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LUNISTICES AT SESTO FIORENTINO: AN INVESTIGATION ON GEOMETRY AND ALIGNMENTS OF THE *THOLOS* TOMBS OF THE ETRUSCAN PRINCES

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ABSTRACT

Among the Sesto Fiorentino (Florence) Etruscan tombs, the most renowned and best preserved are the two architectonically impressive seventh century BC *tholos* tombs of La Montagnola and La Mula. Another *tholos* (Tumulo Montefortini) is placed in the near city of Artimino, circa ten km away from Sesto. The tombs belonged to powerful Etruscan princes and greatly differ for magnificence from other tombs in the surroundings. Several Etruscan *tholos* tombs were found spread in northern Etruria. We have studied the geometry of La Montagnola and La Mula conducting the analyses in CAD working on the best available plans using qualified best-fit methods (Kasa, 1976). The scheme that resulted for La Montagnola (the only one complete and with its original *dromos*) send back to the classification by Ranieri (2008) of the geometries of the Mycenean *tholos* tombs. we have been searching for the employed length units and found to conform to greek-roman cubits and palms. Simulations of the ancient sky with Stellarium have shown that the alignements of all the three *tholos* tombs can be associated to the minor lunar standstill, in a region of the sky that the Etruscans denoted as pertaining to the death. In turn, the toponymy "Artimino" can be reasonably interpreted as deriving from the name of the Etruscan goddess *Aritimi*, associated with the Moon, the death, the night, the nature and the woods.

KEYWORDS: Sesto Fiorentino, Lunistice, Solstice, Tholos tombs, Etruscans, Ancient geometry, Ancient metrology, Alignments.

1. INTRODUCTION

The zone currently corresponding to Sesto Fiorentino lies just north of the river Arno and is usually considered the northern boundary of the Etruscan territories during the VIII and VII centuries B.C.. Beyond this natural limit, rose Visul (Fiesole), the last Etruscan outpost before Ligurian dominions.

Relevant legacies of these settlements are the monumental *tholos* tombs present in the area, probably belonging to important princes. The architectures and their respective grave goods show an evident eastern influence.

A North-West oriented swamp is at the center of the examined area, being the Arno the southern limit and being the sides occupied by the elevations of Monte Morello on the North-East and of the Montalbano on the South-West.

From Monte Morello originates the Zambra creek, which joins the Bisenzio, an Arno's tributary. Exactly by its banks are placed two of the three *tholos* tombs that we have analyzed. The third is located on the slopes of the Montalbano.

At Sesto *Tholos* tombs might have been four. One of the two missing, was possibly located in the nearby Villa Solaria (remains completely demolished around 1850). The other one was only supposedly a *tholos* but not even the form is certain (Rilli 1964): it was totally destroyed at the moment of its finding in 1901 in nearby Palastreto.

The aim of this study is to verify if common geometrical and metric features and common orientations exist for the three *tholoi*.

1.1 Previous studies

The interest of the Etruscans for the sky is certain without any doubt. Their particular attention for religion and divination with respect to specific direction, suggests the presence of cosmological principles in orienting temples (Dilke, 1987). As mentioned by Aveni (1994), "for the Etruscans the setting of directions was not according to man but rather to world itself" and also they "believed in a one-to-one correspondence between the macroscopic structure of the world and the microscopic organization of its component parts".

This suggests a close relationship between cultural rites and the locations of the deities in space through the orientation. Many authors describe the concept of the "sectors division" in the Etruscan sky, that ideally divided it into a favorable and an unfavorable side. Furthermore, the discovery of the liver from Piacenza confirmed the mention by Martiano Capella who reports a division of the Etruscan cosmos in 16 sectors corresponding to 16 Etruscan Gods. Pallottino (1990) locates the "ill fortune" on the domain of the Moon on the liver's underside.

Greeks and Romans differed deeply on the way they oriented their temples: Greeks oriented them generally to the East, Romans had no preferential direction for their bearings (Nissen, 1869). According to Aveni, Etruscans way to align the temples lays in between the Greek and the Roman way, being the orientations confined between East and South-West (Aveni et al., 1994, Fig.8) or, as Bagnasco (2013) notes, mostly between the winter solstice sunrise and the winter solstice sunset.

Each specific orientation appears interpretable as linked to deities and in turn to their location in the sky. This is for instance the case of the west oriented temple of Volterra which was dedicated to infernal gods (Aveni et al., 1994, pag. 561), well toward the zone of negativity. As more recently discussed by Bagnasco (2013) the orientations of temples and sanctuaries and their relationship with the sky is still quite unclear. In regard to the orientations of Etruscan Tombs Bonfante (1986) stresses a clear difference between the early and the late burials (VI century B.C.): "while the tombs were at first usually oriented toward the west or the northwest they were, from the middle of the sixth century B.C., simply planned according to the direction of the streets of the necropolis, and accessible directly from them".

THE TOMBS

2.1 La Montagnola (Sesto Fiorentino)

This tomb is the best preserved with a complete *dromos* (figure 1-top), side rooms and a five metres wide dome supported by a pillar. We had noticed that the *dromos* was possibly aligned to Summer Solstice Sunset. On June 21 we went to Sesto for on place confirmation but, disappointingly, we experimented that the sunlight entered the door of La Montagnola much before sunset. The horizon in front of the tomb is substantially free and therefore the discrepancy could not be justifiable by the effect of the presence of elevations.

The tomb and its *dromos* are perfectly visible on satellite images and we could measure the orientation within the uncertainty of about ± 1 degree.

For the geometrical and metric analyses we made use of the plan in Boethius (1969).

2.2 La Mula (Sesto Fiorentino)

La Mula is some 500 meters south-west of La Montagnola. We had been there in the same day and we verified that, as already known, the current access to the *tholos* does not follow the original path of the ancient *dromos* because the tomb is located under a castle of which it had become the canteen. For this

reason, a direct estimate of the alignment on the even good quality plan by Ugolini (1984) could not be reliably achieved, being the North indication on the drawing untrustworthy (figure 1-bottom). On the other hand, good geometric and metric analyses were possible. An accurate reconstruction of the alignment could however be done having recognized on the satellite images several external points shown on the Ugolini's drawing.

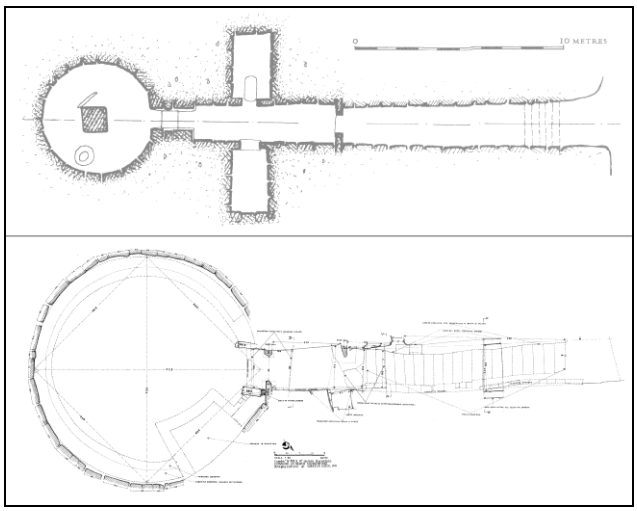

Figure 1. Top: the plan of the Tholos tomb of La Montagnola (partial from Boethius, 1969). Bottom: the plan of the Tholos tomb of La Mula (partial from Ugolini, 1984).

2.3 Tumulo Montefortini (Comeana)

The *tholos* belongs to a burial mound, which also houses a chamber tomb. The *dromoi* of the two tombs are parallel as can be verified on the plan (Figure 1-Top). Unfortunately, the indication of the North is not present in this plan. Another good and reliable plan with contour lines exists (Nicosia 1966), drawn when the *tholos* was not discovered yet (Figure 1-Bottom). In this second plan the indication of the North is clearly incorrect. The presence of the contour lines allowed a reliable reconstruction of the orientation by superimposition in CAD of the two plans to a satellite image from Bing Maps.

2. RESULTS

3.1 Geometries, length-units and numbers.

Metric analyses have been done on the ground plans of La Montagnola and La Mula, while for Montefortini a dedicated study is in progress.

3.1.1 La Montagnola

The perimeter of the circular chamber was best fitted using the algorithm by Kasa (1976) with a circumference the diameter of which has resulted to be 5.306 m which corresponds to twelve roman cubits of 0.444 m. The resulting scheme is shown in figure (3-Top). The part including the dome and the vestibule can be connected to the classification of the Mycenaean *tholoi* by Ranieri (2008).

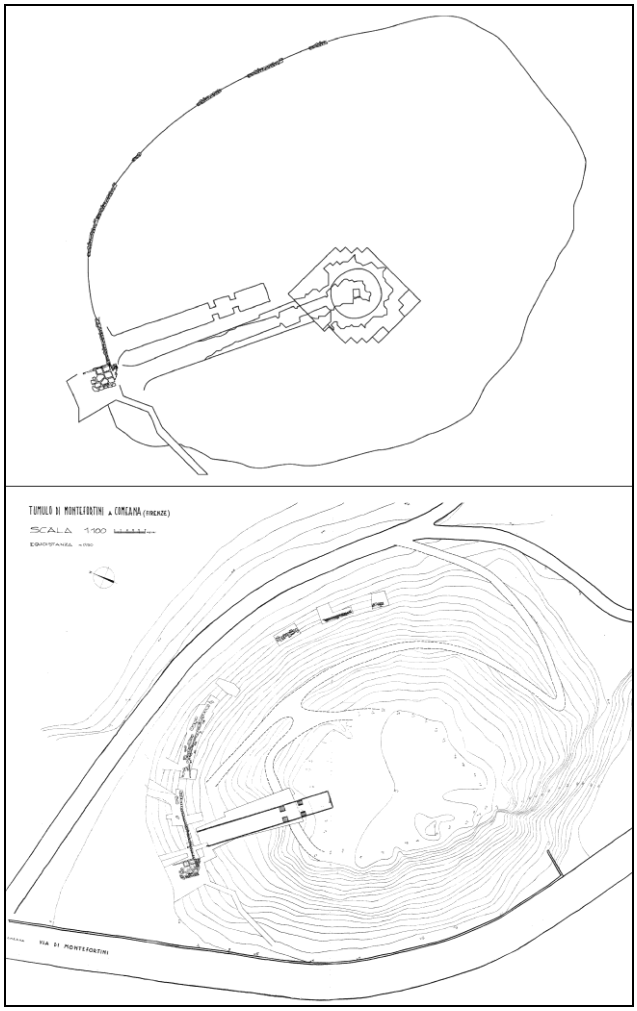

Figure 2. Montefortini. Top: plan showing the parallelism of the two dromoi. Bottom: the good quality plan from Nicosia (1966) showing the topographic elements useful for our recontruction of the orientation.

Table I: Pythagorean and quasi-Pythagorean triples found for La Montagnola.

Triad name	Triad
Q	12-12-17
W	5-12-13
3/W	20-25-32 (x 4/5)
2Q	4-8-9
√2	12-17-21

The recognizable proportions can be associated with Pythagorean or quasi-Pythagorean triples, as shown in Table I. The integer **12** cannot be considered accidental: among the combinations of numbers

well suited for the inscriptions of a circle in a square, the combinations 12-17 is among the most precise.

3.1.2 La Mula

Since the tomb is incomplete, the only element that we could examine was the dome (figure 3-Bottom). The perimeter of the circular chamber was best fitted with a circumference the diameter of which is resulted to be 9,109 m and corresponds to 41 Roman palms (0.222 m = ½ Roman cubit).

The integer **41** cannot be considered accidental: as a matter of facts among the combinations of numbers suited for the inscriptions of a circle in a square, the combinations **29-41** and **41-58** are among the most precise. This may signify that the layout of the circular chamber was planned with the aid of a square of side **58** or **29**.

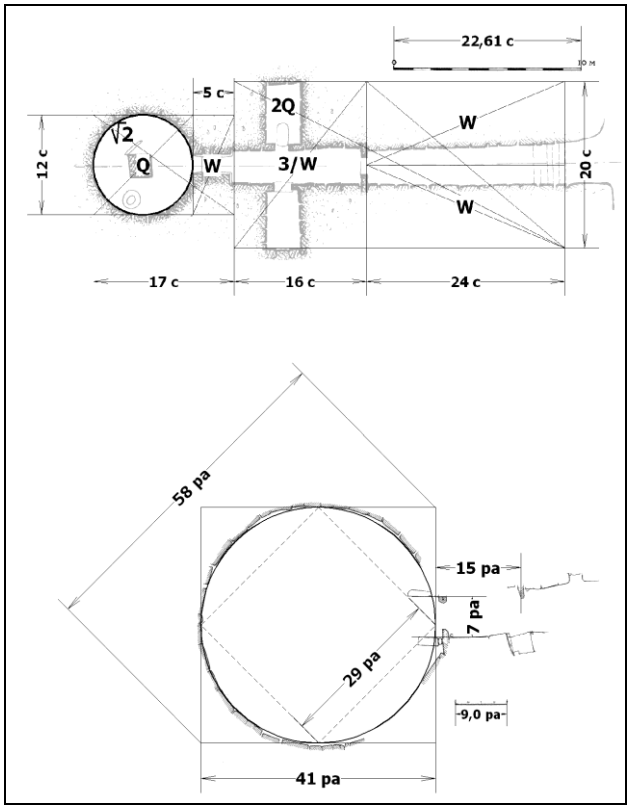

Figure 3. Top: the result of the geometrical analysis for La Montagnola (c=Roman cubit). Bottom: the result for La Mula (pa=Roman palm).

3.1 The orientation of the tombs

The analyses of the orientation have been conducted following the guidelines for the archaeoastronomical research as described by Ruggles (1999).

For all the three tombs, apparent declinations and geocentric lunar declinations (taking into account the parallax effect) have been calculated and are reported in Table III and Table IV. The altitude effect on the declination has also been considered, together with the "high-precision complications" related with the semidiameter of the Moon and the "wobble" (Ruggles, 1999, pp 60-61).

The azimuth were derived determining the bearing between two georeferenced points (lat/long coordinates) from the satellite images.

For La Montagnola we utilized the satellite images available on the web at *Geoportale Nazionale del Ministero dell'ambiente*.

For La Mula we reported on the Bing satellite images the external points recognized from the drawing (taking into account of the castle position).

For Montefortini, as already said, we superimposed the drawings to the Bing satellite image.

It can be seen from Table III and IV that, within a couple of degrees, all the three *tholos* appear aligned to a common direction. Through a sky simulation done with Stellarium it can be noticed that, in the VII century B.C., the common direction is close to the minor lunar standstill (table II), 20' away from the declination in our times. It can be noted that La Montagnola, for which a better accuracy is achievable, shows the smaller difference of declination.

Table II: upper and lower limits of the declinations at the minor lunar standstill (following Ruggle's guidelines).

Lower Limb *northern minor limit, wobble south*	**Centre** *mean wobble*	**Upper limb** *northern minor limit, wobble north*
17° 34'	17° 59'	18° 24'

Table III: Measured Azimuth, accuracy, altitude, apparent declination and geocentric lunar declination of the tombs.

	La Montagnola	**La Mula**	**Montefortini**
Azimuth	293° 57'	295° 7'	294° 29'
Azimuth accuracy	± 1°	± 2°	± 2°
Altitude	1° 4'	1° 8'	2° 26'
Apparent dec	17° 30'	18° 22'	18° 58'
Geocentric lunar dec	18° 11'	19° 4'	19° 39'

Table IV: Azimuth, altitude, apparent declination, geocentric lunar declination for the tombs. Min and Max refers to the error limits.

	Montangola Min	Montangola Max	La Mula Min	La Mula Max	Montefortini Min	Montefotini Max
Azimuth	292° 57'	294° 57'	293° 7'	297° 7'	292° 29'	296° 29'
Altitude	1° 10'	1° 11''	1° 8'	1° 11'	2° 28'	2° 29'
Apparent dec	16° 53'	18° 17'	16° 59'	19° 47'	17° 37'	20° 24'
Geocentric lunar dec	17° 34'	18° 58'	17° 40'	20° 29'	18° 17'	21° 5'

3. SYMBOLISMS INSIDE THE THOLOI

Both La Montagnola and La Mula have revealed, inside the chambers, inscriptions (Etruscan words decipherable as magic formulas or apotropaic invocations) and symbolic representations of the environment carved on stones or plaster. Stars, trees, mountains, animals and the tumulus itself appear on the right stone slab of the door (figure 4A, 4B, 4C, 4D). The river, a boat and the three peaks of Monte Morello appear on the stone laying near the entrance (figure 4E).

Stars can be seen in figure 4A. Animals (boar and horses) are visible in figure 4B: the inscription in the same figure has been interpreted by Rilli (1964) as archaic Etruscan and may have an apotropaic content. The trees, which should represent the surrounding wood, can be seen represented in figure 4C: they appear to be spruce trees as those that covered the Monte Morello until the deforestation done by Cosimo I de' Medici to provide the trunks by which the beams of the Uffizi were made. The dome of the tomb is recognizable in figure 4D: in the representation, under the vault, other elements may represent the *dromos*, the pillar, the Sun or the Moon.

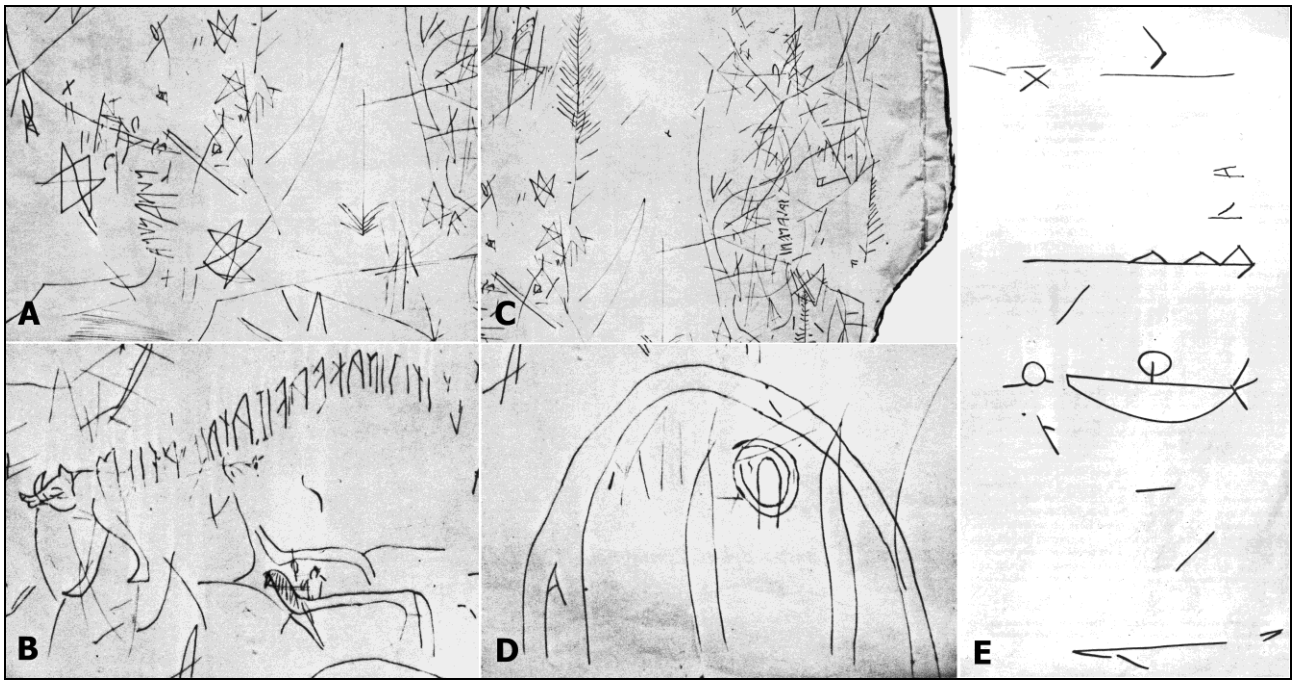

Figure 4. La Montagnola: graffiti on the entrance stones of the right side-room (A, B. C, D) and on a stone laying at the entrance (E). All the images are partial from Rilli (1964).

4. DISCUSSION AND CONCLUSIONS

La Mula, La Montagnola and Montefortini have much in common. The most noticeable is their common orientation, within ± 2°, coincident with the minor lunar standstill, which means a real, tangible and visual relationship with the Moon. It mirrors the spiritual association of Aritimi (the Moon) with the death (the tombs). An orientation to winter solstice sunset is to be excluded being the VII century B.C. sunset declination at solstice five degrees away from the common declination of the tombs.

However, a solar orientation cannot in principle be excluded. As matter of fact the tombs might have

been oriented according to the day in which the Sun entered the tombs in a particular festivity. In the VII century B.C., taking into account the range of the errors, it would be within May 13rd and May 28th (from May 4th to May 19th in current times). Experts on Etruscan festivities may relate this lap of time to some particular festivities. On our side, we prefer the hypothesis of an alignment to the minor lunar standstill for the symbolic (graphical, topographic and toponomastic) evidences.

Common length units were found for La Montagnola and La Mula (Greek-Roman cubits and palms). While same units can be expected for two nearby coeval tombs belonging to two personages of the same social class and culture, the finding of Greek-Roman units in Etruscan architectures is more noticeable. The renowned ability of Etruscan architects is reflected in the wise use of Pythagorean or quasi-Pythagorean combinations in the geometrical schemes arrived at with proper integer numbers.

The toponym of the Zambra creek, according to Rilli (1964), might have an Etruscan origin and could mean "river of the dead". The toponym "Artimino" of the city is linked to the name of the Etruscan goddess Aritimi. For the town, the name should mean "temple of aritimi" (Pittau, 2006). Aritimi was Artemis for the Greeks and Diana for the Romans. The goddess is considered the founder of the Etruscan town Aritie, the modern Arezzo. Aritimi (also Artume, Artames, or Artumes) was associated with night, Moon, death, nature, woods and fertility. This links the burial rituals to the worship of Aritimi in northern Etruria.

Traces of Etruscan burials are spread through the whole territory around the Florentine swamp, mainly belonging to the same period of our *tholoi* or to previous ages. On field verification of possible lunar/solar orientations of all the tombs in the area of the Florentine swamp, might reveal common burial practices perhaps increasing the statistics of this type of lunar alignment. A further contextualization of symbolic contents might unveil unpredicted relationships among divinities, burial rituals and traditions linked to the natural world.

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