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# Astronomical Orientations in the Roman Centuriation of Tunisia

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**Abstract** The centuriation, also known as limitation, was the method used by the Roman surveyors for subdividing the land in a regular chessboard of fields, created by a grid made of parallel and perpendicular roads and canals. Here we discuss the limitation of Tunisia and the existence of some astronomical orientations of the grids, that is, orientations towards the direction of the sunrise on solstices or moonrise on lunar standstills.

**Keywords:** Roman Centuriation, Archaeology, Archaeoastronomy, Modern Ephemeris, Suncalc.org, Photographer's Ephemeris.

Centuriation, also known as limitation, was the method used by the Roman surveyors for subdividing the land to create a regular chessboard of fields, separated by a grid of parallel and perpendicular roads and canals. The majors of these roads were known as “decumani” and “kardines”. The same method of surveying was used for the planning of the new towns built by the Romans during the late republican period and the early empire [1]. In the Figure 1, for instance, it is possible to see the grid and perimeter of the Roman Torino, and the two mains roads.



**Figure 1:** The Romans planned their towns with a precise regular scheme, based on two main streets, which crossed each other at right angles, at center of the settlement. These streets are the Decumanus (D) and the Kardo (K). A well-preserved example of the Roman town-planning is Torino: in this Google Earth image, we can easily see the rectangle of the Roman town, composed of several “insulae”, that is, of several square house-blocks.

Today, the remains of several centuriations still exist. In Italy, it is quite visible the centuriation of the Po Valley in its satellite images; the same happens for some lands in North Africa [2]. In the Twentieth Century, the centuriation of North Africa was first studied Eduard Walter Barthel, (1880-1915), a German archaeologist, who analyzed the orientation of the decumani too. Barthel wrote two dissertations entitled “Zur Geschichte der römischen Städte in Africa” and “Römische Limitation in der Provinz Africa” [3]. In the second dissertation, Barthel tells that the orientation of the Roman planning was based on the “Disciplina Etrusca”, that was a set of rules for the conduct of all sorts of divination, a religious and political "constitution" for Etruscans [4]. In the Appendix of this article, we report what we can find in the Barthel's text [3].

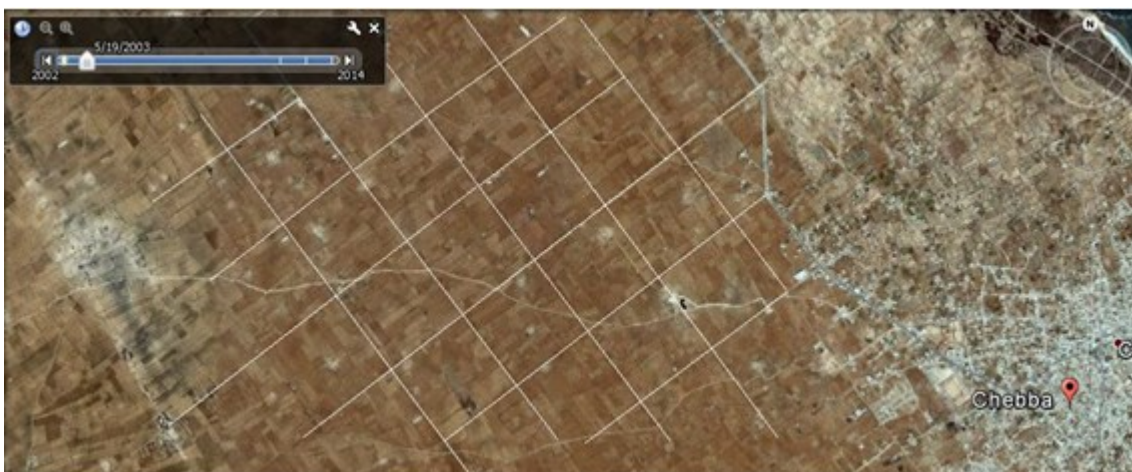
The Roman province of Africa was founded in 146 BC, when Carthage was conquered and razed to the ground [5], after the Third Punic War. The Africa Proconsularis roughly

comprised the Tunisia, the northeast of Algeria, and a small part of the Mediterranean Sea coast of western Libya along the Syrtis Minor (Figure 2). It was one of the wealthiest provinces of the empire, second only to Italia. A first limitation of the Africa Proconsularis occurred in the late second century BC and an extensive new limitation occurred in AD 29-30, made by the third legion, the Augusta [5].



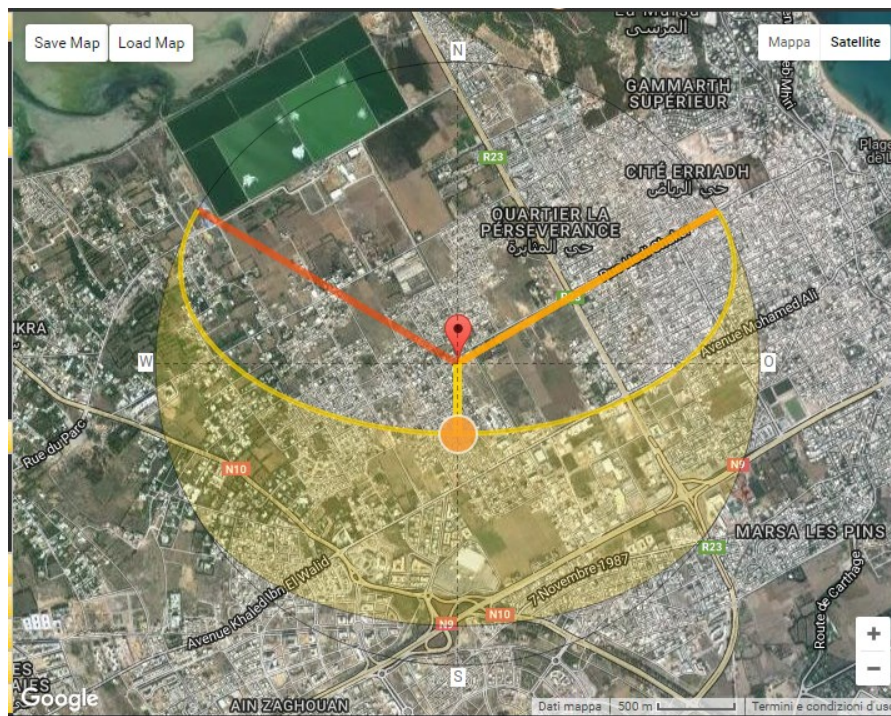
**Figure 2:** The senatorial province of Africa Proconsularis (that is, East Algeria / Tunisia / Tripolitania). Image Courtesy: Wikipedia.

It is usually told that the main direction of the limitation, that is the direction of the Decumanus Maximus, was usually east - west oriented. However, as specified by Haverfield [1], it would be better to tell that the orientation was towards the sunrise, and, for this reason, it could span the range of the sunrise azimuth between the summer and winter solstices. In fact, we have several examples of towns oriented to the sunrise on solstices [6-9], and even to moonrise on lunar standstills [10]. Consequently, the grid of the centuriation appears as astronomically oriented, and not oriented to cardinal points. As noted in [5], the orientation of the centuriation of Tunisia is not towards such points (the Figure 3 shows the limitation near Chebba). The French scholars, Chevallier and Troussset, have examined such centuriation, finding that some of the coastal centuriation are at right angle to the coast. But a number of main systems are oriented to either sunrise on the summer solstice or on the winter solstice [5,11,12]. The systems, which begins at the Jabel Bou el Hanech, has the Cardo Maximo oriented to the sunrise on winter solstice [5]. Other references on the studies of the centuriation of Roman Africa are given in [13-21].



**Figure 3:** The centuriation near Chebba in Tunisia. The grid has a side of about 700 m. The centuriation that we can see in the satellite image of Google Earth, has been accentuated by the white lines.

For what concerns the solar orientation of the limitation of Tunisia, the Reference 22 is very important. This paper reevaluated the different procedures applied to the roman limitations in Africa. In fact, pragmatic possibilities exist, besides the choice of the direction of limitation indicated by the sunrise, as attested by the Latin literature. The centuriation of Byzacium gives example of an orientation depending on the direction of the coastline or of a coastal road [22]; surveying of Vibius Marsus carried out from Ammaedara shows a decumanus inverted to the South-East. However, the rural limitations of Acholla and Carthage seem to have been oriented respectively to the direction of the sunrise on solstices. The article [22] considers the latter example as a quite important example. As told by the researcher, the person that led the limitation of the colonia Iunonia Karthago was Caius Gracchus himself, in 122 BC. This foundation was put under the protection of Juno-Tanit. In the latter example, in the reference [22] it is told that Byrsa was chosen “to settle the groma” - the Roman surveying instrument - “facing the solstice of June ( $29^{\circ}, 19'$  above W-E line)”. In the Figure 4, we can see the direction of the sunrise on the summer solstice for the land near Byrsa.



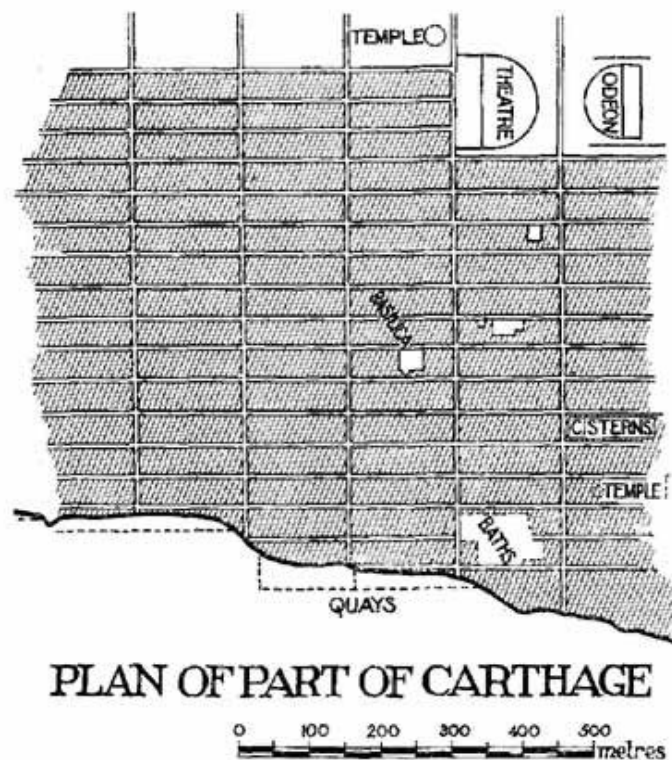
**Figure 4:** Thanks to Suncalc.org we can see the direction of the sunrise on the summer solstice, depicted on a satellite map. Here we can see the land near Byrsa. The orange line is representing the direction of the sunrise, and the red line the direction of the sunset. We can see also the apparent motion of the sun as described by the yellow curve. The direction of the noon is also given.

The planning of Carthage was discussed by Francis John Haverfield too [1]. About the Roman town planning, Haverfield is telling that “in many towns which can be connected with the later Republic or the Empire,” we can find “examples of a definite type of town-planning. This type has obvious analogies with earlier Italy and with the town-planning of the Greek world, but is also in certain respects distinct from either. The town areas with which we have now to deal are small squares or oblongs; they are divided by two main streets into four parts and by other and parallel streets into square or oblong house-blocks ('insulae'), and the rectangular scheme is carried through with some geometrical precision. The 'insulae', whatever their shape—square or oblong—are fairly uniform throughout. ... The Roman towns, which we are now considering, show two

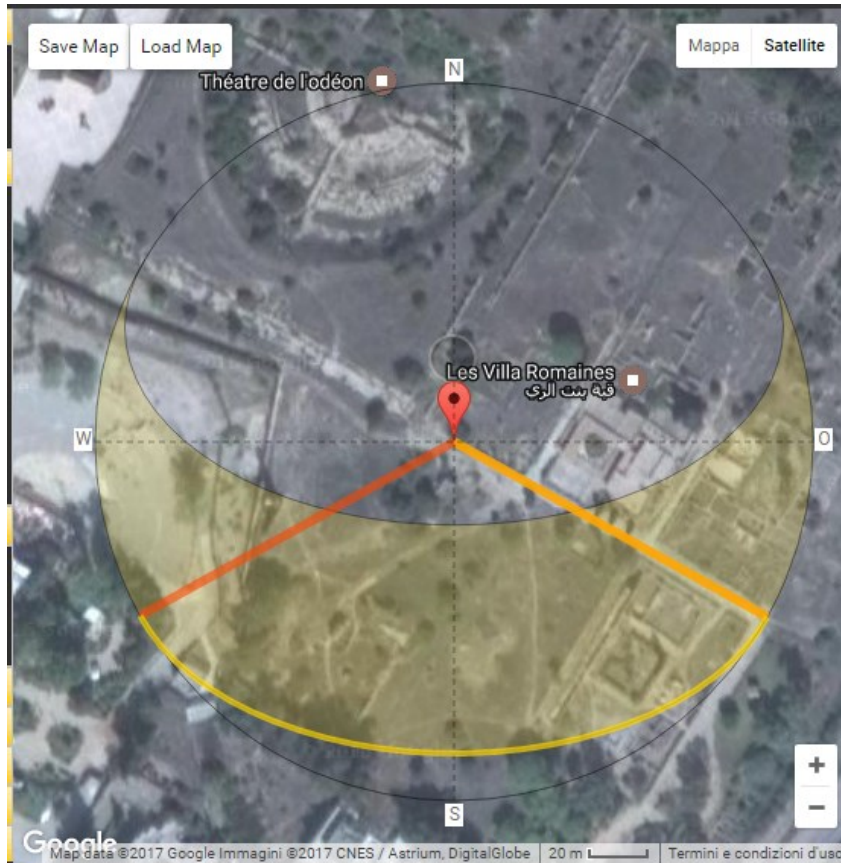
varieties of house-blocks. Sometimes the blocks are square; sometimes, perhaps more often, they are oblong approximating to a square, like the blocks of Priene. But in a few cases, as at Naples among the more ancient, and at Carthage among the later foundations, they are oblong and the oblongs are very long and narrow. It is hard to detect any principle underlying the use of these various forms.” [1].

According to Haverfield, “local accidents, such as the convenience of the site at Carthage, led to occasional adoption of the narrower oblong.” [1]. “Carthage, first founded ... as a Roman 'colonia' in 123 BC and re-established with the same rank by Julius Caesar or Augustus, shows a rectangular town-plan in a city which speedily became one among the three or four largest and wealthiest cities in the Empire. The regularity of its planning was noted in ancient times by a topographical writer ... But the plan, though rectangular, is not normal.” [1].

As told by Haverfield, and according to the French archaeologists who have worked it out, the plan of the town “comprised a large number of streets — perhaps as many as forty — running parallel to the coast, a smaller number running at right angles to these down the hillside towards the shore, and many oblong 'insulae', measuring each about 130 x 500 ft., roughly two Roman *iugera*. The whole town stretched for some two miles parallel to the shore and for about a mile inland, and covered perhaps 1,200 acres. Its street-plan can hardly be older than Caesar or Augustus, but the shape of its 'insulae' appears to be without parallel in that age.” [1]. In fact, as stressed by Haverfield, the blocks of Carthage are like the oblong blocks of Pompeii and of Naples, “and its two theatres also recall those towns. One reason for its plan may no doubt be found in the physical character of the site (Figure 5). The ground slopes down from hills towards the shore, and encourages the use of streets which run level along the slopes, parallel to the shore, and not more or less steeply towards it.” [1].



**Figure 5:** A part of Carthage as shown in a figure of Haverfield’s book [2]. The plan based on the *Carte archéologique des ruines de Carthage*, by Gauckler and Delattre.



**Figure 6:** Using again Suncalc.org we can see the direction of the sunrise on the winter solstice, depicted on a satellite map. Here we can see a part of the Roman Carthage.

In the case of Carthage, it is interesting to note that the streets running “down the hillside towards the shore” have a solar orientation: they align towards the sunrise on the winter solstice, as we can see using Suncalc.org software (Figure 6).

Let us conclude our discussion, considering again the centuriation near Chebba, that is, the centuriation that we have shown in the Figure 3. We can investigate if it possesses a solar orientation. The answer is negative; however, this centuriation could have been oriented towards the moonrise on a major lunar standstill.



**Figure 7:** In this image, obtained from a snapshot of the Photographer’s Ephemeris software, the blue lines represent the northern moonrise and moonset azimuths for a year of major lunar standstill (2025). The yellow and orange lines are the sunrise and sunset azimuths. Here we are close to the summer solstice (the direction of sunrise does not change appreciably). We can see that the orientation is not along the sunrise but along the direction of the northern moonrise.

In the Figure 7, we can see the direction of the northern moonrise for a year of major lunar standstill (the next will be in 2025), represented by the pale blue line. The yellow line is the direction of the sunrise. The day is June 25, close to the summer solstice. On this day, the direction of sunrise is not appreciably different from that observed on the solstice. We can see that the orientation of the centuriation is not along the sunrise but along the direction of the northern moonrise. Because of this result, it seems that it would be interesting to analyze other centuriations in Tunisia, to understand if other alignments along the moonrise are present.

#### **Appendix: Barthel's discussion**

“Hauptlinien teilen das System in vier Regionen, welche fest ausgeprägte Bezeichnungen haben. Frontin berichtet darüber: *limitum prima origo, sicut Varro descripsit, a disciplina Etrusca; quod Aruspices orbem terrarum in duas partes dividerunt, dextram appellaverunt quae septentrioni subiaceret, sinistram quae ad meridianum terrae esset, ab oriente ad occasum, quod eo sol et luna spectaret, sicut quidam architecti delubra in occidentem recte spectare scripserunt. Aruspices altera linea ad septentrionem a meridiano dividerunt terram, et a media ultra antica, citra postica nominaverunt. ab hoc fundamento maiores nostri in agrorum mensura videntur constituisse rationem. Primo duo limites duxerunt; unum ab oriente in occasum, quem vocaverunt decumanum; alterum a meridiano ad septentrionem, quem vocaverunt cardinem. Decumanus autem dividebat agrum dextra et sinistra, cardo citra et ultra. Die Regionsbezeichnung geht also aus von dem im Mittelpunkt des Kreuzes stehenden Limitanten. Dieser schaut in der Richtung des von Osten nach Westen laufenden Decumanus. So wird die nördliche Hälfte zur regio dextrata, die südliche zur sinistrata, die vor ihm liegende (antica) westliche zur ultrata, die hinter ihm liegende (postica) östliche zur citrata. Innerhalb dieser vier Regionen werden die Limites und Centurien je nach ihrer Lage rechts oder links vom Decumanus, diesseits oder jenseits vom Kardo maximus bezeichnet und gezählt. Nach der Lehre der Feldmesser soll der Decumanus alter heiliger Ordnung gemäss nach Westen gerichtet sein, doch erwähnen sie mit grösserer oder geringerer Missbilligung auch andere Orientierung. Zunächst die Umkehrung des Decumanus in die Richtung nach Osten, welche sie mit einem Wandel der religiösen Anschauung erklären: *postea placuit omnem religionem eo convertere, ex qua parte caeli terra inluminatur. Sic et limites in Oriente constituuntur.* Hierbei verdrehte sich natürlich mit dem veränderten Standpunkt des Limitanten die Bezeichnung der Regionen; die dextrata war nunmehr im Süden, die ultrata im Osten. Statt des wahren Ost machten „unwissende Messoren“ wohl auch den Punkt, an dem die Sonne am ersten Tage gerade aufging, zur Norm ihres Decumanus. Auch wird eine völlige Verkehrung der Anlage, so dass der Kardo nach Osten, der Decumanus nach Süden schaute, bezeugt. Und oftmals waren statt solcher Rücksicht auf Himmel und Sonne auch lediglich irdische Gründe für die Orientierung massgebend. So richtete man etwa die Limitation nach einer durchlaufenden grossen Strasse aus, oder man wählte die Richtung des Decumanus nach der grössten Ausdehnung des Gebietes, oder aber man nahm Rücksicht auf eine benachbarte Limitation und legte die neue, um eine bessere Abgrenzung zu erzielen, im Winkel zu jener an. Das sind etwa die wichtigsten Züge der gramatischen Überlieferung über die Orientierung”.*

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