



THE ASTRONOMICALLY ORIENTED MEGALITHS OF THE MONTE JATO AREA (SICILY): THE “CAMPANARU”, THE “PERCIATA” AND THE ENEOLITHIC/EARLY BRONZE AGE WORSHIP SITE OF PIZZO PIETRALUNGA

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ABSTRACT

An imposing megalith is visible from many kilometres of distance near the top of the hill named Monte Arcivocalotto (Sicily). It is made by a single sandstone slab, shaped in triangular form with a large circular hole pierced at the centre. It is known to local people as U Campanaru (“The Bell Tower”) and it was considered as a magic place until recently. The megalith is oriented toward the sunrise of the winter solstice, when the Sun rises at the hole centre, becoming visible from a very large distance. At a few kilometres, on the top of another hill, significantly named “Cozzo Perciata” (“Hill of the pierced one”) a similar megalith was standing until to a few decades ago. It is presently collapsed, probably by a lightning, but the remains clearly show that it is oriented toward the summer solstice sunrise. Both megaliths have to be considered in the framework of the Eneolithic / Early Bronze Age worship centre of Pizzo Pietralunga, located halfway between Monte Arcivocalotto and Cozzo Perciata.

KEYWORDS: Bronze Age, Sicily, Megalithism, Archaeoastronomy

THE MONTE ARCIVOCALOTTO MEGALITH

On Mount Arcivocalotto, a few km from the southern slopes of Mount Jato, in the municipality of San Cipirello, thirty kilometers South of Palermo, there is a large rock with a wide artificial hole (Scuderi *et al.*, 2012). (Fig. 1).



Figure 1: The Campanaru pierced rock on Monte Arcivocalotto.

The site was already known in the archaeological literature because ceramics dating from Eneolithic to the Bronze Age were found in the neighborhood (Scuderi *et al.*, 2011 and references therein). It was also frequented in Roman and medieval times and is in a prominent position midway on the East-West directrix joining the Rocca Busambra mountain, in the territory of Corleone, and the areas immediately South of Mount Jato. The latter is known to be the location of a proto-historical city that, between phases of expansion and moments of crisis or abandonment, lasted up to 1246 AD, when it was finally depopulated by order of Emperor Frederick II (see, e.g. Isler, 2000).

The site of Monte Arcivocalotto seems to have been, between the Neolithic and Bronze Age, the somehow hegemonic center of the surrounding territory: the nearby settlement complex of Pietralunga seems to depend from it. This complex (Scuderi *et al.*, 1996, pp. 21-22; 1997a, p. 20; 1997b, p. 503; 1998) is located at the foot of the homonymous rock (Pizzo Pietralunga), an extraordinary limestone rock of

enormous size and considerable height, totally isolated, emerging from the Belice river plain and visible for miles all around (Fig. 2).



Figure 2: Pizzo Pietralunga: South view (left) and orthophoto with the area of the archaeological findings marked (right).

The Monte Arcivocalotto megalith [1] is part of a sandstone layer, emerging from the Oligo-Miocene Numidian Flysch clays, with North-South direction. The layer is located sideways on a ridge affected by massive landslides in blocks that are slowly undermining its stability.

The megalith appears as an isolated slab, triangular in shape, of about 4 m length and about 3 m height. Its section is roughly triangular, with a thickness of about 1.5 m at ground level. The western side is nearly vertical, while the eastern side is inclined of about 75° with respect to the horizontal plane. It is possible that the "isolation" of the rock is the result of an action of hewing of the other existing blocks on the top, precipitated into the valley below. A subsequent action for cleanup of the area has shaped the clay side, so as to render the position of the pierced rock predominant and selected, visible from throughout the area below at a distance of several kilometers.

This mighty monolith was affected by the action of man. In the thickness of the rock, near to its centre, a large hole, with a diameter of approximately 2 m, was in fact artificially made. The artificial character of

the large hole can not be questioned and this conclusion cannot be weakened by the hypothesis of possible, partial transformations over time. Also the likely changes, especially in the external profile, due to natural causes (erosion, small detachments of stone) do not change the reality of a manifestly artificial hole. The certain and unmistakable work of artificial transformation of the rock of Mount Arcivocalotto by the opening of the large hole allows to speak of "monument" not only in the natural sense. Superfluous, following Mircea Eliade (1948), to recall here, even if only briefly, the importance of the artificial or natural "pierced stones" in the field of anthropology and ethnography.

Below the vault of the circular hole, on the base, a cavity with a rectangular section about 1.60 m long and 0.50 m wide was excavated in the rock; at first glance it may be assimilated to the *formae*, the late Roman and early Christian burials dug in the rock floor, both in the catacombs and *sub divo*. A shoulder appears to divide this cavity from a second one, seemingly similar, but that appears in large part cut down and then canceled by a certainly artificial intervention. The presence of such excavations under the rock has allowed the hypothesis that the large pierced rock of Monte Arcivocalotto may be what remains of a Roman *bisomus arcosolium* (Tusa & Vassallo, 2012). In the present state, in reality, the use as burial of this cavity would seem hardly conceivable, since there is no clear evidence of the way in which it could be closed and sealed. Indeed, because of the concavity of the profile of the excavation, it appears difficult or impossible to assume a closure by means of large tiles or slabs, as it is normal in the case of *formae*. Furthermore, it can be noted, concerning the interpretation of the monument of Monte Arcivocalotto as *arcosolium*, the absolute absence of clearly and unmistakably identifiable *arcosolia* not only in the vicinity of the pierced rock (where there is only a *forma* burial located not far away) but in a

whole wide surrounding area. No other element seems to support the hypothesis of the nature of the complex as a late Roman burial. The local name of the monument, indeed, would seem to exclude this possibility. The local tradition and place names do not refer to tombs, burial grounds and even to a simple cavity. Locally, this unusual worked rock, was and is still named by farmers "*U Campanaru*", i.e. "The bell tower"[2]. This definition, on the one hand, can be read simplistically, given the appearance of the artificially pierced rock, that could be assimilated to the top of a bell tower with the space where the bell swings. On the other hand, a more subtle anthropological reading of the definition would assume that the artificially pierced hole in the rock had some mystical purpose, connected with the passage of time and its measurement, just like a bell tower. In this sense, the local traditions may be referred to the original nature and purpose of the monument.

Below the north-western outer wall of the monument, on a rock step surely artificially tooled and smoothed, almost on the edge of the steep cliff that plunges to the lands in the valley, there is an engraving, representing four concentric squares with four segments that cross the square in the middle of the sides at right angles (Fig. 3): it is an elaboration of the well-known and widely used "triple ring" motif (Uberti, 2008).

The two segments facing East and West are engraved along the same direction of the median axis of the hole. The presence of this petroglyph adds a further problem. The drawing is by no means unusual, being the pattern of concentric squares (almost always three, in our case and in a few other, well-known in the literature, four) found in many medieval monuments, as well as on rocks and lithic or clay fragments, sometime surely identifiable as Roman "*tabulae lusoriae*". The latter interpretation, given the location of the petroglyph of Monte Arcivocalotto on a narrow, overhanging

ledge, is difficult to sustain, even if a fragment with the same pattern was found at a short distance from the pierced rock and is now housed in the Monte Jato Antiquarium ("Case D'Alia").



Figure 3: The concentric squares petroglyph carved on the step at the foot of the megalith on its NW side.

Oral testimonies would indicate the existence, until a few decades ago, of a fence around the monolith, from side to side of the slab, made by small triangular blocks driven into the ground. A possible strengthening of this hypothesis could be found in the chaotic heaps of stones around the megalith. The stone removal is due to the farmers to increase the cultivable area in cereals (sowing reaches, in fact, the limit of the megalith). However, in the top western side, a surviving rock with a characteristic triangular shape is still standing, which could be interpreted as a relic of the past fence of stones planted in the ground that supposedly delimited the large pierced rock in a semicircle [3]. It should be also noted near the top of the slab, some characteristic signs, as small parallel incisions similar to notches, some time grouped by a further perpendicular sign.

THE ASTRONOMICAL ORIENTATION OF THE PIERCED ROCK OF MONTE ARCIVOCALOTTO AND ITS INTENTIONALITY

The light effects during the winter solstice

at the pierced rock of Monte Arcivocalotto was first directly observed by us on December 22nd, 2010 (see Fig. 4). It was found that the Sun light touches the step sited at the foot of the western wall at 7:22 (CEST) and, slowly moving inside the hole, rises to its centre approximately at 8:00 (CEST) [4]. Direct sunlight is visible through the hole for about an hour per day during a period of five days centered on the winter solstice.



Figure 4: Sunrise of the 2010 winter solstice at the Campanaru pierced rock on Monte Arcivocalotto.

Instrumental measurements of the megalith orientation were performed on June 23rd 2011, by using a precision bearing compass. Azimuth measurements were corrected by GPS measurements of the geographical coordinates ($37^{\circ} 55' 44''$ N; $13^{\circ} 15' 29''$ E) and by comparison with the measurements of the direction of prominent reference points from IGM [5] cartography (maps 2581SO and 2584NO) and georeferenced SPOT satellite images for local magnetic declination, that resulted to be $2^{\circ} \text{ E} \pm 0.5^{\circ}$, in perfect agreement with the NOAA Magnetic Field Model (<http://www.ngdc.noaa.gov/geomag-web/>), giving, on the day of the measurement, the value of $2^{\circ} 17' 52''$ E, changing by $6.2' \text{ E}$ per year. It was found that the hole axis has a geographic azimuth equal to $133^{\circ} \pm 1^{\circ}$ and elevation respect to the horizontal plane of $15^{\circ} \pm 1^{\circ}$. This axis is clearly identified in azimuth by a reverse V shaped viewfinder excavated in the upper vault of the hole,

that make it easily noticeable even from a large distance.

Because of this orientation of the hole axis, the Sun appears inside the hole a few minutes after its rising over the geographical horizon at the winter solstice and only in this period. The small change of the sunrise horizontal coordinates due to the precession makes us sure that the phenomenon has been basically the same during the last millennia.

The pierced rock thus presents a manifest astronomical alignment. However, it has to be conclusively demonstrated that this alignment, in itself an unquestionable physical fact, is intentional. In this matter, Schaefer (2006) [6] suggested that, in order to claim the actual intentionality of an astronomical alignment, at least two, and possibly three, conditions have to be satisfied: the alignment has to be statistically significant, at least at a 3 level over the null hypothesis (random orientation); archaeological proofs of intentionality must be present; finally, ethnographical or paleoethnological evidences of the symbolical value of the claimed alignment should be found. This protocol has been widely accepted by the scientific community [7] and is now commonly used to accept the intentionality of an astronomical alignment in an archaeological artefact. This procedure was followed in the case of the Monte Arcivocalotto pierced rock.

The archaeological proofs of intentionality are numerous in this megalith. Actually, the pierced rock shows manifest traces of working made in order to obtain a preconceived orientation of the hole axis. Furthermore, the concentric squares petroglyph traced on the step at the base of the rock north-western side is exactly oriented as the megalith hole axis: it looks thus to be connected with the rock hole and it is undoubtedly oriented toward the winter solstice sunrise. Thus, it allows a person standing on the step to determine

with higher precision that the rays of the rising Sun are actually coming from the direction marking the winter solstice.

Considering the ethnological evidence, it appears difficult to find this kind of testimonies concerning a manifestly ancient artefact as the "Campanaru". However, as stated by Jacques Le Goff (2003), "Sacred is tenacious and a sacred place, once consecrated, maintains its aura through the changes of society, culture and religion". Actually, as mentioned before, witnesses of modern folklore show that the rock was considered up to recent times as a sacred and magic place, as it is demonstrated by the legend justifying its name, that imagines it as the bell tower of a destroyed church, ringing alone in special days, thus ascribing to the megalith a mystical and calendric role.

Last, we have to evaluate the statistical significance of the detected astronomical alignment.

Following again Schaefer (2006), if we adopt a maximal acceptable error in azimuth of 1° as forced by variable refractions and various practical issues, the eight significant solar directions known to all cultures (i.e. the four cardinal directions and the four ones of the sunrises and sunsets at winter and summer solstices) span a range of 16° in azimuth, which is 4.4% of the total horizon (360°). So if a single alignment in a site actually points at one of these significant azimuths within $\pm 1^\circ$, then the hypothesis that the alignment is just by chance alone (the null hypothesis) can be rejected at the 22:1 confidence level (2.08 in Gaussian statistics).

However, in our case, we have to take into account that the detected phenomenon takes place only because, when the Sun transits at the azimuth of the hole axis, it also has the height over the geographical horizon, obstructed by 15° by the Rocca Busambra mountain, equal to the one of the axis. Following the same line of reasoning as in Schaefer (2006), Curti et al. (2009)

evaluated the probability that the local transit of the Sun happens, inside a $\pm 1^\circ$, at a height equal to the one defined by the angle under which a viewfinder is seen by a fixed observing point: in fact, respect to the null hypothesis of chance orientation this probability is equal to 90:2 (being the possible Sun heights anyone between 0° and 90°). The hypothesis that this

coincidence in height alone is just by chance (the null hypothesis) can thus be rejected at the 45:1 confidence level, corresponding, in Gaussian statistics, to $\sim 2.5 \sigma$.

Therefore, the conditional probability of these two independent events is 3.25 and it is thus higher than the commonly accepted threshold of significance (see Table 1).

The Campanaru thus satisfies all criteria

Table 1: Evaluation of the statistical significance of the coincidence between the Campanaru hole axis and the direction of the winter solstice sunrise.

Alignment	positive cases	Null hypothesis (random orientation)	chance coincidence probability	in Gaussian statistics (σ)
<i>The Campanaru case</i>				
Hole axis azimuth with azimuth of one of the 8 significant solar direction ($\pm 1^\circ$)	16	360	$16/360=1/22$	2.08
Hole axis height with the Sun height for the same azimuth ($\pm 1^\circ$)	2	90	$2/90=1/45$	2.50
total conditional probability of chance coincidence ($\pm 1^\circ$) of the axis azimuth and height with winter solstice sunrise direction, taking into account the actual local horizon skyline			$1/22 * 1/45 = 1/990$	3.25

stated by Schaefer (2006) in order to claim that its astronomical orientation is intentional. Nevertheless, if we consider this monument alone, its probability of random orientation, though small, is only slightly lower than the one that the strict rules of Archaeoastronomy accept as significance threshold. However, the *Campanaru* is not the only astronomically oriented artefact in the country located

South of Monte Jato.

THE RELATIONSHIP BETWEEN THE CAMPANARU, PIZZO PIETRALUNGA AND COZZO PERCIATA

In particular, considering the statistical significance of the Campanaru astronomical alignment, the relationship between this monument and Pizzo Pietralunga must be

taken into account.

Pizzo Pietralunga is a single, isolated rock, about 150 m high, standing over the Belice River plain. It came up from the ground millions of years ago because of unusual interactions between the tectonics faults crossing this unstable area, but its impressing phallic shape, dominating the plain, made it a sacred place at least since the Eneolithic to the Bronze Age. Actually, many luxury goods, as well as a fragment of 'Bell beaker' culture ceramics (extremely rare in the area) were found there, suggesting the presence of a worship area and of votive offering.

At winter solstice, exactly at the same time when the rising Sun illuminates the hole of the megalith, it can be seen to shine back to Pizzo Pietralunga, if observed from the north-western side of this pinnacle. Of course, this is a natural fact and can not thus have any statistical significance. However, from the same position, the Sun is seen reflecting, through the megalith hole, on the river Pietralunga [8] down in the valley: this is not a natural circumstance, since it depends on the position of the megalith on the slope of Monte Arcivocalotto and on the azimuth and elevation of its axis which, as we have discussed, are certainly artificial. Since this phenomenon again implies a correspondence between the azimuth and height of the line of sight joining the small part of the river visible from the NW side of Pizzo Pietralunga and the hole of the rock with the ones of Sun at this moment, a statistical significance of 3.25 must be attributed also to this alignment.

Furthermore, a group of four manmade holes were noticed on the SE side of Pizzo Pietralunga. They are clearly made to host poles, sustaining an unknown structure, maybe a panel of some perishable material. These holes are oriented in such a way that at winter solstice sunrise, the sunlight illuminates directly their bottom. This means that, on this date at sunrise, and only at that time, the shadow of the structure

supported by the poles was projected on the surface of the rock exactly on the rectangle defined by the holes, giving a visible signal of the date. Because of the same reasons reported above, this alignment also has a statistical significance of 3.25 with respect to the null hypothesis.

However, we have to ask ourselves if the Campanaru and Pizzo Pietralunga should be considered parts of a single cultural complex, characterized by the same interest for the winter solstice. We can positively answer this question. In fact, in 2012 a carved stone, showing many symbols, was found near the Monte Arcivocalotto megalith (Fig. 5).

Apart from the interpretation of the



Figure 5: The carved stone found near the Monte Arcivocalotto megalith (upper) and relief showing the visible symbols (lower)

other symbols, it is very probable that the shape of the phallic symbol on the left of this stone repeats the one of Pizzo



Figure 6: The worked stone shaped as Pizzo Pietralunga found near the Monte Arcivocalotto pierced rock.

Pietralunga. Furthermore, a large worked stone, that can be assimilated as to shape and dimension to a menhir, has been

discovered a few meters SE of the *Campanaru*. It is abated [9], but it is most probably still in the original position and perfectly aligned with the megalith hole axis. Also the shape of this stone, or possible menhir, seems to reproduce the shape of Pizzo Pietralunga (Fig. 6).

These evidences, together with the archaeological proofs that the two sites were frequented at the same time by the same culture (Scuderi et al, 2011) clearly show that the megalith and Pizzo Pietralunga are connected and that the computation of the composite probability respect to the null hypothesis of the three alignments described above is meaningful. This composite probability of the contemporary presence of the previously cited independent events is thus of 6.5σ [10] essentially ruling out the possibility of chance coincidence (Table 2).

Finally, not far from Pizzo Pietralunga,

Table 1: Evaluation of the statistical significance of the detected astronomical alignments in the case of the *Campanaru* – Pizzo Pietralunga complex

Alignment	positive cases	Null hypothesis (random orientation)	chance coincidence probability	in Gaussian statistics (σ)
The Campanaru / Pizzo Pietralunga case				
<i>Campanaru</i> hole axis with the direction of winter solstice sunrise	1	990	1/990	3.25
Pizzo Pietralunga holes with the direction of winter solstice sunrise	1	990	1/990	3.25
line of sight of the reflected image of the megalith on Pietralunga river with the direction of winter solstice sunrise	1	990	1/990	3.25
Total conditional probability			$1/990 * 1/990 * 1/990$ = 1/970,299,000	6.5

there is a further pierced rock with a solstitial alignment. Actually, at about 6 km from this very peculiar pinnacle, on the top of a hill significantly named “Cozzo Perciata” (i.e., in local dialect “Hill of the pierced one”), there is another pierced rock [11]. It collapsed a few decades ago, maybe because of a lightning or due to the strong Belice earthquake of 1968; however a photograph, taken in the early 1960s, shows as it was quite similar to the *Campanaru* of Monte Arcivocalotto (Fig. 7). Furthermore, the lower part of this rock, surrounded by the fragments of the upper part, is still in place: it was thus possible to measure the direction of the hole. It was found that it points to the top of Pizzo Pietralunga, with azimuth of $60.6^{\circ} \pm 1^{\circ}$ and height over the horizontal plane of $1.7^{\circ} \pm 1^{\circ}$: this direction exactly corresponds to the one of the sunrise over the local geographical horizon on the summer solstice of the beginning of the second millennium BC; following the previously exposed line of reasoning, also this further alignment has thus a probability respect to the null hypothesis of random orientation equal to 3.25σ .

Also in the case of this pierced rock,



Figure 7: The pierced rock of Cozzo Perciata taken in the early 1960s.

there are various ethnographic evidences of the symbolical value of the claimed alignment: in fact, it too was named by local people *Campanaru* or also a *petra unni nasci u suli* (in local dialect “the stone where the Sun rises”). The same witnesses told us that

the rise of the Sun inside the *Campanaru* of Cozzo Perciata indicated, up to a few decades ago, the beginning of the harvesting time.

Concerning the archaeological evidences, in the area of a few meters around the pierced rock of Cozzo Perciata, fragments of Eneolithic and Early Bronze Age ceramics are visible. Thus, also waiting for further archaeological studies that can finally confirm the contemporary frequentation of the Monte Arcivocalotto, Pizzo Pietralunga and Cozzo Perciata sites, the probability that in this area could be found by chance two similar artificially pierced rocks (the ones of Monte Arcivocalotto and Cozzo Perciata), with different and complementary solstitial alignments (to winter and summer solstices) looks to be totally negligible.

CONCLUSIONS

It can be reasonably concluded that, following the standards of Archaeoastronomy, both the *Campanaru* of Monte Arcivocalotto and the *Campanaru* of Cozzo Perciata (no more standing, but well documented) are artificially worked structures, made almost certainly in prehistoric epoch to determine the winter and summer solstices, for calendric and ritual purposes. These two monoliths, modified by man, thus became two solar calendars, connected to the seasons cycle. If this hypothesis will be confirmed by further studies, the two nearby pierced rocks sited in the area south of Monte Jato, centred on the worship site of Pizzo Pietralunga, should represent together a precious archaeological unicum, possibly connected to the megalithic Sicilian *facies*.

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NOTES

1. Here and thereafter, the term "megalith" is used in the etymological sense of "large stone", as reported by Bahn, (1992), p. 317. A preliminary description of this artefact has been presented in Scuderi et al (2012).
2. A. Nania (1995, p. 106) reports the local name of *Campanaru* and notes that "the stone would seem artfully crafted. It has a wide enough nearly circular hole at the base of which is chiseled a basin: it appears to be a sacrificial stone. In the lower part of the North wall, just behind the basin, some graffiti are engraved as a series of concentric squares with a maximum size of about 40 cm."
3. Probably artificial alignments stones are registered in this area by the famous *Rollo* of the Church of Monreale of 1182, but this fact can not lead to any conclusion. The *Rollo* of 1182 is published electronically on the website <http://vatlkat3880.altervista.org>.
4. The exact time of transit of the Sun at the centre of the hole is obviously difficult to determine.
5. The Military Geographical Institute (IGM) is the government institution on duty for official Italian cartography.
6. In his analysis of the intentionality of three of the most famous claimed archaeoastronomical alignments in North America
7. Though it has been considered overstrict by some scholars (see, e.g. Sinclair, 2006)
8. Also called Belice Destro
9. The owner of the ground told us that it was accidentally hit by a tractor a few years ago
10. Corresponding to about one over a billion
11. It is worth to notice that Pizzo Pietralunga is nearly exactly midway between Monte Arcivocalotto and Cozzo Perciata

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