *Enki*. She suggests that the Garlo well temple was created when a group of Sumerians ventured westwards looking for raw materials suitable for development of high-quality bronze metallurgy. After crossing the Black Sea and the Balkan Peninsula this group settled permanently in Sardinia, and on the Balearic Islands and in the Iberian Peninsula. In this area the migrants created the Nuraghi Culture, including the underground well temples (see Mitova-Dzhonova, 1983; 1984a; 1984b; 2012; Mitova-Dzhonova, 2007). Some scholars believe that this migration occurred in the opposite direction (towards the east) and was denoted in ancient written sources as the invasion of the 'sea peoples' into the East Mediterranean (Sheppard Baird, 2011).

From the twelfth to the sixth centuries BCE in the eastern part of the Balkan Peninsula a relatively large and multiform megalithic culture appeared, which included several hundred dolmens and menhirs, and five cromlechs (see Tsonev, 2010; Venedikov and Fol, 1976, 1982).

In the same period a rich and multiform megalithic culture also was developed in Sardinia. It included nuraghi towers, dolmens, tombs of the types 'domus de janas' and 'tombe dei giganti', menhirs and cromlechs. However, in contrast to the Balkan Culture of this era the building of well temples in Sardinia did not stop, but instead they attained a remarkable technical level. The late well temples were constructed in dry masonry using very well-formed cubic stones.

In the period from the fifth to the second cen-

tury BCE the megalithic technique in Thrace was replaced by the use of cubic masonry and fired bricks. The typical sacred sites created in Thrace at this time were monumental tombs and/or temples under tumuli which combine the horizontal plans of the most developed two-chamber dolmens with a dromos (the local Thracian tradition) with the older pattern of Aegean vaulted constructions (the Mycenaean tradition) and with the tumular cover which is of Scythian origin (Kitov and Agre, 2002; Russeva, 2000; 2002).

3.2 A New Interpretation of Garlo Well Temple

Mitova-Dzhonova (1984b) associates the Garlo underground well temple with lunar cults. According to her, there exist specific situations when moonlight enters the tholos vertically through the *opaeon* and is reflected by the water at the bottom of the well. According to Mitova-Dzhonova, these situations allowed the local priests to predict lunar eclipses. However, this interpretation has not been proved by any measurements taken at the temple or by replicated astronomical observations and is mere speculation.

Of course, the Garlo well temple may have been associated with lunar and/or stellar cults, but we prefer to start our interdisciplinary investigation with the most popular cult in ancient Thrace, the solar cult. However, we intend to interpret the Garlo well temple as a structure that combining two basic cults, those of the Sun and of fresh water. We therefore will examine features of the Garlo well temple (its size, scale, construction and location) which could relate to solar observations made for ritual purposes. Three noticeable facts about the Garlo well temple that cannot be explained rationally attracted our attention, and each has a religious aspect.

First is the special interest of the temple-builders in the south direction, which is the orientation of the dromos. Building a genuine dromos

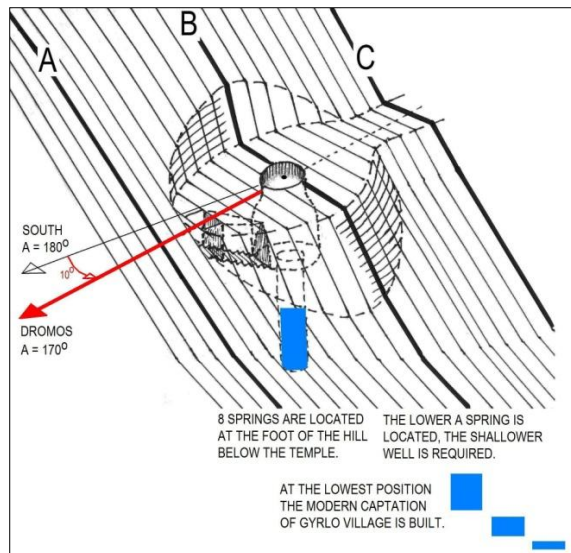


Figure 14: Peculiarities of the Garlo well temple. (a) Numerous springs exist below the temple, at the foot of the hill which would have involved a much simpler and easier temple construction. (b) The dromos deviates slightly from due south (diagram: L.Tsonev).

at the Garlo site in an approximately southerly direction, tangential to the mountain slope (as described here in Section 2), created very complex technical problems. If the dromos was intended as an entrance to the tholos only, the builders could easily have chosen a much simpler approach. The eastern side of the temple is not dug into the hillside but is built freely over the terrain. The entrance could have been placed there using a simple arch, without any corridors or staircases and this would have greatly simplified the construction! It is evident from Table 1 that in Sardinian well temples the orientation of the dromos is not a fixed parameter, i.e. the cult-building tradition permits various dromos orientations. Obviously, the builders of the Garlo well temple intentionally chose the south direction, thereby honoring the culmination of the Sun.

Although Mitova-Dzhonova did not carry out a special archaeoastronomical analysis, what she did, however, was emphasize the second strange feature of the Garlo well temple, which is its striking location high on a steep hillside. There are nine different springs in the surrounding area, most of them at the foot of the hill, yet the highest spring was chosen for the construction of the temple (see Figure 14). Obviously this choice markedly increased the technical complexity of the construction, requiring as it did a deep well in order to reach the spring water. According to Mitova-Dzhonova, only cult requirements could explain such a 'strange' decision. The Minoan specialist, Dr Sheppard Baird (2011), is even more categorical:

The Nuraghic tholos well temples on Sardinia had no practical function at all. While they could have been used as a source of fresh water there's absolutely no reason to expensively cover the well with a subterranean tholos vault approached by a descending dromos stairway. Throughout this period they were the only purely symbolic tholos structures ever constructed and they can be found exclusively on Sardinia with one very notable exception – the Garlo well temple west of Sofia in Bulgaria.

N. Dermendzhiev (2007) has undertaken the only serious attempt till now to analyze the Garlo well temple from an archaeoastronomical viewpoint (see Figures 15 and 16).

According to Dermendzhiev (2007), ancient people used the temple as a solar calendar measuring instrument throughout the year. They examined closely how the sunlight penetrated the temple through the dromos-corridor and marked the position of the lintel shadow on the floor. In Figure 16 this is denoted by OBSERVER SITUATION No.1. At the winter solstice the sunlight penetrated the temple in a most inclined manner and projected the lintel on the northern wall of the tholos. As time passed

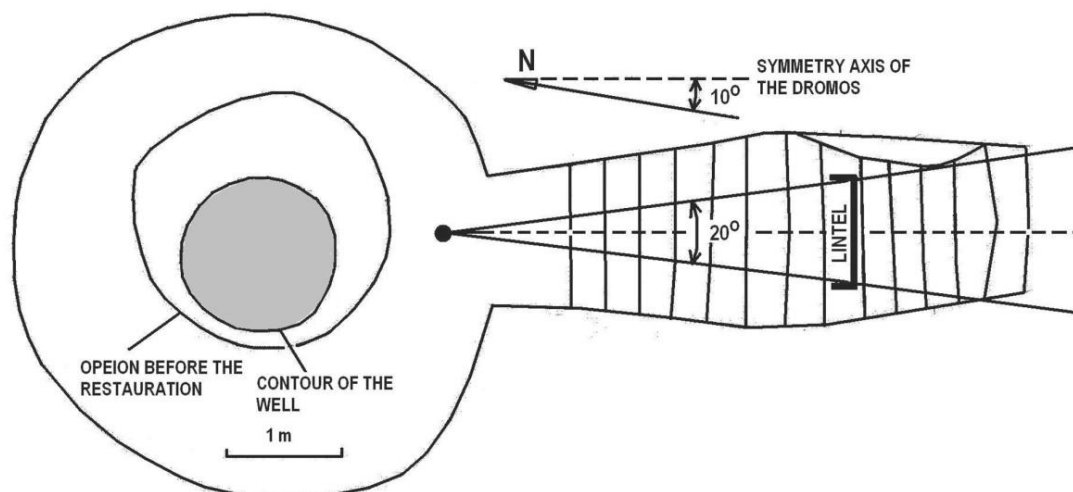


Figure 15: Plan of the Garlo well temple (after Dermendzhiev, 2007).

the lintel shadow moved over the well opening towards the lower end of the dromos. At the summer solstice the sunlight penetrated the temple most abruptly, did not enter the tholos at all, and projected the lintel on the mid-point of the staircase. Then the movement of the lintel shadow was in the opposite direction. Dermendzhiev intended to obtain an exact dating of the temple by examining the process described here, but unfortunately the low professional level of the restoration did not allow him to do this.

Dermendzhiev also published data about the temple parameters before the restoration took place which enable us to draw two important conclusions. Firstly: the observer in situation No.1 in Figure 16 has an azimuthal window of $\pm 10^\circ$ in respect of the vertical symmetry plane of the dromos. Secondly: the original staircase (with an inclination of 40°) was significantly disturbed during the restoration process and the present staircase has an inclination of only 30° .

Dermendzhiev also accurately measured the azimuthal orientation of the dromos as 170° , but he did not comment on the small deviation from due south. And in our opinion this is the third strange feature of the Garlo well temple.

We will now develop our analysis in the direction taken by N. Dermendzhiev, but we will simplify his hypothesis and also introduce some religious interpretative elements. We are looking for a solar connection in the construction of the well temple, and there are two observational possibilities: (1) the Sun illuminates the well vertically through the *opaeon*; and (2) the Sun illuminates the tholos through the inclined corridor (dromos). Vertical illumination through the *opaeon* is practically impossible: since the latitude variation of Sardinia (40°), Bulgaria (43°) and Crimea (45°) is so large that neither the Sun nor the Moon can be expected to stay vertically above all of the temples.

So we shall comment here only on the penetration of sunlight into the Garlo well temple through the dromos, and in doing so we will propose a new hypothesis. We consider the penetration of sunlight into the tholos at the moment of solar culmination during the winter solstice as a ritual action. This assumption is in accordance with the prevailing orientation of the dolmens and classical temples under tumuli in Thrace. The priest in the tholos observes the sunlight (OBSERVER SITUATION No. 2 in Figure 17) and combines this symbolically with a ceremony associated with the underground water. This combination is believed to produce life-giving power, and to celebrate the start of the new life cycle of nature. From this viewpoint the Garlo well temple plays the role of a marker of the winter solstice only and not the role of a

precise calendar-observing instrument. Therefore, our hypothesis does not depend so critically on the low restoration quality and does not require precise knowledge of the original geometrical parameters. Our hypothesis gives a simple explanation for the southerly orientation of the dromos.

In OBSERVER SITUATION No. 2 in Figure 17 the priest has an 'observation window', which is limited above by the lintel, below by the highest staircase step and laterally by both dromos walls. Through this window the priest sees the V-like overlap of the contours of two hillsides, the hill where the temple is built A-A' and the neighboring hill B-B' (see Figures 17 and 18). According to our hypothesis, through this window the observer could not see the solar culmination during the summer solstice and during the vernal and autumnal equinoxes, only during the winter solstice.

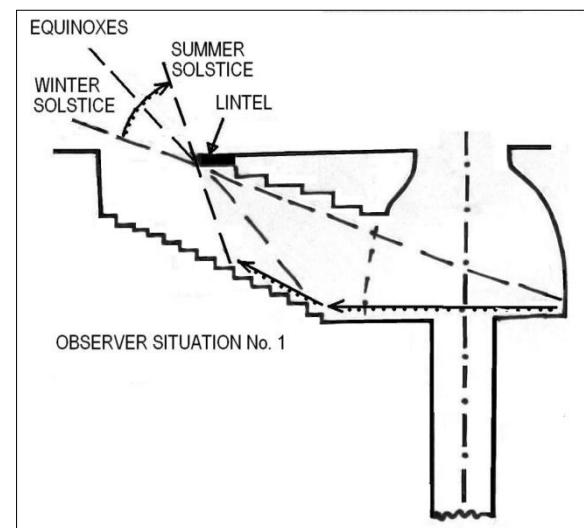


Figure 16: Observer situation No. 1 examined by Dermendzhiev (2007).

The higher the temple is situated the deeper must be the well and the more complex will be the building process. If the temple were situated lower than its actual position, the priest could not observe the solar culmination at the winter solstice from position No. 2 because the Sun would be hidden by the contours of hills A-A' and B-B', and the temple would be in a shady position throughout the whole day. The temple-builders were forced by this situation to place the temple over the highest spring at the hill slope and to build the deepest possible well there (Figure 18). So, our hypothesis explains the apparently anomalous location of the well temple.

We have to add an important remark here. In principle, the possibility of observing the solar culminations in spring, summer and autumn could be achieved from OBSERVER SITUATION No. 2 if the staircase had been steeper.

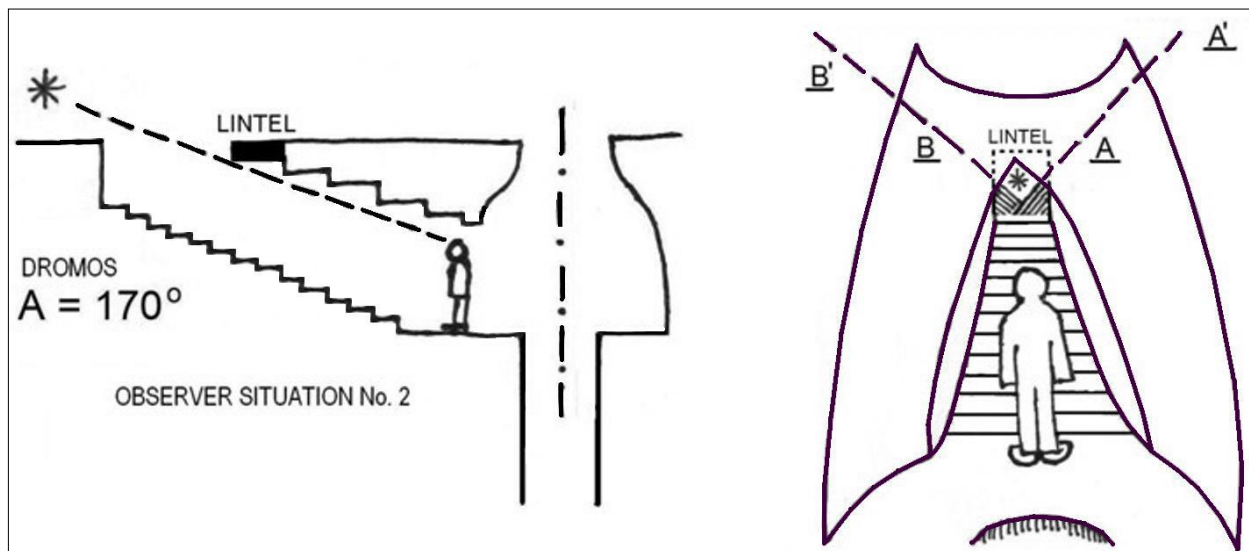


Figure 17: Observer Situation No.2 as viewed from the east (left) and the north (right) (diagrams: L.Tsonev).

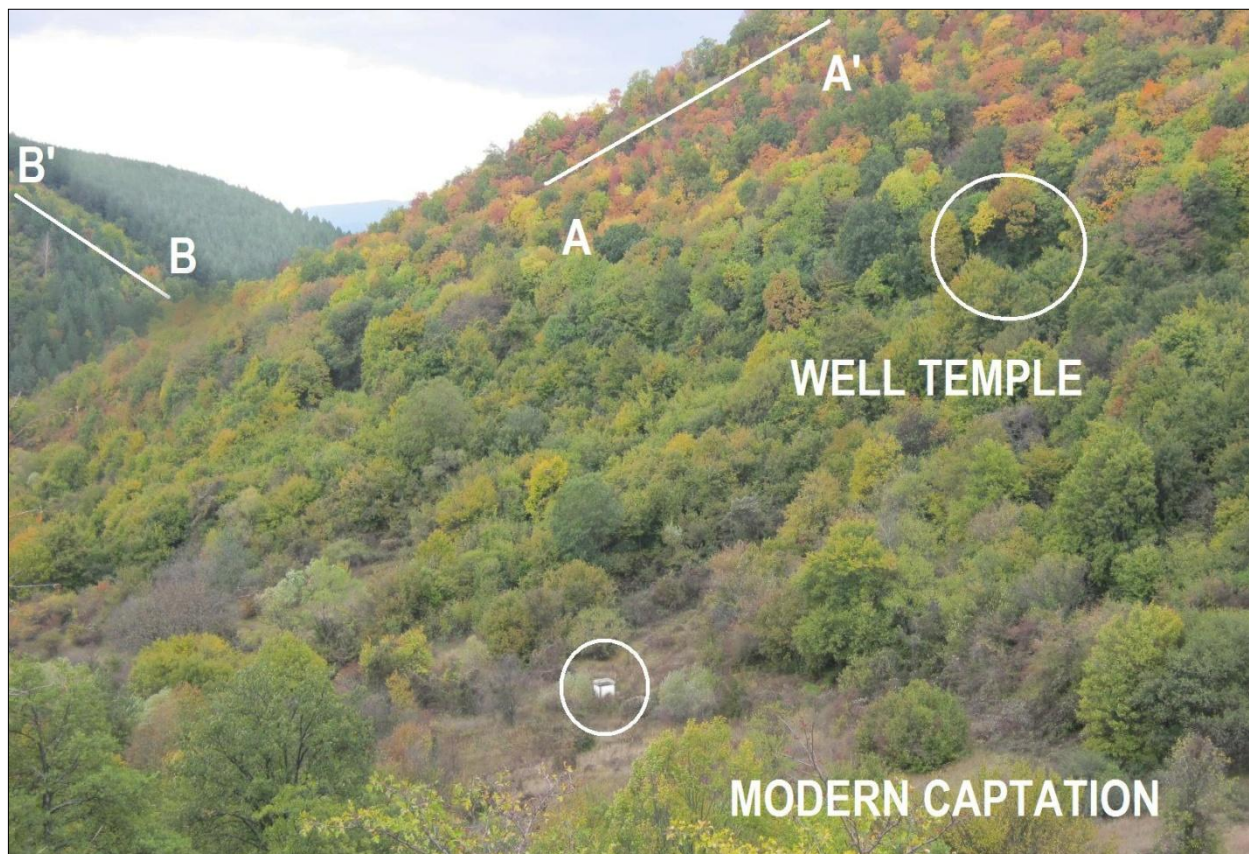


Figure 18: The landscape around the Garlo well temple, showing the contours of mountainsides A-A' and B-B' that were visible from the well temple (photograph: L.Tsonev).

However, Table 1 shows that a dromos inclination of 40° seems to have been very important for the cult and for the temple-builders, and therefore it was never violated.

Let us assume that the builders have already chosen the exact place for the tholos, directly above the highest spring. In this situation it turned out that the local relief hindered the observation of the solar culmination directly to the south, so there were two possible solutions to this dilemma:

- (1) Make the well deeper, and place the tholos higher up the hill slope (relative to its actual position), which would drastically increase the technical complexity of the building process; or
- (2) Rotate the dromos slightly by 10° towards the east in order to direct it towards the saddle between the contours of neighboring hills A-A' and B-B'. An azimuth of 170° would not allow a *precise* observation of the solar culmination at the winter solstice, but the observation would be close enough for ritual and/or agricultural purp-

oses.

The temple-builders decided on the second alternative, which allowed them to utilize the specific characteristics of the local landscape. This solution is in very good agreement with the actual relief in the temple area (see Figure 19). Our hypothesis, then, also explains the slight deviation of the dromos from due south, as was also mentioned by N. Dermendzhiev.

3.3 Verification of the Solar Hypothesis for the Garlo Well Temple

The verification of the hypothesis by means of direct measurements cannot be done due to two obstacles: (1) the protective building around the site hides the southern horizon; and (2) the dense forest around the protective building also prevents direct observations and measurements through the dromos (e.g. see Figure 20).

Therefore, we were forced to use a complicated two-stage experimental procedure in the summer of 2013. At first, we found from observation position No. 2 that point where the dromos axis hits the wall of the protective building from inside. At the second stage we made our measurements from the additional observer point No. 3, located outside the building in the vertical symmetry plane of the temple defined by the imaginary prolongation of the dromos axis with an azimuth of 170° (see Figure 21). So we determined the horizontal direction ($h = 0^\circ$), the visual height of the contour of the hill A-A' (15°) and the upper limit of the observer window in situation No. 2 (23.5°) realized by the lintel of the dromos.

The observation window was reconstructed according to our measurements and is represented by the rectangle in the photograph taken from observer position No. 3 (Figure 22). The result is in very good agreement with our hypothesis. We need to add the following remark here: at the latitude of the Garlo well temple ($\approx 43^\circ$) the height of the Sun at its culmination at the winter solstice is equal to $h_{ws} = 23.5^\circ$; this value coincides with the upper limit of the observer window imposed by the lintel.

If we ignore the inconvenience caused by the unsuccessful restoration it is very likely that the Garlo underground well temple in its original form was used for ritual activities when light from the Sun at the winter solstice penetrated the tholos through the dromos. When this was linked to the underground water, it symbolically marked the start of the new life cycle for the year. The symbolic connection was accomplished if the priest stood in the tholos at observation position No. 2. At this time, the Garlo well temple probably was regarded as a ritual marker of the solar culmination at the winter solstice.

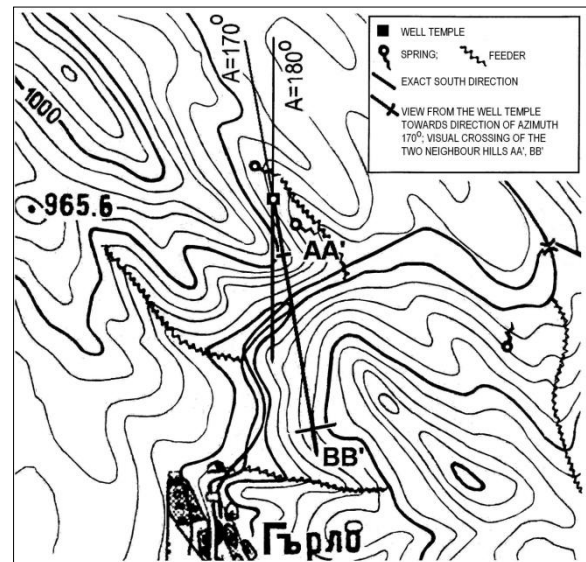


Figure 19: Topographic map of the region around the Garlo well temple.

4 CONCLUDING REMARKS

The underground well temple at the village of Garlo in Bulgaria is very similar to well temples on the island of Sardinia, but at the same time it has a unique terrain location and a very specific azimuthal dromos orientation, both of which have very important architectural and astronomical implications. Solar and water cults are well known in ancient Thrace, but they were never combined and expressed in so impressive a manner as occurred at Garlo. The Garlo well temple incorporates both cults in a way that is atypical of ancient Thracian society and its architectural traditions.

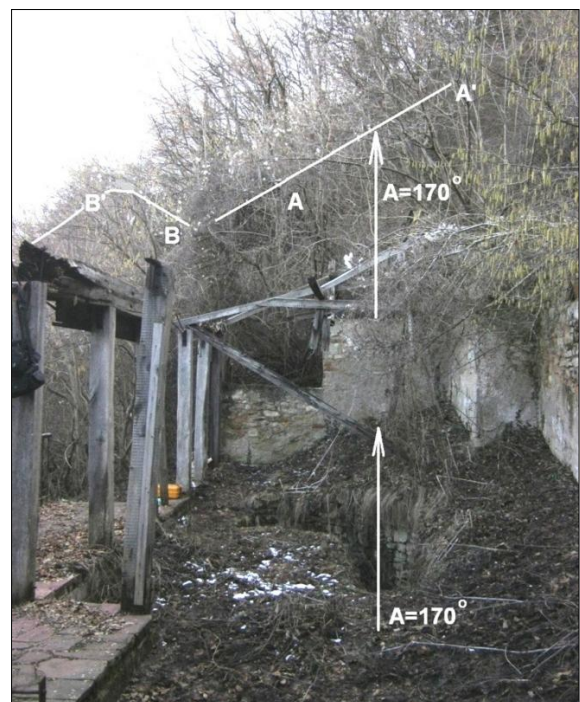


Figure 20: View from a point located inside the protective building along direction with an azimuth of 170° . The shelter collapsed in 2007 (photograph: L.Tsonev).

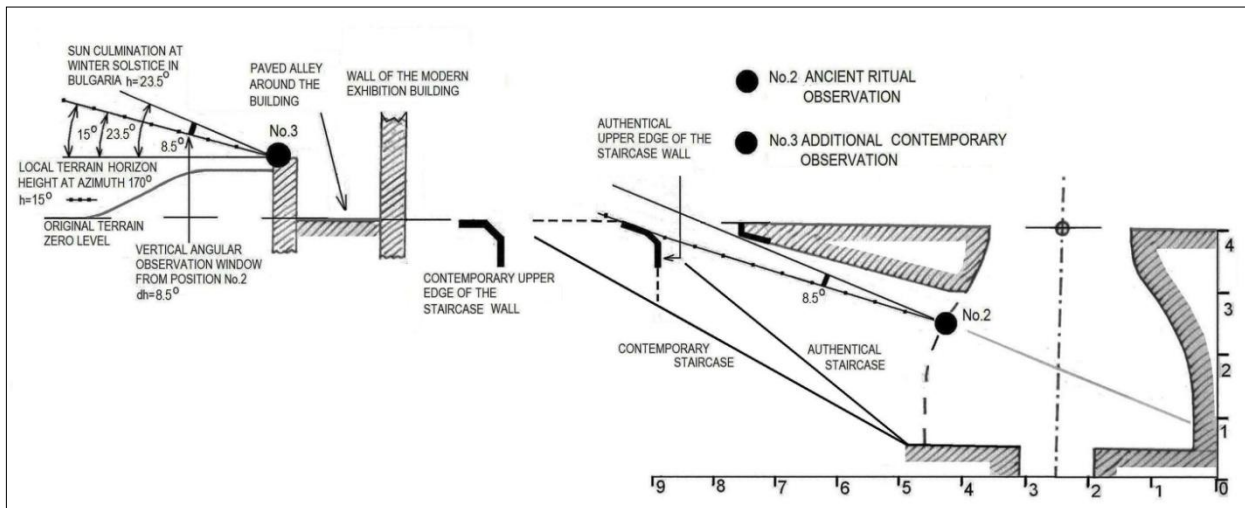


Figure 21: The two-step measuring procedure (points 2 and 3) at the Garlo well temple used to test the possibility for observing the solar culmination at the winter solstice through the dromos (diagrams: L.Tsonev).

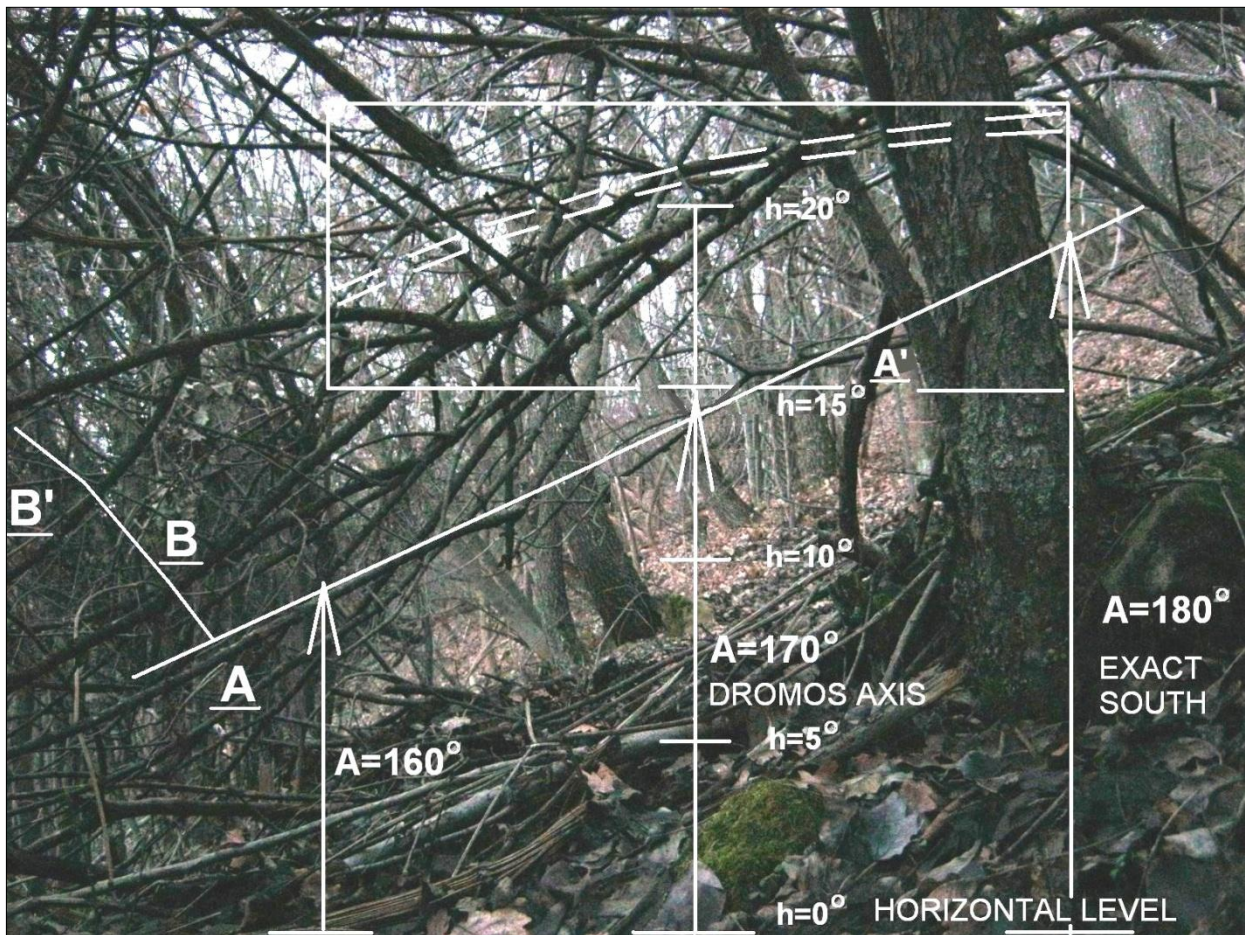


Figure 22: A view from observation point No. 3 in Figure 19, outside the protective building and along azimuth direction 170°. The rectangle represents the observation window for position No. 2 in Figure 19. The double-dashed curve indicates the supposed solar trajectory near the time of the solar culmination at winter solstice ($\approx 23^\circ$) (photograph and modifications: L.Tsonev).

Our measurements show that the structure and the location of the temple agree well with this supposition.

Using the framework of the ritual solar hypothesis presented here we obtain for the first time a reasonable explanation for three peculiarities of the temple's construction which have long been noticed but have not been adequately

explained by other investigators:

- (1) The orientation of the dromos in a southerly direction;
- (2) The strange location of the well temple high on a steep hillside; and
- (3) The small (10°) deviation of the dromos from due south.

The possibility of explaining all three of these peculiarities can be considered as an argument in support of our hypothesis.

While we do not claim that the interpretation of the Garlo well temple presented here can be applied to all prehistoric underground well temples, it does provide some keys for the future investigation of these structures.

The connection of the Garlo well temple with lunar and/or stellar cults is still an option, but these possibilities require additional research.

Finally, the local vertical relief profiles that we measured at the Garlo well temple site suggest that it may be possible to use optically stimulated luminescence (OSL) for more precise dating of this important archaeoastronomical site.

5 NOTES

1. The Balkan Peninsula, also known as 'the Balkans', is the easternmost of Europe's three great southern peninsulas. However, there is not universal agreement on the region's components. Some define the region in cultural and historical terms and others geographically, though there are even different interpretations among historians and geographers. In an historical sense it includes all of present-day Bulgaria, Greece, Macedonia, Albania, Kosovo, Montenegro, and Bosnia and Herzegovina, and the more southerly parts of Serbia, Croatia, Slovenia and Romania, as well as the European part of Turkey known as Eastern Thrace.

6 ACKNOWLEDGEMENTS

We wish to express our cordial gratitude to Kate Christova, Petyr Dimitrov, Kiril Dimitrov, Zhoro Martinov, Velin Stoychev, Nikolay Genov, Nikolay Golemanov, Georgi Angelov, Dimitri Bourilkov, Leonid Marsadolov, Larissa Vodolazhskaya and Vesselina Koleva for their support during our long-running investigation of the Garlo well temple.

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Dr Lyubomir Tsonev graduated from Sofia University



'St. Kliment Ohridski' in 1978. He is now an Associate Professor in the Institute of Solid State Physics at the Bulgarian Academy of Sciences, Sofia. His Ph.D. thesis was on planar optical waveguides for integrated optics. His main fields of research and interest are integrated optics, holography, spectroscopy, optically stimulated luminescence (OSL) dating in archaeology, and archaeoastronomy. Over the last decade he has investigated Bulgaria megaliths, and in 2008 and 2010 he joined Bulgarian and Spanish colleagues and participated in two expeditions. In 2009 he organised the First Symposium on Balkan Megaliths in Sofia (*Balkan Megaliths. Proceedings*, 2009) and recently he initiated the development of a special web site devoted to these objects (<http://www.balkanmegaliths.bgjourney.com>). Lyubomir is on the Editorial board of the *Journal of Archaeoastronomy and Ancient Technologies*. He is the author of two books on archaeological subjects (*Bulgarian Megaliths*, 2010; *Once Again About the Madara Horseman*, 2012) and about fifteen papers on archaeology and archaeoastronomy.



Dimiter Kolev has M.Sc. and Ph.D. degrees in astronomy from the University of Sofia and is an Associate Professor at the Institute of Astronomy with the National Astronomical Observatory, Bulgarian Academy of Sciences. He is a member of SEAC (ESAC-European Society for Astronomy in Culture) and on the Editorial Board of the e-journal *Archaeoastronomy and Ancient*

Technologies. His interests in archaeoastronomy lie in the field of possible astronomical orientation of ancient structures, ethnoastronomy and related topics. He is the author and co-author of many papers on these topics and is a co-editor of the Proceedings of SEAC meeting held in Smolyan, Bulgaria, in 1993.