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# THE ORIENTATION OF ROMAN TOWNS IN HISPANIA: PRELIMINARY RESULTS

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**ABSTRACT**

Despite the fact that ancient writings indicate a clear necessity to orient Roman towns according to the path of the sun (Hyginus Gromatius, Constitutio, 1), Le Gall (1975) in an early work made clear that there was no clear preferred orientation pattern. However, Le Gall's analysis was done by taking into consideration a sparse number of Roman towns from widely different latitudes, ranging from England to Algeria. However, recent results show that when a restricted geographic area is considered, some patterns of orientation do arise (Magli 2008, González-García and Costa-Ferrer 2011). We present the preliminary results from a survey to obtain a statistically significant sample of the orientation of Roman cities in Hispania. This region was where the greatest number of cities were founded in the western part of the Roman Empire, both during the Republic and the Empire (Laurence, Esmonde Cleary & Sears, 2011), and it provides a perfect test bed for ideas on the orientation of Roman towns. So far, we have measured 43 Roman settlements in Hispania, and we can already verify some of the ideas on how Roman towns were oriented. The orientation of Roman towns in Hispania do seem to follow an astronomical pattern, with certain directions perhaps connected to particularly important dates of the Roman calendar.

**KEYWORDS:** Orientation of Roman cities; Roman urbanism; Hispania; Vitruvius; Wind orientation; Solar orientation;

## 1. INTRODUCTION

Urban life was one of the main characteristics of the Roman world. The foundation of new cities was a key element in the Roman expansion, especially in the western part of the Empire (Laurence, Esmonde Cleary and Sears, 2011) where literally hundreds of towns were founded –or refounded over pre-existing settlements – from the third century BC to the fourth century AD. The act of foundation of a Roman town had a deep political and ritual meaning (Woodward and Woodward, 2004).

A new town had a clear practical dimension of land control and exploitation, but also a highly symbolic one, as the new settlement highlighted the role of Rome as the ruler city while the new town was viewed as a small portion of Rome itself in the area to be controlled.

The Romans built their towns in a characteristic shape, incorporating a grid of orthogonal streets with minor variations (Castignoli, 1971; Kaiser, 2011).

## 2. THE CITY GRID

It has been argued that the origin of Roman city planning resides in the Hyppodamean grid, through its use at military camps (Castagnoli, 1971), although it is clear that the Romans themselves give preeminence to its Etruscan roots (Laurence *et al*., 2011).

The *groma* was the instrument used to lay out the orientation of the city grid in order to obtain an orthogonal plan (Grimal, 1983). The *groma* is described in ancient writings, and a few carvings have been found in bas-relief, for instance in the funerary inscription of Nicostratus in Pompeii and the tombstone of Aebutius Faustor found in Ivrea (both in Italy). A few remains have appeared at archaeological excavations, notably in Pompeii itself and at Eichstätt in the German *Limes* (Della Corte, 1922). The *groma* consisted of a rod with a metal arm at the top perpendicular to it. From the tip of this arm extended four straight metal pieces at right angles (see Fig. 1). In this way, if the surveyor finds a direction with one of the straight sections, the other immediately gives the perpendicular direction, facilitating the laying out of the orthogonal grid.

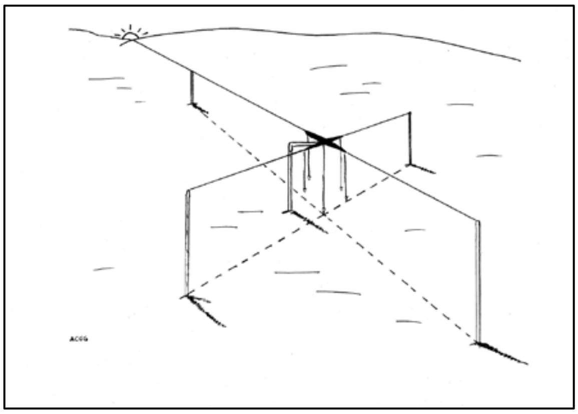

**Figure 1: Possible reconstruction for the *groma* and its use to obtain the direction of the grid according to the path of the sun.**

The Roman grid had an urban layout normally defined by a series of streets running largely north-south, called *cardines*, and their perpendiculars running broadly east-west, called *decumani*. The main streets would be those often called *Cardus Maximus* and *Decumanus Maximus*. Although these names (*cardines* and *decumani*) are not attested in proper relation to towns, but in relation to the division or *centuratio* of the fields, researchers have assigned these names to streets through analogy.

The two main streets cross near the town centre, where usually the forum is located. The forum was the main square of Roman towns, where most of the administrative, judicial and representation buildings were congregated, such as the basilica or the curia, together with buildings for commerce and temples (Fig. 2; Gilman Romano, 2013).

Although this urban layout is, of course, a generalisation and an ideal one, it agrees well with the remains found in most Roman sites.

The history of Roman urbanism runs parallel to the history of the Roman expansion throughout the Mediterranean. Rome itself was a large, but mostly crowded and disordered, city by the second century BC. It must have impressed the Romans to reach cities in the West (such as Carthage in North Africa or Cartago Nova in southern Spain) and more notably in the East, with Hellenistic cities such as Athens, Pergamon, Antiochia or Alexandria, where the local rulers had developed substantial programs for building large public spaces with a clear propaganda agenda behind them. It must have also been a shock for the ambassadors of these cities to find that the new potency, displaying such a military power, was a huge but ugly, untidy and chaotic city. The first colonies in Italy, Hispania or the Narbonensis province started a process of monumentalization, mirroring and mirrored by the Urbs (Laurence *et al*. 2011). However, it seems that the orthogonal plan was already present from early times (Gilman Romano, 2013).

**Figure 2: Forum of the Roman town of *Lucentum*, in present day Alicante. The *basilica* was located next to the colonnade plaza, to the right in the image. The other sides were occupied by *tabernae*. A temple was located in a higher ground on the side closer to the foot of the image. Picture courtesy of A.C. González-García.**

The last century of the Republic showed a clear impulse for the building of monumental structures in Rome and in the provinces, which increased during Julian and Augustan times. In fact, a substantial part of the remains visible today in the main area of the forum at Rome come from this period. Likewise, in many towns in the West, massive plans of building and embellishment were carried out during the time of Augustus and his successors. For example, an Augustan colony replaced the old Latin colony in Verona. These series of new colonies form a homogeneous group with an extremely standard design (Owens 1992).

New pulses of building appeared in Flavian times (end of the first century AD) and by the Low Empire (third and fourth century AD), when a reorganization of the urban life clearly appeared in the western end of the Empire (Laurence et al., 2011).

Not all towns had the same internal organization, as they were founded at various times and locations. All these factors, history, geography and cultural background have to be considered separately before examining the Roman plan in each case (Owens, 1992; Kaiser, 2011). However, all of them were Roman foundations and tended to incorporate the ideal plan.

### *2.1 Roman Cities in Hispania*

The Iberian Peninsula, known to the Romans as Hispania, was the battleground for the expansion of the Roman army in the West for nearly two centuries, since the arrival of the Scipios in 218 BC until the final conquest of the northwest by the time of Augustus (19 BC; Barceló and Ferrer, 2007).

The number of towns founded or reorganized by the Romans during this and the latter Imperial period exceeds 300 (Bravo, 2007). Divided at first into two provinces (Hispania Citerior and Hispania Ulterior), it was later divided into three provinces during the epoch of Augustus: Hispania Citerior Tarraconensis, Hispania Ulterior Baetica and Hispania Ulterior Lusitania. After Diocletian the Peninsula was further divided into five provinces, (by segregating from the Tarraconensis two areas to form the Carthaginensis in the centre and southeast and the Gallaeacia in the northwest; Barceló and Ferrer, 2007).

There were various legal statuses for the cities inside the Roman realm. If a town was sieged during the expansion of the Roman army and it did not surrender, the town could be declared a relic (*dedicta*) town, or *civitas stipendiaria*, meaning that it did not have any legal rights, lost all representation, and had to pay a tribute to Rome. If the town negotiated or got to be an ally, the town would be called *civitas* *libera* or *foederata* and would maintain some rights and representative structures. There were also different kinds of towns whenever the Romans planned a new city or rebuilt a previous one, populating it either with veterans or people coming from Italy. If the city had similar political structures as those of Rome and was populated by soldiers who were Roman citizens, it was commonly called a *colonia* (colony). If the foundation was otherwise and people from other areas of Italy populated the city, it was commonly called a *municipium*. However, the status was given not only by the title but also by the type of legal code that was followed, namely Roman or Latin (Barceló and Ferrer, 2007; Bravo, 2007). It should be noted that apart from colonies founded in that way (*deductio*), in several cases the towns suffered changes in legal status: for example Italica, which after a petition by its inhabitants was changed from a *municipium* into a *colonia*.

Other types of settlements included areas normally of smaller populations, such as *mansio, vici* or *villae*.

Roman cities in Hispania were often founded where a pre-existing settlement (an *oppidum*) already existed. Normally it was a pre-Roman settlement, favoured by Roman governors for strategic reasons that commonly agglutinated the representative Roman buildings, although in a mostly indigenous environment. The progressive settlement of Roman population and culture meant the formation of *civitates* where those *oppida* existed. Over time, some of those *civitates* eventually reached the status of *colonia* or (Bravo, 2007).

A note aside is required for the army camp commonly called *castrum*, or *castellum* in the case of a small settlement. These *castra* were usually the seats of a complete Roman Legion or of one of its smaller corps stationed within the territory. The *castra* also had a normalized plan, with a rectangular ditch and wall and with doors in the middle opening onto the main streets, the *Via Praetoria* and *Via Principalis*, which met next to the centre of the camp, close to the buildings of the Principia and the Praetoria. In some cases, a *castrum* developed into a larger entity that may be called a town. Indeed, it has been argued that the origin of the Roman grid is the military camp, although apparently the influences run both ways (Grimal, 1983).

## 3. THE ORIENTATION OF A NEW CITY

A number of rituals needed to be performed at the time of foundation of a Roman settlement in order to set cities, towns or even *castra* in the right place, at the right time and with the needed orientation (Briquel, 2008).

The ritual described by Solinus, from a lost account by Varro, was based on the Etruscan tradition and was supposedly the ceremonial followed by Romulus in the foundation of Rome.

According to this ritual, the first steps had to be done by the augur, who would inspect the skies for auspicious signs in order to set up the *templum*, a symbolic image of the heavens where all the ceremony should be performed. Next, a cow and an ox would be yoked to a plough in order to define with a furrow the *pomerium*, the sacred precinct of the new town, and where the city walls would be built. Next, a pit, the *mundus*, was dug, into which the first fruits were offered. Presumably near this place the surveyors laid the *groma*, the instrument they used to set the orientation of the city grid after taking again the appropriate auspices (Rykwert, 1988). In this sense, it is clear that the foundation of a city was a sacred act (Grimal, 1983).

However, a cautionary note must be stated. One should not overestimate these rituals, at the expense of losing focus on the practical nature of the new foundation. The actual establishment of a new colony was entrusted to three high-ranking officials, the *tresviri coloniae deducendae*. They were in charge of the definition of the boundaries and its subdivision and among other duties for which they have full powers (*imperium*) they also contracted a staff of trained surveyors (*agrimensores;* Ward-Perkins, 1974).

Probably, both priests and surveyors used very similar procedures to determine the orientation of the grid, and the final pattern would be widely similar. However, the base difference is fundamental, as one is ritual and the other practical. Another difference arises when *centuriatio*, or the division in lots of the countryside next to the city, is considered, as here the *agrimensores* probably had a certain degree of freedom to accommodate the grid to topographic features or principal communication routes (Ward-Perkins, 1974).

### 3.1 *Textual evidence*

As stated above, the orientation of the streets was determined by a professional group of land surveyors called *agrimensores* who were imbued with a sacred character while performing this task (Rykwert, 1988). A number of writings of these professionals have reached us, and they are grouped in the so-called *Corpus Agrimensorum*. Here, a number of practical recipes are given and they are a valuable source of information on practical procedures for land demarcation and surveying (Gilman Romano, 2013).

With regard to the issue of orientation, Frontinus (De Agri Mensura, 27; translated by the authors) states:

"The limits and the origin [of the layout], just as described by Varro, came from the Etruscan Discipline; the soothsayers [*aruspices*] divided the world into two parts, the right hand towards the north, which they called *Septemtrion*, to the left would be the meridian of the earth, from east to west, where you can see the paths of the sun and the moon…"

Thus, Frontinus informs us that there are two main parts in the world, north and south, separated by the line connecting the west with the east, which is that connecting the paths of the sun and/or the moon (Fig. 2). The geometry of the image that Frontinus describes indicates that the sense of observation was towards the west, i.e. towards the setting of the heavenly bodies. Similarly, Hyginius (Constitutio, 1; translated by the authors) tells us: "The limits are set not without a reason, but direct the *decumani* in accordance to the course of the sun, and the *cardines* towards the polar axis."

Both records highlight the use of astronomical means to obtain the directions of the two main axes of the town. However, the main source of information on Roman urbanism comes from Vitruvius' *de Architectura*. In his first book (*de Architectura* I, 6), Vitruvius indicates that an architect must know astronomy, but a few lines below indicates that the ultimate reasons to locate and orient a town in a correct way must be those of healthcare, with a special emphasis on the direction of the principal winds in the area. Thus, the city planner must take into account such currents of air and orient the city grid accordingly, in order to avoid suffering a channelling of such winds into the city. Pliny describes a similar method for the division of the land in order to also take the winds into consideration when planting the crops (*Naturalis Historia* XVIII, 76-77).

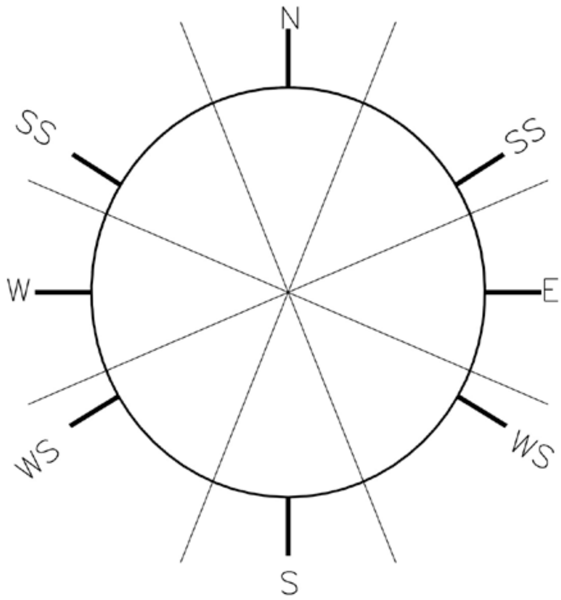


**Figure 3: Diagram showing the eight divisions of the horizon used to obtain the main wind directions according to Vitruvius. The orientation of the city grid should avoid the central areas and thus follow the solid lines. Short heavy lines indicate the cardinal directions and the sunrise and sunset at the solstices (WS and SS).**

To achieve such a goal, Vitruvius describes a method based on astronomical observations. The main task was to find the meridian line. Using a *gnomon* and a circle drawn on the ground, one should inspect the shadows of the *gnomon* in the morning and in the afternoon, at symmetric hours. The meridian line is obtained by finding the bisector of the angle. From this point we have to divide the circumference into eight sectors, one for each wind, starting at 1/16 of the circumference from north. Then, the advice of Vitruvius is to direct the city grid by avoiding the central areas of the wind zones and going for the division lines between them (*de Architectura* I, 6; the solid lines in Fig. 3).

It is interesting that the two sources, although pointing towards the use of astronomical means, are contradictory on the importance of such in the final outcome. While Frontinus and Hyginius tell us that the directions are given directly by the observation of the sun (or perhaps the moon), Vitruvius states that the final direction must be directed by the local winds.

Also, one must always bear in mind the practical nature of the Romans that might have prompted them to modify the rules in order to accommodate to local pre-existing conditions, whether geographic or cultural.

### *3.2 Previous works*

Given the account of the *agrimensores*, a number of works have been using the orientation of the Roman grid to give a day of the year for the foundation of Roman towns (see, for instance, Audin, 1949 for Lugdunum, present-day Lyon; see also García Quintela and González-García, 2014).

Le Gall (1975) refuses such uses while reviewing the evidence pointing towards the astronomical orientation of Roman towns, suggesting for instance that Hyginius or Frontinus are not talking about city planning but about the land division (*centuriatio*). The ritual described above does not need to be used in every single foundation, and thus Le Gall highlights the practical nature of the Roman surveyors as the key factor in city planning. Le Gall also explores the actual orientation of 14 towns from different areas of the Roman Empire, from York in Britannia to areas in North Africa, to show that most of them are not in agreement with solar orientations. However, there are two major drawbacks in his work. The first is the scarce nature of the sample employed in such a large area, which may render the statistics unreliable. The second is the fact that he uses published plans to obtain the orientation measurements, and in some cases, like that of Emerita, where we could actually check his numbers, the errors between the map and the real orientation are as large as 10º, rendering his conclusions unfounded.

A number of Roman cities in Northern Africa have been shown to present orientations consistent with astronomical orientations (Belmonte et al. 2006), although a systematic work comparing the different orientations of Roman sites is still missing for this area.

More recently, Magli (2008) also obtained the orientation measurements from good resolution maps for 38 towns in the Italian Peninsula. Although he does not take into account the altitude of the horizon, which might substantially modify the orientation towards a rising or setting phenomena, he finds that the orientation of towns in Italy is far from random, with two concentrations towards a direction 10° off from southeast and a second group consistent with a winter solstice sunrise direction.

González-García and Costa-Ferrer (2011) indicate that in a small area around the Roman city of Emerita Augusta there are three Roman towns, founded within a period of less than 50 years at the end of the Republic, with orientations consistently in the area of the solstices. This is a fact perhaps connected to the local substratum of pre-Roman peoples.

However, González-García and Magli (2014) have confirmed that the solstices possibly were quite important in the orientation of Roman Cities, both in Italy and in Hispania.

Finally, Richardson (2005) obtained the orientation of 67 Roman camps, mainly in Britain but also in other areas in the Roman Empire, from maps. He finds that the orientation seems not to be explained by strategic reasons, pointing better to a probable astronomical explanation. However, Peterson (2007) shows that at best, the surveyors of Roman camps preferred orientations within ten degrees of the meridian.

In any case, the prescriptions of the *agrimensores* or Vitruvius certainly indicate a degree of practical usage of the astronomical orientation on Roman grids. Under such circumstances, either the orientations tend to avoid the central areas of the winds, as advised by Vitruvius, or the orientations follow those of sunrise or sunset along the year. However, from a ritual point of view, certain dates could be viewed as much more auspicious than others, and as such, one could expect a particular concentration of orientations on certain dates.

It is thus important to obtain a wide enough sample with measurements taken on the terrain, considering both the orientation and the angular height of the horizon, to see if the Romans selected any of the above practices at the moment of the foundation or re-foundation of a new town. With this goal in mind, we have started a project to measure a statistically significant number of Roman settlements in the Iberian Peninsula.

## 4. DATA SAMPLE

We have measured the orientation of 43 towns, in different degrees of preservation. These sites are dispersed throughout the Iberian Peninsula, and had different legal statuses and urban developments (see Fig. 4).

To obtain the orientation of the town grid, we have measured the orientation of the forum, the *cardus* and/or *decumanus*, or the urban layout wherever it was available. Thus, we obtained four directions for each town.

To extract the needed numbers, we used a high precision Suunto 360PC/360R compass and clinometer. The error of an individual measurement is ±¼° for the azimuth and ±½° for the angular height. However, the error in the azimuth could be larger due to the characteristics of the preservation of the different sites.

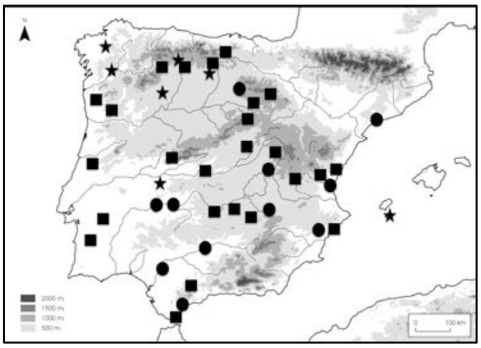

**Figure 4: Distribution map of the 43 cities measured so far. Stars depict Roman camps, circles, Roman colonies, and squares, other types of towns.**

These data are finally corrected for magnetic declination; this value was in most cases estimated from the model WMM2010, available at http://www.ngdc.noaa.gov. In those cases where the angular height could not be measured due to blocked horizons, we used a reconstruction of the horizon by a Digital Terrain Model, available on the Internet at http://www.heywhatsthat.com. We have made some comparisons with clear horizons directly measured by us, and the accuracy is good enough for our purposes.

Table 1 presents our data. We have measured so far 43 towns including 11 *colonia*, 25 *municipia* or other type of towns, and seven camps (either *castrum* or *castellum*). In some cases, two different urban layouts can be recognized within the same town, perhaps due to the change of status (as in the aforementioned case of Italica), or two different *forae* can be recognized. In those cases, the two orientations have been measured. Summing up, we have measured 47 structures.

At the present stage, we would not divide the sample into segregated sets to study the possible influences of different cultural origins, geographic areas or foundation periods, but it is clear that once the sample is completed, this will be one of the mandatory steps to follow.

## 5. PRELIMINARY RESULTS

Fig. 5 shows the orientation diagram for the forty-seven structures measured so far. Here we present the orientation of the four axes, and thus it is not surprising to find that the orientations almost completely saturate the diagram.

The dotted lines across the diagram indicate the angles at 45º, 135º, 225º and 315º. These would be the theoretical divisions between what we may term a *cardus*, i.e. a street running mostly in the north-south direction, and a *decumanus*, running broadly east-west.

### *5.1 Testing Vitruvius*

Usually, in order to test the null hypothesis, i.e. that there is no astronomical orientation at all in our data, we would plot a histogram, or curvigram, of the azimuth and search for accumulations of orientation to particular points of the horizon not consistent with a random distribution.

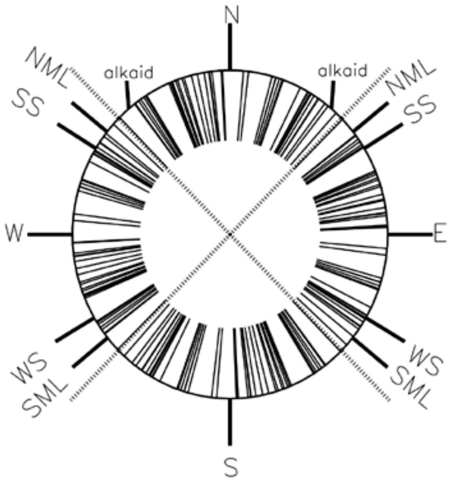


**Figure 5: Orientation diagram for the data sample. Each short line gives the azimuth of one of the ends of the town grid. Each town is thus represented four times. Dotted lines give the separation in four sectors. SS and WS stand for sunrise and sunset at summer and winter solstice, respectively, for a location close to the centre of the Iberian Peninsula. NML and SML stand for the northern and southern major lunistice. The term *alkaid* marks the maximum digressions of this star.**

Fig. 6 presents such an exercise, and we can see that there are a number of conspicuous peaks. Interestingly, they seem to be repeated at certain sectors of the distribution, showing that we are not dealing with independent orientations, but with sets of four perpendicular orientations of the same site. It is thus not surprising that there are no single maxima above a normalized frequency of 3 in this plot (statistical significance of the 99%).

This figure alone does not prove or disprove by itself the null hypothesis, but it may serve to test if the Roman towns in the Iberian Peninsula followed the rules offered by Vitruvius.

Let us remember that Vitruvius states that in order to obtain the directions of the winds, one should divide a circumference, i.e. the horizon, into eight sectors, with the first one centred in the north. This division is marked in Fig. 6 by the solid vertical lines. Then Vitruvius states that, in order to avoid the prevailing winds, one should "let the directions of the streets and lanes be determined by the tendency of the lines which separate the different regions of the winds" (translation by the authors).

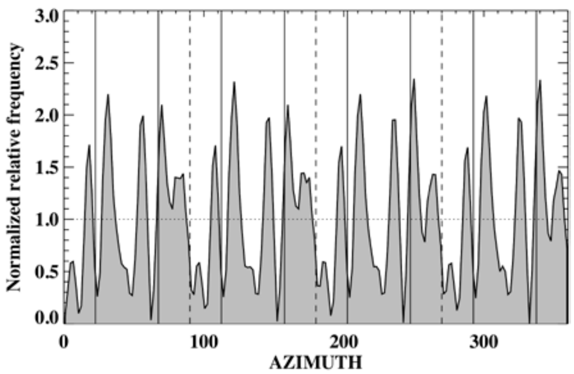


**Figure 6: Azimuth histogram for the data sample. Vertical solid lines define the lines that separate the different regions of the winds according to Vitruvius. Vertical dashed lines give the cardinal points.**

Hence, we should expect to find concentrations of orientations close to the solid lines in this diagram. This is what we find at values slightly higher than 67.5º, 157.5º, 247.5º and 337.5º. All of them correspond to the same family of orientations (i.e. they represent the same *cardus*, and its corresponding *decumanus*). If Vitruvius had been followed, we should expect to find the other families of orientations close to these values (although perhaps at slightly smaller ones) and in concentrations of orientations also close to 22.5º and the subsequent orientations.

However, apart from the family described above, the other families are several degrees off these lines. It is significant that the lines separating the winds are closer to local minima of the distribution rather than to the maxima. This may prompt us to disregard Vitruvius in this particular case. However, a cautionary note should be added here. The central areas of the wind zones are also areas of minimum concentration of orientations, in agreement with the advice of Vitruvius to avoid the central parts of the wind zones.

Perhaps another method was used to find the broad dividing lines between wind zones?

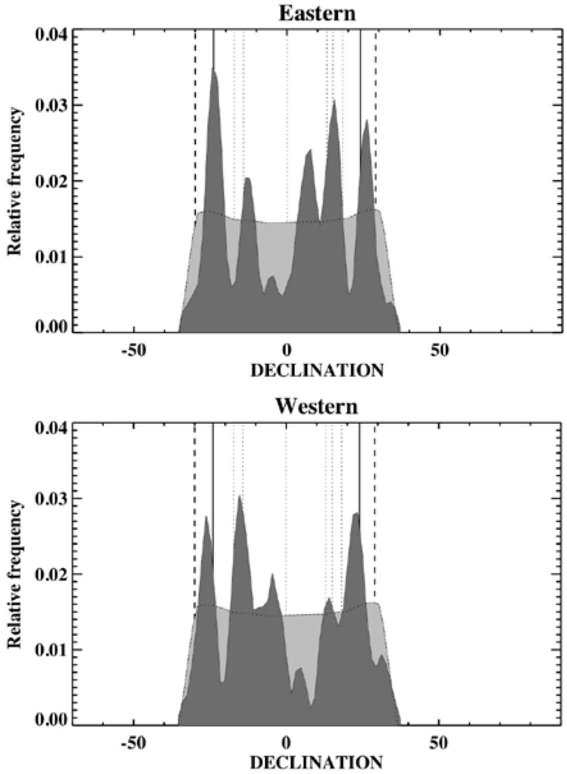


**Figure 7: Declination histograms towards east (up) and west (bottom). The dark grey area is given by our sample. The light grey area is given by a data set of the same size but homogeneously distributed in the *decumanus* sector. Vertical solid lines indicate the extreme declinations of the sun, vertical dashed lines indicate the extreme lunar declinations, and vertical dotted lines indicate the equinoxes (δ=0°) and solar declination for particular dates (see text for details).**

### 5.2 *Orientation of the* decumani

In the next step, we have restricted ourselves to the east-west orientation of the *decumani*. In order to test the astronomical hypothesis, it is better to use the declination. This is shown in Fig. 7 for the eastern (top) and western (bottom) directions. The subtle differences between the two are due to the local topography.

Fig. 7 includes also the distribution in declination that we might expect by populating homogeneously a sector between 45° and 135° with 47 independent orientations. According to the behaviour of the declination, we should expect to find a concentration close to the edges of this sector and a shallow valley in the middle. Indeed, we find that the concentrations are not at the edges, pointing to a non-homogeneous (non-random) distribution.

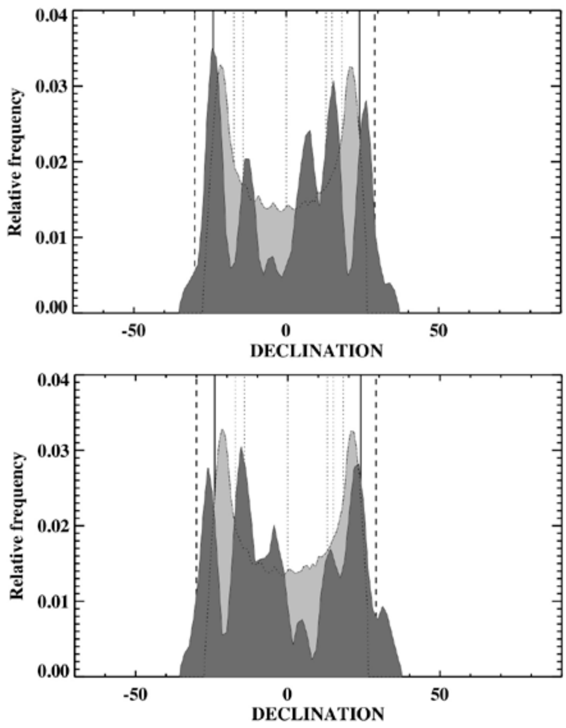


**Figure 8: Declination histograms compared to a homogeneous data set distributed along a solar year (eastern above, western below). Vertical lines are as in Fig. 6. The dotted lines stand for the particular dates the maxima could be related to. See text for further details.**

Fig. 8 includes the same information, now compared with a homogeneous distribution of orientations of the sun along a year (light grey area). This is what we would expect if the orientation were laid out by the *agrimensores* with only a prosaic solar-orienting custom in mind. Such practice would produce two maxima close to the two solstices. Indeed, our data shows such concentrations, with peaks of declination with amplitudes close to the expected. However, we do not find a smooth distribution of orientation between those two maxima, as expected in the homogeneous distribution along the year. This indicates that perhaps those solstitial clusters are better explained by an intentional aiming towards those particular orientations. Besides, we also find some other concentrations at other moments. The largest of such concentrations appears at $\delta \approx \pm 12°$ to $\pm 15°$ (positive looking east and negative towards west). On the one hand, the eastern directions would be consistent with dates close to May 1, with August 1 out of the maximum by a few degrees. However a second, and perhaps more culturally significant, possibility arises, as such a peak could also be explained by an orientation towards April 21, the traditional date for the foundation of Rome. On the other hand, the peak towards the west could be explained by orientations towards the setting sun on November 1 or February 1, although this second possibility appears as less likely.

## DISCUSSION AND CONCLUSIONS

We have measured the largest sample of orientation of Roman towns in Hispania so far. Our data consist of 47 measurements in 43 towns of various typologies and epochs.

The data seem to be non-randomly distributed, indicating that orientation was presumably planned according to particular favoured directions.

On first approach, it seems that the detailed prescriptions given by Vitruvius were not followed precisely. We should have expected a better agreement between the orientation of the streets and that of the lines separating the winds in the Vitruvius scheme. This test, however, does not deny that the main wind-sectors tended to be avoided. In fact we do find a tendency to have fewer orientations towards the central parts of the wind zones. In order to positively discern this chance, specific on-site studies ought to be done to compare the orientation of the city layout with that of the direction of the prevailing winds.

If we consider the orientation of the *decumani* to be subject to the orientation of the course of the sun or the moon, as stated by Frontinus and Hyginius, we find that our data set is not explained by a random or homogeneous distribution, either in space or in time along the year. This seems to highlight the ritual aspect of the foundation and point to particular dates as determinants for the laying out of the Roman cities in Hispania.

One group of such dates includes those close to the solstices. The largest collection of orientations clusters quite precisely with declinations close to the winter solstice sunrise. A similar situation has been reported previously (Magli, 2008, González-García and Magli, 2014). Such pattern of orientation coincides with important Roman festivities, such as the Saturnalia, celebrated by the end of December. Sunset at summer solstice appears to be another possibility, given the symmetry of the orientations. However the significance of the maxima is smaller in this case, perhaps pointing to a better aiming in the opposite direction, towards sunrise.

The second nearly solstitial peak appears to have values of declination slightly larger than the solar extreme, and one could be tempted to relate it to other celestial bodies, such as the moon. Indeed, this peak could be consistent with a lunar extreme or, if we consider the setting sector, with the Venus extreme. It would be important to consider this last possibility, as some of the cities with these orientations were founded during the epoch of Julius Caesar or right after it, and it must be remembered that his family, the Gens Iulia, was allegedly a descendant of this deity.

Finally, the third maxima situated at declinations close to $\pm 12°$ could be related to dates ranging from April 21 to May 1 towards the east or November 1 or February 1 to the west. Three of these dates belong to the set of dates known as mid-quarter days and could have been important to the local substratum of the pre-Roman population, as recently highlighted in present-day Galicia (ancient Galleacia) (García-Quintela, González-García and Seoane, 2014). However, it is worth remembering that the date of April 21 also points to a major Roman festival related to the foundation of the Urbs.

Indeed, further investigation is certainly needed. The complete sample will undoubtedly help to clarify whether these conclusions hold. In addition, once the full sample is at hand, specific studies on geographic or cultural areas, or based on foundation dates and types of town, could be carried out.

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**Table 1: Orientation data for the 43 Roman sites measured so far. If the Roman name is known or surmised it is given in normal typeface; otherwise, the present name is given in italics. The Roman province is given in parentheses: T stands for Tarraconensis, L for Lusitania and B for Baetica. Each site is characterised by four orientations (A1 to A4) and by four horizon heights (h1 to h4) in each direction of the Roman Grid, starting from the northern sector, the northern end of the *cardus*. Reconstructed horizon heights are indicated with an asterisk. The symbol φ gives the latitude of the site, while δ2 gives the declination of the *decumanus* towards the rising sector, the rising end of the *decumanus*.**

| Roman Site | A1 | h1 | A2 | h2 | A3 | h3 | A4 | h4 | φ | δ2 | δ4 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Cidadela* (T) | 17 | 2 | 107 | 2½ | 197 | 0½ | 287 | 0½ | 43.1 | -10.6 | 12.2 |
| Juliobriga (T) | 34¼ | 1 | 124¼ | 0½ | 214¼ | 0 | 304¼ | 0 | 42.99 | -23.9 | 23.9 |
| *M. Cildá* (T) | 340½ | 2 | 70½ | 1½ | 160½ | 1 | 250½ | 1 | 42.75 | 15.2 | -13.9 |
| Pisoraca (T) | 26½ | 1* | 116½ | 0 | 206½ | 0 | 296½ | 0½* | 42.59 | -19.1 | 19.1 |
| Legio (T) | 339¾ | 1¼* | 69¾ | 1* | 159¾ | 0 | 249¾ | 0½* | 42.6 | 15.02 | -14.8 |
| Lancia (T) | 29¾ | 0½ | 119¾ | -1 | 209¾ | -1 | 299¾ | -0½ | 42.5 | -22.1 | 20.7 |
| Asturica (T) | 340½ | 1¼* | 70½ | 0½* | 160½ | 0¼* | 250½ | 2 | 42.46 | 14.2 | -14.7 |
| Petavonium (T) | 30½ | 1 | 120½ | 0 | 210½ | 0 | 300½ | 0½ | 42.08 | -22.1 | 22.1 |
| Aquae Q. (T) | 38½ | 2 | 128½ | 5 | 218½ | 1½ | 308 | 6 | 42 | -23.7 | 31.1 |
| Numantia (T) | 19¾ | 0 | 109¾ | -1 | 199¾ | -0½ | 289¾ | 0 | 41.8 | -15.2 | 14.2 |
| Clunia (T) | 325½ | 0 | 55½ | 1 | 145½ | -1 | 235½ | -1 | 41.76 | 25.7 | -26.1 |
| Uxama (T) | 356¾ | 0 | 86¾ | 6 | 177 | 0 | 267 | -0½ | 41.58 | 6.40 | -2.9 |
| Bracara (T) | 342¼ | 0½ | 72¼ | 2¼ | 162¼ | 0 | 252¼ | 0 | 41.5 | 14.8 | -13.6 |
| Tiermes (T) | 338 | 2 | 77½ | 0½ | 168 | 2½ | 248 | 1 | 41.33 | 9.69 | -16.1 |
| Tongobriga (T) | 343 | 1 | 73 | 4 | 163 | 4 | 253 | 0½ | 41.16 | 15.4 | -13.1 |
| Tarraco (T) | 34 | 1* | 124 | -0¼* | 214 | -0¼* | 304 | 1¾* | 41.11 | -25.5 | 25.7 |
| | 29½ | 1½* | 119½ | -0¼* | 209½ | -0¼* | 299½ | 1¾* | 41.11 | -22.4 | 22.6 |
| Complutum (T) | 338½ | 0¾* | 68½ | 1* | 158½ | 2 | 248½ | 0 | 40.5 | 16.4 | -16.6 |
| Ercavica (T) | 350½ | 5 | 80½ | 0 | 170½ | 0 | 260½ | 0½ | 40.4 | 7.22 | -7.6 |
| Segobriga (T) | 345¾ | 0 | 75¾ | 7½ | 165¾ | 4½ | 255¾ | 0½ | 39.88 | 15.7 | -11.0 |
| Valeria (T) | 30½ | 1 | 120¾ | -0¼ | 210¾ | 1 | 300½ | 1 | 39.8 | -23.3 | 23.2 |
| Saguntvm (T) | 19¼ | 0 | 109¼ | 4½ | 199¼ | 11½ | 289¼ | 7 | 39.67 | -11.8 | 18.8 |
| | 353½ | 1 | 83½ | 5* | 173½ | -1 | 263½ | 4 | 39.67 | 7.80 | -2.96 |
| Edeta (T) | 337 | 0* | 67 | 1 | 157 | -0½ | 247 | 0* | 39.62 | 18.1 | -17.8 |
| Valentia (T) | 6¾ | 0 | 97¼ | 0 | 186¾ | 0 | 277¼ | 0 | 39.5 | -5.59 | 5.22 |
| Libisosa (T) | 357¼ | -1 | 87½ | -0½ | 177¾ | 0½ | 267¼ | 0 | 38.95 | 1.63 | -2.50 |
| Mentesa (T) | 323 | 0 | 53 | 0 | 143 | 0 | 233 | 0 | 38.7 | 28.0 | -28.4 |
| *Formentera (T)* | 32¼ | 0 | 122¼ | 1 | 212¼ | -0½ | 302¼ | 0½ | 38.68 | -23.9 | 24.5 |
| Oretum (T) | 357¼ | 0 | 87¼ | 1 | 177¼ | 2 | 267¼ | 2 | 38.67 | 2.83 | -2.57 |
| Sisapo (T) | 326¾ | 4 | 56¾ | 0½ | 146¾ | 0½ | 236¾ | 0½ | 38.65 | 25.7 | -25.4 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Lucentum (T) | 37 | 1 | 125¼ | 0 | 216¾ | -1 | 306¾ | 2½ | 38.3 | -26.9 | 29.3 |
| Ilici (T) | 352½ | 0 | 82½ | 0 | 172½ | 0 | 262½ | -1 | 38.25 | 5.88 | -6.82 |
| | 348 | 0 | 78 | 0 | 168 | 0 | 258 | 0 | 38.25 | 9.40 | -9.75 |
| | | | | | | | | | | | |
| Caparra (L) | 324½ | 1¾ | 54½ | 2¼ | 144½ | 3½ | 234½ | 0 | 40.16 | 27.9 | -26.7 |
| Coninbriga (L) | 327½ | 0½ | 57½ | 1½ | 147½ | 4 | -4 | 0 | 40.08 | 25.3 | -24.7 |
| *Caceres V* (L) | 17 | 0½ | 107 | 0½ | 197 | 2¼ | 287 | 0¼ | 40 | -12.5 | 12.6 |
| Cesarobriga (L) | 4.9 | 1¾* | 94.9 | 0¼* | 184.9 | 1* | 274.9 | 0* | 39.95 | -4.00 | 3.39 |
| Metellinum (L) | 31 | 0½ | 121 | 0 | 211 | 0 | 301 | 1 | 38.97 | -23.6 | 23.2 |
| Emerita (L) | 322¾ | 0 | 52¾ | 0 | 142¾ | 0 | 232¾ | 1 | 38.9 | 28.1 | -27.9 |
| L.Iulia (L) | 328 | -0¼ | 58 | 0 | 148 | 0 | 238 | 0 | 38.57 | 24.5 | -24.9 |
| Mirobriga (L) | 315½ | 1½ | 45½ | 0½ | 135½ | 0 | 225½ | 2¾ | 38 | 33.9 | -32.0 |
| | | | | | | | | | | | |
| Corduba (B) | 15½ | 1½* | 105½ | 0½* | 195½ | 0½* | 285½ | 2¼* | 37.88 | 12.3 | 13.1 |
| Italica (B) | 327¾ | 0½ | 57¾ | 0 | 147¾ | 0¼ | 237¾ | 2¼ | 37.43 | 25.0 | -24.0 |
| | 337¾ | 0½ | 67¾ | 0 | 157¾ | 0 | 247¾ | 1 | 37.43 | 17.5 | -17.2 |
| Acinipo (B) | 352¼ | 0 | 82¼ | 0½ | 172¼ | 0 | 262¼ | 0 | 36.8 | 6.5 | -6.5 |
| Carteia (B) | 42¼ | 2 | 132¼ | 2½ | 222¼ | 3 | 312¼ | 2 | 36.12 | -31.1 | 33.8 |
| Baelo (B) | 18¼ | 5½ | 108¼ | 3 | 198¼ | -0.1 | 288¼ | 4 | 36.08 | -12.8 | 16.7 |

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