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Traces of Foundations within Ancient Skies:

Archaeoastronomical Orientations of Towns and Temples in Campania between the 8th and 3rd cent. BC

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ABSTRACT

The aim of this research is to investigate the topographical and astronomical orientation of towns and temples in Campania from the 8th to the 3rd cent. BC. As emphasised by Carlo Rescigno and Felice Senatore, the towns in ancient Campania show a specific pattern in their orientation design. After a theorical overview on the role of the sky in urban and temple planning, the research focuses on the skyscape analysis of 14-case study: *Capua, Calatia, Suessula, Acerrae, Atella, Abella, Nola, Kyme, Neapolis, Herculaneum, Pompei, Nuceria, Stabiae,* and *Surrentum.* As an outcome, the orientation data distribution trend shows a prevalence for orienting towards a sector of the sky where the sun would have risen in early summer, synchronically to the helical rising of the Pleiades. This asterism is attested both literarily and iconographically in Campania, and it is interpreted accordingly to its function as timekeeper for agricultural and navigational activities. Indeed, the process of urbanisation Campania went along with an increasing extensive exploitation of the countryside, organised and integrated within the urban life, for cereal production and maritime exportation. Thus, from the 5th cent. onwards, Athens, and later Rome, became the main interlocutors of this commercial network with Neapolis. It is not difficult to see how the Pleaides might have played a cultic and practical role in this context, possibly celebrated within a festivity related to early summer crop harvesting. According to a Late Antiquity literary tradition, the Pleiades decorated the Nestor Cup preserved at Capua in honour of Diana. Moreover, in Hellenistic Cumae, a new Temple (A) was built in the forum area with a roof decorated by antefixes possibly representing the Pleaides carrying ambrosia, the immortal nectar for the gods, probably referring to a late spring or early summer (May/June) agrarian rite. It may be not a coincidence that, on an Capuan Oscan *Iuvila* inscription, a full moon celebration before summer solstice was mentioned, which would correspond to the time of the Pleiades heliacal rising. Moreover, as in the Etruscan-Italic world, in Campania the new year started in March: on this occasion the first new crescent moon was observed to regulate the whole calendar. This role was possibly under the jurisdiction of the temple of Diana Tifatina, with a cult which similarly developed in Latium: the axis of the sanctuary aligned with the new year *novilunium*. The Mt. Tifata above Capua might have used as a landscape target for the whole plain, as well as for the orientation of the Inferior Temple in the Greek Kyme, suggesting a strong cultural interconnection between the two towns. The ambrosia carried by the Pleiades was also present in a version of the myth of Herakles, specifically during his immortal apotheosis: the hero was the mythical founder of Pompei and Herculaneum. If the archaeological evidence is lacking for the latter, at Pompei this research has put in light a foundation ritual related to the cycle of the sun and summer solstice. The Etruscan presence in the Sarno Valley may suggest a similitude with Marzabotto urban design in the Po Valley, where a similar solar foundation ritual was suggested. Finally, it is clear that the observation of the sky in ancient Campania was necessarily performed integrating the ritual with the practical needs, the towns with the countryside, the cycle of sun with the moon's and the stars' recurrent movements. The celestial vault was the only means for orienting oneself in time and space, and therefore should be considered in landscape and topographical studies through the tools proper of the discipline of skyscape archaeology, as this pioneering study has attempted to do.

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SOMMARIO

I contributi originali di questa tesi si possono brevemente sintetizzare a partire da Pompei, dove l'urbanistica e la topografia del sacro, grazie allo studio archeoastronomico qui condotto, sono state inquadrate in una prospettiva fino ad ora mai propriamente indagata. Infatti, le strade della città corrono parallelamente verso nord-est, traguardando l'alba del sole nascente nei giorni più lunghi dell'anno, il solstizio estivo, quando il sole compie l'arco più largo nel cielo. Lo studio degli orientamenti templari della città ha evidenziato che anche il Tempio Dorico segue una simile dinamica celeste. Il tempio, il più antico della città, è ruotato in modo tale da traguardare il sole al tramonto nello stesso giorno dell'anno. Forse, anche la luna può aver avuto un ruolo importante nei culti qui svolti: subito dopo il tramonto del sole, nel giorno delle Idi, la luna piena sarebbe sorta davanti al tempio. Frammenti di calendari etruschi ed oschi della vicina Capua testimoniano come lo scandire del tempo all'epoca era ritmato dal moto del sole e della luna. Non a caso Strabone narra di aver passato il giorno della luna piena al solstizio estivo a Gadir nel tempio di Melquart, il corrispettivo fenicio di Eracle. L'eroe tutelare di Pompei ed Ercolano, dove il culto si è suggerito essere presente proprio presso il Tempio Dorico con Minerva, è anche il garante della fondazione. Una fondazione dal carattere solare ben si inserirebbe nella lettura già proposta di una probabile fondazione etrusca. Inoltre, la città di Pompei, in una delle sue varie fasi cronologiche, potrebbe essere stata coinvolta in un piano urbanistico di tipo Neapolitano incentrato nella *Regio VI*, risultante con l'orientamento coincidente tra il Tempio di Apollo e il Tempio dei Dioscuri a Napoli.

A Capua un sistema urbanistico arcaico può essere letto nelle frammentarie evidenze dell'abitato del Siepone, e come piano univoco nella topografia del sacro tra il Tempio di Diana Tifatina e il santuario di Fondo Patturelli. Il settore residenziale e periferico del Siepone presenta un'urbanistica regolare ma non perfettamente ortogonale. Tale pianificazione potrebbe essere leggibile in connessione al calendario etrusco della Tabula Capuana: il primo giorno dell'anno corrispondeva alle calende di marzo, ovvero all'osservazione della prima falce di luna crescente. Questa era visibile solo appena dopo il tramonto, e coincideva con l'asse del tempio di Diana Tifatina: fin dalla cella del tempio, incorniciata dalle colonne del santuario, l'astro di Diana sarebbe stato visto scendere verso l'orizzonte. Lì Stazio ricordava la cerva sacra a Diana, che rinnovava il suo chiarore immergendosi nelle acque del fiume, forse allegoria della luna ciclicamente nuova e piena. Dal Latium a Kyme, passando per Capua e il Monte Tifata, la Diana italica era una divinità centrale del pantheon Campano. Infatti, presso questo santuario probabilmente avveniva l'osservazione sistematica del cielo e la regolamentazione del calendario per la città di Capua, e forse per l'intera Campania. Infatti, l'apertura del santuario verso ovest permetteva una chiara visione di tutte le lune nuove dell'anno. L'orientamento di Capua a 75° azimuth (nord-est) coincide con un gruppo di città della piana Campana più interna fino alla penisola Sorrentina. È possibile ipotizzare che tale orientamento sia stato esportato direttamente da Capua durante l'espansione dell'egemonia etrusca nel periodo Orientalizzante e Arcaico. Quindi resta da definire tutto il gruppo di città della Piana

Campana più interna fino alla penisola sorrentina, Sorrento, Stabiae, Suessula, Abella, compresa la stessa Capua, di forte influsso etrusco-italico, che puntano verso un arco del cielo ben definito, compreso tra i 70° e 78° azimuth. Qui si nota una coincidenza degli assi urbani con il sorgere del sole nel periodo della prima estate, che corrisponderebbe verso la seconda metà di maggio o inizio giugno con il sorgere eliaco delle Pleiadi. Ulteriori studi sono necessari per confermare o meno se tale orientamento astronomico sia la reale intenzione dei costruttori. Inoltre si può ipotizzare che questo orientamento così presente nelle città campane più periferiche sia un riflesso diretto della capitale Capua, esportato dagli agrimensori etruschi-italici. Inoltre, la geomorfologia è un fattore predominante nelle fondazioni urbane che andrebbe indagato con degli studi specifici sul paleosuolo.

A Cuma la città di dispone con un orientamento a sé stante dal resto delle città della Campania. Forse a causa di problemi di bonifica della zona paludosa, già in epoca Arcaica, la città bassa si dispone e cambia orientamento con angolature non leggibili sul piano astronomico. Sull'acropoli, l'orientamento astronomico cardinale del Tempio Maggiore è indubbio, mentre il Tempio della Terrazza Inferiore guarda e traguarda verso il Monte Tifata a Capua e il Tempio stesso di Diana Tifatina per motivi forse non casuali. Sullo stesso Monte Tifata qualche secolo dopo verrà eretto il Tempio di Giove Tifatino con lo stesso sguardo, ma opposto, verso il Monte di Cuma in asse con la Via Campana. Questo doppio orientamento topografico si potrebbe interpretare alla luce della *fides*, l'attributo principale di Giove italico garante dei giuramenti, in stretto rapporto con l'apertura alla luce celeste e diurna garantita proprio dalla posizione sulla sommità delle vette. In alternativa, è ancora Diana Tifatina il riferimento topografico dell'anomalo orientamento del tempio, con la ipotizzabile corrispettiva dedicazione del tempio ad Artemide importata a Cuma come Diana Italica.

Con la fondazione di Neapolis si consolida in Campania un sistema di pianificazione urbana geometrico, forse da inserirsi nel contesto della diffusione del pitagorismo in Magna Grecia. Come già ben illustrato dai recenti studi di Fausto Longo e Teresa Tauro, la geometria del cerchio e del quadrato si fondono tramite l'uso di corde per mezzo della sezione aurea. Da aggiungere a questa lettura è l'uso centrale dello gnomone per trovare l'asse sud-nord del meridiano celeste, che quindi corrisponderebbe all'asse generatore della geometria urbana di Neapolis. L'orientamento risultante potrebbe essere spiegato tramite l'uso della terna pitagorica 5:12:13 per la creazione di triangoli rettangoli da applicare al disegno urbano, o comunque di un ottagono o della partizione del cerchio in 16 sezioni. Un simile procedimento potrebbe essere letto ad Atella se le evidenze archeologiche fossero più cospicue. Come già accennato l'influenza dell'urbanistica Napolitana è visibile evidente anche a Pompei con l'isorientamento del tempio dei Dioscuri (Neapolis) e del tempio di Apollo (Pompei).

Il contesto variopinto della Campania, fatto di molte etnicità di cultura cosiddetta meticcia di componenti greca, etrusca, italica, sannita e poi romana, ha contribuito all'eterogeneità del campione che quindi non può avere una sintesi sistematica esauriente. Non esiste un unico filo di lettura per spigare l'orientamento delle città nell'antica Campania, ma piuttosto delle riflessioni critiche. L'osservazione diretta del cielo può essere letta nell'ambiente etrusco-italico e poi romano, con Pompei, Ercolano, e Acerra che si avvicinano alla posizione dei solstizi; Nuceria e Calatia che guardano agli equinozi; Capua, Suessula, Abella, Stabiae, Surrentum che presentano un'orientamento solare sincronico con il sorgere eliaco delle Pleiadi. La luna era di pertinenza del santuario di Diana Tifatina a Capua. Oltre all'incertezza sui dati su Nola, Kyme si disingue dall'andamento generale delle altre città. Infine, Neapolis, forse seguita da Atella, si impiantano su disegni geometrici dove l'osservazione del sole è indirettamente finalizzata al tracciamento del meridiano celeste su cui si construiscono altre precise geometrie.

Questa ricerca può apparire a tratti limitata o approssimativa. Ciò è dovuto principalmente allo stadio dell'arte su questi studi e alla ristrettezza dei confronti tracciabili. Ovvero, questa disciplina è molto recente, gli strumenti conoscitivi epistemologici e metodologici sono nuovi e ancora non largamente condivisi e/o conosciuti nell'ambito specifico e in generale, financo dagli addetti ai lavori stessi. Oltretutto la disciplina viene approcciata da studiosi con formazioni differenti, che siano archeologici o astrofisici, e solo recentemente il mondo accademico sta formando la figura specializzata dell'archeoastronomo. Per questo motivo si è voluto porre enfasi sull'aspetto teorico, che abbraccia l'intera prima parte di questa tesi, con considerazioni di più ampio respiro ma sempre all'interno del Mediterraneo antico. La mancanza di dati archeologici sull'azione culturale del cielo in Campania è ancora troppo limitata per poter tralasciare un più ampio contesto geografico e cronologico. Ne consegue che ermeneuticamente l'archeologia ha spesso tralasciato l'aspetto celeste. Aggiungere quindi la prospettiva archeoastronomica o dell'astronomia culturale può aggiungere uno strumento prezioso ed interessante al bagaglio degli strumenti metodologici e conoscitivi dell'archeologia odierna. Sebbene non si possa garantire che qualsiasi studio possa avere questo coté, del resto non avrebbe senso togliersi a priori questa possibilità.

Di conseguenza va constatato – ed anche questo elemento andrebbe messo nel costituendo bagaglio metodologico di questa e di simili ricerche nel campo dell'archeoastronomia – che di frequente, se non spesso, quando si va a compiere uno studio su una città, per sua stessa natura l'agglomerato socioculturale storico dalla fortissima stratificazione e modificazione, oppure laddove c'è continuità di vita, difficile sarà pervenire a risultati solidi, cogenti e saldi. Come è nel caso di Pompei, o di Marzabotto, che è difatti più un'eccezione per il suo straordinario stato di conservazione e i risultati archeoastronomici risaltano proprio in questo lavoro con la sua ipotizzata fondazione solare. Per quanto riguarda le altre città è più difficile attribuire alla pianificazione il fattore celeste, data anche la funzionalità delle città e per il loro adattamento al territorio (avvallamenti, dossi, fiumi, clima ecc.). In tanti altri casi potremo avere una traccia di probabilità attorno a orientamenti possibili, senza poter avere una certezza solida sull'allineamento possibile. L'analisi statistica è sicuramente utile per l'archeoastronomia urbana, ma le peculiarità di ogni caso studio sono sicuramente da contestualizzare storicamente con un dovuto approfondimento. Al contrario – per citare Jacques Le Goff – il sacro resta e perdura, laddove le città mutano. Così anche nell'orientare o focalizzare una ricerca sarà sempre opportuno o comunque prevedibile poter avere dei risultati saldi e cogenti sugli elementi architettonici all'interno della sfera del sacro. D'altronde, è difficile eliminare del tutto il sacro dal cielo, di conseguenza l'aspetto religioso è il più adatto alle ricerche archeoastronomiche.

Sicuramente l'ambito del cielo è incorporato tacitamente in templi e altari in termini spaziali, di orientamento, e temporali, di festività. Soprattutto in ambito etrusco c'è ampio margine di ampliare la ricerca ad altre zone territoriali. Integrare la prospettiva sull'orientamento dei templi con la modellazione 3D può essere ulteriore linea di avanzamento: per il Tempio Dorico a Pompei, il tempio di Diana Tifatina, oppure in ambito etrusco a Pyrgi o laziale ad Ardea, l'anastilosi digitale delle architetture integrata ad una ricostruzione 3D virtuale della volta celeste permette l'immersione nell'orientamento stesso con fenomeni di illuminazione e di epifania all'interno della cella. I valori numerici delle statistiche sono così propriamente visualizzati. Quando si è certi di un allineamento astronomico è opportuno e bello valorizzarlo con la modellazione 3D anche per l'usofrutto all'interno di un sistema museale. Sicuramente l'osservazione del cielo era di fondamentale importanza nel mondo antico per le nuove fondazioni e molto lavoro ancora è necessario per un dovuto approfondimento nelle varie sfaccettature della disciplina dell'archeologia del paesaggio celeste.

INTRODUCTION

The arguments in this thesis are conceptually divided into two main parts. The first part is a critical review of the secondary literature, analysing and questioning scholars' theories and hypotheses on the role of the celestial sky in urban design and temple orientation, within a broader contextualising survey of Greece, Etruria, and the Mediterranean world. The second part, starting from Chapter Four, focuses on the area of ancient Campania with specific data analysis on urban and temple orientation in the region: this is made up of fourteen case studies analysing the archaeoastronomical factor in each settlement, together with their major temples. This analysis should be understood as a development, through the supply of an astronomical perspective, of the work previously done on the topic by Carlo Rescigno and Felice Senatore, who highlighted a surprising and intriguing trend in urban orientations in ancient Campania[1].

For the critical literature review, the attempt was made to consult as many modern bibliographic resources as possible. The importance of the knowledge of previous traditions of study was sharply highlighted by Arnaldo Momigliano[2]. Thus, it is fundamental to acknowledge that the data, on which each research into antiquity is based, is the collective result of a tradition of study of various types of sources across time, made by scholars with different academic backgrounds, generations, and nationalities[3]. This tradition of study should not be neglected but explored consciously as a kaleidoscope of critical analyses. The impossibility of referencing all authors in the field meant that a critical choice on modern sources of information had to be made, with the necessary omission of authors who have not offered new contributions to the topic. Apart from their novelty and originality in the field, works of authors have been chosen for their quality of writing, for clearly summarising concepts in an elegant and understandable way, for their recency of publication, and the comprehensibility of their published research.

Chapter One deals with the rationale behind this thesis, and the broader scope it offers for the application of skyscape archaeology within archaeology generally and the history of religion. This set the theoretical scope for adopting such a type of approach. First, what the discipline of skyscape archaeology is, how it should be placed within academia and, specifically, within archaeological studies. Second, it was necessary to clarify the terminology adopted, particularly on how the term 'astronomical' has been used by previous scholars to indicate 'cardinal' orientations. There follows a discussion of methodology on the survey and data analysis procedures used for gathering orientation measurements and effecting its statistical study. Chapter One concludes with an overview of the historical context in ancient Campania from the 8th to the 3rd cent. BC when the urbanisation of the area took place.

The literary review starts in Chapter Two with the technical procedures used in building cities and temples, and ends in Chapter Three with the sphere of the sacred. Chapter Two focuses on the archaeological and literary evidence on city and temple foundations techniques. Starting from an

[1] RESCIGNO - SENATORE 2009.
[2] MOMIGLIANO 1989, 134–135.
[3] MOMIGLIANO 1989, 134.

overview of ancient instruments - for instance the gnomon, and its use across the Mediterranean world - the main ancient techniques for planning by observing the sky are discussed. There follows an examination on the theoretical aspects behind the division of space in the Greek, Etruscan, and Roman world, with a focus on the ideological super-structures related to foundation rituals. The last section is on the possible environmental or ritual factors which may have constrained urban orientation. Especially applicable to town orientations, these factors are divided into *secundum naturae* and *secundum caelum,* terms borrowed from Giancarlo Cataldi's theory on Roman urbanism[4].

In Chapter Three, the idea of the sky as the source of the sacred is explored. From examples drawn from astral religions, the possible equivalence of deities with natural sky elements - celestial light, the sun, and the moon - are briefly investigated. Then the study focuses on the astronomical orientations of temples with several in-depth critical reviews of previous studies and new original insights. Finally, the role of the progressive movement of the celestial bodies as timekeepers for the constitution of calendars and the setting of festivities is further considered and questioned.

For the second and practical part, the geographical frame considered is the area of Campania in its ancient limits. The territorial area associated with the concept of 'ancient Campania' is defined by Latin Imperial Age historiography. The northern limit was up to the borders of Latium, nearby *Sinuessa* or the river *Volturnum*[5]. To the south, the area extended to the Sorrentine Peninsula, as Strabo recorded.

> We shall in the first place speak of Campania. From Sinuessa to Misenum the coast forms a vast gulf; beyond this is another gulf still larger, which they name the Crater. It is enclosed by the two promontories of Misenum and the Athenæum. It is along the shores of these [two gulfs] that the whole of Campania is situated. This plain is fertile above all others, and entirely surrounded by fruitful hills and the mountains of the Samnites and Osci[6].

As Strabo recounts, the area was called *Krater* before the formation of the ethnic group of the Campanians[7]. The term Campanians is here used as the Latin ethnic referred to the inhabitants of Capua whose ethnogenesis is fixed in 438 BC[8]. In fact, the name Campania means literary the plain of Capua[9]. The variegated ethnicity of the population was a characteristic typical of the area during the whole 1st millennium BC[10]. Indeed, together with Italics and Greeks, the Etruscan component was a further factor of differentiation in respect to the rest of southern Italy[11].

The chronological time frame used for the present analysis is five centuries, from the 8th to the 3rd cent. BC. This choice can be regarded as a huge chronological range, but it is necessary in order to identify the mutation that happened in the orientation of structures. Jacques Le Goff,

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4 Cataldi 2004b.
5 Ruffo 2010, 11–13.
6 Strab. 5.4.3, trans. H.C. Hamilton and W. Falconer, 1903.
7 Lepore 1976, 573.
8 Rescigno - Senatore 2009, 443.
9 Diod. XII, 31, 1; Liv. IV 37, 2.
10 Colonna 1991, 25.
11 Colonna 1991, 25.

discussing the elements of the sacred, emphasised how sacred places tend to endure over time[12]. In the words of Claudia Moser, «religious rituals typically cannot support substantial variation because the specific action of the ritual itself is understood by the community as having been prescribed by the gods to conform to a specific pattern»[13]. Indeed, Mauro Cristofani considered how, in ancient Campania, evidence of a *continuum* in the spatiality and temporality of cult activities can be attested from the Archaic period to Late Antiquity[14]. With this in mind, the determination of anomalies in orientation can be read as a sign of cultural and/or socio-political discontinuity, especially when sacred civic structures are involved.

The practical part will start in Chapter Four as a discussion of the orientation of cities in Campania case by case. These are discussed starting from *Capua, Calatia, Suessula, Acerrae, Atella, Abella, Nola, Kyme, Neapolis, Herculaneum, Pompei, Nuceria, Stabiae* and ending with *Surrentum*[15]. With each settlement, there is a historical overview focusing on the topographic urban elements combined with a diachronic analysis of its orientation and a skyscape reconstruction. The main temples of each town are also discussed in terms of their orientation and within other archaeological evidence on the cultic activities evident from each.

In Chapter Five the data analysis of the sample is discussed. The data analysis is drawn from the catalogue of the case studies and discussed within the context of the theoretical background previously laid out. A diachronic perspective is also attempted with a division between cities founded in a chronological timeframe between the 8th to the 7th cent. BC, compared to foundations datable between the 6th–5th cent. and 4th–3rd cent. BC. Finally, a conclusion completes this thesis by summarising the main original achievements and discoveries represented here and by reflecting upon the role the discipline of skyscape archaeology has within archaeology generally and its scope for future advancement and development.

[12] LE GOFF 1982.
[13] MOSER 2014b, p. 363.
[14] CRISTOFANI 1998, 173.
[15] Due to the frequent repetition of these towns' names across this thesis, these will be rendered in roman font.

Chapter One. Methodology And Context

1. *RATIONALE AND AIMS*

1.1 Skyscape Archaeology as a Discipline

Skyscape archaeology or archaeoastronomy can be regarded as a branch of archaeology and as an extension beyond what the discipline of landscape archaeology is, with its focus on the upper half of the world, that is on the celestial vault[16]. It differs from the history of astronomy as the latter deals with technical astronomical knowledge and discoveries from ancient to modern times, whereas skyscape archaeology also includes the celestial vault as a cultural background for imagination, eschatology, and divinity. These topics can be included within the wider field of cultural astronomy[17]. The discipline of archaeoastronomy has strived to acquire its proper place as an academic discipline, being itself highly inter-disciplinary [18] . For this and other reasons, the whole field of 'archaeoastronomy' was recently renamed 'skyscape archaeology' by Fabio Silva to emphasise its legacy with other '–scape' concepts and to finally define its proper place within the archaeological literature[19]. When dealing with human relationships with the environment, the '-scape' perspective places an emphasis on the social and anthropological representation of space instead of on the physical adaptability to a geographical reality. Moreover, current discourses on landscape archaeology and archaeology in general, especially within English-speaking academia, tend towards the concept of 'agency' and its epistemological consequences. The idea of agency contemplates that network of relationships between an individual or a social group and its surrounding reality. The powerfulness of the -scape approach is that it questions the ideological distortion acted upon reality by every social group. This perspective stands on the side of the people who lived in those territories, in such a way that is beyond anachronistic interpretations based only upon adaptive processes to an environment[20]. Landscape and skyscape can be read as cultural and social products, mutable with sociological transformations.

1.2 Rationale: Time, Space, Memory

This thesis aims to analyse time, in its inherently astronomical connotation, and space, as spatiality and orientation of the built environment, through the means of skyscape archaeology. According to Filippo Coarelli, one of the most typical structural aspects in the Archaic period is the unity between space and time[21]. He gave the example of the Roman god *Terminus*, both God of physical borders, and of the end of the year festivity of *Terminalia*. In Greece[22], the cycle of 100 lunations, after which the sun and the moon would have synchronised, was reflected in the sacred measure of 100 feet[23]. In

[16] SILVA 2015, 3.
[17] CAMPION 2015, 17.
[18] See Liz Henty, *Exploring Archaeoastronomy: A History of its Relationship with Archaeology and Esotericism*, Oxford, 2022; MOSCATI 2010.
[19] SILVA 2015, 3.
[20] NIZZO 2016, 117.
[21] COARELLI 2005, 29.
[22] On time and space in the Classical *polis* also see CALIÒ 2014, 172 ss.
[23] BRELICH 2015.

line with the vision expressed by Coarelli, time and space can be studied as connected categories. Time is indeed inherently an astronomical concept, which can be spatialised on land with alignments to specific celestial events. Thus, in ancient thought, spatial directions acquired qualitative connotations. The Greek word σκαιός meaning both 'west' and 'infamous' might be related to the direction where the sun is at sunset and the underworld. This would produce an absolute system of orientation based on day and night with the west on the left, and the east on the right, and the facing direction being towards north[24]. Other orientation systems between human beings and the cosmos were transmitted from the Roman world: Frontinus mentioned an observer looking west, with his right hand towards the north[25]. The sky is the natural medium for orientation in place and time. Therefore, the spatial topography of towns and sanctuary areas can be read as socio-natural systems regulated by cyclical astronomical events.

Thus, the spatiality of the built environment can act as a medium for preserving the memory of foundation myths, heroic acts, or social remembrances[26]. Within an orientation system, the periodicity of sky and thus time carries the mythical memory and the fixing of festivities[27]. Thus, long term memory in the ritual actions is preserved in the spatial arrangement of sanctuaries[28]. For Jan Assmann «[t]hrough regular repetition, festivals and rituals ensure the communication and continuance of the knowledge that gives the group its identity»[29]. Also, in the work of Marco Filippucci, orientation is regarded as a fundamental factor of civic identity in the urban fabric[30]. Entire landscapes can become mnemotechnical places of social cultural memory[31]. The directionality of the monuments itself is a mnemonic model of reiterative identity. The materiality of the architectures can encode and reactivate the memory of the religious order[32]. The layout, orientation, and monumental arrangement of sanctuaries would have tacitly informed ritual activities in sacred places[33]. Votive objects added to the special local character of the site. Deposition of votive objects can also follow precise orientations. In Etruria, at Pyrgi, in the public-ceremonial quarters, a loom weight oriented according to cardinal directions was found in a votive pit. A further example can be drawn from Monte Casale (Sicily), where several weapons were found intentionally deposited pointing towards north[34]. Similarly, the foundation ritual offerings discovered in the well at the centre of the urban area of Servirola in the Emilian plain (end 6th – beginning of the 5th cent. BC) were sealed by a wooden beam placed to orient again to the cardinal points[35]. Further considerations on the application of skyscape archaeology to temples and sacred structures are discussed in Chapter Three, in the 'Temple

[24] Van Tilburg 2015, 168.
[25] Fron. *Lim.* 27.13-28.4 L.
[26] Di Fazio 2012a, 148; Martin-Mcauliffe - Papadopoulos 2012, 354.
[27] Brelich 2015, 68–69.
[28] Boutsikas 2020, 21–30.
[29] Assmann 2011, 42.
[30] Filippucci 2012, 118.
[31] Assmann 2011, 44.
[32] Moser 2014b, p. 399.
[33] Sassu 2018, 448.
[34] Scarci 2021, 23.
[35] Chierici 2007, 245; Fogliazza 2020, 125.

Orientation' introductory paragraph. Mario Torelli stated that the role of festivities in the study of sacred architecture is one of the most ignored themes in archaeological research[36]. Therefore, the ideal process of inquiry of skyscape archaeology would progress as follows: from the investigation of the topography of the built environment with its specific orientation, to the study of astronomical events in that direction, the possible timing of the related ritual activities is inferred. From this deductive reasoning arises the question of the possibility of inferring seasonal time after topography.

This ideal line of thought is far from being applicable to every real case study. However, it can work in very specific sites related to sacred activities, sanctuaries, altars, and temples, where 'space' and 'time' are separated from common day-to-day activities[37]. It can also be applied to towns when these were 'inaugurated' as sacred spaces, as further discussed in this thesis[38]. For Guido Rosada, the orientation *secundum caelum* is related to the sacred sphere[39]. As Rosada wrote, such layout is a projection of the sky, sacred and oriented: «we speak here of a planned and agrarian design commonly defined as *secundum caelum*, a ground projection of the celestial *templum*, a space therefore 'sacred' and at the same time oriented and subdivided»[40]. Indeed, a city foundation can be regarded as a ritual act of establishing a new political community[41]. In ancient thought, the act of building itself was regarded as artificial, unnatural, and against the natural status; the choice of a place to be inhabited should therefore be done in accordance with divinity or subjected totally to the gods' will[42]. This is a fundamental aspect emphasised by Joseph Rykwert on the anthropology of the urban form: in ancient times the foundation of a town is primarily the construction of a mythical narrative[43]. The first primordial act of building was a rehearsal of the world creation myth, with the plan of the settlement reflecting those of the cosmos[44]. Luigi M. Lombardi Satriani stated that the domestication of space coincides with the foundation of time, and the constitution of a protected place to live in where time is organised in liturgical and calendric rhythms[45]. The fixing of reference points in space and time is a condition necessary for being in the world[46]. The town foundation was commemorated annually and the founder himself acquired a central position in the spatiality of the city. The founder was the community first ancestor, and its memory was recalled annually at its monument with sacred rites[47]. According to Numa-Denis Fustel de Coulanges, nothing was more important in a city than the memory of its foundation[48]. The solidity of a built environment was not only guarantee by the building

[36] TORELLI 2013, 43.
[37] BRELICH 2015, 64.
[38] The term 'inauguration' is used here with its specific sacral connotations within Etruscan and Roman rituals.
[39] ROSADA 2010, 133.
[40] «si parla qui di un disegno planimetrico e agrario definito di norma *secundum caelum*, proiezione sul suolo del *templum* celeste, spazio dunque "sacro" e insieme orientato e suddiviso», ROSADA 1991, 90, trans. by author.
[41] LONGO 2014, 230.
[42] RYKWERT 1988, 174; LOMBARDI SATRIANI 1984, 180.
[43] RYKWERT 1976; see also F. de Polignac, *La naissance de la cité greque. Cultes, espace et société, VIII-VII siècles*, Paris 1995.
[44] RYKWERT 1988, 191.
[45] LOMBARDI SATRIANI 1984, 177.
[46] LOMBARDI SATRIANI 1984, 178–179.
[47] FUSTEL DE COULANGES 1972, 168.
[48] FUSTEL DE COULANGES 1972, 168.

techniques and materials, but by the correct application of symbolic and rituals norms[49]. The rationale behind this research is profoundly inspired by this tradition of studies on history of religion and the anthropology of the urban form, and thus this thesis' title has been chosen in a way to reflect the title of a famous essay edited by Marcel Detienne on foundation rituals.

1.3 Aims and Research Question

The investigation question is whether such specific architectural orientation in sacred places might have been dictated by the occurrence of celestial phenomena contextual to the celebration of periodical festivities. Moreover, the neat divergence of certain structures (temples, altars, etc.), when spatially independent from the rest of the site, is considered as a hint of intentionality. In the case of towns, the situation is more complex since urban settlements are extended areas; their design had to adapt to the local terrain, as well as climatic and functional peculiarities. For this reason, debates on the question of whether Greek, Etruscan, Italic, Oscan, Roman towns were inaugurated as sacred spaces, will be dealt with in the following sections. In fact, it is a difficult matter to attempt to leave the study of the celestial vault in ancient thought as outside the sphere of the sacred. Nevertheless, the strict practical use of the sky for urban planning is also presented in terms of solar irradiation problems and survey instruments, such as the gnomon. A secular relationship with the astral bodies will also be presented within functional scopes purely related to navigation and the timing of agricultural activities. Gaston Bardet stated that the affirmation of the solar orientation of a city may imply that it is possible to find one or more systematic directions, and to find an effective relationship between such directions and the characteristic positions of the sun[50]. This relationship, continued Bardet, can be of hygienic and functional purposes (as is the aim of his current architectural activity), or pertain to a ritual and religious levels of awareness in the case of past civilizations[51]. However, there should be no strict differentiation between the functional and the religious, since ritual prescriptions and hygienic habits were often intertwined[52].

The aim of this thesis is to bridge the gap between ancient urban planning and contemporaneous knowledge of the motion of the sky. A long tradition of studies on urbanism and archaeoastronomy started from the hypothesis of considering the 'east', referred to as the real point of the sun rising, to calculate the day of foundation[53]. Apart from cardinal organisation, *secundum caelum* planimetries may deviate according to the arc of the horizon where the sun rises, even though Pliny regards it as a wrong practice:

> The point that must be verified first of all is the south, as that is always the same; but the sun, it must be remembered, rises every day at a point in the heavens different to that of his rising on the day before, so that the east must never be taken as the basis for tracing the lines. Having now ascertained the various points of the heavens, the extremity of the line that is nearest to the north, but lying to the

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[49] M. Eliade, *I riti del costruire*, Milano 1990 cited in MORO 2005, 23–24; LOMBARDI SATRIANI 1984, 177–178.
[50] BARDET 1945, 202.
[51] BARDET 1945, 202.
[52] BARDET 1945, 202.
[53] NISSEN 1906; PROSDOCIMI 2009; GONZÁLEZ-GARCÍA - MAGLI 2015.

east of it, will indicate the solstitial rising, or, in other words, the rising of the sun on the longest day, as also the point from which the wind Aquilo blows, known to the Greeks by the name of Boreas[54].

In ancient planning, 'east' is the point of sunrise but its position is changing within an arch defined by the solstices, which depends on the latitude. Due to the lack of understanding about this concept and about the general motion of the sky, in the academic literature, the use of the term 'astronomical' to describe the orientation of a city is often found to describe a very narrow semantic field. For instance, this is the case for Roman Capua and its 1st cent. BC centuriation[55]. However, there, the use of 'astronomical' stands for 'cardinal', as in its orientation in relation to the four cardinal directions, or *secundum caelum* in Giancarlo Cataldi's theory[56]. Also, Pier Giovanni Guzzo mentioned that the urban grid of Pompei is not oriented astronomically, meaning 'cardinally', but results described in this thesis would suggest the astronomical, specifically 'solstitial', orientation of the city[57]. Therefore, it should be pointed out that the astronomical orientations of cities are not just the ones which reflect cardinal directions, as has often been assumed[58], but they can be generalised for any orientations which have a clear reference to the sky. Each direction is potentially astronomical. The pivotal question of the discipline is to detect intentionality behind any hypothesis of astronomical alignment. Archaeoastronomical alignment is here referred to as the orientation of any archaeological structure surveyed as having an intentional and non-casual spatiality with a clear reference to the celestial vault. This search for intentionality is further discussion in the 'Data Analysis' paragraph.

54 Plin. *HN* 18.331-333.
55 Ruffo 2010, 165.
56 Cataldi 2004b.
57 Guzzo 2016, 77.
58 Sommella 1988, 231.

2. *METHODOLOGY: SURVEY AND DATA ANALYSIS*

2.1 Orientation: Azimuth

This research has, as its pivotal centre, the analysis of urban and temple orientation in relation to topography and astronomy. The topographical research has been based on the diachronic reading of cartography, by times validation on the field of territorial persistence, valorisation of orientation anomalies, and the check of structure orientations in the archaeological documentation of published reports in excavations[59]. The region of ancient Campania has been subject to tremendous changes since antiquity, but remains of the cardinal centuriation of the *Ager Campanus* and of the viability of the Appia Way and Regio-Capuam are still recognisable in modern traces[60]. Long *durée* changes in landscapes, such as paleochannels of rivers, have been considered when relevant for the investigation. Archaeological traits are often perpetuated by modern alignments, roads, or territorial divisions[61]. Surveys in the field with Total Station, Terrestrial Laser Scanner, RTK GPS, UAVs have been used to get an orthographic projective representation of structures. In this context, the survey needs to achieve the most precise definition of the shape and of the materials used in relation to the reality of what is in situ, using accurate geodetic measurements to define a correct positioning. Digital tools were used to complement fieldwork values, and for sites impossible to survey using ground-based methods. To fully determine the orientation of a town at the time of its design and construction, the most effective methodology was to consult the archaeological digital cartography of the area, usually in CAD or GIS format. In alternative, LiDAR Digital Elevation Model data (DEM 1m or 2m resolution) was used to measure orientation values and to produce reliable cartographic maps[62]. Furthermore, the Relief Visualisation Toolbox was applied to raster DEM to emphasise archaeological structures[63]. Legacy data from previous excavations was also the main source of orientation values for covered structures, in some cases using raster files georeferenced within the GIS environment. Measurements were also compared with Google Earth ruler tool to assess the heading of structures. Satellite photos are not a reliable way to measure angles since they do suffer from a skew error[64]. Rose diagrams and polar histograms were also adopted to plot orientation of urban grids[65]. For instance, within the QGIS environment the Line Direction Histogram plug-in was used to plot the vectoral cartography of urban morphology into rose diagrams[66].

Archaeological data are not homogeneous across ancient Campania, with different chronology resolutions for different urban settlements. Some of the sites preserved structures from the Roman

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59 RUFFO 2017, 58.
60 FECONDO 2015, 93.
61 RUFFO 2017, 61.
62 Due to the COVID-19 emergency, fieldwork campaigns have been limited. For this reason, LiDAR data have been mostly used as the most reliable source of topographical information.
63 KOKALJ - HESSE 2017; KOKALJ - SOMRAK 2019.
64 Google Earth ruler tool was compared with QGIS measurement by RODRÌGUEZ-ANTÒN 2017, 42.
65 KADISH 2014; BOEING 2019; AGAFONKIN 2018.
66 TVEITE 2015; The distribution bin can vary accordingly to the research question. For this study, 1° distribution bin was applied.

period, such as Herculaneum, Pompei, Stabiae, Suessula. Others show a continuity of life to nowadays, such as Capua, Acerrae, Neapolis, Nola, Abella, Nuceria, and Surrentum. Kyme archaeological park preserved a stratification of different diachronic orientations continuously revealed by its ongoing excavations in the acropolis and the lower city. Instead, Atella and Calatia, are embedded in the modern agricultural or peri-urban landscapes. When excavations remained unpublished or on a preliminary state of publication, the lack of a deep knowledge of the material evidence only allows a generic dating. In most of the case studies in the analysis, the archaeological structures did not have a size and degree of preservation status well suited to guaranteeing the delineation of orientation values with good accuracy[67]. Unfortunately, it is common practice in archaeology to assign due north very approximately, although this situation has improved through the use of geographic information systems. This practice limits the discourse diachronically, and would otherwise have allowed a more coherent picture to be develop of the Campanian plain in its different phases of occupation. The result emerged from hypothetical reconstructions of urban orientations, yet still in a scholarly accepted form[68]. Although hypothetical, the resulting urban morphology does make use of unequivocal archaeological evidence, such as the spatiality of necropolis areas which gives a clear indication of the spatial perimeters of the living.

Geographical data are fundamental parameters in this research. First, the determination of azimuth values is dependent on the position of true North. Azimuth values are here considered as the angle spanned clockwise from Geographical North, since it corresponds to the North Pole on the Celestial Sphere. This is the standard surveying coordinate system for archaeoastronomical use, with North as the starting point being 0 degrees and by measuring the angle in a clockwise direction, with East being 90 degrees (fig. 1). But the geographical reference system of longitude and latitude distorts areas and lengths; for this reason, rectangular Cartesian projections are mostly used in archaeological documentation. If the first system describes coordinates in degrees, the second describes a point on the Earth's surface in metrical distance from a reference meridian using "Easting" and "Northing" values. However, with Cartesian projection, if the location is not on the central meridian line, the top of the map does not point to the Geographical North but to the Cartographic North[69]. Flat maps indeed approximate the surface of the spherical Earth. Therefore, it is important to convert grids, carefully considering the reference systems and the geographical projection[70]. The difference between True/Geographic North and Cartographic North is known as Meridian Convergence γ. The approximate formula for the Meridian Convergence γ is as follows, where Λ is the longitude of the Monte Mario meridian, and λ and φ are the longitude and latitude of the place considered:

$$\gamma(\lambda; \varphi) = \tan^{-1}\{[\tan(\lambda - \Lambda)] \times \sin\varphi\}$$

[67] RODRÌGUEZ-ANTÒN 2017, 42.
[68] RESCIGNO - SENATORE 2009.
[69] ZOTTI 2019, 40.
[70] The IGM on-line service Verto On Line was used for conversion.

For the region of Campania, the Meridian Convergence can be estimated at around 0,25°, a value that renders it irrelevant for the present analysis which operates on a margin of error of at least ±1°. The difference between the True North and Magnetic North is called Magnetic Declination. This has not been an issue in the context of the field research for this thesis since no magnetic instruments were used during surveying, but it has been necessary to double-check information in the case of reference to magnetic-bearing published data. The difference between True North, Magnetic North and Cartographic North has to be considered when converting data.

With the intent of reconstructing the development of the cities in this study in their multi-stratified histories, it should be reflected upon how the anachronistic cartographic vision might reflect upon the reconstruction. Clemente Marconi emphasised the importance of adopting the perspective the visitor or inhabitant of an ancient city, as a real and immersive space: he called it creating 'a visible city'[71]. The use of aerial photography as well as cartographic imagery has the advantage of giving the scholar a global perspective, but somehow detached from that of actually walking through the city. Therefore, whenever possible, the results of the digital analysis have been integrated with the phenomenological participation of the skyscape event on site, in order to provide photographic documentation beyond the numerical data and, also, to attempt an immersion into the complete experience of land and sky. Moreover, on several occasions, the archaeoastronomical identification was backed up with autoptic fieldwork and photographic documentation. Indeed, a correct skyscape methodology, for instance by using the open-source package *Stellarium*[72], can predict adequately the celestial phenomena in a way that makes it possible to attend some archaeoastronomical events in person. This is especially true for solar and lunar events, which are subjected to smaller changes in respect to stellar events, so that an autoptic observation of the ancient sky can be experienced in a similar way in the present[73].

When applying the methods of skyscape archaeology, the branch of astronomy used is typically horizontal astronomy. This approach focuses on the study of celestial events happening just above the local horizon. The basic tool of the discipline involves a knowledge of the sky through naked-eye observation in a similar way to how ancient peoples would have known it, achievable by looking at it every night and living it, together with a basic understanding of spherical astronomy. For each archaeological structure, a one-dimensional topographic direction[74], that is a line defined on the Earth's surface, is considered. Indeed, since the starting point of skyscape archaeology is an archaeological structure within a planar two-dimensional design, the basic methodology to be applied for this chronological period where heights are often not preserved, is to work without considering the Z axis. Thus, for any archaeological structure to be analysed, for instance a temple, the main axis is measured. The angular deviation from the north is called 'azimuth', or more generally 'bearing'

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[71] MARCONI 1996, 759.

[72] This open-source software package is currently one of the fundamental digital tools of archaeoastronomical research as it allows a planetarium desktop reconstruction of the sky in different epochs and places.

[73] On the occasion of the summer solstice 2021, the archaeological Park of Pompei had a particular opening at dawn where it was possible to watch the sun rising parallel to the urban grid.

[74] For instance, a temple main-axis or a main urban street.

(fig. 1). This value can be measured with a compass, a Total Station, or a GPS. The one-dimensional topographical direction on the Earth's surface is prolonged infinitely towards and then beyond the horizon. Any topographical directions meet the celestial sphere on the horizontal plane. Only the celestial events which took place just above that precise point on the horizon are relevant for the investigation. All the rest of the celestial vault is, thus, ignored[75].

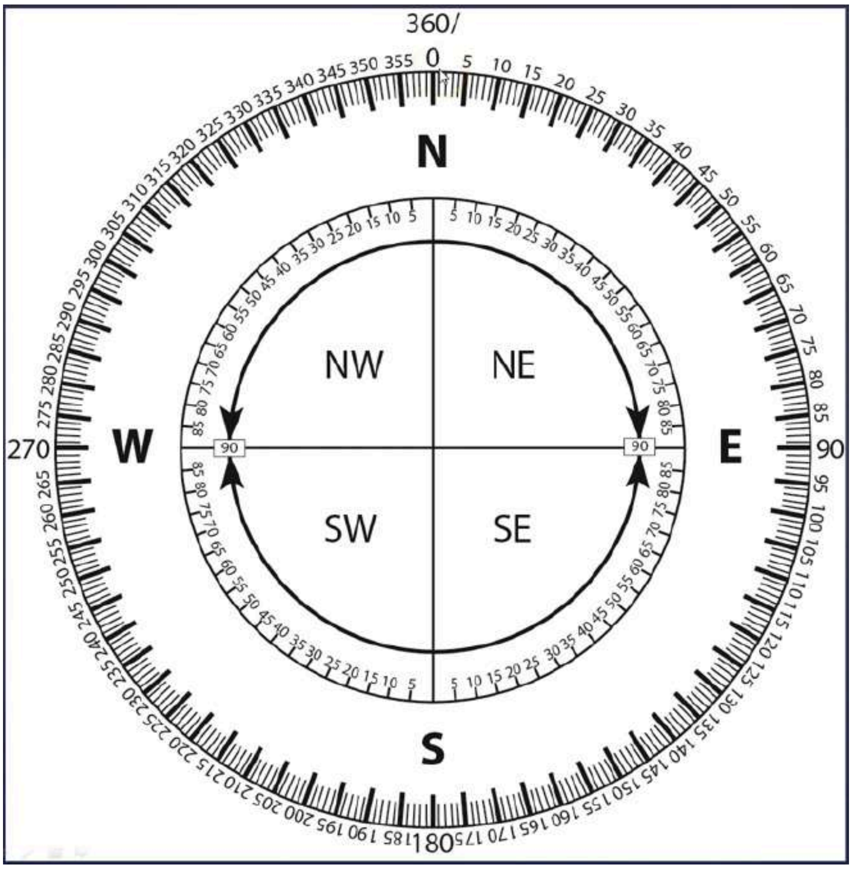

Figure 1. Azimuth values across directions.

2.2 Skyline Horizon: Altitude

Mountains, hills, plains, or the sea visible from a site constitute the local horizon or skyline. For any point on Earth, the skyline is defined as «the projection of the outline of either hills, mountains or buildings situated at the direction of view of an observer» and in relation to the celestial sphere[76]. The outline of a skyline, and its positioning in respect to the celestial vault, is directly dependent on the

[75] It may be useful to consider zenithal orientation for equatorial zones where the sun can reach the zenith at precise times of the year.
[76] PANTAZIS - LAMBROU 2018, 24.

observation point: it may change considerably even every 100 meters distance observation point[77]. Also, the nearer the skyline features are to the observer, the more they are subject this parallax errors. As expressed by George Pantazis and Evangelia Lambrou, «the apparent positions of the celestial bodies at the time of their rising or setting as seen from the monuments depend on the profile of the perceptible horizon in respect to the monument»[78]. In the boreal hemisphere, in the case of a non-flat horizon, the exact position of any celestial bodies rising and setting is always shifted towards the south[79]. Therefore, the measurement of the apparent height of the landscape should be considered in any archaeoastronomical analysis. Skyline altitudes can be calculated with a clinometer, a Total Station, or a GPS if the peak of the mountain is reachable. In other terms, «the altitude of the horizon in the direction marked by each city grid was also measured in order to compute the astronomical declination of a hypothetical object that would rise or set at that specific point on the horizon», as further discussed later here when introducing the concept of declination (figs. 2–3)[80]. Moreover, in respect to a past ancient skyline, variations in tree-cover and even terrestrial morphology for volcanic area such as Mt. Somma-Vesuvius[81], should be considered.

A virtual landscape can be created starting from DEM and then be verified by measurements on site for the direction of interest. The web service *HeyWhatsThat* is dedicated to the conversion of the Shuttle Radar Topography Mission (SRTM) 3" (~90m) DEM to horizon profile[82]. These data can be downloaded as a polygonal landscape for Stellarium directly through *HeyWhatsThat* or via the web service *HoriZONE*[83]. Exporting landscape for Stellarium can also be done using *Google Earth Pro* software package: a photographic landscape can be created by stitching together many 3D Google Earth ground views[84]. Similarly, a photographic landscape can be made on site rotating the camera on a tripod or using a full dome camera[85]. Different web services with similar aims are *PeakFinder, Create a panorama* and the *ViewFinder Panoramas* software[86]. A basic skyline profile valuation of the size and dimension of an obstructed view caused by mountains can be achieved in the previously described ways[87]. For a more detailed view of the artificial polygonal landscape, the *Horizon* software package by Andrew Smith should be preferred[88]. It converts SRTM (3" or 1") DEM or different DEM raster format into a panorama. The polygonal landscape, together with a detailed terrain panorama rendering based on progressive coloured elevation and distances, can be exported from Horizon into Stellarium. Moreover, the program Horizon itself provides basic archaeoastronomical analysis with

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77 Cristofaro - Silani 2021, 7.
78 Pantazis - Lambrou 2018, 24.
79 Zotti et al. 2021, 229.
80 Rodríguez-Antón et al. 2019, 107.
81 Cioni - Santacroce - Sbrana 1999; De Simone 2014.
82 Kosowsky 2014.
83 for *HoriZONE* see Doyle 2019; given the repetition of these terms across this thesis, the name of software packages will be kept in standard non-italics font after the first mention.
84 Zotti 2013.
85 For this research the iSTAR NCTech 360-degree camera was employed.
86 Soldati 2023; Deuschle 2018; Ferranti 2011.
87 Zotti et al. 2021, 232.
88 Smith 2020.

sun paths and major bodies positions across time; for this reason, this software has been preferred to show results. When not explicitly stated, the panoramas were produced with Horizon after SRTM 1" and the epoch of the sky set to accord with the chronology of the archaeological remains. For achieve even better simulations, a higher resolution of around 1m LiDAR data DEM can be employed as source data[89].

The above-mentioned solutions are valid when working for one single viewpoint. Whereas, when working with more observation points the building of a 3D landscape model should be considered. The main advantage is that the viewpoint can be modified when exploring the virtual environment. Building a 3D immediate and immersive experience means it is also possible to have a fact-finding model that can be explored as needed. Within the present research, this exercise was tested for the town of Pompei enabling the testing of sunlight and shadow effects across seasons using the Scenery3D plug-in in Stellarium[90]. Such extended site, as the whole urban area of Pompei, would be appropriate for a 3D virtual walking experience under ancient skies.

Such solutions are not free from errors depending on the location and the different methods used[91]. First, some simulations, such as the Horizon software and the *HeyWhatsThat* web service, do take into account the curvature of the Earth when modelling skyline profiles[92], whereas others, such as the Scenery3D plug-in in Stellarium, do not. Second, these digital models are preferable for reconstructing distant landscapes, whereas near features can suffer greater errors. 1 m of vertical error in a 3 km distant real landscape feature, in the polygonal landscape, would correspond to 1 arcminute of error, and this error would increase for nearer feature[93]. Near reconstructed features would generally appear lower in the artificial landscape than in the real one[94]. Third, refraction caused by the Earth's atmosphere can cause a slight deviation from the expected height of the skyline, tending to raise far peaks up by a few arcminutes: this problem is not addressed in Google Earth, but it is dealt with in the *HeyWhatsThat* web service, Stellarium, and Horizon[95]. Extinction can change across time given specific local conditions, such as the long-term presence of volcanic eruption gases[96]. Distortions caused by atmospheric refraction have been corrected during calculation, since stellar events nearby the line of the horizon can also be affected by it in their apparent position[97]. Each method of virtual landscape reconstruction can thus be chosen accordingly to its potentiality and the relative research question.

[89] ZOTTI 2019, 41.
[90] CRISTOFARO - SILANI - ZOTTI n.d.
[91] REIJS 2015; FERRANTI 2015.
[92] ZOTTI 2019, 46.
[93] ZOTTI ET AL. 2021, 232.
[94] ZOTTI ET AL. 2019, 40.
[95] ZOTTI 2019, 46.
[96] ANTONELLO ET AL. 2015.
[97] SCHAEFER 2001; KELLEY - MILONE 2011, 61–64.

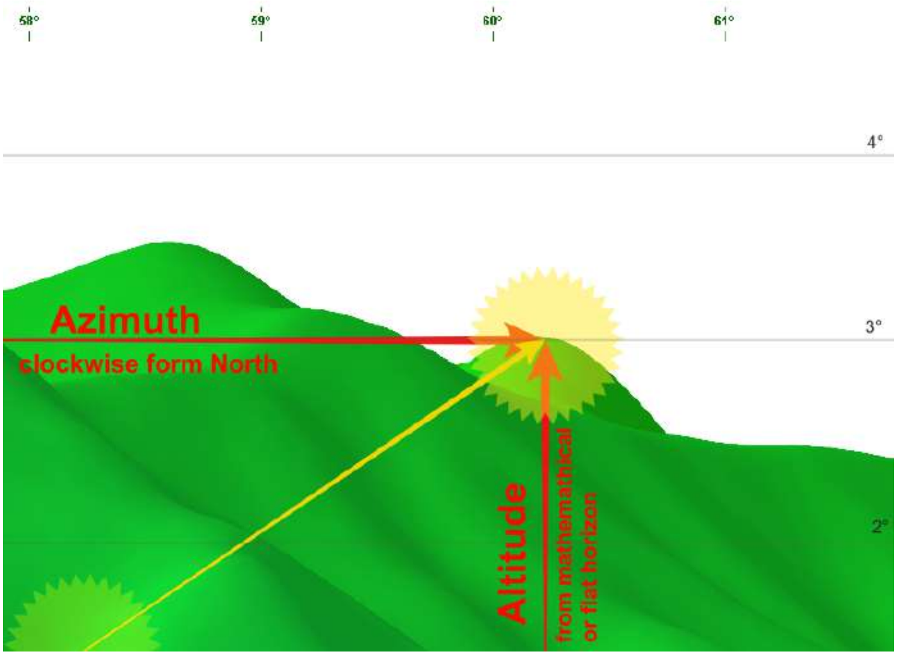

Figure 2. Visualisation of the values of azimuth and altitude (in red): the mountain (in green) is affecting the exact point of visibility of a rising celestial body (in yellow). Elaborated by the author with *Create a panorama* web service after DEUSCHLE 2018.

2.3 Celestial Sphere: Conversion into Declination

The method employed here included not only measuring the horizon within the whole range of a 360° angle using azimuth values (or, to put it another way, the angle clockwise in respect to True North), but also converting orientation structures into declinations (δ), passing from the horizontal system to the equatorial system of the celestial sphere[98]. This offers several advantages for the scope of this research. Generally, the use of the horizontal system, based on the zenith and the local horizon, and the equatorial system, based on the celestial equator and the celestial North Pole, suffice for the present research aims. These spherical reference systems to map the celestial sphere are centred on the Earth, ideally considered as punctiform. A structure orientation has a direction which can be projected towards the horizon and into the celestial sphere. On this ideal mathematical sphere, it is possible to assign to each point a couple of coordinates (fig. 2). Moreover, it is possible to assign more pairs of coordinates according to the reference system used. Declination is a coordinate of the celestial sphere in the equatorial system, representing the angle of an object in respect to the celestial equator (fig. 3). Declination can be imagined as the celestial transposition of latitude on the sky vault[99]. Declination values cannot be measured on site, but it can be calculated by converting the

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[98] Basic declination calculator to be found in Clive Ruggles' website https://www3.cliveruggles.com/index.php/tools/declination-calculator [accessed November 2022].
[99] GONZÁLEZ-GARCÍA - BELMONTE 2014, 100.

coordinates from the horizontal system (azimuth and altitude)[100]. Given the site latitude (φ), the azimuth (az) and the skyline altitude (h), the declination (δ) is determined as follows[101]:

$$\sin \delta = (\sin \varphi \times \sin h) + (\cos \varphi \times \cos h \times \cos az)$$

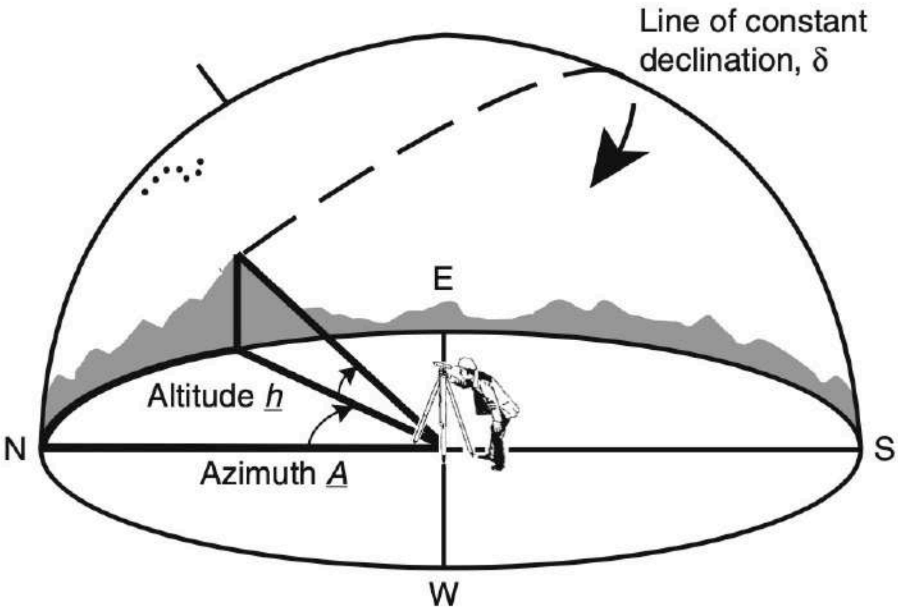

Figure 3. On site measurement of azimuth and altitude to calculate the declination value. From RUGGLES 2015, 461.

Each system offers its own advantages for the data analysis. If the horizontal system can give a useful and straightforward reference in terms of the local topography, the equatorial one is a fundamental and universal tool for cross-comparison among different latitudes and contexts, since it reflects the motion of the sky independently from local parameters. Furthermore, the latter inherently takes into consideration the local horizon at each specific site. Indeed, with this conversion it is possible to work with a single value which covers both the orientation of a structure and the height of the horizon where the structure is pointing. It is easy to understand how this can be of benefit with this methodology[102]. Moreover, the interpretation process is advantaged as well.

Indeed, stars have a fixed declination across a human life span: they move across the sky following lines on the same declination (fig. 3). However, across many centuries, a star's declination changes due to the phenomenon known as the precession of the equinoxes, caused by an astronomical wobbling of the Earth's axis, which changes the position of the whole equatorial reference system[103]. This causes a progressive shift in the apparent position of stars, both in their seasonal appearance as

[100] The declination error can also be calculated as a propagation of the azimuth and altitude errors.
[101] RUGGLES 2015a, 461.
[102] RODRÌGUEZ-ANTÒN 2017, 27.
[103] RUGGLES 2015b, 473–479.

well as in their rising and setting position, as well as this modifies the identification of the North Pole Star. Some stars, such as the Southern Cross constellation, were visible in the Mediterranean area during the 1st millennium BC and progressively vanished from view[104]. The variations caused by the precession of the equinoxes can be overcame as it is a predictable phenomenon with an average declination shifting value of circa 1° every century, and is fully acknowledged in this research.

For the sun and the moon, the situation is a bit different, since their declination value changes daily. The sun appears to travel on the celestial sphere within the two tropics in progressively wider or smaller circles through the year. The astronomical definition of solstices has been applied for calculation, where the sun's path is constrained within the solstices, from +23° 45' at midsummer to -23° 45' at midwinter, reaching the declination of 0° at the equinoxes. The date of maximum and minimum declination of the sun are considered as respectively summer and winter solstice[105]. Due to the progressive change in obliquity in the ecliptic, itself due to the Earth's axis slightly changing its angulation in respect to the orbital plane, present declination values have changed by circa 0.5° with respect to two and half millennia ago, which corresponds to the apparent width of the sun's diameter [106]. Due to changes of the calendric date, the solstitial and equinox dates have also shifted across centuries, so that, for example, summer solstice dates between the 7th–6th cent. BC fall on 29/06/-600 according to Stellarium calculation, which uses Julian dates[107]. To keep modern canonical calendric dates for equinoxes and solstices would not make any sense[108]. The moon's motion is much more complicate than the sun. It appears to move on similar paths of the sun, but its limits are wider. It spans the celestial sphere within limits known as major (δ = +28.5°) and minor (δ = -28.5°) lunar standstill over 18,6 years, even if it also swings rapidly across the sky during a single lunar month. Generally, sun and the full moon are found at opposite positions and alternate with seasons.

The previous examples indicate how much using declination can advantage the data analysis. By knowing with precision the declination on the celestial sphere where each structure is pointed, it is possible to combine an orientation with a precise astral body event. It provides the parameters needed to be able to compare one structure with similar ones on different sites, in terms of local horizon conditions and latitudes. However, working with declinations has its limitations. In a declination graph, it is not possible to discern the topographical position of temples. For example, declination 0° corresponds to due east and, at the same time, to due west. Similarly, the declination of 23° 45' when the sun is at summer solstice is a circle in the celestial sphere touching the horizon at north-east and at north-west. In conclusion, a step forward in the comprehension of the role of the wider cosmos at ancient sites can be achieved by moving on from simply studying orientations in relationship to the four cardinal points: other patterns of statistical tendency become evident through

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[104] Cristofaro 2021.
[105] Zotti - Wolf 2020, 338.
[106] Ruggles 1997, 57.
[107] Zotti et al. 2021.
[108] Moser 2014b, 70.

applying a methodology which places structures and their coordinates in a direct relationship with major astral events[109].

2.4 Star Seasonal Phases: Heliacal Rising

From the boral hemisphere, not all stars are always visible of course; they have a period of invisibility according to the latitude of the site and the relative position of the sun which is seen to illuminate a half portion of the celestial vault: for this reason, they are subjected to ‘phases’ or ‘apparitions’[110]. Moreover, the local skyline will affect the timing of these events. Recently, Bernadette Brady clarified some issues, often little considered, regarding star phases[111]. The topic is drawn from Claudius Ptolemy (2nd cent. CE)’s treaties[112]. In short, there are stars that are always visible at a given site, called circumpolar stars. Other stars that appear to rise and set but that are visible every night of the year, are called ‘Curtailed Passage’ phase. A third category also appear to rise and set but they can disappear for whole nights over a period varying from a few weeks to months. Finally, a fourth category is never seen as these are on the other hemisphere. By bringing attention to the third category, which is the most important one for calendric purposes and time reckoning, some important notions should be clarified (fig. 4). Specifically, the moment when they ‘rise’, meaning they rise for the first time after a long period of invisibility, can be called here ‘heliacal rising’[113]. On the heliacal rising, the stars appear to rise on the east at dawn just before sunrise. For the Pleiades the timing of the heliacal rising during the 1st millennium BC is fixed in early summer, around May and June. In the following days, the star rises earlier and earlier and therefore it is visible for longer hours before dawn. With the passing of days or months, the star is seen to set in the west just before dawn, after nights when it was visible. This moment may be called the ‘morning setting’ of a star[114]. For the Pleiades, this would have happened around the beginning of winter, in November, at the time for ploughing. Gradually, the star will rise earlier and earlier, to be seen rising at sunset and therefore visible for the whole night after its ‘evening rising’. Finally, the stars will be seen setting at sunset in its ‘acronychal setting’; from this moment, the star begins its period of total disappearance from the night sky until the cycle starts again with the ‘heliacal rising’ of the star. For the Pleaides, this last moment happens around the spring equinox, after which they start their 40-day period of invisibility. Phases of stars were very important in antiquity for calendric reckoning as these are synchronised with the solar year, as further discussed in this thesis[115].

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[109] BOUTSIKAS 2020, 33.
[110] PTOLEMAIOS 2017, 84.
[111] BRADY 2015, 79.
[112] PTOLEMAIOS 2017, 161–183.
[113] BRADY 2015, 82.
[114] BRADY 2015, 82.
[115] Further discussed in Chapter Three, in 3.1.2 ‘Stars and Agriculture’ section.

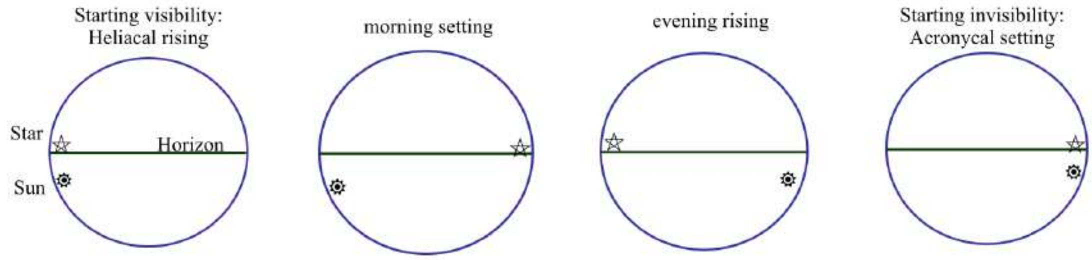

Figure 4. Star phases in relation to the horizon and the movement of the sun. Elaborated by the author. Adapted after Lucia Bellizia in PTOLEMAIOS 2017, 161-183.

2.5 Data Analysis & Sources

According to Bradley E. Schaefer, «[t]he primary paradigm of archaeoastronomy is that man-made features are pointing at astronomically significant directions. But before anyone should get excited, we have to establish that the pointing is intentional on the part of the builders and not just random happenstance» [116] . Vito Francesco Polcaro suggested evaluating the credibility of archaeoastronomical research by following a six-test procedure in line with Bradley E. Schaefer's discussion of this[117]. For Polcaro, a good practice includes not formulating hypotheses before data were acquired, calibrate instruments, repeating measurements on multiple sites, present all possible astronomical results and alternative hypotheses, and perform a statistical test[118]. Here, the intention is to evaluate whether an alignment was intentionally meant by its builders.

The major test is the statistical one, as applied in Chapter Five. If for a single site the statistical test can be very hard to prove, a sample made of multiple and similar sites can return a high degree of confidence on the intentionality of the alignment[119]. Thus, statistical analysis aims to compare the sample and to discern patterns of orientation. After all orientation data of the 14 Campanian towns were acquired, curvigrams made of azimuth values and declinations values were built. A curvigram represents the frequency a given value returns, and this was transformed into a Gaussian density distribution function[120]. The precise choice of the parameters employed here corresponds to the method explained and applied by Andrea Rodrìguez-Antòn[121]. The data analysis was also informed by the work done by Antonio César González-García and Juan Antonio Belmonte[122]. A normalised relative frequency was thus employed to scale the distribution. This allows to state if a given orientation is significant in respect to a uniform distribution, that is a random distribution where each value has the same probability. This means to apply a 'null hypothesis' test, that is that the

[116] SCHAEFER 2006, 27.
[117] SCHAEFER 2006; POLCARO 2016.
[118] POLCARO 2016, 4.
[119] SCHAEFER 2006, 29.
[120] RODRÌGUEZ-ANTÒN 2017, 29–30.
[121] RODRÌGUEZ-ANTÒN 2017, 29–34; I would like to express my gratitude to Andrea Rodrìguez-Antòn for sharing with me her data analysis methods for archaeoastronomy. This was possible during the period spent at INCIPIT Instituto de Ciencia de Patrimonio (Santiago de Compostela, Spain), where I was tutored by Antonio César González-García.
[122] GONZÁLEZ-GARCÍA - BELMONTE 2014, 100.

archaeoastronomical alignment is due to chance[123]. It is a common practice in archaeoastronomy to assume that a result is significant when it has a confidence above 98%, corresponding to 3σ[124]. The data analysis has thus been broken down into diachronic phases to emphasise choice of urban design for the different periods of urbanisation in Campania.

Statistics do not have *per se* the epistemic value necessary to validate their own result, and needed to be confirmed by other archaeological or literary evidence to have some degree of credibility[125]. Schaefer stated that «[a]rchaeoastronomical claims must get corroboration from other sources, since the alignment alone is never enough»[126]. The evidence for the period in consideration is limited but also varied, and the interpretation of different sources within the same context can be problematic[127]. Numismatic sources are cited as material evidence of the socio-economic institutional changes in the territory. Literary sources are mentioned to support the argument here, even though the focus of the discourse does not allow a concentration on the chronological, historical, and philological transmission problems which those sources bring with them. However, as far is possible, these were used within a critical and contextual approach. For instance, Plato's and Aristotle's discussion of the city in its political and topographical terms should be regarded as utopic notions, and thus very different, or even opposite, to the concrete archaeological reality of a site. Their treatises are recommendations, and maybe critiques, about the status of urban space. In summary, even a significant probability of a chance alignment should draw more data from literary, archaeological, ethnographic, and cultural astronomical evidence, as further discussed in Chapters Two and Three of this thesis[128].

[123] POLCARO 2016, 4; SILVA 2020, 5–6.
[124] SCHAEFER 2006; RODRÌGUEZ-ANTÒN 2017, 33.
[125] RODRÌGUEZ-ANTÒN 2017, 20.
[126] SCHAEFER 2006, 29.
[127] MOMIGLIANO 1989, 131.
[128] SCHAEFER 2006; RODRÌGUEZ-ANTÒN 2017, 33.

3. *Historical Context: The Urbanisaton of Campania*

3.1 From Proto-Urban Settlements to Urbanisation

The urbanisation phase of ancient Campania can be recognised as part of a long-term process extending throughout overall the most advanced regions of the Italian peninsula. The urban phenomenon transversally involved different ethnic groups with shared capabilities in organising settlements and in territorial planification[129]. The process of urbanisation of Campania is initially evident on the coasts and along river valleys (fig. 5). It started in the Iron Age (9th cent. BC) with proto-urban centres[130], such as Capua and Pontecagnano for the Villanovian facies, but also Kyme, Pompei, and Nola for the Fossakultur facies[131]. Proto-urban structures usually start from a settlement concentration, in which topographical, social and economic aspects constitute the antecedent to urban formation[132]. According to Colin Renfrew, three characteristics can define the proto-urban settlement: the demographic agglomeration, the presence of any reunion and cult sites, and the presence of any places for the redistribution of goods and services[133]. Renato Peroni highlighted the absence of non-perishable material within a proto-urban settlement, together with the lack of any monumental architecture or an urban planned design[134]. A marked distinction between the Villanovian facies and local Fossakultur groups is evident at this stage of settling, particularly as shown in the variant burial customs[135]. Such emergent groups were involved in the manufacture and commercial Mediterranean exchange of goods, probably mediated through Phoenician and Sardinian merchants. Among scholars, there is a debate on the process leading from proto-urbanisation to urbanisation in Etruria, as well as on the definition of the concept of city. On the debate regarding the main causes of what led to urbanisation, scholars generally follow one of two main theories[136]. The first, promoted by the Roman palaeontology school of Renato Peroni, highlighted the diffusion of pre-urban and proto-urban settlements from the Late Bronze Age in the Italian peninsula, converging naturally into the urbanisation of the 8th cent. BC: the role of Greek colonisation remains marginal, being only a natural continuation or successful completion of the process[137]. Near to this line of thought, Colin Renfrew suggested a focus on the study of the interaction between the local groups from different regions of

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[129] Cerchiai 2019, 11.
[130] On the concept of proto-urban centre see A. Guidi, 'Sulle prime fasi dell'urbanizzazione del Lazio protostorico', *Opus*, I, 2, 279-289; B. d'Agostino, 'Considerazioni sulla formazione della città in Etruria, in *L'incidenza dell'antico, Studi in onore di E. Lepore*, I, Napoli 1995, 315 ss; R. Peroni, 'Formazione e sviluppi dei centri protourbani medio-tirrenici', in A. Carandini - R. Cappelli (a cura di), *Roma. Romolo, Remo e la fondazione della città*, Milano 2000, 26-30; M. Pacciarelli, *Dal villaggio alla città. La svola protourbana del 1000 a.C. nell'Italia tirrenica*, Firenze 2001, 115 ss.
[131] Cerchiai 2019, 11.
[132] Mandolesi 1999, 86.
[133] Renfrew 1975.
[134] Peroni 1989, 21.
[135] Claude Albore Livadie 2010, 167.
[136] Nizzo 2016, 128.
[137] Peroni 1988, 34–35; Fulminante 2014.

the peninsula[138]. The second argument, mainly supported by Etruscologists, emphasised the role of Eastern contacts for the formation of the urban settlements in the Italian peninsula.

In favour of the first argument, it can be pointed out that an exploitation of the Campania Plain is already evident in the Early Bronze Age, as revealed under the geological stratum of the pumice and pyroclastic surge of the Avellino Eruption of the Somma-Vesuvius volcanic complex around the early 2nd millennium BC (1950-1820 Cal BC). Apart from the Palma Campania facies villages excavated at Palma Campania, Nola, and Afragola, both destroyed and preserved by the eruption, in the fields around these villages, there is evidence of plough marks, furrows, gullies, banks, tracks, and fences. These marks are below the Avellino Pumice eruption stratigraphy as brought to light in the Gricignano US Navy Support Site (USNSS) preventive excavation and Acerra. Such marks are characterised by a regularity in inter-distance, orientation, and orthogonality, suggesting an agrarian matrix of organisation and exploitation of fields[139]. The orientations of the agrarian marks range from 42° to 45° east in respect to the North[140]. The pollen analysis emphasised a prevalence of non-arboreal plants suggesting a marked deforestation in the area. In fact, the Campanian plain was one of the most deforested areas in the Copper and Early Bronze Age in the Italian peninsula. The arboreal pollen increased after the eruption, suggesting a reduced used of the soil, but a continuation of the Palma Campania facies in the centuries afterwards was inferred by the continuity of the burial rituals.

The subsequent urbanisation and synoecism process of diffuse housing clusters might have been caused by the emerging need to privatise land for the use of family groups[141]. Although the role of the Hellenic presence in the Italian peninsula is undeniable for the formation of an urban civilization, Marco Pacciarelli backdates the start of the process to around the year 1000 BC, in the transition from the Bronze to the Iron age[142]. He read the constitution of pre-urban Villanovan communities in Etruria, such as Veio, Caere, Tarquinia, and Vulci, as a political reformation of the society, with a preference for unitarian settlement over wide naturally defensible areas, extending from 125 to 175 hectares in contrast with the 20 hectares of the previous crammed but fragmented Bronze Age villages[143]. In the external territories are the necropolises, where status symbols are eloquent of the social stratifications of the community, at least by the end of the 9th century BC. Seeking to explain the choice of wider plateau, Pacciarelli speculated that in the pre-urban communities there might have occurred a transition in favour of the constitution of private property[144].

Capua and Pontecagnano rose together with settlements such as Veio, Caere, Tarquinia, and Vulci. At the time, the region of Campania was inhabited by several ethnic groups, such as the Auruncs in the north of Volturno and the Oscans along the coastal area north of the gulf of Naples.

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[138] Renfrew 1986, 32.
[139] Saccoccio 2020.
[140] Saccoccio - Marzocchella - Vanzetti 2013, 87.
[141] Peroni 1989, 20.
[142] Pacciarelli 2014, 49.
[143] Pacciarelli 2014, 50.
[144] Pacciarelli 2014, 50.

The Etruscans chose a wide and fertile costal plateau for their settlements, to the north of Naples for Capua and to the south of Salerno for Pontecagnano, protected areas that offered easy access both to the sea and to the hinterland, with the fluvial routes given respectively by the rivers Volturno and Picentino[145]. While Capua progressively became the hub of the political unification of the Campania plateau in the course of the 9th cent. BC, Pontecagnano, as inferred by the material culture preserved in its necropolis, can be seen to had early contact with Sicily, Sardinia, and the Near East[146]. In Pontecagnano, two phases of development can be noted, with the evident abandonment of a nearby village which suggests a first fractional settlement, followed by a later, more unitary organization (fig. 6)[147]. Similarly, at Capua, more individual villages and necropolises were present in the area in the Iron Age period, and then there followed a gradual concentration into a single urban unity[148]. Moreover, a quite complex situation appears in the evaluation of the cultural identity of Capua in the Early Iron Age, characterised by strong local roots[149]. In the case of Capua, Gianluca Melandri hypothesised that the abandonment of a hill-top settlement on the slope of Mt. Tifata and the subsequent synoecismatic urbanisation, might have been caused by a rising demographic, economic factors such as the need for spaces for handcraft workshops and for agriculture, the need to establish control of commercial routes, fluvial, and maritime networks, military stability, and by intermediation in Capua between indigenous and foreign groups, resulting in an exponential growth of population and of socio-economic activity[150]. The formation of urban settlements in Campania is part of a transformation process which embraced Etruria at the beginning of the 1st millennium BC, even though with very peculiar features[151].

According to the second line of thought, increasing contact with Eastern civilisations provoked a motivation for the aggregation of villages and synoecism. With the Etruscan and Greek presence in the region together with the Italic components, at the end of the 8th cent. BC, it can be noted that a stable territorial organisation of settlements developed on the wide and fertile Campanian plateaus[152]. The impact of the Villanovian and Greek world upon the indigenous population is evident in the qualitative leap in the occupation model of the Campanian plain; however, this process is not so evident in the Sarno Valley Fossakultur ambit with its persistence of sparse villages[153]. Since the formation of the emporium of *Pithekoussai*, the Greeks established a slow but long-lasting relationship with the Campanian *mesògeia*, mainly based on the commercial exchange of wheat and agricultural products with handcrafted luxury goods of Greek production among elite groups[154]. In

145 D'AGOSTINO 2014, 44.
146 D'AGOSTINO 2014, 45.
147 PACCIARELLI 2014, 52.
148 PACCIARELLI 2014, 52.
149 PACCIARELLI 2014, 52.
150 MELANDRI 2012, 493; 503–505.
151 D'AGOSTINO 2014, 44; PACCIARELLI 2014, 52.
152 CERCHIAI 2019, 11.
153 CINQUANTAQUATTRO 2000, 63.
154 CESARANO 2004, 31.

parallel, the Etruscan based at Capua fostered the acculturation in an urban sense of local groups, to be understood not as a colonisation but as a continuous process of integration both through permanent relationships and also diverse interactions between diffuse groups[155]. The reorganisation of the indigenous population due to a new degree of order and stability on the Campanian plain was the result of a redefinition of territorial control centred on the *apoikia* of Cuma and the Villanovian Capua[156]. According to Teresa Cinquantaquattro, this asset provoked the agglomeration of indigenous centres on the periphery of the plain, with access to the inner Apennines, such as Suessula, Calatia, Abella, and Nola[157]. The only planned topography known for these settlements for the centuries 8th–7th BC is the division of space between the residential areas and the necropolises. This datum reflects the beginning of a centred political agglomeration and a complex social stratum[158]. From the beginning of the 8th century, Greek-produced vases for holding wine appear at Capua and Pontecagnano, starting an accelerated process of acculturalisation. The Greek ceremonial custom of wine drinking among elites was the consolidating vehicle for the bonding of relationships, and opened up a commercial economy for the supply of metals and other goods, which were most abundant in the Tyrrhenian areas[159]. The arrival of the Greek population in the Italian peninsula accelerated transformation processes and acculturalization of the local communities in a dialectic relationship[160]. Mixed marriages, the mercenary phenomenon, and slave labour were among those modes of interchange between the newly arrived groups and the indigenous populations[161].

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155 BONGHI JOVINO 2010, 129–130.
156 CINQUANTAQUATTRO 2000, 61.
157 CINQUANTAQUATTRO 2000, 62–63.
158 CINQUANTAQUATTRO 2000, 63.
159 D'AGOSTINO 2014, 46.
160 GRECO 1997, 634.
161 LONGO 2014, 232.

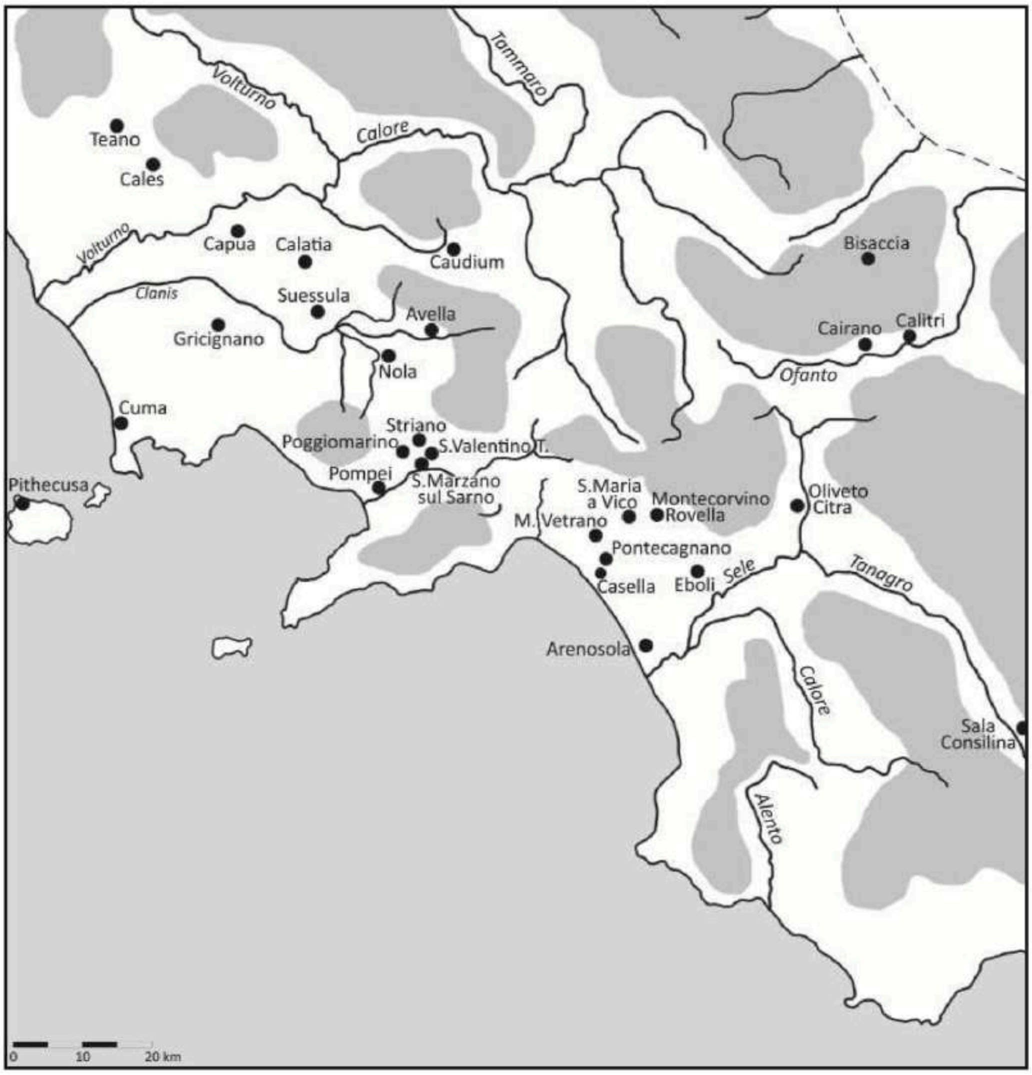

Figure 5. The region of Campania between the Early Iron Age and the Orientalising period. After PELLEGRINO - RIZZO - GRIMALDI 2017, 210.

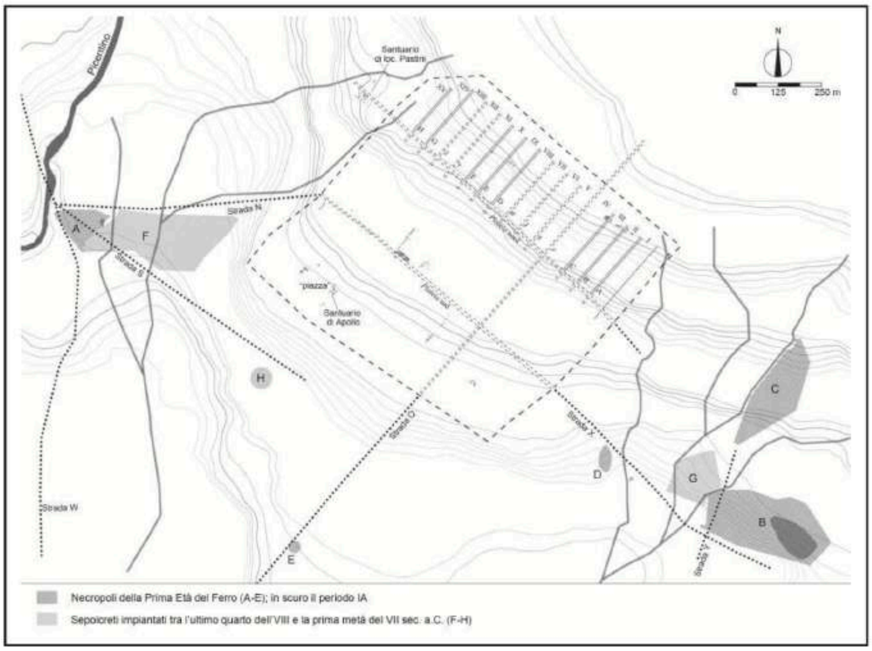

Figure 6. Pontecagnano, the settlement and necropolises in the Iron Age and Orientalising period. After PELLEGRINO - RIZZO - GRIMALDI 2017, 224.

3.2 The Archaic Towns

The socio-economic forms typical of an urban culture, such as high specialisation in arts and crafts, started in the peninsula in the second half of the 8th century BC, reaching full maturation in the 7th century[162]. Pacciarelli noted that these phenomena can be linked to the establishment or affirmation of aristocratic groups, as evidenced by the emergence of high-quality grave goods in single tombs, as well as by the rise of monumental architecture together with the increasing refinement of figurative art, the use of an alphabet and writing, and the establishment of new trade routes[163]. Most important for the present research, the developing urban civilization is characterised by the structuring of urban spaces, by the medium of establishing a rationale for the planning of cities and the surrounding rural areas. In Etruria, from the beginning of urbanisation during the Iron Age (9th–8th cent. BC), Etruscan settlements gradually developed into city states in the Archaic period (6th cent. BC), with institutionalised spaces dedicated to sacred, public and commercial activities[164]. This process involved a new progressive reorganisation of power from that of aristocratic élites to a more isonomic distribution of authority among the community, as evinced by the transition in funerary architectures from tumuli to modular structures[165]. According to Giovannangelo Camporeale, the first visible

[162] PACCIARELLI 2014, 49.
[163] PACCIARELLI 2014, 49.
[164] MICHETTI 2019, 161.
[165] MICHETTI 2019, 161.

evidence of organic urban planning comes from the necropolis of the 6th cent. BC, where straight streets were organised at right angles to each other; by the end of the century, clear evidence of an organic plan is indicated by the ex-novo urban foundation of Marzabotto[166]. In the 6th–5th cent. BC, the Etruscan city is characterised by a monumentalisation of sacred spaces, some of which were placed at access gates through walls encircling the urban area to form a «sacred belt», and from where a network of routes towards satellite settlements and emporia spread out[167]. This network served an economic system based on the exploitation of natural resources, mainly metallurgic and woodland ones, agricultural and pastoral activities, and commercial traffic[168]. Coastal emporia developed where fluvial navigation allowed a safe harbour and access inland.

In Campania, by the end of the 7th and beginning of the 6th cent. BC, the process of urbanisation was consolidated with the allocation of functionality to different types of spaces, and the monumentalisation of sacred and public buildings[169]. In this phase, in the Sarno Valley, the reorganisation of the territory is also reflected in the use of different pottery types, the importation materials and the Etruscan *koinè* with diffuse Greek acculturation[170]. At this point in time, the evidence coming from Pompei is a clear example of the community's purpose, advantaged by political organisation and labour strength, towards the building of city walls and monuments[171]. From the last quarter of the 6th cent. BC, the use of planning processes extends across the Campanian plateau around the urban settlements for the management of agricultural activities[172]. Evidence has recently come to light of pre-roman land division together with water channellings and drainage systems[173]. In the words of Stefano De Caro, in some parts of ancient Campania, remnants of planned Etruscan centuriation were found, with «a great and rational territorial agrarian organisation, with out-and-out prehistoric "centuriations", with routes and channels traces, parallel to each other and several kilometres long, to serve tens of hectares»[174]. Cinzia Rampazzo has given an overview of the pre-roman land division in the Campanian plan[175]. The relationship between the agrarian territorial structure with respect to the urban grid is a useful tool where the lack of archaeological data does not give many hints on the urban orientation. Thus, the choice of orientation of agrarian territorial structures has also been considered in relation to the urban design where there is archaeological data for the latter. The establishment of agrarian organisation is another clear consequence of urbanisation, as Luca Cerchiai reminds us[176]. Concentrated anthropisation through synoecism and the specialisation

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166 CAMPOREALE 2017, 71.
167 MICHETTI 2019, 161.
168 MICHETTI 2019, 161.
169 CERCHIAI 2019, 11.
170 JOHANNOWSKY 1994, 103–108.
171 BONGHI JOVINO 2010, 131.
172 CERCHIAI 2019, 12.
173 DE CARO 2002.
174 «una grandiosa e razionale organizzazione agricola del territorio, con vere e proprie "centuriazioni" preistoriche, con tracciati di sentieri e di canali, paralleli fra di loro e lunghi chilometri, a servizio di decine e decine di ettari» in DE CARO 2002, 136.
175 RAMPAZZO 2011, 203–211.
176 CERCHIAI 2019, 12.

of labour required extra food supplies to be achieved through the careful control of agricultural activities[177]. The orientation of urban streets and the division of land often correspond, being directly connected to each other, for instance in the case of Pontecagnano and Suessula[178]. In Campania, a systematic agrarian organisation can be seen occurring from the last quarter of the 6th cent. BC, synchronically to similar processes of consolidation happening in Magna Grecia, Etruria, Latium, and the Po valley, which took place along the urbanisation growth[179].

3.3 The Classical Period in Campania

The apparent stability of the Archaic period on the Campanian plain is disrupted during the 5th cent. BC with the Battle of Cumae (524 BC and 474 BC) between Etruscans and the Greeks from Kyme. This affected mostly the Etruscan communities and it was just preceding the formation of the *ethnos* of Campanians, fixed by the historical sources to have happened in 438 BC[180]. On the ethnogenesis of the Campanians, as stated by Alfonso Mele, the name Campania and Campanians is derived from Capua, referring only to its territory and inhabitants, the *Kappanòi*-*Kampanòi*[181]. In a later stage, after the Samnite conquest of Capua, the name became synonymous with the Samnites settled in Campania[182]. In 423 BC the Kampanos conquered Capua, and in 421 BC they occupied Kyme. The slow decline of Etruscan Campania is attested archaeologically from the mid 5th cent. BC, for example by the lack of renovation of buildings in the urban sphere and the crisis of agricultural activities, such as with the obliteration of the drainage system at Fratte acropolis[183]. La Regina hypothesised the existence of a pre-roman centuriation of Samnite origin with a system of division with *decumani* only[184]. Similarly to the Roman practices, the Italic division of the landscape used different modules of metrological unity[185]. Although it is uncertain how to chronologically date such evidence, research to reconstruct an Etruscan[186], and Italic, metrology has been attempted[187].

Between the 6th and the 5th cent. BC if the Etruscan presence was blocked in the Phlegraean Fields, it did achieve a degree of diffusion in the Sarno Valley, also accompanied by the flux of Italic populations accessing the area cutting through the Apennines, specifically from Daunia to Nola. This phase is synchronic to the tyrannies of Aristodemus at Kyme and of Tarquinii in Rome. At Kyme, after the experience of the tyranny (504–485 BC) a decline followed, with the developing new city of Neapolis ready to inherit the Greek influence over the Gulf[188]. The growing importance of Neapolis

177 Cerchiai 2019, 12.
178 Cerchiai 2019, 12.
179 Cerchiai 2019, 12.
180 Cerchiai 2019, 16.
181 Mele 1991, 267; 2014, 133.
182 Diod. XII, 31, 1; Liv. IV 37, 2.
183 Cerchiai 2020, 334.
184 La Regina 1999.
185 La Regina 1999.
186 Vinaccia 1926.
187 La Regina 1999; Monaco 2002.
188 Mele 2014, 135–139.

in the Gulf is particularly demonstrated in the minting of coins for the whole Campanian territory and communities. Following the numismatic evidence analysed by Keith Rutter, after 421 BC coin production was transferred to Neapolis with the closing down of the production facility at Kyme. However, for Renata Cantilena, the production should be divided into two phases: the Kyme coin production did not stop at Kyme with the synchronous starting of the production at Neapolis, as is evident from the overlap of the Kyme series and the first Kampanos series[189]. This shows an appropriation of the Greek institution by the Kampanos, with a proper coin simulating the customs of the communities they conquered[190]. Only in a second phase, for Cantilena, was all the production moved to Neapolis. As a third hypothesis, according to Nicola Parise the production of coins could have been happened across different communities apart from Neapolis, with different production locations. Numismatic evidence can be very telling on the anthropology of ancient Campania, which has been described as mixed race culture, or 'cultura meticcia'[191]. This may be read in the epigraphic data, for instance, in the epigraphy of the name of Hyria on the coins of the community, though this location in ancient Campania is unknown. According to Michael Crawford, beyond the prevailing Oscan inscription *Urina*, in Greek Euboic alphabet *Hurietes* is attested, as well as some signs of syllabic interpunct pertinent to the Etruscan language[192]. This example shows the co-presence of at least three cultural components in the area of ancient Campania at the end of the 5th cent. BC. An interruption of material evidence was caused by a general crisis in the area which is attested to have occurred between the middle of the 5th to the middle of 4th cent. BC, including the exploitation of the agricultural terrain as well. According to Cerchiai, this can be read as a transformation of the system of agricultural activities and propriety[193].

3.4 Romanisation

The affirmation of Rome in Campania is started with the First Samnite War (343–341 BC) and the Latin War (340–338BC)[194]. In pursuit of establishing its presence in the territory, Romanisation happens in a slow process of mediation and strategic choices. With the Romanisation of the area by the end of the 4th–3rd cent. BC, new urban foundations appeared, such as at Acerrae and Atella[195]. With the gradual Romanisation of the Campania area, new systems of territorial organization and division are attested at Capua, Suessula, Acerra and Atella, starting from the end of the 4th–3rd cent. BC[196]. This process gradually started from the centres where the *civitas sine suffragio* status was conferred: in 338 at Capua, Cumae, and Suessula, and in 332 BC at Acerrae, Atella, and Calatia[197].

[189] CANTILENA 2009, 219–223.
[190] CERCHIAI 2010b, 105.
[191] D'AGOSTINO - CERCHIAI 2004, 272; the concept was borrowed from the anthropologist J.L. Amselle.
[192] CRAWFORD ET AL. 2011, 21–22.
[193] CERCHIAI 2019, 16.
[194] CERCHIAI 2010b, 117.
[195] CERCHIAI 2019, 17.
[196] CERCHIAI 2019, 16.
[197] RESCIGNO - SENATORE 2009.

The presence of Rome in this strategic territory is marked by a key turning point in 326 BC with the political and diplomatic agreement between Neapolis and Rome. Though the complex agrarian history of the area is not here an object of study[198], it is useful to remember that the centuriation of a territory, and thus the setting of its orientation, was part of a wider politics related to Roman conquest: possession of a new area, regimentation and swamps reclamation, resources exploitation, defensive possibilities[199]. The religious sphere recalled by the corpus of agrimensores, *posita auspicaliter groma*[200], according to Guido Rosada, even though subjected to many practical issues, was a form of legitimation of the delicate operation of land division[201]. Cerchiai highlighted how such planning was rendered coherent and unitarian given its wide extension by following a single orientation[202].

City	Size	Estimated population	
		150 pp/ha	250 pp/ha
Capua	177 ha	26,550	44,250
Nuceria	113 ha	16,950	28,250
Neapolis	75 ha	11,250	18,750
Nola	73 ha	10,950	18,250
Pompeii	64 ha	9,600	16,000
Atella	53 ha	7,950	13,250
Suessula	45 ha	6,750	11,250
Abella	29 ha	4,350	7,250
Acerrae	20 ha	3,000	5,000
Herculaneum	14 ha	2,100	3,500
Calatia	11 ha	1,650	2,750

Figure 7. Estimated data for cities in the Campanian plain. From DE SIMONE 2016, 31.

At the end of the 3rd cent. BC, the urban communities present in the area were involved in the events of the Hannibalic war. The end of the conflict in 211 BC marks also the end of a territorial organisation with the *debellatio* of Capua and the imposition of a new order. The requisitioning of land by Rome in the first half of the 2nd cent. BC, was followed by a reorganization of land in the *ager campanus*[203]. Ten *praefecturae* were instituted: Capua, Cumae, Casilinum, Volturnum, Liternum, Puteoli, Acerrae, Calatia, Suessula, Atella[204]. A new centuriation system was set up after the second Punic war, following an orientation almost exactly north-south[205]. The romanisation of the plateau in the 2nd cent. BC was characterised by a street network and a centuriation of the area with an orthogonal axis on a north-south orientation (N -0° 40' W), and quadrangular *centuriae* of 20

198 CHOUQUER ET AL. 1987, 215–231.
199 ROSADA 2010, 92–93.
200 Hyg. Grom. *Const. Lim*., 170.5 L = 136.19–20 C.
201 ROSADA 2010, 92.
202 CERCHIAI 2019, 17.
203 By the consul Lucius Postumius Albinus in 173 BC recounted in Liv. XLII.1.6; XLII.19.1-2; the *praetor urbanus* P. Cornelius Lentulus in 165-162 BC in Cic. *Leg. agr*. 2.30.81-82.
204 Fest. L. 262.
205 ROSSI 2019c, 24.

actus, with a side dimension between 704m to 709m, for a total of 200 *iugera* (50 hectares)[206]. The *ager* organisation of the 20x20 actus system had the unusual characteristic of having the *decumanus* north-south and the *kardo* east-west[207]. This exception to the rule is evidenced both literarily and archaeologically. For instance, Hyginus and Frontinus mention it explicitly in the corpus of the *Gromatici Veteres*[208]. It is possible that this inversion to the rule was due to the fact that the *decumanus* was the principal road to be identified with the road exiting on the south from Capua[209]. Moreover, at Calcarone (St. Angelo in Formis), just at the foot of Mt. Tifata, a Gracchian cippus was brought to light[210], with an engraved *decussis* and the indication of the *decumanus* towards south[211]. After this discovery, the *Decumanus Maximus* and the *Kardo Maximus* were identified: the former running north-south near the western extremity of the urban extension of ancient Capua passing near the amphitheatre, the latter reaching towards the ancient city of Calatia[212]. Indeed, Clara Bencivenga Trillmich published the discovery of part of the *Decumanus Maximus* west of the amphitheatre, the third *decumanus* east of the *Decumanus Maximus*[213]. Moreover, in the locality of Trentola, south of Marcianise, a cylindrical mute terminus with no inscriptions was identified between the sixth eastern *decumanus* and the fourth southern *kardo*[214]. According to Monaco, such organization was extended across the *ager* to the foot of Vesuvius, enclosed within the palaeovalley of the river *Clanis* in the west[215]. In such a way, the river divided the western sandy dunes from the eastern fertile terrain[216]. To the west of Capua and east of Atella, there are no traces of centuriation, probably due to the marshy nature of these territories[217]. In Campania, between the *ager Campanus* and *ager Nolensis* two adjacent but deviating systems of organisation can be attested[218]. In summary, from the middle of the 3rd cent. BC, the *ager Campanus* become *ager publicus romanus* of the state propriety of Rome[219], and rustic villas made their appearance in the region with extensive agricultural activities in the hands of s few landowners[220].

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[206] Chouquer et al. 1987, 199–206.
[207] Monaco 2004, 49–50.
[208] Fron. *Lim.* 29.4-6 L=10.2–4 C; HygGr. *Const.* 17.14-16 L=136.25–27 C.
[209] Luisi 2001, 86.
[210] CIL X, 3861.
[211] Monaco 2004, 50; 1998, 5.
[212] Monaco 2004, 50.
[213] Pagano 1983, 231–234; See C. Bencivenga Trillmich, "Un nuovo contributo alla conoscenza della centuriazione dell'ager Campanus", in *Rend. dell'Accademia di Acheologia, Lett. e Belle Arti di Napoli* LI, 1976: 79–89.
[214] Pagano 1983, 231.
[215] Monaco - Clavel-Lévêque 2004, 193–199.
[216] Monaco - Clavel-Lévêque 2004, 194–195.
[217] Monaco 1998, 2.
[218] Rosada 1991, 91.
[219] Liv. XLII.1.6; XLII.19.1-2
[220] Chouquer et al. 1987, 338–339.

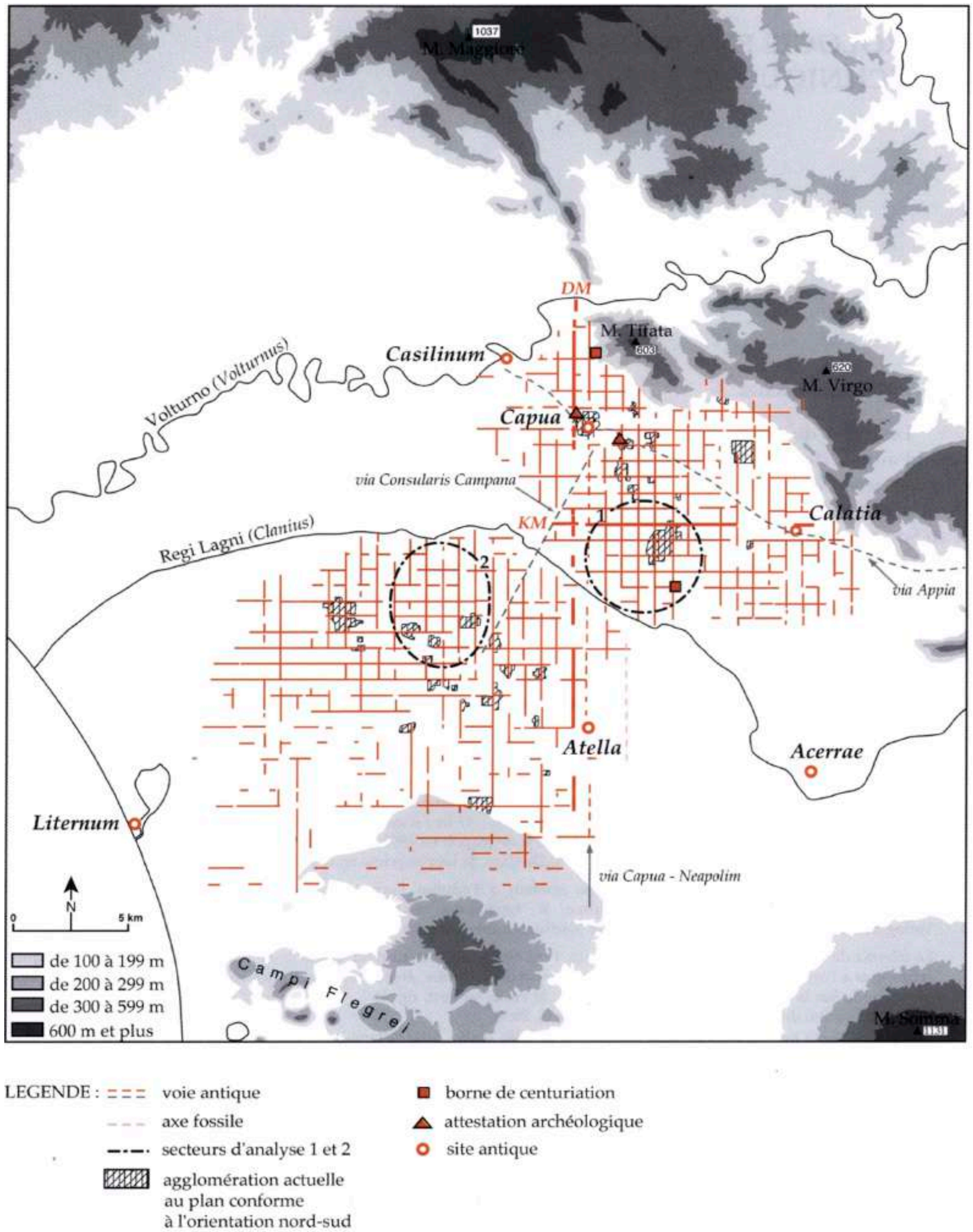

Figure 8. The pattern of the south-north centuriation after the first middle of the 2nd cent. BC, with Mt. Tifata on the north-west on cartography IGM 1/25.000. After MONACO 2004, 50.

Chapter Two. Founding Cities and Temples: Practical and Theoretical Aspects

1. ANCIENT INSTRUMENTS

1.1 Sighting poles: Gnomon, Cruma, Groma

The theory and practice of land surveying were transmitted to the Mediterranean world from an earlier Eastern legacy. In the 5th cent. BC, Herodotus mentioned that «the Greeks learned the art of measuring land; the sunclock and the sundial, and the twelve divisions of the day, came to Hellas from Babylonia and not from Egypt»[221]. However, for Michael J. T. Lewis, it is plausible to argue that «Greece may indeed have been indebted to Egyptian for the basic concept of land surveying and the most basic equipment»[222]. Egyptian astronomy and geometry were very basic; whereas, the Babylonian approach to land surveying was very similar to that later adopted by the Greeks[223]. This idea is supported by a relief from Ur dating to about 2100 BC[224], depicting «a god commanding the king to build a ziggurat and holding what appear to be a coiled measuring cord and a measuring rod»[225]. In general terms, the practice of land surveying has its legacy in the Babylonian tradition more than in the Egyptian one[226].

John James Coulton stated that «[n]othing is known in detail about the measuring instruments used by the Greeks, for none have survived»[227]. One of the most known instruments for setting boundaries and foundations in antiquity is the *groma*. This is the primary tool of the Roman *agrimensor* for land survey and division. The name of the Roman *groma* was probably Etruscan in origin, coming from *cruma*, itself deriving from the Greek *gnomon*[228]. Thus, the *groma* took its name from the Greek *gnoma*, or the sundial pointer called *gnomon*, passing through the Etruscan language with a change of a consonant[229]; it arrived in the Roman world slightly changed in name, structure, and function in the shape of a cross-staff[230]. It might have its origin in the ancient Egyptian surveyors' tool. Herodotus asked if the Greeks learned the art of surveying from the Egyptians' ability to restore land boundaries after periodic inundations from the Nile[231]. Indeed, records since the 1st Dynasty attest the foundation ritual of a temple known as the 'stretching of the cord'[232]. The tutelary deity of this activity was Seshat, who is depicted with an upon her head within an eight-point motif within a semicircle[233]. Belmonte et al. speculated that this motif might have been the representation of an instrument for topographical surveying similar to a Roman *groma*: by pointing north, the planning of

221 Hdt., 2.109.3, trans. A. D. Godley 1920.
222 LEWIS 2001, 17.
223 LEWIS 2001, 18.
224 WOOLLEY 1925, 398; pl. xlviii.
225 LEWIS 2001, 21–22.
226 LEWIS 2001, 17.
227 COULTON 1975, p. 90; the word κανών was mentioned in early Greek inscriptions and literature as an instrument for checking strait lines and flat surfaces.
228 DILKE 1971, 66; VAN DER MEER 2011, 88.
229 Festus, *Gloss. Lat.* 86, 1-3.
230 DILKE 1971, 66.
231 Hdt., 2.109.
232 BELMONTE - MOLINERO POLO - MIRANDA 2009; BELMONTE 2015, 1502; ROSSI 2003, 148–173.
233 BELMONTE 2015, 1503.

temples with specific angles could have been assessed[234]. In a different account transmitted by Diogenes Laertius[235], it was Anaximander of Miletus (*c.* 610–545 BC) who might have 'invented' the gnomon, or at least 'introduced' it to Greece[236]. The *gnomon* was a vertical pole used to cast a shadow on the ground, used as a clock and calendar or to establish the true cardinal directions[237]. For instance, Aristophanes gave an account of the quotidian act of consulting a meridian (γνώμων) in Athens[238]. According to John McKim Malville, the best days to get accurate cardinal directions using a *gnomon* were the solstices, since the sun's declination variations are reduced to a minimum during solstices from the morning to the afternoon[239].

According to Lewis, the *groma* «is the only ancient surveying instrument to be attested archaeologically»[240]. A probable example can be found in a 1st cent. AD relief on the tombstone of Lucius Aebutius Faustus of Eporedia, in the museum of Ivrea, in the north of Italy[241]. A *groma* was found in Pompei in 1912 in the workshop of an artisan called *Verus*[242], together with other instruments typical of the work of the agrimensores[243]. The instrument can also be recognised on Hellenistic Metapontum coinage[244]. A pebble with *decussis* was recovered in Patavium (Padova): it was worked with a grooving crux to be suspended and used as a weight: this might testimony of a possible gromatic practice with the tool before the use of the proper Roman *groma*[245]. Furthermore, part of an Etruscan *cruma* has been recognised in a plumb sphere found at the Crocifisso del Tufo necropolis at Orvieto[246]. Moreover, several pebbles were found with an inscribed *crux*, with some examples coming from Marzabotto, Spina, Genua: on the pebble from Spina is inscribed *mi tular*, which means 'I {am} the border'[247]. The *crux* might be related to the use of the *cruma*, as later Roman practices attest. Inscribed *cippi* with *decussis* were useful to define the directions of the *decumani* and *kardi*[248]. An inscription DE found on a pebble with a crux at *Pativum* (Padova) caused Aldo Luigi Prosdomici and Anna Marinitti to think that the stone functioned as a sort of *groma*[249]. The notation DE was interpreted as *decumanus/decimanus*, the main line for territorial organisation[250].

The practical use of the *groma* consisted in planting the *ferramenutum* on the ground at a bracket distance from the starting point of the survey (fig. 9) [251]. The centre of the centuriation, where

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234 Belmonte - Molinero Polo - Miranda 2009; Belmonte 2015, 1512–1517.
235 Diog. Laert. II, 1-2.
236 Kirk - Raven 1983, 102–103.
237 Malville 2008, 41–44.
238 Ar. *Eccl.* 650; Franzoni 2002, 142.
239 Malville 2008, 43–46.
240 Lewis 2001, 5.
241 Dilke 1971, 39.
242 Dilke 1971, 50.
243 Rosada 1991, 88.
244 Rutter 2001, 138–139.
245 Prosdocimi - Marinetti 2012, 11.
246 Bizzarri 1962, 57–58; Van Der Meer 2011, 455.
247 Sassatelli - Govi 2013, 295.
248 Pagano 1983, 234.
249 Prosdocimi - Marinetti 2012, 11.
250 Prosdocimi - Marinetti 2012, 11–12.
251 Rowland - Howe 1999, 170.

the *groma* was placed was called the *umbilicus soli* or *tetrans,* since from there a quadripartition of space was set[252]. At this point, *decusati in capitibus lapides* stones inscribed with a cross indicating the direction of the axes were placed on the ground[253]. According to Rosada, such cippi were part of the sacrality of the delimitation of space since it was prohibited to move them[254]. The cross was then rotated until the plum lines aligned with the required direction of sighting. A second *groma* or a *meta* might have been placed an *actus* away, with a care to ensuring the alignment of the plumb lines. Or, it is possible that another three *gromae* were placed at right angles to form a square[255]. The plum lines were subject to oscillation caused by winds or movements. Indeed, Hero of Alexandria (1st cent. AD) stated that strong winds may render difficult the use of plumb lines[256], noting «the inconvenience which arises from the cords with weights hung on them, which do not come to a rapid standstill but continue to swing for some time, especially when a wind is blowing»[257]. To avoid this and other problems, Hero of Alexandria dedicated a brief treatise on the *dioptra*[258]. This is a sophisticated sighting instrument comparable to a modern theodolite, even though the instrument was not used to measure angles, at least according to Coulton[259]. It stands as the only Greek literature on land surveying, in contrast to the body of Latin literature in the *Corpus Agrimensorum*[260]. However, limitation in its design and use were considerable to be disregarded by surveyors.

The method of choosing the direction of sight using these instruments is not clear. According to the Roman agrimensor Hyginus, «*[m]ulti ignorantes mundi rationem solem sunt secuti, hoc est ortum et occasum, quod is semel ferramento conprehendi non potest»,* «[m]any surveyors, being ignorant of the principles of the universe, have followed the sun, that is its rising and setting, although this cannot be sighted once and for all by the *ferramentum*»[261]. His critiques are directed at ignorant agrimensores who sighted the apparent course of the sun for measurements. Since the position of the rising sun changes across seasons, the determination of the east by this method could readily be erroneous. Moreover, sighting the sun directly with the *groma* might have been uncomfortable for the eyes staring directly into solar light, even though at sunrise or sunset sunlight is less intense. However, the passage from Hyginus continued stating that «*[q]uid ergo? Posita auspicaliter groma, ipso forte conditore praesente, proximum vero ortum comprehenderunt, et in utramque partem limites emiserunt, quibus kardo in horam sextam not convenerit*», «[w]hat takes place then? When the *groma* had been positioned after the taking of the auspices, perhaps in the presence of the very founder himself, they sighted the next sunrise, and established *limites* in both directions; but in this system

252 Rosada 1991, 88.
253 Rosada 1991, 88.
254 Rosada 1991, 89.
255 Dilke 1971, 70.
256 Lewis 2001, 132.
257 Hero *Dioptra* 33 = Lewis 2001, 282.
258 A recent translation of Hero's *Dioptra* can be found in Lewis 2001.
259 Coulton 2002, 162.
260 Coulton 2002, 150.
261 Hyg. *Cons. Lim.* 12-16 Th., trans. Campbell 2000, 137.

the *kardo* did not tally with the sixth hour (i.e. did not face due south)»[262]. Although inconvenient under theoretical prescriptions, the sun was used as a target of the sighting with the *groma*. Its direct legacy with the gnomon supports the hypothesis that the *groma* was used in relation to the sun. Moreover, among the instruments used by Roman agrimensores in the analysis by Rosada[263], these included a meridian, as recovered in Pompei, together with the *groma*, useful to determine *secundum caelum* orientations[264]. Ancient astronomers knew that looking directly at the sun was dangerous to eyesight, especially during an eclipse[265]. It is also possible that the sun shadow was used for such surveys. From an analysis of the literary sources and topographical evidence, Joël Le Gall has questioned whether the direction of sunrise was used as a starting point of urban planning[266], as will be further explored in the 'solar orientation' section.

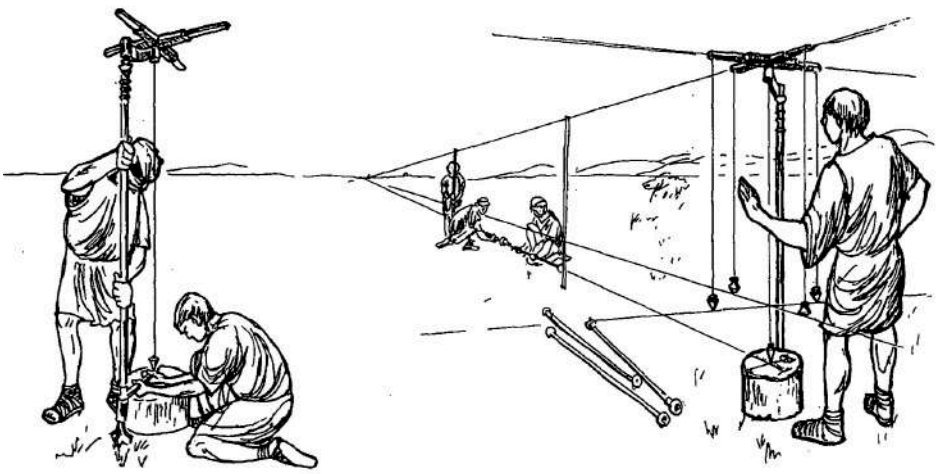

Figure 9. Drawing of Roman agrimensores setting orientation with the *groma*. Illustration by Thomas Noble Howe in ROWLAND - HOWE 1999, 170.

1.2 Cords and Rods: *Schoinion, Kalamos, Naper, Pertica*

In the ancient Greek world, the common instruments for measuring lengths and setting orientations were cords. The σχοινίον (*schoinion*) was one of such measuring rods, also denoting the distance of 100 cubits[267]. The word *schoinion* is not found in the literature before the Hellenistic period, but according to Coulton, the tool was probably in use from an earlier period[268]. Cords needed to be made with the use of a strong fibre so that, as Hero recounted, it was necessary to use «a cord (*schoinion*) that has been well tensioned and tested so that it will not stretch or shrink»[269]. The whole preparation

262 Hyg. Grom. *Cons. Lim.* 170, 5-8 L. = 136, 19-1 C.
263 ROSADA 2010, 132.
264 ROSADA 1991, 88–89.
265 Pl. *Phd.* 99d.
266 LE GALL 1975.
267 LEWIS 2001, 19.
268 COULTON 1975, 90.
269 Hero, *Dioptra* 20, trans. LEWIS 2001, p. 20.

for avoiding such problems and preparing an accurate *schoinion* followed in his description[270]. Cords could also be used to set out right angles when other instruments were not available, by using empirical geometrical properties of triangles and circles[271]. For example, a triangle within a semicircle was right angled[272]. Furthermore, the *schoinion* could have been knotted at intervals of 12 ½ cubits forming 8 *hammata*[273]. The knots might have been used with Pythagorean triplets to set right angles[274]. There are no many sources on the topic for the Archaic or Classical period[275]. Of relevance is the mention by Clemens of Alexandria regarding Democritus (5th–4th cent. BC) of the latter's travelling to Egypt and spending time with the *Harpendonaptai*, the 'cord-stretchers'[276]. It is useful to remember that Egyptian temple foundation ritual included a method for orienting based on stretching the cords[277]. The Greek geometrical division of space was discussed by Marcel Detienne and as cited in Herodotus «*skhoînoi diametreîsthai*»[278], 'to be measured with the rod'[279]. Although their interest in space division is undeniable, for the Etruscans not much evidence on their measurement instruments is attested. According to Daniel Maras, it is possible that «the Etruscan unit corresponded to the fixed measure of a rope», named *naper*[280]. This meaning was attributed after a comparison between the Etruscan *naper* and the Latin *napurae,* as mentioned by Festus: it would correspond to a medium unit of length of a standard cord[281]. The term appears in the *Cippus of Perugia* (2nd cent. BC), where one of the longest Etruscan inscriptions appears, and it is present two more times on other *cippi*[282]. Very little evidence of Roman surveyors using cords has been found.

The κάλαμος (*kalamos*) was an alternative method to the *schoinion* for measuring lengths. It was originally made in reed, but could also be made in wood. The longer one was also known as ἄκαινα (*akaina*)[283]. Rods were more precise for smaller measurements, cords more practical for longer ones. The measuring-rod in the Roman world was called *pertica*, usually 10 feet long, but which could also have been lengths of 12, 15, or 17 feet[284]. It was called *decempeda* when measuring 10 feet and corresponds to the length of the *akaina* of 6 2/3 cubits long [285].

Rods and cords were covered with iron or brass ends to avoid wearing and to facilitate alignment with another rod or cord[286]. Archaeological examples of rod end-pieces include some from

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270 Hero, *Automata* II, 4-5, trans. LEWIS 2001, p. 20.
271 LEWIS 2001, 23.
272 Balbus, grom., *Expos. et Ratio Omn. Formarum* L 107.12–108.8 = C 212.41–214.12; CAMPBELL 2000, 436.
273 SHELTON 1981, 94.
274 ROSSI 2003, 153.
275 CALIÒ 2020, 229–237.
276 Clemens of Alexandria, *Stromata,* I, Fr.68B 299 DK.
277 ISLER 1989.
278 Hdt. I 66.
279 DETIENNE 2002, 129.
280 MARAS 2013, 486.
281 Festus, *Gloss. Lat.* 160.7 ; see Trombetti, *La lingua etrusca*, Firenze, 1928, 159 in FACCHETTI 2000, 14; MARAS 2013, 486.
282 MARAS 2013, 486.
283 LEWIS 2001, 21.
284 COULTON 1975, 91; LEWIS 2001, 21.
285 LEWIS 2001, 21.
286 COULTON 1975, 91; DILKE 1971, 73.

Enns, Austria[287], and a few from Pompei.[288] The ones found at Enns are made of iron, measured 8.5 cm long, tapered and with a flat circular end[289]. Indeed, the *pertica* «was furnished at the end with bronze ferrules marked in digits or inches for small measurements and flanged to butt neatly against its neighbours» [290]. Thus, *perticae* were used in pairs to achieve longer distances (fig. 9)[291]. The calibration of these instruments was discussed by Coulton as necessary to achieve precise long measurements «to an integral number of rod- or cord-lengths»[292]. Indeed, building design, such as of Greek temples, showed a preference for integer numbers of feet[293].

1.3 Boundary Stones: *Horoi, Cippi, Termini*

In Greece, boundary stones known as *horoi* were in use since Homer, and in use in Athens since the Late Archaic period for space delimitation[294]. The term 'horizon' itself derives from the Greek word for boundary *horos*, so that it corresponds to the limit of heavens[295]. Boundary stones are typical of sanctuaries, tombs, and roads[296]. According to Burkert, «[t]he limits of the *temenos* are marked by stones, *horoi*, or by a wall surrounding the whole place»[297]. More than a physical division, these markers appear to separate space in its qualitative and functional aspects, for instance in the social and religious character of the Agora[298]. Therefore, more than simply boundary stones, *horoi* «were both practical and symbolic expressions»[299]. Their location, orientation and precise setting was highlighted by Gerald V. Lalonde and colleagues[300].

In Etruria, there is evidence of topographical markers of space, especially evident with the boundary stones from the 4th cent. BC. Etruscan boundary stones bear the inscription '*tular*', meaning 'boundary', marking the limits of territories [301] . Several inscribed *cippi* were found. The archaeological record counts 8 actual inscriptions with *tular*, plus 4 which have been lost. Camilla Zeviani mapped the boundary stones with *tular* inscriptions in North Etruria[302]. Boundary stones can be categorised in regards to marking private property, including funerary plots, while others marks the limits of the city and national boundaries[303]. To the first category can be ascribed the *Cippus of Perugia* for the transfer and transaction of funerary land, and the *Cippi of Bettona* in an Etruscan

[287] LYONS 1927, 140; DILKE 1971, 67.
[288] DELLA CORTE 1922, 85–86; DILKE 1971, 73.
[289] DILKE 1971, 67,73.
[290] LEWIS 2001, 21.
[291] LEWIS 2001, 21.
[292] COULTON 1975, 91.
[293] COULTON 1975, 98.
[294] CALIÒ 2014, 172.
[295] ROWLAND - HOWE 1999, 163, n. 80.
[296] OSBORNE 2007, p. 198.
[297] BURKERT 1988, 35.
[298] CALIÒ 2014, 172.
[299] LALONDE - LANGDON - WALBANK 1991, 5.
[300] LALONDE - LANGDON - WALBANK 1991, 7.
[301] BECKER 2013, 361.
[302] ZEVIANI 2022, 44–45.
[303] See R. Lambrechts, *Les inscriptions avec le mot « tular » et le bornage étrusques*, Firenze 1970, 75-76.

necropolis. When the boundary stones marked the private property of a family, land ownership and legal agreements can be explicitly set out on the boundary markers, such as in the *Cippus of Perugia*[304].

Public boundary stones setting the limit of the city are the *cippi* from Fiesole, mentioning the two officials presiding over the administrative act. These can be compared with the *Tabule Iuguvine*, even if the latter are made in bronze[305]. The location of the finding spot of the markers are telling about the civic and religious space: at Bolsena (*Volsinii Novi*) a boundary stone was found at the entrance of the city[306]. The *Cippus of Cortona*, from the 2nd century BC, is a boundary stone of monumental size with a wider target. It was found on the road between Cortona and Perugia, with a pit containing ritual remains. The stele presents an inscription '*tular rasnal*' mentioning a boundary, which would mean something like *fines Etruria*, the end of the Etruscan 'nation'[307]. According to Colonna's interpretation, the boundary marker might indicate a separation, between inner and outer national space, including specific lustration rituals of the sacralisation of the *ager*[308]. National identity may not particularly relevant for interpreting Etruscan populations, and some scholars are very reluctant to draw significant conclusions from a few inscriptions. The lack of sources renders suspect any conclusions of any epistemological value. Nevertheless, Roger Lambrechts emphasised the connection between boundary stones and the *Etrusca Disciplina* in a cosmological sense, and the latter will be further discussed in the 'Theoretical and Ritual' section of the Etruscan world[309].

In the Roman world, diversity in the epigraphical forms of the corpus of *termini* is attested from the 2nd cent BC. *Termini*, were representations of the god *Terminus*, the tutelary divinity of the festivity on the 23rd February, when offerings to the god and as well to the *cippi* were made. For instance, the *terminus* of *Gubbio*, with the inscriptions F P, *fines publico*, marked a separation of the urban from the agrestic space. *Cippi* with *decussis* were found to delimitate territories. Two from Oderzo, one with a single groove in the middle, the other with a crux, both are inscribed with XE, to be read as TE, *teuta*, or DE, *decumanus*[310]. Such *cippi* were interpreted as defining the boundary of an urban settlement[311]. A cylindrical mute *terminus*, which means one with no inscriptions, was identified in the *ager Campanus*, in the locality of Trentola, south of Marcianise, indicating the south-north organisation of the territory in the Roman period[312]. According to Marco Pagano, it referred to the proximity of a body of water, in this case the river *Clanis*[313]. It can be regarded as falling within the category of *limites muti*, with a couple of carved angles cut out from the top of the *cippus*, to be

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304 BECKER 2013, 363.
305 SISANI 2001.
306 BECKER 2013, 361.
307 BECKER 2013, 362.
308 COLONNA 1988, 25–28.
309 See R. Lambrechts, *Les inscriptions avec le mot « tular » et le bornage étrusques*, Firenze 1970.
310 PROSDOCIMI - MARINETTI 2012, 17–18.
311 PROSDOCIMI - MARINETTI 2012, 18.
312 PAGANO 1983, 231; LUISI 2001, 95–96.
313 PAGANO 1983, 233.

read after the indication of the gromatic texts[314]. According to Mario Pagano, the fact that the *cippus* stands out in no much depth as it would be expected suggested a then-recent attempt at moving it by the local population, causing the incisions to not point at the cardinal directions[315]. Some notions of Oscan land division are attested in the *Abellan cippus*[316], witnessing the Oscan form of the Latin *limes*, *liímítú[m]*[317]. The *cippus* commemorates an agreement between Abella and Nola dated to the 2nd cent. BC about the sanctuary of Heracles.

[314] Grom. Vet. *Ordines Finitionum ex diversis auctoribus* L 343.6-15, fig. 321 = C 247.18-24, Ill. 249.
[315] PAGANO 1983, 231.
[316] On the *Abellan cippus* see A. Franchi De Bellis, *Il Cippo Abellano*, Urbino 1998; A. Franchi De Bellis, 'Il cippo abellano: il santuario di Ercole', in M. Tagliente (a cura di) *Gli italici in Magna Grecia. Lingua, insediamenti e strutture*, Venosa, 1990, 111 ss.; A. La Regina, 'Il trattato tra Abella e Nola per l'uso comune del santuario di Ercole e di un fondo adiacente', in *Sanniti*, 214-222; R. Antonini, 'Vestirikio e Abella. I documenti. Problemi vecchi e nuovi di interpretazione', in *Klanion/ Clanius*, 7-8, 2001.
[317] LA REGINA 1999, 11.

2. PLANNING WITHIN THE SKY

2.1 Cardinal Orientations

2.1.1 NORTH POLE STAR

During the 1st millennium BC, the North Celestial Pole was not pointing at any bright star. However, in the 3rd century BC, Eratosthenes of Cyrene (275-194 BC) introduced a cartography with a reference to the north direction mentioning the North Pole Star[318]. Nowadays, due to the precession of the equinoxes and the turning of the terrestrial axis, the North Celestial Pole points, with a good approximation, to α Ursae Minors, the so-called North Pole Star. In 1000 BC, the nearest star to the North Celestial Pole, about 6° distant, was Kochab, that is β Ursae Minoris[319]. Whereas, α Ursae Minors was still distant by 18° in 1000 BC, and by about 12° in 1 AD [320]. The previously identifiable North Star was α Draconis in the constellation of Drago, indicating at north during the 4th millennium BC. For the lack of a star corresponding to the north, the sun was a most useful celestial body to define the north in the 1st millennium BC, so that due north could be determined by observing the longest shadow of a gnomon during the day.

As a general indicator of the north, the position of the constellation of Ursa Major was made use of. In the Hellenistic period of the Egyptian world, literary evidence suggests that the planning of temples was initiated with astronomical observations and, in particular, by determining the north using the stars[321]. The ceremony was known as 'the stretching of the cord' corresponding to «the first practical act in the foundation of a temple» when the orientation of a structure was outlined[322]. There are textual attestations of the foundation ritual dating from the Ptolemaic period, even though the practice can be dated back to Early Dynastic times[323]. Imagining such an occasion, after the king arrives at the site, he and «the goddess Seshat drive into the ground two poles around which a rope is extended»[324]. According to Corinna Rossi, the orientation of the temple and its four corners were fixed at this stage of the ceremony[325]. In some texts, the foundation ritual is strictly related to the observation of the stars. Written on the wall of the Horus' temple of Edfu at the time of Ptolemy III which was founded on the 23rd August 237 BC[326], the inscription, in the form of a royal monologue, reads:

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[318] AKKERMAN 2016, 107.
[319] LEWIS 2001, 22.
[320] LEWIS 2001, 22.
[321] SHALTOUT - BELMONTE 2005, 290–291; BELMONTE 2015, 1502.
[322] ROSSI 2003, 151–152.
[323] ROSSI 2003, 148–152.
[324] ROSSI 2003, 148.
[325] ROSSI 2003, 148.
[326] CALIÒ 2020, 232.

I take the measuring cord in the company of Seshat. I observe the progressive movement of the stars. My eye is now fixed upon Meskhet(yu). The god of time-keeping stands by me, in front of his merkhet. Then, I have established the four corners of your temple[327].

The king looked at Meskhet(yu), which is the constellation of Ursa Major, one of the most evident asterisms among the circumpolar stars[328]. In another inscription, it is mentioned «the king stretches the rope with joy. With his glance toward the Akh of Meskhet(yu), he establishes the temple»[329]. In the imagery and critical interpretation of the ritual, after arriving at the selected place, together with the goddess Seshat the king stretched the cord between two poles to define the axis of the temple before digging the foundation trench and performing offerings and purification rites[330]. According to Luigi Caliò the ritual of foundation with the cord can be attested also in the Vedic, Judaic, and Hellenistic traditions, emphasising the strong connection between the foundation rituals and astronomy[331].

2.1.2 GNOMON: FINDING CARDINAL DIRECTIONS

As mentioned earlier, due to the fact that there was no North Pole Star during the 1st millennium BC, the sun was the most useful celestial body to define orientations in space. The north direction can be defined by observing the longest shadow of a gnomon during the day. As an alternative, the method of the circle described by Vitruvius was also commonly used[332]. A circle was traced on the plain ground around the central pole of the gnomon (figs. 10–11); before midday, the extremity of the gnomon shadow would have touched the circumference; symmetrically, it would have happened after midday. The line passing through these two points is the east-west direction (fig. 11)[333]. This segment is then divided into two equal parts: the line passing through the midway point and the gnomon, perpendicular to the east-west line, corresponds to the north-south line. A more complex but similar method based on solid geometry is also described by Hyginus Gromaticus[334]. Pliny also gave some advices on working with a gnomon, such as about its verticality and about the horizontality of the plane on which the shadow is cast[335].

A similar method for orienting structures towards the north could be done also by using the movement of stars, although the sun's shadow would give a better accuracy[336]. Iorwerth E. S. Edwards referred to the method of building an artificial circular horizon, better levelled by water on

[327] BELMONTE - MOLINERO POLO - MIRANDA 2009, 203.
[328] BELMONTE 2015, 1502–1503.
[329] MIRANDA - BELMONTE - MOLINERO 2008, 57.
[330] BELMONTE - MOLINERO POLO - MIRANDA 2009, 197–198.
[331] CALIÒ 2020, 229–237.
[332] Vitr. *De arch.*, 1.6.6-7; Procl. *Hypotyp.* 3.23–24.
[333] ISLER 1989, 197.
[334] Hyg. Grom., *Const.* 188.14–189.15 L=148.26–150.2 C.
[335] Plin. *HN* 18.332 s.
[336] LEWIS 2001, 23.

the top, and observing the relative rising and setting of a star from a sighting pole at the centre[337]. One of these methods might have been used by the builders of the Great Pyramid, which diverges from the cardinal direction north by an error between 1' 57" and 5' 30"[338].

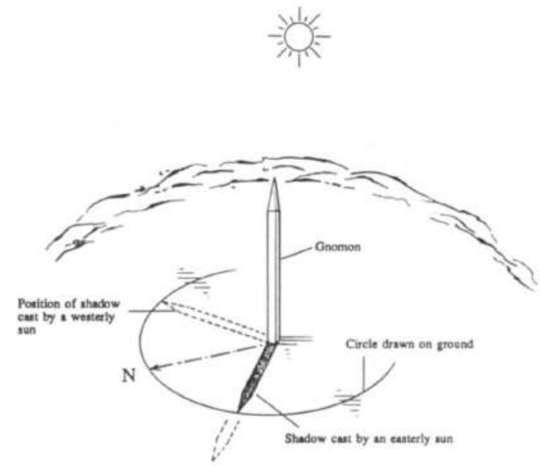

Figure 10. Using the gnomon to find cardinal directions, first step. From ISLER 1989, 197.

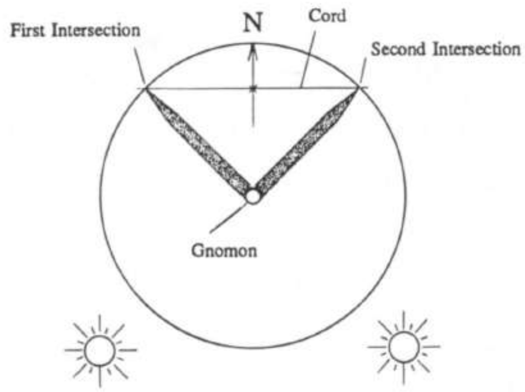

Figure 11. Using the gnomon to find cardinal directions, second step. From ISLER 1989, 197.

2.1.3 EQUINOXES

With respect to the equinoxes, it is best to be cautions in terms of argument. As has been stated already, while the observation of the solstices «implies no astronomical theory whatsoever» as the sun rises and sets at the very same time for several days before turning backwards[339], the midway points of the equinoxes are not visually marked by the sun but require a rough guess or a geometric calculation[340]. Secondly, the day of the equinox is not a simple date to obtain by just observing the sun, being relative to the length of daytime and night in its literary definition. Due to its anachronistic

337 See I.E.S. Edwards, *The Pyramids of Egypt*, Harmondsworth 1985, 246–7.
338 See I.E.S. Edwards, *The Pyramids of Egypt*, Harmondsworth 1985, 99.
339 DICKS 1966, 30–33.
340 KAHN 1970, 112–114.

assumptions, according to Clive Ruggles «it would probably be helpful if the word 'equinox' were simply eliminated from archaeo-astronomers' vocabulary»[341]. Recently, Juan Antonio Belmonte distance himself from Ruggles' statement, saying that « 'equinoctial' alignments are as variegated as definitions of 'equinox' we might imagine», but should not be avoided as term[342]. These definitions of equinox include the literary one, 'equal night' and 'equal day', but which has no neat technique to be properly determined; the day counted midway between the solstices, which is the common Roman and Classic definition; the day when the sun rises on due east; the day when the sun rise on the mid-horizon point between the two solstitial points; or, the modern astronomical equinox when the sun has $\delta = 0°$[343]. Moreover, Alfredo Guarino considered the methods which might have been in use for the calculation of the equinoxes in Etruria before and after Anaximander[344]: it should be noted that in the 5th the Greek philosopher Anaximander established a correct calculation of the equinoxes using the gnomon, according to the definition of the midway day between the two solstitial days[345].

2.2 Solstices

The solstices are precise events in the solar year. A knowledge of the position of the solstices in relation to the local landscape was important for town planning. In Hippocrates' *Airs, Waters, Places*, the position of sunrises on the local horizon was recommended to a physician upon arriving in a city he is unfamiliar with[346]. These occurrences happen twice a year when the sun is at the maximum solar distance, or declination, from the equator. More simply, they happen when the sun reaches its southernmost (in winter) and northernmost (in summer) rising and setting points along the local horizon. As D. R. Dicks outlined, the simple observation of the solstice does not need any kind of astronomical theory behind it, for this reason, namely that ancient people's knowledge predates any form of scientific speculation on the celestial vault[347]. Their observation on a spatial level belongs to a very early stage of the human experience. In terms of the astronomical horizon, the points of summer and winter solstice sunset are in the opposite direction to the ones of sunrise, symmetrically to the south. This means that for any observer watching the summer solstice sunrise, they would see the winter solstice sunset in the same line, but on the opposite versus. However, it is important to recall that local landscape features can alter this symmetry. Though, as part of wider drama of the sky, at solstices it is possible to watch the crossing over of the Milky Way and the sun, events which may have been relevant for eschatological beliefs[348]. On a temporal level, the longest and the shortest daytimes of the year can be related to the daylight length matching with the cyclicity of the seasons. However, if in Athens the summer solstice was the new year, in other parts of ancient Greece it was marked by the winter solstice. At least two calendars, the Boitian and the Elean ones, began their

341 RUGGLES 1997.
342 BELMONTE 2021, 31.
343 BELMONTE 2021, 11-12,31.
344 GUARINO 2011.
345 See F. Franciosi, *Le origini scientifiche dell'astronomia greca*, Roma 1990.
346 BILIĆ 2016, 200.
347 DICKS 1966, 31.
348 Porph. *De antr. nymph.* 28

recount from the winter solstice[349]. Thucydides also mentioned the winter solstice as a time marker[350]. Though, the direct observation of the sun at the solstices can be affected by some problematic issues. First, there is the difference between a flat ideal horizon, technically known as the astronomical horizon, and an actual horizon with mountains and unevenness; the latter may cause a discrepancy with the ideal by delaying or advancing the position of the sun on a certain day. Second, the approximation of the date of the solstice is about five days, although the position is clearer during its *statio*.

2.2.1 LITERARY EVIDENCE

According to Tomislav Bilić «[i]t is certain that the Greeks observed the solstices at least as early as the second half of the fifth century B.C.E.»[351]. This statement is supported by the body of literary evidence on variations of the expressions mentioning 'sun' plus a word coming from the root τροπ-, designating the idea of 'turning'[352]. The sentence τροπαὶ ἠελίοιο and its variations may signify 'the solstices'. The idea of referring τροπαὶ as solstices is already present in Hesiod[353]. Several scholars have discussed Hesiod's passage[354]. More than indicating his awareness of this phenomenon, there is an amplification of meaning to indicate not only the day of the solstices, but also the two seasons of the year when these happen[355]. For instance, activities such as ploughing were ending with the winter solstice[356]. Hesiod is using the event in a temporal sense to suggest the passing of the seasons, relating this fixed time in the year with the heliacal rising of specific stars and with seasonal-dependent variations in agricultural, pastoral, and navigation activities[357].

Also, in Homer's Odyssey, a reference to 'solar turnings' occurs. Ulysses' arrival on the island of Syrie is described in the following line «Νησός τις Συρίη κικλήσκεται εἴ που ἀκούεις Ὀρτγίης καθύπερθεν, ὅθι τροπαὶ ἠελίοιο»[358]. This translates as «there is an island called Syrie – perhaps you have heard of it – above Ortygie, where there are the turnings of the sun»[359]. The passage is quite controversial and ambiguous, and it has been the object of many academic discussions. First, there is no certainty if the islands mentioned are the Cycladic ones, identifying Syrie with Syros and Ortygia with Delos, or indicate the Sicilian cape of Syracuse and the nearby island of Ortygia, or the country of Syria, or whether they may even be a poetic fiction. Although the first interpretation is often the preferred one due to its topographical consistency, the interpretation of τροπαὶ ἠελίοιο remains

349 Plut. *Vit. Pel.* 24.1, trans. Perrin 1917.
350 Thuc. 7.16.2.
351 BILIĆ 2012.
352 BILIĆ 2016, 196.
353 Hes. *Op.* 479, 565, 663; BILIĆ 2016, 198.
354 PANNEKOEK 1961, 95–96; DICKS 1966, 31; 1970, 34–35, 37; KAHN 1970, 113; VLASTOS 2005, 34, n. 21; BALLABRIGA 2010, 107; see also M. P. Nilsson, *Primitive Time-reckoning,* Lund, 1920, 316; J. Evans, *The History and Practice of Ancient Astronomy,* New York, 1998, 4–5, 56.
355 KAHN 1970, 113; BILIĆ 2012, 513; 2016, 198.
356 Hes. *Op.* 479-80, 564ff-67, 663-65.
357 Hes. *Op.* 564 ff.
358 Hom. *Od.* XV 403-404.
359 KIRK - RAVEN 1957, 52.

controversial as well. It may be a description of the relative positions of Syros, Ortygia/Delos and the sun on the horizon, describing their positions during solstices or on an undefined day. For some scholars, τροπαὶ ἠελίοιο is indeed a formula to indicate the solstices[360]. Or, in this particular case, it may be more precisely understood as the point on the horizon when the sun sets at summer solstice, that is towards the north-west[361]. According to William Arthur Heidel, the passage might refer to the practice of observing the rising sun across seasons in relation to the local landscape[362]. For Alfonso Fresa, from Delos it was possible to watch the solstitial sun setting between the islands of Syros and Tinos[363]. George Pantazis and colleagues examined the orientation of Delos' existing monuments and the Cave of the Kynthos mountain, but found no correlation with the sun's position at the solstices[364]. Thomas Heath preferred to interpret the word τροπαὶ as simply 'turning', therefore describing the position of the sun during its setting when it was supposed to turn on its journey round the Ocean towards the eastern horizon[365]. In his interpretation, the statement is about the place on the island, situated on the west, where the sun sets[366]. Geographically, either west or west/north-west would work for the position of Syros as viewed from Delos. David Dick opted for an imaginary island, located to the far west, behind a distant Syria[367]. A Homer scholiast mentioned the presence of a cave (σπήλαιον) of the sun on Syros oriented in such a way that, from there, it was possible to detect solstices by means of the sun's ray illuminating a particular feature of the cave, although it seems a quite late association to explain the cryptic Homeric couplet[368]. Giuseppina Paola Viscardi, in her discussion of the foundation myth of Delos, which involved a quail being transformed into the island, pointed out the linguistic association between the Greek *ortyx* with the Vedic Sanskrit *vart-ika* (= lat. *vertere*), with the meaning of 'the one who returns', also considering that in Vedic India the quail had solar attributions, specifically in relation to the birth and returning of the sun[369]. Finally, the pre-Socratic philosopher Pherekydes of Syros has been associated with the skill of solstice-making in relation to the much-debated passage from Homer.[370] Whatever might be the original motif of the Homer reference, an early attestation of the concept of solstices had made its appearance in the Greek literature.

2.2.2 Archaeological Evidence

The astronomical device used to individuate the solar turning of the year was called a *heliotropion*[371]. For this reason, Bilić emphasised the importance of the spatial aspect of the phenomenon and, above

[360] Kahn 1970, 113 nn.50–52; Heidel 1976, 59; Vlastos 2005, 34 n.21; Bilić 2012, 513; 2016, 197–198.
[361] Martin 1879.
[362] Heidel 1976, 58–59.
[363] Fresa 1965.
[364] Pantazis et al. 2009, 63.
[365] Heath 2004, 27.
[366] Heath 2004, 27; on a similar option Dicks 1966, 31.
[367] Dicks 1970, 32–33.
[368] Kirk - Raven 1957, 52–53; Bowen - Goldstein 1988, 73.
[369] Viscardi 2015a, 109–110.
[370] Diog. Laert. 1.119; Kirk – Raven 1957, 52–54; See also H.S. Schibli, *Pherekydes of Syros*, Oxford 1990, 5, 144.
[371] Bowen - Goldstein 1988, 72–73; Hannah 2009, 5–9, 56, 71; Bilić 2016, 195.

all, the idea of turning over of the sun with respect to the local horizon, the coming back after having reach its spatial limits in the symmetrical points of risings and settings with respect to the south[372]. Even without a device, the solstice determination could have been made by comparing the position of the sun, rising or setting, with precise features on the horizon, for instance by looking to the unequal profile of a mountain: in this way, it was possible to detect any variations in the rising position of the sun, until it reached its extreme position, before turning back again[373]. From the testimony of Theophrastus, astronomers from the Greek world used to determine the solstitial phenomena (τὰ περὶ τὰς τρόπας) by comparing the sun's position with natural landscape markers, such as mountains: thus, «Matriketas at Methymna observed the solstices from Mount Lepetymnos, Cleostratus in Tenedos from Mount Ida, Phaeinos at Athens from Mount Lycabettus »[374]. Eudoxos explicitly mentioned the points on the horizon where the solstices occur (τόποι τῶν τροπέων ... ὁ ἥλιος ποι- ούμενος)[375]. The same happened in Asia Minor with Mount Ida being used as a marker, as Cleostratus of Tenedos was wont to do[376]. The Athenian astronomer Phaeinos used to ascertain the time of the summer solstice by looking toward Mount Lycabettus[377], a prominent hill on the north-east side of ancient Athens, nowadays incorporated within the city[378]. Phaeinos' pupil was the Athenian Meton[379], whose ἡλιοτρόπιον was situated on the Pnyx hill in Athens[380]. Robert Hannah showed how this could have precisely been made by standing at the Pnyx hill, the location of the Athenian political assembly[381]. Moreover, on winter solstice, the sun rose above another landscape peak, Mt. Hymettus, just to the south-east of Pnyx hill[382]. Both the Parthenon and the temple of Hephaestus in Athens face towards Mt. Hymettus[383]. With a different interpretation, Paul Tannery hypothesised the use of the peaks as gnomons, where variations of the shadow cast by the sun might have been observed[384]. In another instance, the claim is made that Meton had erected stelae and marked on them ἡλίου τροπὰς.[385] Archaeological excavations by K. Kourouniotes and H. A. Thompson suggested the possible use of the *heliotropion* on the Pynx hill[386].

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[372] Bilić 2016, 196.
[373] Pannekoek 1961, 107.
[374] Theophr. *Caus. pl.* 4, trans. Arthur F. Hort, 1926.
[375] Fr.63b Lasserre (Hipparch. 1.9.2); See E. Dekker, *Illustrating the Phaenomena. Celestial Cartography in Antiquity and the Middle Ages,* Oxford 2013, 9; A. C. Bowen, "Eudemus' History of Early Greek Astronomy: Two Hypotheses," in I. Bodnár and W. W. Fortenbaugh (eds.), *Eudemus of Rhodes,* New Brunswick, 2002, 307–322, 311 n.10; Bilić 2016, 200.
[376] Theophr. *Caus. pl.* 4.
[377] Theophr. *Caus. pl.* 4.
[378] Pannekoek 1961, 107.
[379] Theophr. *Caus. pl.* 4.
[380] Σ Ar. Av. 997 = Philoch. FGrHist 328F122; Aelian, *Miscellany* 10.7; scholion to Aristophanes, *Birds* 997; Bowen - Goldstein 1988, 72–73; Franzoni 2002, 141–142; Hannah 2009, 56; García Quintela 2022.
[381] Hannah 2009, 5–7.
[382] Hannah 2009, 6.
[383] Pantazis - Lambrou 2018, 21.
[384] P. Tannery, *Recherches sur l'histoire de l'astronomie ancienne*, Paris 1983, 17-19 cited in Bowen – Goldstein 1988, 80.
[385] Ael. *VH* 10.7.
[386] Kourouniotes - Thompson 1932, 207–211; Franzoni 2002, 142.

From Itanos in Crete, a part of an authentic *heliotropion*, a solstice marker from antiquity, was preserved on a pillar with a 4th century B.C. inscription mentioning 'winter turnings' (τροπα[ὶ] χειμεριναί) and 'the turnings of the sun' (ὁ ἥλιος τρέπεται)[387]. The found inscription runs as follows: «Patron set this up for Zeus Epopsios. Winter solstice. Should anyone wish to know: off 'The little pig' and the stele the sun turns» [388] A rock formation standing out above the water there was called 'the little pig'[389]. Although the stone was not found *in situ* but as spolia, it can enhance our understanding of how a *heliotropion* worked. Federico Halbherr disregarded the idea of a gnomon, a pole to mark the hours with its shadow, as also evinced from the wide size of the stele of 0.23 cm wide, for 1 m long, even though a stick might have completed the device. It was more probably a target, which would have marked a direction with the standing rock in the sea[390]. That was the direction of the rising sun in midwinter, when it reached its southernmost rising position[391]. For Halbherr the stele marked the winter solstice time as the end of the navigation period, much needed in the context of an emporium location such as Itanos, on the east coast of Crete[392].

2.2.3 Oikoumene

Since the Archaic period, evidence of mapmakers of the inhabited earth, or *oikoumene,* is attested. It is possible to visualise the point of the solstices by the reference to a work by Ephorus of Cyme, Aeolia (c. 405 – 330 BC), where what is known as the 'Ephorus' parallelogram' is described (fig. 12)[393]. This evidence is transmitted by Cosmas Indicopleustes (4th century BC), and the same scheme is also cited by Strabo.[394] In his IVth book of the *History*, within a treatise entitled *On Europe*, Ephorus traced the boundaries of the known Earth, starting from a rectangular shape, naming the local inhabitants and the main wind for each region of the world with, in the centre, Greece or the Aegean [395]. On the four vertices, the horizon points of the solstices are alluded to: on the side of south, the winter rising and setting, and on the side of north, the summer rising and setting[396]. In the words of J. Oliver Thomson «[t]he horizon provided certain fixed points, like those where the sun rises and sets at solstices»[397]. In a similar fashion, Gerard Nadaff stated that not only do they indicate fixed points on the horizon, but also the boundaries of the inhabited world as perceived by the ancients[398].

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[387] Halbherr 1890, 585-586; Kirk – Raven 1957, 53; Isager - Skydsgaard 1992, 163; Bilić 2016, 205.
[388] IC IV.11 = Isager - Skydsgaard 1992, 163.
[389] Isager - Skydsgaard 1992, 163.
[390] Halbherr 1890, 586.
[391] Halbherr 1890, 586.
[392] Halbherr 1890, 586.
[393] Ballabriga 2010, 138–139; Bilić 2016, 196.
[394] Ephorus F30a = Strab. 1.2.28; Dilke 1985, 27, 171; Ballabriga 2010, 138-39; Roller 2015, 82.
[395] Dilke 1985, 27; Roller 2015, 82.
[396] Heidel 1976, 16–20; Dilke 1985, 27; Ballabriga 2010, 138–140; Roller 2015, 82.
[397] Thomson 2013, 97.
[398] Naddaf 2005, 110.

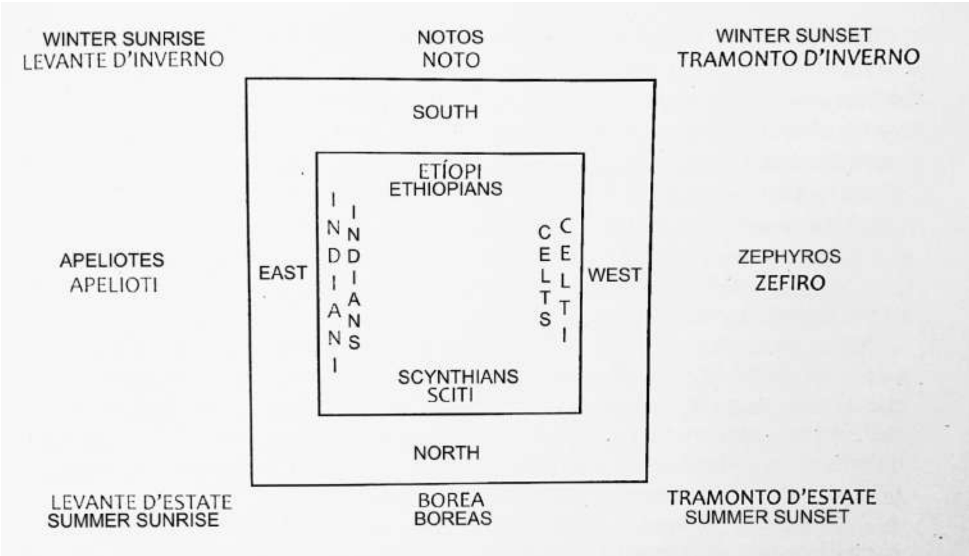

Figure 12. Ephorus' parallelogram. Adapted by the author from BALLABRIGA 1986, 139.

3. Theoretical and Ritual Aspects

3.1 The Greek World

The *apoikíai* (ἀποικίαι), or colonies for simplification, usually come into being after a foundation act[399]. An expedition of *ápoikoi* is conducted far from the motherland, with an *oikistés*, a founder in command. The names of few founders are known, apart from *Ois* for Sybaris, *Miskellos* for Croton, *Phalantos* for Tarentum, *Archias* for Syracuse, *Lamis* for Megara Hyblaea, *Anthiphemos* for Gela, etc[400]. The *oikistés* was considered a hero and had the privilege of being buried in the city agora[401]. In Greece, the Oracle of Delphi was directing the founding of colonies. Apollo Archegetes was the patron god of colonisation and the Oracle of Dephi the main adviser for founding colonies[402]. The poet Callimachus of Cyrene (c. 310–240 BC) in his *Hymn to Apollo* wrote:

> And Phoebus it is that men follow when they map out cities. For Phoebus himself doth weave their foundations. Four years of age was Phoebus when he framed his first foundations in fair Ortygia near the round lake. [403].

In the Temple of Apollo at Delphi, the sacred flame of *Hestia Pythomantis* was kept lit and a flame from it given to colonists to consecrate the founding of a new town[404]. The role of the Delphic oracular sanctuaries of Apollo in the phenomenon of establishing Greek colonies, or *ktisis,* was relevant for its religious aspects although the actual consultation is considered to postdate the factual foundation[405]. Cicero (106–43 BC) asked in a rhetorical manner: « what colony did Greece ever send into Aeolia, Ionia, Asia, Sicily, or Italy without consulting the Pythian or Dodonian oracle, or that of Jupiter Hammon? »[406].

The first literary example of the foundation of a Greek city dates back to the Odyssey, when Nausithoos founded Scheria[407]. Homer gave an indication of how a foundation might have happened by describing how «their king Nausithoos moved them thence and settled them in Scheria, far from all other people. He surrounded the city with a wall, built houses and temples, and divided the lands among his people»[408]. It is evident from Homer's testimony that the division of land, in terms of private and sacred spaces, as well as the construction of a wall were primary acts during a city's foundation. Fausto Longo stated that the assignation of rural allotments, the *kleroi*, was probably a point of contention among *ápoikoi*[409]. Land division was a fundamental part of the establishment of the *ápoikoi* in a new area as attested by the intriguing story recounted by Archilochus, in which a

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399 Greco 1997, 635.
400 Longo 2014, 231.
401 Hdt. 6.38; Pind. *Pyth.* V; Longo 2014, 231.
402 Graham 1964, 26; Detienne 2002.
403 Callim. *Hymn* 2.55, trans. A. W. and G. R. Mair 1921.
404 Partida 2020, 181.
405 Giangiulio 2012, 393; Longo 2014, 230.
406 Cic. *Div.* 1.3, trans. by W. A. Falconer 1923.
407 Hom. Od. 6.7; Marconi 1996, 755.
408 Hom. *Od.* 6.7-10, trans by S. Butler and revised by T. Power and G. Nagy.
409 Longo 2014, 232.

settler sold their future land allotment that «he had drawn by lot and was going to own» for a honey cake during the sea journey with Archias before the foundation of Syracuse[410].

The Greek city, *polis*, which describes both the community and the space it occupies, includes the settlement, *asty*, and the countryside, *chora*. In this context, Dieter Mertens traced the distinction between colonies with an agricultural scope in the search for fertile land, and colonies with a harbor and commercial potential[411]. The urban *apoikía* layout does not reflect that of motherland urbanism, as evident in the enormous dimensions of the *agorai,* the public squares[412]. According to Emanuele Greco, colonial urbanism is a distinct way of conceiving and dividing space, where a place's function is assigned to it from the foundation's beginning[413]. Orthogonal settlements were common designs in *apoikíai* planning in Archaic, Classical, and Hellenistic Greece. According to Ferdinando Castagnoli, «the use of an urban grid defines, upstream, the existence of the authorities' planning intentions; and for this reason, it is a common feature of foundation cities (as colonies, military camps and reconstructions)» [414] . Uniform and regular patterns allowed a convenient approach to land distribution. If, for some authors, a social and cultural change can be read in the morphology of the orthogonal grid, the hypothesis would lead to a binary automatism if not correctly analysed and as discussed by Graham J. Shipley[415]. For instance, Pierre Lévêque and Pierre Vidal-Naquet argued that there is a political reformation in Classical Athens with Kleisthenes but there is not a Kleisthenes' approach to urban planning: they distinguished between the equal land distribution, isomerism, and the political concept of isonomy between citizens[416]. On the other hand, Robin Osborne questioned what role democracy had had in Athens in shaping the urban space[417]. Inferring a political dimension from urban arrangements can be challenging and misleading. Wolfram Hoepfner and Ernst-Ludwig Schwandner Hoepfner persistently conceived of grid-planning as being projections of democracy and identified chequering and quadrangular shapes typical of Classical urbanism, naming them 'Hippodamian' and 'Pythagorean'[418]. In contrast, Davide Asheri argued that the morphological isometry of the quadrangular division of space is neither democratic nor tyrannical, but acts only as a means of functionalising individual urban spaces[419]. Therefore, beyond any political assumptions, structured planning was primarily a method of organising space and was especially so in the foundation of new towns.

In the academic literature, up to a few decades ago, it was common to name Hellenic grid-planning as 'Hippodamian'[420]. However, in recent years it has become clear that the historical figure

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[410] Archil. fr. 293 West = Ath. IV, 167d.
[411] MERTENS 2006.
[412] GRECO 1997, 635.
[413] GRECO 1995, 87; 1997, 635–640.
[414] CASTAGNOLI 1956b, 107; GIOVAGNORIO - CHIRI 2016, 42.
[415] SHIPLEY 2005, 335–337.
[416] LÉVÊQUE - VIDAL-NAQUET 1964.
[417] OSBORNE 2007b.
[418] HOEPFNER - SCHWANDNER 1994.
[419] ASHERI 1966, 13–16.
[420] SHIPLEY 2005, 337.

of Hippodamos of Miletus (5th cent. BC) is very complex, especially in understanding the exact nature of his innovative contributions to urbanism[421]. Emanuele Greco discussed the archaeological evidence, with respect to the Aristotelian tradition, where Hippodamos is described as an innovator[422]. In short, Hippodamos may have been the first to have described and conceptualised, in a treatise, political and spatial aspects of urban planning[423]. Most important for the present discussion is the description of Hippodamos as *meteorologos*, which Shipley translated as 'cosmologist' and then questioned whether «[c]urrent work on astronomical alignments in ancient Greek towns may confirm whether this, too, was an aspect of Hippodamos' work»[424]. Unfortunately, no systematic research on the archaeoastronomical orientation of Greek towns has been conducted yet. The contribution of other Milesian natural philosophers, such as Anaximander of Miletus, in connection with an aerial view and urban planning might be also considered relevant for understanding astronomical notions applied to urban design[425].

In the context of urbanism and astronomy can be placed this satirical description of how to lay out a radiant city in *The Birds* by Aristophanes (c. 448–385 BC). The Athenian astronomer Meton explains to Pisthetaerus how he would trace out an ideal city for the birds:

Meton:
I want to survey the plains of the air for you and to parcel them into lots.

Pisthetaerus:
In the name of the gods, who are you?

Meton:
Who am I? Meton, known throughout Greece and at Colonus.

Pisthetaerus:
What are these things?

Meton:
Tools for measuring the air. In truth, the spaces in the air have precisely the form of a furnace. With this bent ruler I draw a line from top to bottom; from one of its points I describe a circle with the compass. Do you understand?

Pisthetaerus:
Not in the least.

Meton:
With the straight ruler I set to work to inscribe a square within this circle; in its centre will be the market-place, into which all the straight streets will lead, converging to this centre like a star, which, although only orbicular, sends forth its rays in a straight line from all sides.

Pisthetaerus:

421 Greco 2018, 17–30.
422 Greco 2018, 97–105.
423 Greco 2018, 28.
424 Shipley 2005, 375.
425 Hahn 2001, 163–169.

A regular Thales! Meton...[426]

Such description of a circular layout has been challenging since there is no archaeological evidence of a city with such a shape. Though, as a potential Greek example, the city of Rhodes (founded c. 408 BC), was described as being «built in the form of a theatre»[427]. Parallels can be drawn with the Persian city of Ecbatana, recorded in the *Histories* by Herodotus of Halicarnassus, as having seven different coloured concentric walls, with the palace of the chief at the middle[428]. For Plato, the ideal state should be circular[429]: thus, a circular urban layout was described in the depiction of the island of Atlantis in the *Critias*[430]. Since Homer's mapping of the Earth as a shield[431], the circumference was the ideal representation of the cosmos[432], and the city a reflection of it. The city might have been understood as the place where earth and sky meet[433]. For Luigi Caliò, the city and the sanctuary can only assume their functions effectively when they are incorporated within a cosmic and natural order[434]. Fausto Longo and Teresa Tauro found in the passage from Aristophanes the principle of the 'golden ratio' done with square and compass and applied it to the urban layout of Neapolis[435]. The circle thus become a square, and the radial star converging towards the middle should be interpreted as orthogonal streets meeting at the agora[436]. Indeed, according to Caliò, the Greek city in the Classical period found its mythical foundation story in the mathematical model and rational thinking of *ratio* or *logos*[437].

Foundation rituals in Greek planning are mostly attested by the archaeological evidence. According to Caliò, a similar ritual of foundation to that of 'the stretching of the cord' might have been practised in Greece up until the Hellenistic period, much like that employed in Ptolemaic Egypt[438]. However, evidence for this statement is quite scant. Instead, in Greek Sicilian urban settlements, bases for quadrangular altars at crossroads have often been recovered. For instance, Grazia V. M. Spagnolo working at Gela found archaeological evidence of an urban grid at the site of the Stazione Vecchia locality: in a *platèia* near a *stenopòs* crossroad, she recovered a plastered altar base with votive statuette offerings on it[439]. At Hymera, altars with remnants of plaster were found at every crossroad; they were considered points of reference within the city design. At Naxos, these

[426] Ar. *Av*. 995–1010, trans. E. J. O'Neill 1938.
[427] Akkerman 2016, 96.
[428] Hdt. I, 98, 3-6.
[429] Saunders 1976, 23.
[430] Pl. *Criti.* 117 c–e.
[431] Hom. *Il.* 18.462–489.
[432] Hahn 2001, 169.
[433] Caliò 2020, 240.
[434] Caliò 2020, 240.
[435] Longo - Tauro 2017, 23–25.
[436] Longo - Tauro 2017, 23–25.
[437] Caliò 2020, 273.
[438] Caliò 2020, 236.
[439] See G.V.M. Spagnolo, "Recenti scavi nell'area della vecchia stazione di Gela", in *Quad. dell'Istituto di Archeol. della Fac. di Lett. dell'Università di Messin.* 6, 1991: 55–70.

bases were found at every road crossing, in a way that appeared to articulate an urban structured plan at every intersection between *platèiai* and *stenopòi*. The spatial position of these sacred structures is very specific with respect to the morphology of the cities. Moreover, the architectonic form of altar at crossroad can be understood in the context of a permeability between the sacred and the secular in ancient thoughts, having the role of both defining the secular grid but also sacred places of cult. More common are foundation rituals within temples. At Selinunte, in the temple R within the cella, Clemente Marconi found three iron spearheads which were remnants of spears planted blade-first into the ground, two of which crossed. The chronology of this stratum fits with the foundation date of the urban settlement in 628 BC. The archaeologist stated that these findings are a «votive offering to the warrior deity… also a clear symbol of appropriation of the new land by the first generation of colonists»[440]. In Kyme at the higher terrace temple, an iron spearhead was found, a possible and similar indication of a foundation ritual and land appropriation[441].

3.2 The Etruscan World

In the context of the Etruscan world, later Latin literary sources refer to the Etruscan divination as *Etrusca disciplina,* a fund of knowledge which was stored in the form of books, none of which are known directly[442]. Etruscan proprietary law was an important aspect of the *Etrusca disciplina*, and had a book to itself, known as the *liber iuris Terrae Etruriae*, or the 'book of the law of the land of Etruria'[443]. A very important part of Etruscan ideology seems to have focused on space limits and delimitation. This is explicit in the so-called Prophecy of Vegoia, a text preserved in the *Corpus Agrimensorum Romanorum*[444]. In this prophecy, borders and boundary stones are assumed divine and untouchable[445], so that «whosoever shall have touched and moved (a boundary stone), in the act of extending his own holding and diminishing that of another, will be condemned by the gods for this crime»[446]. For Joëll Le Gall, the prophecy of Vegoia was a pseudo-prophetic text used by the Etruscan aristocracy against Roman laws in the context of controversies over territorial boundaries, dated to the late 2nd cent. BC[447]. The foundation ritual of the city in pre-roman Italy is attributed to the Etruscans[448]. In the *Libri Rituales*, the actions of the ritual were, it would seem, described[449]. An urban foundation started with the *sulcus primigenius,* where the founders traced the perimeter of the city with a plough[450]. The anti-clockwise direction of the ritual might be associated with the movement of the stars in the northern sky. The constellation of the Big Dipper, or the Plough, was

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440 MARCONI - PUMO 2017, 5.
441 PALLONETTI 2018, 311.
442 DE GRUMMOND 2013, 342.
443 Serv. *A.* 1.1.2; FACCHETTI 2000, 46; BECKER 2013, 364.
444 DE GRUMMOND 2013, 542–546; DI FAZIO 2018, 158.
445 DI FAZIO 2018, 158.
446 L 350 = C 259.3–5; trans. CAMPBELL 2000.
447 LE GALL 1975, 308.
448 CAMPOREALE 2017, 69.
449 «Rituales nominantur Etruscorum libri, in quibus prescribtum est, quo ritu condantur urbes», Paul. Fest., 358-359L.
450 Cat., *Orig.*, fr. I 18 Peter ap. = Serv., *A.* 5.755; Ov. *Fast.* 4.819-826.

thought to plough the sky with its seven oxen around the fixed North Celestial Pole. However, evidence on this topic is quite scant.

As for archaeological *realia,* the Piacenza Liver is often mentioned as evidence for Etruscan space division. It must be pointed out that this is a complex and late record (3rd cent. BC), partly contaminated by Eastern and Roman doctrines, with theories and models beyond the original *Etrusca Disciplina*[451]. Adriano Maggiani has described how each part of the liver should be appreciated within the frame of reference of Etruscan haruspicy[452]. On the external band, the names of 16 divinities were inscribed, possibly in a significative correspondence with the 16 regions of the skies of Martianus Capella (5th cent. AD). For Massimo Pallottino, the liver was applied to land division and therefore was strictly oriented in both its shape and decoration, as well as oriented as a manual tool[453]. The Piacenza Liver has a both clockwise and anti-clockwise arrangement of the divinities when reading the inscriptions[454]. On this complex topic only an observation can be added: by looking at the movement of the sky, the celestial vault appears to rotate in a clockwise direction only if looking toward the south, and an anti-clockwise direction when looking north; correspondingly, in the Piacenza Liver, the southern divinities can be read clockwise, and the northern divinities in an anti-clockwise direction. Moreover, according to Giovanna Bagnasco Gianni, there are some allusions to the Etruscan quadripartition of the sacred space in graphic representations from the Orientalising period[455]. These allusions can be read in the iconographic motifs of the crux inscribed within a circle, which can be found in several objects from Etruria to Lazio, such as in the decoration of ollas from the Villanovan period onward in the area of Tarquinia[456]. Such ideogram (NYWT, *cross-in-circle*) might indicate the representation of a city[457].

In terms of the archaeological evidence available, one important example of an Etruscan planned city is Marzabotto, dating to the early 5th cent. BC. Guido A. Mansuelli reported that inscribed pebbles with a *decussis* oriented towards the cardinal points were found at several crossroads, and these can be interpreted as markers for the *groma*[458]. Mansuelli considered the urban grid to have been planned in an astronomical orientation[459]. After the studies of Antonio Gottarelli at Marzabotto, according to Giuseppe Sassatelli and Elisabetta Govi, the annual solar celebration of the town's foundation can be read in the acropolis disposition of altar D: the *auguratio* and *inauguratio* locations had two different functions and fate, with the former receiving a monumental structure, and the latter being buried under the planking level[460]. In this sacred geography, the line observed from

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[451] PALLOTTINO 1956 ; See also L.B. Van Der Meer, *The Bronze Liver of Piacenza. Analysis of a polytheistic structure*, Amsterdam 1987.
[452] MAGGIANI 2005, 56–59.
[453] PALLOTTINO 1956.
[454] PERNIGOTTI 2018, 190.
[455] BAGNASCO GIANNI 2019, 21–22.
[456] BAGNASCO GIANNI 2008; BAGNASCO GIANNI - GOBBI - SCOCCIMARRO 2015; BAGNASCO GIANNI 2018.
[457] BAGNASCO GIANNI 2018, 26.
[458] MANSUELLI 1972, 120–121; BARONIO 2017, 115.
[459] MANSUELLI 1972, 121.
[460] GOTTARELLI 2003; 2005; 2013; SASSATELLI - GOVI 2010, 36; BARONIO 2019, 432–435.

the *auguraculum* towards the local position of the sun rising in winter solstice, or within a month from winter solstice, «can be considered the first action performed at the beginning of the rite of foundation»[461]. The podium D in Marzabotto on the north-west side of the urban area, has a symmetrical monumental structure in the north-east[462]. Symmetrically to the acropolis, a further altar recovered on the north-east side of the settlement emphasises the organic design of the planning, according to Paola Desantis and Luigi Malnati, in relation to the summer solstice sunrise[463]. Marzabotto, with a foundation dating in the 5th cent. BC, was considered a *templa augurale*, as were Este and Rosselle in the 6th cent. BC[464]. Similarly, with reference to Felsina/Bologna, Sassatelli and Govi stated that «from the arx the eye could embrace the whole urban area, the necropolis and much of the chora (adjacent farmland); the arx is perfectly suited to the function of auguraculum, i.e. "ritual observatory", where the augur could conduct the rites of foundation in relation to a quadripartition oriented in space that transformed the city into a templum, according to the prescribed Etruscan discipline»[465]. Marzabotto, as it will be shown for Pompei, is a perfect example of the transposition of the sky and sun's course on earth, with the lines of the town set in accordance with the astral motion.

Mario Torelli defined *templum* as «the representation of the sky as abode of divinities and fundamental concept among Etruscan-Italic thought on the relationship between the celestial realm and sensible world»[466]. First of all, it is a «portion (of the sky)» as derived from Greek τέμενοζ, -*tem, «to cut», therefore a part of the sky for the *spectio*, the 'observation' performed by the augur[467]. As recounted by the sources, space had to be *effatus*, 'liberated' from hostile spirits with the *liberatio* rite, before the inauguration for the creation of a *templum* and boundaries (*fines*) by explicit formulas[468]. Torelli catalogued some *templa* suggesting a difference between their operating realm, being *templa in terris* or *templa sub terra*, yet both symbolically reflect the sky[469]. Among the ritual *templa in terris*, have been considered Este (6th cent. BC), Lavello (5th cent. BC), Cosa from the 3rd cent. BC, Bantia in the 1st cent. BC (fig. 13)[470]. These are rectangular spaces functional for taking the auspices by looking at birds[471]. According to Torelli, *templa sub terra*, underground reflection of the *templum in caelo*, can be identified at Bolsena and Caere with hypogeal quadrangular structures oriented with angles at the cardinal points[472]. This specific orientation with sides rotated through 45° in relation to commonly seen astronomical-cardinal orientation, with angles and not sides pointing in

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[461] SASSATELLI - GOVI 2010, 36; GOTTARELLI 2005, 123.
[462] DESANTIS - MALNATI 2009.
[463] DESANTIS - MALNATI 2009, 301–302.
[464] D'ALESSIO 2013, 320.
[465] SASSATELLI - GOVI 2013, 287.
[466] «rappresentazione del cielo in quanto sede delle divinità e concetto fondante della relazione che la mentalità etrusco-italica istituisce tra mondo celeste e realtà sensibile», TORELLI 2005, 341.
[467] TORELLI 2005, 341.
[468] Festus, *Gloss. Lat.*146; Liv. 1.18.5-10.
[469] TORELLI 2005.
[470] TORELLI 1966; D'ALESSIO 2013, 320.
[471] TORELLI 2005, 342–343.
[472] TORELLI 2005, 346–347.

the cardinal directions, is defined as 'chthonic' by Torelli[473]. The same orientation is shared by two angles of a rectangular structure found in a 6th century BC extra-urban sanctuary at Este, Meggiaro[474], but regarded as *templum in terris* by Torelli, yet with chthonic connotation as revealed by the presence in a nearby well with votive offerings related to initiation of young people[475]. These three structures are put in contrast to other basements interpreted as *templa in terris,* specifically those found at Roman Bantia, Lavello, and Cosa, which are positioned with their sides facing the cardinal points and, for Torelli, destined to the proper *auspicium*[476]. It can be argued that some determination of the nature of the cult based on the orientation of these structures should not be overlooked. Moreover, all orientations need to be checked again with a reasonable degree of accuracy. At Meggiaro, Este the quadrangular structure 7.5m x 5m has its main axis oriented 45°W from the North[477]. This data is in contrast with the structure having its diagonal axis oriented to the cardinal points, as this would coexist only if it was a quadrangular structure. For example, at Cosa the limestone basement (7.40m) cut into the bedrock is oriented 12° east of north[478], thus it cannot be regarded as having sides to the cardinal points. Torelli's distinction between a chthonic and astronomical orientation can be further subject to critique if considering the presence of the many cavities, pits, and wells, with material evidence of chthonic deposits pertinent to Torelli's type of 'astronomical orientation' *templa*. For instance, at Cosa a natural pit, with a regularised opening, stands nearby the limestone basement and placed with a similar orientation, even though the two structures seem destined to a different cosmological realm. The pit was on the central of the middle cella of the later Capitolium, and foundation deposits of burned vegetables were found[479]. The basement and the pit were obliterated but an altar in the forecourt reiterated the same orientation of them[480]. Similarly, at the arx of Marzabotto, the well within a quadrangular altar has the sides oriented to the cardinal points. For Torelli it is not clear which is the relationship between the *templum* and the *auguraculum* as defined by the source: for sure a partial correspondence is certain[481]. For Castagnoli, the *templum* should not be considered an inspiration for urbanism but more as an accidental co-occurrence[482]. The correspondence between the augural *templum in caelo* and the urban layout has been ascribed to the intellectual erudition of later sources, such as Varro[483]. Nevertheless, recent studies are attesting the strict relationship between the celestial *templum* and the urban layout, as shown by the case of Marzabotto or of Cosa for its centuriation, whose explanation follows.

473 TORELLI 2005, 341.
474 BALISTA - SAINATI - SALERNO 2002.
475 TORELLI 2005, 344.
476 TORELLI 2005, 344–346.
477 BALISTA - SAINATI - SALERNO 2002, 129.
478 MAGLI 2008b, 152.
479 TORELLI 2005, 345–346.
480 MAGLI 2008a, 152.
481 TORELLI 2005, 342.
482 CASTAGNOLI 1993, 232–233.
483 SOMMELLA 1988, 231.

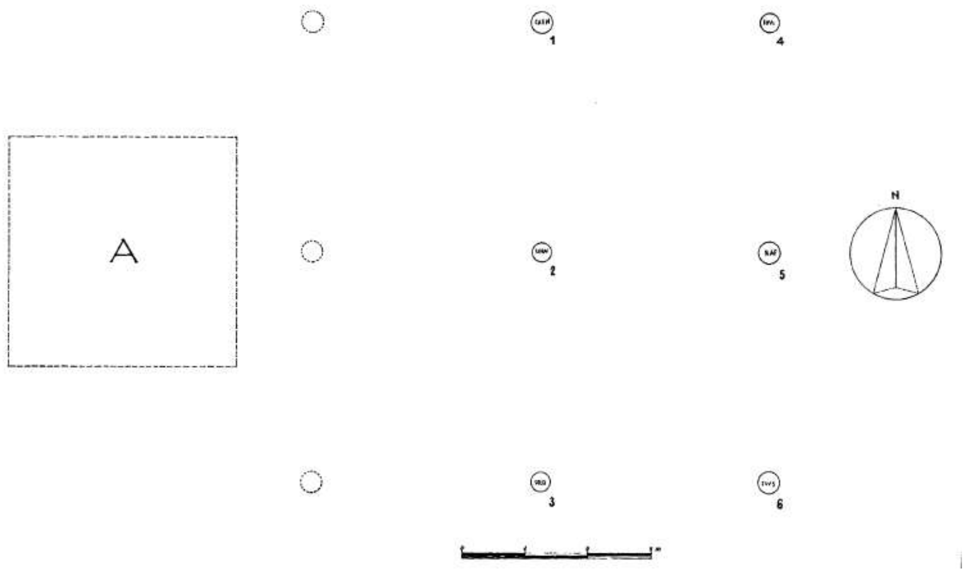

Figure 13. Reconstruction of the *templum augurale* at Bantia. After TORELLI 1966, 294.

In the Roman colony of Cosa founded in 273 BC, a square platform cut into the bed rock with dimensions of 7.4 m on each side, and corresponding to 25 Roman feet, was recovered in the *arx*, just below the Capitolium. It was interpreted as an open-air *auguraculum* by Frank Brown and colleagues, a *templum in terris* by Paolo Brocato, and generally named Cosa Quadrata when compared with Roma's foundation ritual[484]. Recently, Rabun Taylor conjectured that it might have been a small roofed temple dating to the first Roman colonisation of the area[485]. The dating of the platform is in the 3rd cent. BC. A crevasse with burned vegetables, interpreted as a *mundus* or ritual pit, was also excavated adjacent to the platform, at an axial orientation of azimuth 12°[486]. Brown *et al.* pointed out that «[t]hough centred upon the crevasse, the square was oriented neither to the cardinal points nor to the axes of the street plan of the town»[487]. They affirmed that «its orientation seems to have been a function of a field of vision delimited by significant natural features of the immediate horizon»[488]. The hill peak of Poggio dei Venti rises to the north-east of the main axis of the squared platform and crevasse, obstructing the view further, as well as topographical targets were identified to embrace the sight of the landscape from that observation point[489]. They suggested that the specific orientation might have been related to the region from which a *fulmen perpetuum* appeared at the town's foundation as a sign of Jupiter's benevolence[490]. And yet, the diagonals of the platform might suggest a more down-to-earth explanation. In particular, Brown *et al.* stated that the diagonals of the square

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[484] BROWN - RICHARDSON - RICHARDSON 1960, 9–19; BROCATO 2000, 271.
[485] TAYLOR 2002.
[486] BROWN - RICHARDSON - RICHARDSON 1960, 11.
[487] BROWN - RICHARDSON - RICHARDSON 1960, 13.
[488] BROWN - RICHARDSON - RICHARDSON 1960, 13.
[489] BROWN - RICHARDSON - RICHARDSON 1960, 13.
[490] BROWN - RICHARDSON - RICHARDSON 1960, 10.

platform reflected the direction of *decumani* and *cardi* of the territorial organisation of Cosa centuriation[491]. According to Castagnoli, the centuriation *decumani* are oriented 56° of azimuth after a theodolite measurement on site[492]. If the squared platform has its main axis oriented 12°, then its diagonal pointed at azimuth 57° (45° + 12°), and in clockwise succession at 147°, 237°, 327°. Thus, this orientation would indeed correspond with an error of 1° to the measured values of the centuriation of the *ager Cosanus* published by Castagnoli. The centuriation of the *ager* seems to have been set up concurrently at the time of foundation[493]. According to Elizabeth Fentress and Phil Perkins «the *kardo* of the centuriation was drawn from the north-east gate of Cosa sighting towards the mouth of the river Albegna»[494]. The river might have played a role in the orientation of the centuriation[495]. If the diagonals were extended southwest, the limit is the Mt. Argentario cape at 236°-237°. On the opposite side, the north-eastward diagonal at 56°–57° points towards Capalbiaccio according to Brown *et al.*, or better perhaps towards Poggio del Corno, 24 km distant from Cosa *arx*. In that direction of 56°-57°, the line of sight encounters the Eastern Height, which is also the eastern limit of the urban settlement, and the location of a 2nd cent. BC sacred building according to Rabun Taylor's study[496]. In that direction the sun would have risen at summer solstice given a flat horizon, with the summer solstice full moon setting on the opposite side just on the southern extremity of Argentario promontory (fig. 14). The orientation of the Cosa centuriation is reflected in the Saturnia and Heba centuriated landscape (fig. 15)[497]. According to Elizabeth Fentress, «[t]he common orientation in the survey of three of the four cities founded on the old territory of Vulci betrays a common project on a large scale, laid out over more than a century as the land was re-settled, for the original centuriation of Cosa dates probably from its foundation in 273 BC»[498]. She identified mountains that peak surveyors might have pointed at, as they «could give long sightings for the *kardo* and the *decumanus*» [499]. Above the *auguraculum*, a later Capitolium was built with a different orientation (75°az), with its main diagonal reflecting the orientation of the urban grid (40°az). The altar of the Capitolium has a different orientation from that the temple axis. However, it has been argued that the Capitolium altar reflected the orientation of the so-called *auguraculum*[500]. Similarly, Josep Maria Palet has shown that the *auguraculum* of Tarraco was probably used in a similar way to plan the land at Cosa: the *auguraculum* has indeed a specular orientation in respect to Cosa, a few degrees westward of North[501]. At Pollentia, the 'ediculo pollentino', also interpreted as functioning as an *auguraculum*, has the same orientation of N 9°30' W[502].

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491 CASTAGNOLI 1956a.
492 CASTAGNOLI 1956a, 149.
493 FENTRESS - PERKINS 2016, 387.
494 FENTRESS - PERKINS 2016, 387.
495 BROWN 1980, 9; RAMPAZZO 2011, 216; See also P. Tozzi, *Saggi di topografia storica*, Firenze 1974, 10.
496 TAYLOR 2002, 80.
497 FENTRESS 1996, 80.
498 FENTRESS 1996, 80.
499 FENTRESS 1996, 80.
500 TAYLOR 2002, 66; MOSER 2014b, 314.
501 PALET MARTÍNEZ - FIZ FERNÁNDEZ - ORENGO 2011, 642.
502 ORFILA PONS - CHÁVEZ ÁLVAREZ - SÁNCHEZ LÓPEZ 2014, 115.

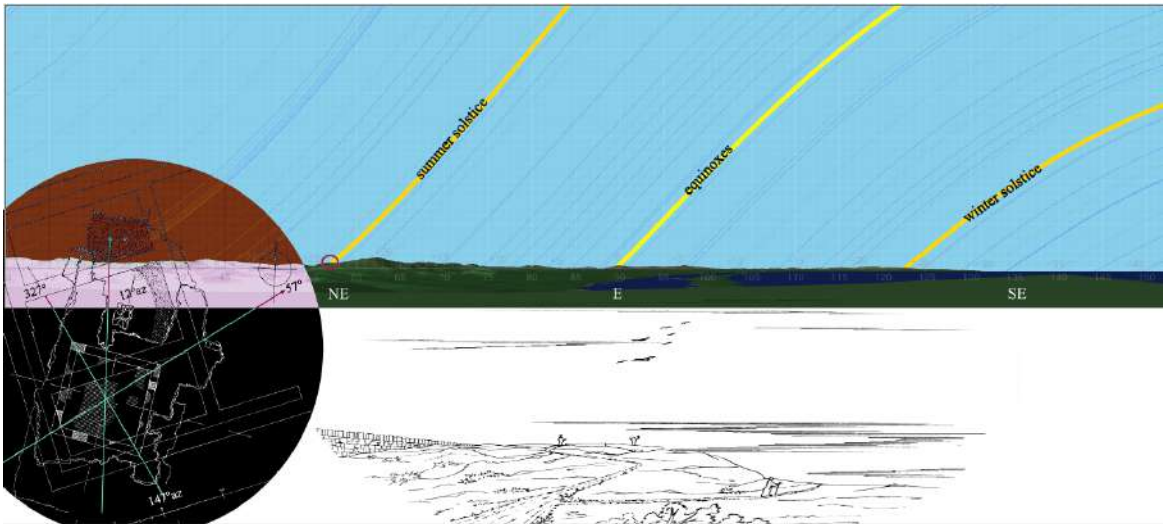

Figure 14. Cosa landscape in the direction of the diagonal of the *auguraculum* of the *arx* at 57° azimuth. This orientation reflects the *decumani* of the centuriation of the *ager*, as well as corresponding to the direction of the summer solstice sunrise in the 3rd cent. BC. Elaborated by the author with Horizon©SMITH 2022 combined with images from BROWN - RICHARDSON - RICHARDSON 1960, 12, 16.

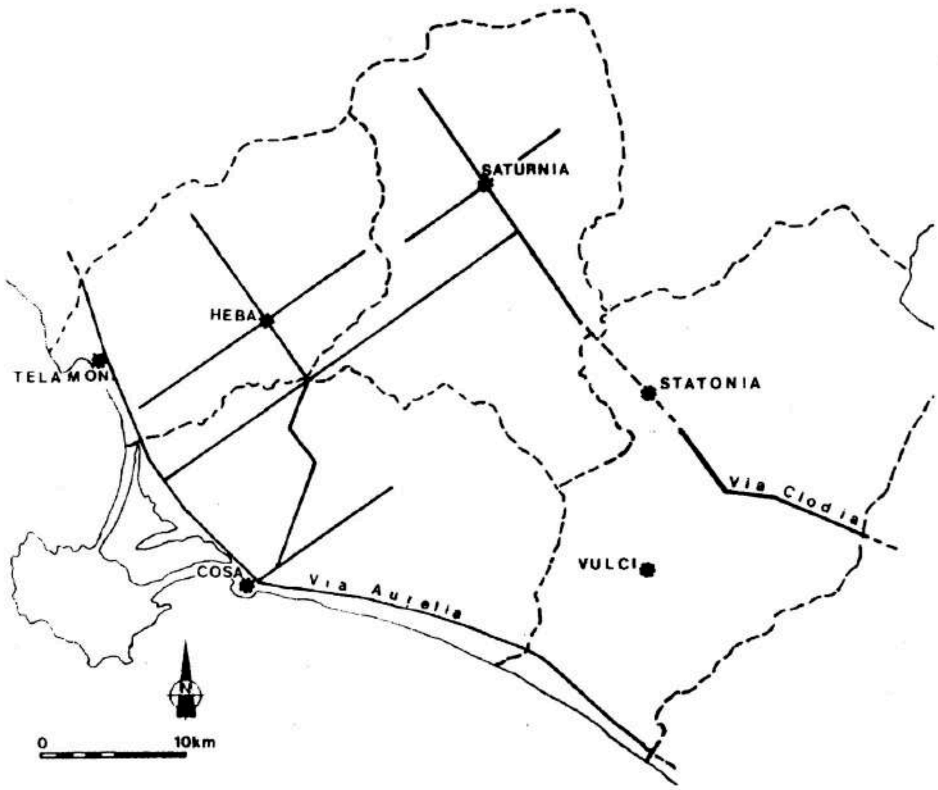

Figure 15. The centuriation of Cosa and surrounding territories. From Fentress 1996, 95.

Beyond the presence of the *auguraculum* and its possible relationship with centuriation, the example of Cosa represents a meeting point between the Etruscan and the first Roman agrimensor designs between the 4th and the 3rd cent. BC[503]. Rampazzo highlighted examples of continuity and discontinuity between the Etruscan system of land and urban division with respect to that of the later Roman colonies[504]. The Etruscan agrimensory was based on *per stringas* or *per scamna* rectangular design. In this aspect, it differs from the later Roman quadrangular centuriation and, instead reflects a Greek approach to land division during their colonial experiences. However, the typical Etruscan module of 1:2, corresponding to 300 x 600 feet, and which has no comparable examples in the Greek world, is found in the first Roman centuriation of Cosa (273 BC), which constitutes an important legacy of the Etruscan system to the Roman[505]. In the context of Campanian Etruria, the rectangular division, in some contexts, is based on non-orthogonal angles, comparable to the Metaponto *chora*[506]. This design is not present in the Po Valley Etruria, where oblique channels for water irrigation indicate isolated private arrangements and not a corporate design of land division.

[503] Rampazzo 2011, 215–217.
[504] Rampazzo 2011, 217.
[505] Rampazzo 2011, 215–217.
[506] Rampazzo 2011, 218–219.

3.3 The Roman World

3.3.1 CARDO AND DECUMANUS

A characteristic feature of Roman expansion was territorial organisation. The Roman organization of land is based upon the discipline of *gromatica*. In simple terms, this theory is realised through the systematic repetition and reproduction of a unity, the *centuria*, resulting in a modular grid, the centuriation[507]. To achieve such designs over large areas, several instruments were used. Orientation was carried out with poles (*spectiones et metationes*), squares (*quadrationes*), and triangulation (*triangulationes*) to check the right angles with Pythagorean triples[508]. Such organisation and division of space is physically visible in the landscape in the form of agricultural plots, roads, or canals[509]. The discipline of *gromatica* has been transmitted down the ages through the written *corpus* of the *Gromatici Veteres*, but whose interpretation is problematic given the complex stratigraphy in the transmission of the manuscripts and the very technical terms used. The agrimensor writers were active from the Imperial period onwards, and the original theory of space division may date back six centuries at least[510].

Most authors believe that Etruscan approach to the division of the sky predates and informs Roman land surveying practice. The astronomical competence of agrimensores, and at least of the *Gromatici* writers, have been emphasised by scholars, for instance by Aldo Luigi Prosdocimi and Libera Alexandratos[511]. It is probable that the Roman agrimensores were experts on the projection of the celestial vault on the ground and in applied geometry. Such interests may be demonstrated in the house of Orion at Pompei, where astronomical myths are illustrated in the mosaic decoration in the house of an agrimensor[512]. According to Rosada, Roman agrimensor texts citing the origin of land division from within the Etruscan culture might be interpreted as these agrimensores' way of giving value and legitimating their work by implying they are acting in accordance with divine laws[513]. However, Le Gall suggested that the *corpus* is mainly secular in character[514]. Moreover, Le Gall and Haverfield affirmed that the *Gromatici Veteres* dealt with territorial organisation and centuriation, not with town planning, and that, within the Roman world, there are no literary sources on the topic of city design[515]. Also, the use of the terms *decumanus* and *cardo* should be used only for countryside plots[516]. According to Lucia Monaco, the *Gromatici Veteres* are a mediation between theory and

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507 MONACO 2004, 52.
508 CATALDI 2004a, 24–25.
509 LE GALL 1975, 301.
510 PROSDOCIMI 2009, 719.
511 PROSDOCIMI 2009, 724–726; ALEXANDRATOS 2009.
512 OSANNA - MAGLI - FERRO 2019; FERRO - MAGLI - OSANNA 2020.
513 ROSADA 1991, 92.
514 LE GALL 1975, 308.
515 LE GALL 1975; HAVERFIELD 1913.
516 SOMMELLA 1988, 234–235; in this thesis the use of the terms *decumanus* and *cardo* have been avoided for urban axes when possible, but by times adopted when the tradition of studies on a site has accepted this terminology.

practice, between the distinct pulls of applied geometry and practical considerations, that is the *natura loci* proper of a place[517]. For Aldo Luigi Prosdocimi, there is a diachronic estrangement in the *Gromatici* writing in their relationship with fundamental principles of the discipline, sometimes resulting in misunderstandings and rejections of them[518]. This may be evident in the dichotomy between *cardo* and *decumanus* and their temporal sequence of sketching them on ground[519].

The Roman partition of space was based upon using two perpendicular lines, the *deci/umanus* and the *k/cardo*[520]. For Prosdocimi, the *decumanus* line is anterior to the *cardo* for a series of reasons[521]. This is indeed the direction of the *auspicium* in the theological and cosmological sense, in that the celestial division of space was anterior to the terrestrial one[522]. The line *ab oriente ad occasum* was thus later called *decumanus/decimanus* after the introduction of the *groma* and its relationship orthogonally with the *kardo ex transverso currens*[523]. According to Prosdocimi's theory, the etymology of line *k/cardo* refers to 'to cut' from Latin *caro/carnis*, since it was meant to cut the *decumanus*[524]. Prosdocimi emphasised how from an initial, independent, pre-gromatic bipartition of space followed a quadripartition of it[525]. The *kardo* and the *decumanus* ideally met perpendicularly in the *ombelicus*, forming a «X» or «+». Therefore, these symbols indicate the quadripartition of space, but they also correspond to the Latin and Etruscan numeral for ten, *decem*[526]. The sign «X» or «+» was thus a pseudo-logograph for *decem*, ten, from which the term *decumanus/decimanus* derived[527]. The derivation of decumanus from ten is asserted in Festus and Isidore of Seville[528]. Prosdocimi asserted the groma is the condition necessary for the marking of the *cardo*[529]. However, this sounds like a huge statement if right angles drawing is the technique required for this scope.

Moreover, Prosdocimi considered a misleading etymology for the cosmological foundation for the *cardo*[530], being associated with the hinge of the world, the ideal line around which the celestial sphere spins, visible in the celestial pole if looking north at night, as only developed at a later stage of the discipline. Nevertheless, the priority of the *decumanus* is also evident in Vitruvius' method[531]. It is also factually more plausible when considering that such activities of land division were carried out in the light of the sun, and not during the night. In the past, the celestial pole did not correspond exactly to a bright star, as it might appear nowadays, and the nocturnal measurement of the north-

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517 Monaco 2002, 91.
518 Prosdocimi 2009, 719.
519 Prosdocimi 2009, 719.
520 Prosdocimi 2009, 717.
521 Prosdocimi 2009, 717.
522 Prosdocimi 2009, 717–718.
523 Prosdocimi 2009, 718.
524 Prosdocimi 2009, 718.
525 Prosdocimi 2009, 718; 724; 727.
526 Prosdocimi 2009, 718.
527 Prosdocimi - Marinetti 2012, p. 12; *Contra* E. Gabba, "Per un'interpretazione storica della centuriazione romana", in *Athenaeum* 73, 1985: 265–284, 268.
528 Festus, *Gloss. Lat.* 182; Isid. *Etym*. 15.14.
529 Prosdocimi 2009, 719.
530 Prosdocimi 2009, 719.
531 Vitr. *De arch*. 1.6.6-7; Procl. *Hypotyp*. 3.23–24; Hyg. Grom. *Const*. 188.14–189.15 L=148.26–150.2 C.

south line would have been much more complex, even if ancient Egyptian surveyors might have applied it previously. Eventually, the constellation of the Southern Cross, or *Crux*, would have been considered important as the south marker due to its rough vicinity to the south pole until its disappearance from the northern skies in the 8th cent. BC[532]. Most importantly, the sun casts shadows, whereas stars do not. The only inherent astronomical indication for determination of the southern direction is the culmination of the sun and the minimum length of its shadow, as well as the culmination of other celestial bodies: culmination is not an astronomical event that is easy to measure with precision[533]. The sixth hour was indeed the best hour to set the meridian line, the south-north line, as Hyginus advised[534]. As an alternative to this method[535], it was possible to use a vertical gnomon, drawing a circle around it and marking the shadow entering the circle and exiting it, to determine the exact east-west direction independently from the season[536]. Such practice requires level soil, or even a liquid platform, to achieve the best result. In an obscure passage, Prosdocimi supposed that the measurement of the south-north line through observing gnomonic shadows would cause divergent lines, but this is impossible, given the significant distance of the sun or stars from Earth[537]. Astronomical targets have the advantage of not causing parallax errors if measurements are carried out synchronously, even when different points are several metres away from each other. Finally, Prosdocimi noticed a very significant point: if the *decumanus* line is always *ab oriente ad occasum (occidentem)*, the cardo line is *a meridiano in septentrionem*, even though it is the north pole and the cosmological reference system of the *cardo*[538]. Le Gall noticed, in a passage from Hyginus, that, there, the *kardo* is regarded as the direction of the shadow that indicates the six hours, and, thus, is the meridian line[539]. The astronomical meaning of the sentence *ab oriente ad occasum* is further scrutinised by Prosdocimi[540]. He pointed out, correctly, that the position of the observer is on the same line connecting sunrise and sunset only two times a year, that is at the equinoxes[541]. Of course, this is an ideal theoretical speculation, as if the mountains and local skyline features were nullified in a zero-horizon landscape, and without considering the different definitions of equinoxes as explored in Chapter Two, section 2.1.3. Nevertheless, it poses an interesting question as to the real significance of the sentence.

In a later stage, the *cardo* became assumed to be the fundamental line for cosmological reasons[542]. In this regard, the testimony from Pliny put emphasis on the *cardo* as the original line[543]. For Isidore of Seville (5th cent. AD), the *cardo, qui a septentrione directus a cardine caeli est* fully

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532 Cristofaro 2021.
533 So-called ‘approximate method’ in Malville 2008, p. 42.
534 Rosada 1991, 89; Hyg. Grom. *Const.* 188.14-17 L =148.26-28.
535 Already described in detail in the section 2.1.2 ‘Gnomon: Finding Cardinal Directions’, Chapter Two.
536 Malville 2008, 43–44.
537 Prosdocimi 2009, 726.
538 Prosdocimi 2009, 724.
539 Le Gall 1975, 304.
540 Prosdocimi 2009, 725.
541 Prosdocimi 2009, 725.
542 Prosdocimi 2009, 719.
543 Plin., *HN* 18.76-77.

expressed this ideology[544]. Such inversion was reflected in the orientation, with the *cardo* running from east to west, and the *decumanus* from north to south. The cosmological justification is the location of the sun in the southern realm[545]. In Prosdocimi's words, the compounding of ideologies produced «the inversion of the importance/priority between the *decumanus* and the *cardo*, until the cosmic references were inverted»[546]. Cases of reverse centuriation, such as in the *ager campanus*, were present in other parts of southern Italy, such as at Cosentia, Vibo Valentia, Campetia, and Benevento[547]. For Hyginus, such territories were not socially or economically disadvantaged in any way by the reverse centuriation. According to Rosada, such inversion, which reflects the maximum deviation possible, is so hyperbolic as to nullify itself, by returning, factually, to the normal cardinal arrangement[548]. Prosdocimi suggested that the issue of having a translating but parallel *ab oriente ad occasum* line across seasons might have caused agrimensores to opt for the *cardo* as the fundamental line, being fixed all year-long[549]. According to Prosdocimi, seasonality could determine a change of position of the east-west line both in the sky and on earth[550]. On the contrary, though, the *cardo* is a fixed line[551].

Much recent research has pointed out a correlation between the orientation of the *decumanus* and the turning point positions on the horizon of the sun. Some scholars statistically plotted the main roads of the urban settlements. Gaetano Vinaccia produced a polar diagram of the orientation of Roman cities, emphasising a deviation of the urban *cardo* of around 30° from the meridian[552]. Other authors identified the tendency of the urban *cardo* of Roman urban grids to not deviate from the meridian by more than 30°[553]. According to Gaston Bardet, the cause of such oscillation can be the 'real east', to be understood as the visible position of the rising sun varying with seasons[554]. César A. González-García and Giulio Magli concluded their study of the orientation of Roman towns by saying that «any global statistical analysis is anyway doomed to failure, while special cases – specific towns or small group of towns – can yet reveal interesting clues about the symbolic world and way of thinking of the Romans»[555]. This has been tested for the Campanian cities. In the case of Pompei and Herculaneum, it was calculated that the orientation of the azimuth corresponded to the direction of summer solstice sunrise/winter solstice sunset. Silvia Sclavi *et al.* found a similar solstitial orientation

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[544] PROSDOCIMI 2009, 729; Isid. *Etym*. 15.14.
[545] PROSDOCIMI 2009, 719.
[546] «l'inversione di importanza/priorità tra *decumanus* e *cardo* fino a invertire i riferimenti cosmici» PROSDOCIMI 2009, 720.
[547] LE GALL 1975, 305.
[548] ROSADA 1991, 91.
[549] PROSDOCIMI 2009, 725.
[550] PROSDOCIMI 2009, 725.
[551] PROSDOCIMI 2009, 725.
[552] VINACCIA 1939b; BARDET 1945, 203.
[553] BARDET 1945; OLGYAY 2015, 54.
[554] BARDET 1945, 203.
[555] GONZÁLEZ-GARCÍA - MAGLI 2015.

of the urban *decumanus* in ancient Ostia, founded at the beginning of the 4th cent BC, which is considered the first Roman colony[556].

3.3.2 *ROMAN FOUNDATION RITUAL*

The model for Roman urban planning was the mythical foundation of *Roma quadrata romulea*[557]. Romolo A. Staccioli stated that the only evidence for considering the *cardo* and *decumanus* to be part of the Etruscan ritual of foundation comes from the *Roma quadrata*[558]. The prototype was a square divided by a crossroad in the middle, enclosed within a wall with four doors placed symmetrically in the middle of each side[559]. Elio De Magistris concludes his analysis by stating that *Roma quadrata* is the embodiment of the unity of space and time in Roman society, so that the foundation act occurs in an urban public space with an acknowledgement of the apparent motion of the sun[560]. It is not clear, however, where the *auguraculum* in Rome was[561]. To Coarelli, the axis of the *spectio* follows the *Sacra via*, cutting through the city and targeting *mons Albanus* from a north-west to a south-east direction[562]. Recently, González-García and colleagues emphasised the role of the winter solstice in relation to Rome's Republican forum[563]. According to Giancarlo Cataldi, the *mundus* was the centre of the foundation ritual, representing the connective axis between earth, sky, and underworld[564]. The first to use the concept of *mundus* in connection with foundation rituals was Plutarch in respect to Rome's *etrusco ritu*. It differs from the *mundus Cereris*, as the latter has not connection with foundation rituals[565]. The *sulcus primigenius* for the sacral foundation of Rome, the *urbs*, was configured as circular, as an *orbis*[566]. The direction of the *sulcus* was anti-clockwise[567], reminiscent of the anti-clock rotation of the heavens when observing towards the north[568]. According to Cataldi, a pole fixed on the *mundus* was the centre of the *circulus*, marked by a cord rotating around the pole[569]. The delimitation line was the *pomoerium*, the sacred and inviolable division between the urban and the extra-urban territory. A defensive area might have encircled the walls, a moat (*vallum*) and an embankment (*agger*). The colonnaded forum was placed in the middle of the urban space, along with the main public buildings. Around the forum, the urban space was divided into *insulae* with private *domus* for residency. Rome's foundation was the model for the future actions of colonial establishment[570].

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556 SCLAVI ET AL. 2016, 264.
557 CATALDI 2004a, 25.
558 STACCIOLI 1968.
559 CATALDI 2004a, 25.
560 DE MAGISTRIS 2007, 2006.
561 COARELLI 1983b; ARATA 2010.
562 RICHARDSON 1978; COARELLI 1983b; DE CAZANOVE 2005.
563 GONZÁLEZ-GARCÍA ET AL. 2022.
564 CATALDI 2004a, 15.
565 ROSE 1931, 121–132; BENDLIN 2002, 54–55.
566 PROSDOCIMI 2009, 727.
567 D'ALESSIO 2013, 318.
568 For instance, in Oscan Pompei the 12 towers were numbered anti-clockwise starting from the Triangular Forum.
569 CATALDI 2004a, 15.
570 ECKSTEIN 1979, 87–88; Dion. Hal. *Ant. Rom.* 1.88.2.

Roman colonies did celebrate a day of the year as a foundation day[571]. However, during the long ritual and the political actions of founding a colony, the process might have taken many days, and Arthur M. Eckstein questioned which action corresponded to the actual foundation day of colonies to be remembered as an anniversary[572]. The orthodox interpretation was inferred by Theodor Mommsen, for whom it corresponded to the day of the *lustrum,* that is the purification of the inhabitants after the first census and the assigning of land plots[573]. Mommsen's hypothesis derives from Cicero though, according to Eckstein, the passage was misinterpreted and colonies did not celebrate the *lustrum*. The passage from Cicero states that «when the sacred ceremony of purification was held by one starting on an expedition to found a colony, or when the commander-in-chief was reviewing his army, or the censor was taking his census, it was the rule to choose men with names of good omen to lead the victims»[574]. For Eckstein, the assumption by Mommsen that the *lustrum* followed a census is baseless, since it is not mentioned when or where the *lustrum* might have taken place. Moreover, making a comparison with other *lustra*, such as the military *lustrum*, Eckstein suggested that the colonial *lustrum* might have happened before the colonists' departure from Rome in military formation *sub vexillo*[575]. And yet, Edward Togo Salmon argued that the official day corresponded to the setting away of the *groma*, when the *forma* and the *lex colonia* were exposed in the forum[576]. To answer «which act technically constituted the 'birth' of a city or a temple?», Linderski did not have much doubt[577]. Similarly to Rome, «[a] Roman colony celebrated its natalis on the real anniversary of its foundation; for most cities in Italy, including Rome, this was a fictitious anniversary of a legendary foundation»[578]. In both cases suggested by Mommsen and Salmon, the *natalis dies* happened after land division and the definition of spaces, almost at the end of the process of foundation, whereas for Eckstein it happened at the very beginning[579]. Agrimensores might have been on site before the arrival of the colonials[580]. Eckstein stated that the reading of the sources suggested «[t]he foundation day, rather, commemorated the day on which the boundaries of the original colonial town-site had been marked out and established – marked out and established by the ritual ploughing of a furrow around the town-site according to the archaic prescriptions of the *Etrusca disciplina*, immediately after sacrifices and the taking of auspices had been performed at the site»[581]. Such an idea can be supported by comparing it with the ritual founding of Rome by Romulus and its anniversary at the Paralia, where the ritual actions preceded the physical building and establishment

[571] ECKSTEIN 1979, 85.
[572] ECKSTEIN 1979.
[573] See T. Mommsen, *Römisches Staatsrecht*, Vol. 2.1, Leipzig 1887 cited in ECKSTEIN 1979, 85.
[574] «in lustranda colonia ab eo, qui eam deduceret, et cum imperator exercitum, censor populum lustraret, bonis nominibus qui hostias ducerent eligebantur» Cic. *Div.* 1.102.8-11, trans W. A. Falconer 1923.
[575] ECKSTEIN 1979, 91–92.
[576] SALMON 1969, 26.
[577] LINDERSKI 1983, 229.
[578] LINDERSKI 1983, 230.
[579] ECKSTEIN 1979, 86.
[580] SPARAVIGNA 2020b.
[581] ECKSTEIN 1979, 86.

of the town[582]. According to Jerzy Linderski, following Eckstein, this 'foundation' day corresponded to the *sulcus primigenius* ritual act[583]. The colonials, after arriving from Rome at the site, traced the *sulcus* by demarcating the perimeter and «ritually plowed a sacred furrow around the proposed colonial town-site»[584]. According to Linderski, «[t]his legendary act was in historical times repeated time and again at the foundation of Roman colonies»[585]. Adding to Eckstein's hypothesis, Gianfranco Tibiletti considered that the day of the ritual act of ploughing corresponded to the marking of the first *decumanus*[586].

The story of Rome born as sacred time. According to Plutarch, Rome was founded on a day in which occurred «a conjunction of the sun and the moon, with an eclipse». The conception of Romulus was, also, traditionally marked by a celestial event: a total solar eclipse. This occurrence is said to have corresponded with the first day of the first year of the first Numan Cycle (extending over 24 years), and was later celebrated at the festivity called *Feriae Martis*[587]. Plutarch stated that it was on the thirteenth day of the month, thus a full moon; consequently, it must have been an eclipse of the moon not of the sun[588]. In Rome, the *dies natalis* was on 21st April, at the *Paralia* festival[589]; thus, the derived etymology of the verb *pario*, 'to be born', should not signify a frame of reference only to the capital[590]. In this context, roman colonies, especially those within the Eastern side of the Empire, depicted the zodiacal sign associated with their foundation *dies natalis* on their coinage design type[591]. The beginning of time in Roman reckoning corresponds to the foundation of the city. According to this evidence, a linear conception of time starting *ab urbe condita*, with an arrow of time oriented and irreversible, can be inferred. Time and history both started with the foundation of town, so that Gianluca De Sanctis named Roman cosmology as an 'urbigony'[592]. In his *De Divinatione*, Cicero criticised the belief in the astrological foundation of Rome: «does it also follow that the stars could have had any influence over the bricks and cement of which the city was built? »[593]. On many other occasions, there is evidence to suggest that the birthday of a colony was celebrated as a *natalis urbis*[594]. At Patavium, Linderski interpreted inscriptions with the notation N as signifying *natalis die*, to «commemorate events that took place on the very dies natalis of Patavium»[595]. Related celebratory events included *ludi* and theatrical performances, taking place on the anniversary of the city's birth[596].

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[582] Eckstein 1979, 87.
[583] Linderski 1983; Eckstein 1979.
[584] Eckstein 1979.
[585] Linderski 1983, 230.
[586] See G. Tibiletti, "La struttura topografica antica di Pavia", in L. Canepari - A. Peroni - G. Testa (ed. by), *Atti del Convegno di studio sul centro storico di Pavia, Pavia 4-5 luglio 1964*, Pavia 1968.
[587] Magini 2003, 107–108.
[588] Plut *Rom*. 12.2
[589] Dion. Hal. *Ant. Rom.* 1.88.2.
[590] Linderski 1983, 229.
[591] Caliò 2020, 241; See F. Cumont, *Lo Zodiaco*, Milano 2012, 19-20.
[592] De Sanctis 2012.
[593] Cic. *Div.* 2, 98-99, trans. W. A. Falconer 1923.
[594] Linderski 1983, 228; Cic. *Att.* 4.1.4.
[595] Linderski 1983, 231.
[596] Linderski 1983, 232.

Setting to one aside Linderski's extensive perceptions of the past, the *natalis urbis* might well have been remembered and celebrated in some way or other. For colonies set up in existing cities, the re-foundation ritual might have differed in some respects. In Carl Olof Thulin, except for the building of walls, the ritual was almost the same as that in virgin-soil colonies[597]. The evidence on the topic is very scant. Eckstein took as evidence the presence of the *aratrum* on colonies' coins, both from virgin sites and existing settlements, as a proof of founding ritual action with a plough[598]. He suggested that «one cannot exclude the possibility that some version of the *aratrum* ceremony was performed even for *coloniae* placed in already existing communities»[599]. A passage from Cicero, accusing Anthony of having re-founded the existing *colonia Casilinum*, mentioned the plough as well *ut aratrum circumduceres*[600]. In summary, there is consistent evidence of the application of ritual and sacred actions as part of the norm of Roman town foundation. There, the circling of the *aratrum* recalls the anti-clock movement of the circumpolar stars, as evident in the Latin term for indicating the Big Dipper asterism and its seven circumpolar stars, *septem triones*, the seven oxen ploughing the sky, indeed also known as 'the Plough' in the English-spoken world.

[597] THULIN 1909, 3–7.
[598] ECKSTEIN 1979, 19.
[599] ECKSTEIN 1979, 19.
[600] Cic. *Phil*. 2.102-103.

4. Factors Determining Orientations

The freedom of choice on orientation, for temples, cities, or land plots, should be considered in direct, but not strict, correlation to the function of the built environment. While, for temples, it is possible to assume a greater range of choices in terms of orientation[601], for cities, the freedom is restricted by more practical considerations, as well as wider land division issues. Such considerations should not strictly relate to the function of the area: for instance, temples built within an urban grid can have a limited space afforded to them by existing streets; whereas, cities and land division could be placed ritually or cardinally *secundum caelum* when the physical terrain allowed it. As Strabo affirmed, «neither builder nor architect could build house or city properly and as it ought to be, unless acquainted with the *climax* of the place, its position in respect to celestial appearances, its shape, magnitude, degree of heat and cold, and similar facts»[602]. The scope of land and urban division was to prepare the soil for structural foundations and for agriculture and, thus also, consideration of issues of water management, wind direction, and solar irradiation was necessary[603]. It would be too easy to argue that «[a]lthough the application of a grid structure can be ascribed to different purposes (political, religious, military, etc.), most scholars agree on both the importance of its orientation and how the orientation is strongly related to astronomical issues: in particular, to the sun's path and the winds' main directions»[604]. The setting of a structure can be constrained by a collection of factors, in a compromise between the planned layout and the practical conditions in the field. Beyond the considerations on astronomy and meteorology, such factors include: adaptability to geomorphological conditions, necessities related to the supply of water and communication viability, inter-visibility between specific parts of a territory, the adaptation of a theoretical plan to the actual situation[605]. According to Le Gall, there are nine ways of orienting *limites secundum naturae,* at least with regard to the territorial centuriation, which include: the greatest dimension of the territory, to seacoast, to mountain slope, to an extra-urban road, to differentiate one centuriation from another[606]. For the *secundum caelum* orientation, Le Gall mentioned four modalities: the position of the rising sun or to the relationship to the cardinal directions, and by reversing the position of *cardines* and *decumani* with respect to the previous two just mentioned[607]. Concerns on land division according to cardinal directions were stated by Hyginus[608]. Due to the fact that the *decumanus* followed the course of the sun, the east and west directions were subject to changes. For Cataldi, in the planning, the celestial grid *secundum caelum* was rotated to adapt and fit into morphological conditions, such as coast lines, ridges, rivers, hillsides and so on[609]. Moreover, Cataldi stated that the angle of rotation

601 Coulton 1975, 60.
602 Strab. 2.5.1.
603 Rosada 1991, 92.
604 Giovagnorio - Chiri 2016, 42–43.
605 Zanker 2013; Ward-Perkins 1974, 40.
606 Le Gall 1975, 306.
607 Le Gall 1975, 306.
608 Hyg. Grom., *Cost. Lim.*, 166 L = 134 C.
609 Cataldi 2004a, 21.

was implicit in the sacral act of foundation, with the intention of imposing human will upon nature[610]. However, Paolo Sommella affirmed that the practicalities of topographical conditions rose above ideological ones: «most of the urban orientation are based upon oro-hydrographic and climatic factors, not according to the cardinal points and, therefore, not subjected to the ideal conditioning of obliged alignments *ad caeli regionum directiones*»[611]. In this context, the analysis must deepen into that thin liminal separation between sacredness and functionality, which should be explored without falling into anachronistic distinctions. Sommella's statement confirms the suspicion that the common underlying assumption is to regard the regions of the sky as just related to cardinal directions. However, a better knowledge of the apparent movements of the main celestial bodies, the sun, moon, brightest stars, and the Milky Way, would open up a different scenario. Each direction is potentially astronomical: the question is to determine whether this was the intentional in matters of an urban orientation.

In summary, city planning is a question of the negotiation between variant factors. If, for urban settlements, these factors had to be all negotiated between to provide a healthy lifestyle for the city, temples might have answered to a more ideological, political, identarian necessity, directing sacredness and memory towards precise point of reference[612]. Therefore, problems arose in determining the prevailing factor of constraint with urban and temple orientation. As Horace Bushnell stated, «where the prevailing breeze of summer requires the streets to quarter in one line of diagonal, and the sun in another, the conflict can be settled only by compromise, or by sacrificing one advantage to the other»[613]. In the present study, the astronomical factor was mainly explored as a possible cause or prompt of orientation decisions. Indeed, the paleosurface nature of a site and the slope of the ancient terrain would seem to necessitate accurate and specialised studies with ground analysis coring and stratigraphical excavations[614]. In particular, the geomorphological conditions of the Campanian plain were preliminarily studied by Marina Monaco in her doctoral thesis, with a specific study in the variations on altitude and soil composition in the area[615]. All factors of orientation data may be compared in the future with a Bayesian statistic to discern what was the main orientation constraint[616].

4.1 Secundum Naturae

Ancient Campania extended from Mt. Tifata to the Sorrentine peninsula, with Mt. Somma-Vesuvius being an element of discontinuity in the middle, fostering elements of differentiation in the cultural and linguistic characterisation of human groups[617]. The rivers Volturno, *Clanis*, and Sarno cut through

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[610] CATALDI 2004a, 22.
[611] «si giustifica in tal modo la massima parte degli orientamenti urbani basati su fattori oroidrografici e climatici non coordinati ai punti cardinali e dunque non soggetti al condizionamento ideale di allineamenti obbliganti i sistemi stradali *ad caeli regionum directiones*» SOMMELLA 1988, 231.
[612] MILES 2016a, 152.
[613] BUSHNELL 1864, 321.
[614] BOSCHI - GIORGI - SILANI 2017, 308–309.
[615] MONACO 2003, 77.
[616] PIMENTA - TIRAPICOS - SMITH 2009.
[617] DE SIMONE 2011, 301.

these lands and constrained the gradual urbanisation of the area. In particular, the *Clanis* valley cutting through the Campanian Plain had a low flowing course tending to create marshy environments, as recounted by the sources[618]. However archaeological excavations around Acerrae did not find any traces of water stagnation[619]. According to Lucia Monaco, the nature of the territory and its hydrology can impact on the organisation of land, which had to respond to specific conditions[620]. The richness of water is considered in the *ager Campanus* as both a resource and a constriction[621]. Bushnell stated that it is optimal to take advantage of any natural depression and lower ground to allow drainage. He says «it is one of the first and most important matters in adjusting the plan of the city, to prepare a sufficient drainage or sewerage. And if the ground is too low, or too flat, to allow enough drainage by gravity, the plan must be arranged so as to favor an artificial and forced drainage, discharging at a point under water and remote from the shore»[622]. At the opposite extreme, if low ground is filled in to achieve an even surface for the city, sewerage will suffer[623]. According to Rosada, the direction of the altitude line could be followed to favour the defluxion of water[624]. However, to avoid a strong influx of water down a huge slope, oblique orientation could also be traced, as in the case of Tortona[625]. In Etruscan ambits, water channelling is documented at Pontecagnano, where the agrarian and necropolis division orientation follows the natural slope of the terrain to avoid stagnation[626]. At Suessula the urban walls are iso-oriented with water drainage channels from a few centuries earlier[627]. As Rampazzo emphasised, the Campanian Etruscan *limites* are not orthogonal in their principal lines and, for this scholar, this can be attributed to a particular need for ease of water drainage[628]. These are the cases of Placentia (Piacenza) and Caesena (Cesena) in northern Italy, where the centuriation orientation follows the natural slope of the plain[629]. Also, Firenze, Pavia, and Concordia have been constrained by the slope factor[630]. Fabrizio Sudano discussed the case of the recent excavation at Terina, itself dating to the 4th cent. BC in Magna Grecia, where a drainage system of the whole *polis* of both domestic and public drainage influenced the orientation of the urban layout. In other case studies, it has been shown how the slope of the terrain was used to facilitate water drainage[631]. In general, the preference is for cities to be established on high ground, also to avoid proximity to marshes generally considered dangerous for health[632]. Indeed, Vitruvius mentioned that the best

618 Virg. *G.* 2.223-225; Sil. *Pun.* 8.513.
619 Giampaola - Ronga - Sica 1997, 226.
620 Monaco 2002, 90.
621 Monaco 2002, 91.
622 Bushnell 1864, 319.
623 Bushnell 1864, 319.
624 Rosada 2010, 92.
625 Rosada 2010, 92.
626 Cerchiai 2020, 330–332.
627 Cerchiai 2020, 333.
628 Rampazzo 2011, 203–204, 219; Rampazzo mainly infers this evidence from U.S. Navy di Gricignano d'Aversa archaeological excavations.
629 Orfila Pons - Chávez Álvarez - Sánchez López 2017, 118; See also P. Tozzi, *Saggi di topografia storica*, Firenze 1974, 9.
630 Rosada 2010, 92.
631 Sudano 2022.
632 Van Tilburg 2015, 169.

option is to place a city in a high place[633]. Aristotle stated that healthier cities are the ones on slopes facing east or the rising sun[634]. Thus, Cornelis Van Tilburg says «the best situation for a city is on a slope, facing east or receiving the east wind», or at least facing south[635]. Mary Shepperson emphasised that «[s]outh-facing slopes, however, are highly favourable, and maximise a building's access to winter sun, while maintaining better solar protection than east or west-facing slopes»[636]. The positioning of Capua on the plain on the southern slope of Mt. Tifata can be read as responsive to such climatic factor. The mapping of altitude variations in the Campanian plain was attempted by Marina Monaco (fig. 15)[637].

External pre-existing viability can act as a factor in the urban orientation of streets and buildings. Road systems following countryside communication routes have been determined as causes of non-orthogonal grids, such as at Megara Hyblaea[638]. Indeed, on the dichotomy between the inner and outer space, for Archaic *poleis* in their most ancient phases, the arguments by Polignac highlighted the importance of allowing permeable categories for boundaries delimiting what is commonly considered inner and outer urban space[639]. On the same line of thought, Emanuele Greco stated that the urban space does not limit itself within a wall[640]. Polignac suggested seeing urban viability as benefiting from a centripetal force towards the external space, stating «an 'introverted' and blinkered vision of the town as turned to the inside, to the centre, must be replaced by a conception of Archaic urban organization which is more 'extrovert' and more open»[641]. Rossella Filippi pointed out that the *decumanus maximus* of Roman colonies were often in direct relationship with a major road route, a *via consularis,* such as the *via Aemilia* or *via Postumia*[642]. The direction of the urban grids along the *via Aemilia*, such as at Imola, Faenza, Forlì, and Forlimpopoli, followed the extra-urban road, deviating by around 62° from the meridian in the south-east, north-west direction[643]. The centuriation of Asolo was set to fit to the *via Postumia* coinciding with the *decumanus maximus*[644]. Other cases of Roman colonies following a main street can be attested at Terracina set in line with the *via Appia*, but, in the Campanian towns, the *Appia* route had to adapt to the urban grids of Capua and Calatia, therefore it is chronologically subsequent. In other cases, an extra-urban road might have been the diagonal for defining a *centuriae*'s orientation[645]. Le Gall commented on the passages from Hyginus and Frontinus of orienting according to the *limites montani* or the *limites maritimi*[646]. For

633 Vitr. *De arch.* 1.4.1.
634 Arist. *Pol.* 7.1330a.
635 Van Tilburg 2015, 168.
636 Shepperson 2017, 242.
637 Monaco 2003, 77.
638 de Polignac 2005, 51.
639 de Polignac 2005, 48.
640 Greco 1999, XI.
641 de Polignac 2005, 51; Lippolis - Livadiotti - Rocco 2007, 173.
642 Rossella Filippi 1983, 125–126; Hyg. Grom. *De lim. Cons.* 179 L= 142 C.
643 Barbolini 2014, 39.
644 Rosada 1991, 91.
645 Soricelli 2002, 125.
646 Le Gall 1975, 305–306.

limites maritimi the *ager Lunensis* (Luni, Ligury) is an example where the centuriation carried out in 177 BC is orthogonal to the shoreline[647] Also, the centuriation of Rimini and Zara reflect an adaptation to the littoral[648]. In Campania, there are few towns set nearby the coast, and the ancient shoreline orientation will be discussed case-by-case as a possible constrain in the fourth chapter.

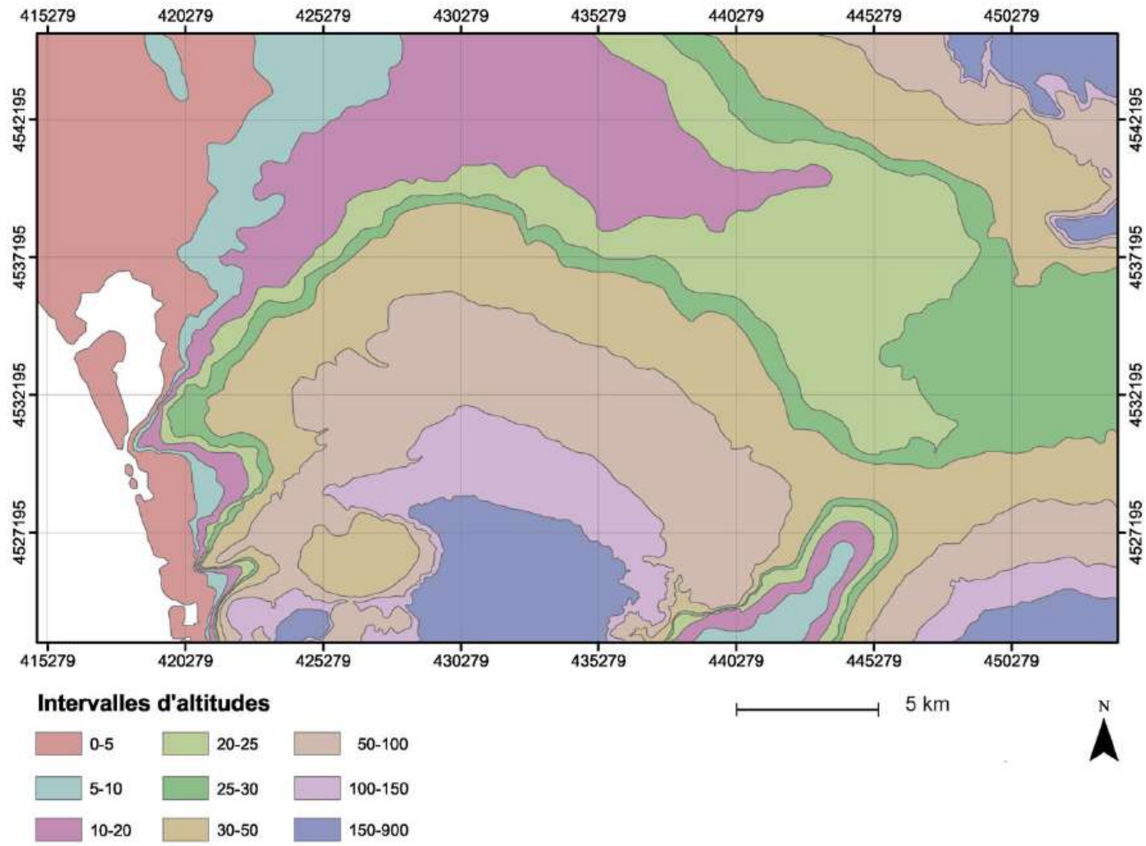

Figure 16. Altimetric variation in the Campanian plain. After M**ONACO** **2003, 77.**

4.2 *Secundum Caelum*

Apart from cardinal layout, celestial orientation of urban grid can take various forms. In Giancarlo Cataldi's theory, the semantic ambit of *secundum caelum* orientation is only in relation to the four cardinal directions[649]. And indeed, several towns show cardinal orientations: in Magna Grecia, Elea can be offered as an example, and Thurii, founded in 443 BC, presented a north-south orientation[650]. In Greece, Olynthus's (432 BC) avenues are aligned in a north-south direction on an orthogonal grid pattern, as well as at Priene, which had to deal with remarkable geomorphological steps in height[651].

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[647] See C.D. Smith - D. Gadd - N. Mills - B. Ward-Perkins, "Luni and the 'Ager Lunensis' the Rise and Fall of a Roman Town and Its Territory.", in *Pap. Br. Sch. Rome* 54, 1986: 81–146.
[648] ROSADA 1991, 92.
[649] CATALDI 2004b.
[650] CERCHIAI 2002, 120.
[651] WARD-PERKINS 1974, 15.

As for Etruscan planning, several towns showed a cardinal or almost cardinal orientation, with the exemplary case of Marzabotto. In the Roman world, the *ageres* of Torino, Cesena, and Firenze are cardinally oriented[652].

However, in the present thesis the ambit of the *secundum caelum* is expanded in respect to Cataldi's definition to include towns that were organised in relation to the sky[653]. In the context of urban grid orientations, it is common to evaluate the role of the sun, as irradiation factor or as marker of the foundation day. A more functional orientation in response to climatic issues of solar illumination and irradiation can be noted, alongside matters of a religious character often interpreted as the foundation days of a city being determined by the direction of sunrise[654]. When the intention behind an orientation, particularly whether functional or symbolic, is not explicitly stated, it is convenient to speak about solar orientation in general. Massimo Pallottino is clear about the idea that solar orientation is an obvious fact prompting orientation decisions[655]. In the Roman context, the idea that the *decumanus* was traced by following the course of the sun comes from the Gromatic literature of the Imperial period, thus «*decumani* faced from the part (of the heavens) where the sun was rising at the time when the survey was carried out»[656]. However, these famous passages from Frontinus and Hyginus remains problematic if not contextualised[657]. For some scholars, discourses on land division techniques cannot be applied to town planning. Thus, Le Gall stated that the gromatic literature is referring to rural areas and agricultural division, and not urban planning[658]. Indeed, the attribution of *decumanus* or *cardo* to urban streets is a modern attribution[659]. However, it is true that the inner and outer urban network often tended to coincide in Roman design planning, with urban streets running in the same direction through the countryside. And yet, Le Gall considered it was important to distinguish between a camp, a town and a centuriation in terms of differing approaches to design. Another critique is that the *corpus* is mainly secular in character, and the conception of Roman planning deriving from Etruscan religion is a fictitious antiquarian notion[660], even though he regards cardinal and solar orientation as possible determiners of centuriation choices[661]. The following analysis on solar orientation will be distinguished among 'solar irradiation' and 'sunrise on foundation day' to divide between more practical considerations in respect to celebrative connotations, to finalise with a 'wind directions' thoughts.

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652 ROSADA 1991, 90.
653 See section 1.3 in Chapter One.
654 CRISTOFARO n.d.
655 PALLOTTINO 1971.
656 «decimani spectarent ex qua parte sol eo tempore, quo mensura acta est, oriebatur» Front. *De Lim.* 31.4-7 L.
657 HygGr. *Const.*166.7, 170.5-8 L.
658 LE GALL 1975, 300.
659 LE GALL 1975, 300.
660 LE GALL 1975, 308.
661 LE GALL 1975, 307.

4.2.1 Solar Irradiation

In Classical Greece, thoughts on solar irradiation developed into the concept of a passive-house design, and the idea was attributed to Socrates and recorded by Xenophon [662].

> Now in houses with a south aspect, the sun's rays penetrate into the porticoes in winter, but in summer the path of the sun is right over our heads and above the roof, so that there is shade. If, then, this is the best arrangement, we should build the south side loftier to get the winter sun and the north side lower to keep out the cold winds[663].

Edwin D. Thatcher's studies confirmed the effectiveness of the Socratic passive house finding a comfortable irradiation for 67% of the days during the colder months[664]. For Ken Butti and John Perlin, domestic solar architecture was widespread in ancient Greece as evident in the city plan of Olynthus and Priene[665]. According to Mohamed Boubekri, «[t]he Greeks believed in democratizing solar access, as was apparent in the town planning of model communities such as Olynthus and Priene»[666]. J. Walter Graham considered that the preoccupation with the right to receive the sun was independent of social strata[667]. Solar irradiation was also a preoccupation in Vitruvius, «as the position of the heaven with regard to a given tract on the earth leads naturally to different characteristics, owing to the inclination of the circle of the zodiac and the course of the sun, it is obvious that designs for houses ought similarly to conform to the nature of the country and to diversities of climate»[668].

Around the 19th and 20th cent. AD, an area of architectural interest was a focus on the right presentation of building to sun's rays, especially with schools and hospitals, for potential health benefits[669]. According to modern architects, the interaction between structures and sky light and sunlight should be a defining feature of the built environment[670]. William Atkinson started his analysis of streets in the urban environment by distinguishing between sunlight and sky light, since «[s]ky light comes from all directions of the heavens; sunlight from only one direction, constantly varying with the revolution of the sphere. The direction or orientation of the street affects the sunlight particularly: the height of the buildings bordering upon it affect both»[671]. For John Mardaljevic, the perceived use of public and private spaces should take into account sun access, as in the amount of solar light an urban environment can facilitate[672]. As Victor Olgyay pointed out, «[w]ith the development of techniques for measuring radiation and the accumulation of factual data, the approach

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662 Butti - Perlin 1980, 3–5.
663 Xen. *Mem.* 3.8.9, trans. by Heinemann 1923.
664 Butti - Perlin 1980, 289.
665 Butti - Perlin 1980, 2–13.
666 Boubekri 2008, 18.
667 Graham 1972.
668 Vitr. *De Arch.* 6.1.1, trans. by M. H. Morgan 1914.
669 Di Nallo 2014, 165.
670 Mardaljevic 2005, 371–372.
671 Atkinson 1912, 110.
672 Mardaljevic 2005, 371.

to orientation was made on a calculative basis»[673]. Such data analysis occasioned to the development of many solar-orientation theories[674]. Thus, Gaston Bardet started his essay stating that «[l]es idées les plus confuses et les plus contradictoires règnent en matière d'ensolleiment»[675]. For a historical overview of the theories and solutions proposed, the doctoral thesis by Marylène Montavon gives a very clear summary (fig. 17)[676].

673 Olgyay 2015, 54.
674 Olgyay 2015, 54.
675 Bardet 1945, 202.
676 Montavon 2010, 14–20.

Theories	Years		Authors
North-South axis	1876	–	Benjamin Ward Richardson (Hygeia city)
	1885	–	Adolphe Vogt
	1885	–	Félix and Emmanuel Putzeys
	1887	–	Etienne Clément
	1887	–	Emile Trélat (moderate countries)
	1891	–	Charles Barde
	1896	–	Léon Duchesne
	1904	–	Paul Juillerat & Louis Bonnier
	1905/1908	–	Henri Provensal
	1909	–	Raymond Unwin
	1925	–	Jules Courmont
	1930	–	Edmond Marcotte
	1934	–	Jean Raymond
	1947	–	Albert Besson
	1948	–	Robert Leroux
East-West axis	1891	–	Charles Barde
	1896	–	Léon Duchesne
	1902	–	Achille-Adrien Proust
	1943	–	André Hermant
	1948/1951	–	Robert Leroux (hot countries)
East-West axis objectors	1890	–	Joseph Stübben
	1921	–	Emile Juillerat
	1933	–	Jean Raymond
45° axis	1885	–	Joseph Stübben
	1887	–	Etienne Clément
	1894	–	William Atkinson
	1901	–	Georges Handly Knibbs
	1901	–	R. Henson Broadhurst
	1902	–	Achille-Adrien Proust
	1908	–	Henri Provensal
	1909	–	Inigo Triggs
	1912	–	A. J. Macdonald
	1925	–	Jules Courmont
	1922	–	Raymond Unwin
	1943	–	André Hermant
58° axis = Solstices	1943	–	Gaetano Vinaccia (Paris, Rome)
19° Heliotermic axis	1908/1928	–	Augustin Rey, J. Pidoux & C. Barde (19° Paris)
	1930	–	Le Corbusier (1887-1965)
	1930	–	Edmond Marcotte & André Gutton
	1941	–	André Gutton
19° Heliotermic axis objectors	1943	–	Gaston Bardet
	1943	–	Gaetano Vinaccia
	1943	–	André Hermant
	1946	–	Robert Leroux
15°< To <20°	1887	–	Etienne Clément (latitude 0 to 30°)
15°< To <35°	1904	–	Léon Jaussely (Barcelona) a
-5°< To <45°	1928	–	Augustin Rey
0°< To <45°	1904	–	Paul Juillerat
	1945	–	Jean Lebreton
0°< To <60°	1921	–	Paul Juillerat
	1925/1934	–	Jean Raymond
60°< To <70°	1910/1937	–	Félix Marboutin
	1941	–	Gaston Bardet

Figure 17.Table of 19th and 20th centuries theorisation of preferable orientation according to solar insolation in chronological order. In red the solution by Gaetano Vinaccia stating the significance of the position of the solstices. Adapted after MONTAVON 2010.

The advocators of cardinal directions have been numerous across the centuries. Less common have been the advocators of diagonal orientations, which are going to be dealt with here briefly. For example, Bushnell's (1802-1876) essay *City Plans* (1864) stated that «[i]t is also a great question, as respects the health of the city, in what direction, or according to what points of the compass, the streets are to be laid»[677]. Although most people would probably favour having a city planned to coincide with the cardinal directions, for the comfort and health of every house, Bushnell stated that the disposition should be made northeast and southwest, northwest and southeast, «that so the sun may strike every side of exposure every day in the year, to dry it when wet by storms, to keep off the mould and moss that are likely to collect on it, and remove the dank sepulchral smell that so often makes the tenements of cities both uncomfortable and poisonous to health»[678]. Diagonal directions in the urban fabric were also the favourites in ancient Mesopotamia[679]. There, according to the study by Mary Shepperson, «[d]iagonal street grids are seen as the best solution for providing a balance between shading for streets and solar protection for building», especially in the hot and arid summer season[680]. For Atkinson, the cardinal arrangement of a city is the worst possible[681]. Atkinson supports some consideration of orientation and sunlight across seasons for a schematic urban built environment at a latitude of 42° where the buildings are high, one-half times the width of streets[682]. For such parameters, cardinal east-west roads should be avoided, since the surface of these streets, as well as the south façades of buildings, would not receive any sunlight for six months[683]. As a possible advantage of the cardinal disposition, it is true that, with orthogonal north-south streets, the irradiation is symmetrical on both façades.

Augustine Rey, Justin Pidoux, and Charles Barde, in *La science des plans de ville*, calculated the best urban orientation suggesting the concept of the heliothermic axis, combining issues of insolation and temperature[684]. The heliothermic value was the product of the duration of the insolation and the average temperature for that day of the year. In particular, the temperature over the second half of the day is greater than in the morning, adding to the heliothermic value of a west-facing direction[685]. The best design for Paris, with an azimuth of 19°, was calculated to be a south-east/north-west grid[686]. In general terms, the sum of insolation and solar thermic impact is the most equilibrate for long facades facing south-east and north-west, given that the second part of the day is warmer[687]. Rey *et al.*'s ideas influenced Le Corbusier's thinking. Solar insolation was applied in *La Ville radieuse* (1935), an urban project designed by Le Corbusier as the ideal form of a utopian city: it was

[677] Bushnell 1864, 319.
[678] Bushnell 1864, 320.
[679] Shepperson 2017, 93–94.
[680] Shepperson 2017, 242.
[681] Atkinson 1912, 118.
[682] Atkinson 1912, 115.
[683] Atkinson 1912, 115.
[684] Rey - Barde - Pidoux 1928, 14–35.
[685] Rey - Barde - Pidoux 1928, 22.
[686] Rey - Barde - Pidoux 1928, 22.
[687] Rey - Barde - Pidoux 1928, 21.

traced on the two axes of *cardo* and *decumanus*, orthogonal and diagonal with an angle of 45°, ordered by the rhythm of the solar day in a way that its orientation was the heliothermic axis. This solar axis was «l'armature du tracé urbain» in this radiant city[688]. According to this mode of thought, orienting cities in line with this principle effectively managed thermic variations. However, according to Montavon, the theory developed by Rey and colleagues was strongly disagree by Gaston Bardet (1943), Gaetano Vinaccia (1943), André Hermant (1943), and Robert Leroux (1946)[689]. Among the objectors to the heliothermic axis, Bardet argued that the heliothermic factor is meaningless since a temperature should be multiplied by a mass and not by a duration[690]. Indeed, recent research has confirmed Bardet's objection, by testing the temperature of building façades and finding that the thermic symmetry expected is not achieved (fig. 18)[691].

The equalisation of insolation and the right to the sun was one of the major topics in the work by Gaetano Vinaccia[692]. He disagreed strongly with Rey *et al.* about the heliothermic axis. In respect to them, the calculation was done on the four side of a buildings, not on the two longest ones[693]. His aim was to rationalise sun exposure, especially as thermal factor[694]. Since the western sides take the advantage of a higher diffuse temperature when the sun reaches them, the optional deviation will be towards the east, clockwise[695]. The characteristic of this style of planning is that the northern façades are perpendicular to the direction of summer solstice sunrise (fig. 19)[696]. The north façade, technically on the north-west, does not receive any sunrays for only one day a year, that is the winter solstice: this is a great result for a north facing wall having circa 364 days of sunrise, excluding the possible presence of clouds [697]. Even at winter solstice time, the last ray of the sun would penetrate the street running parallel to this northern façade. This simple idea can explain in functional and secular terms why many ancient cities were oriented according to the solstices, especially in Roman urbanism[698]. As far as concerns the present study, Vinaccia's theory is the only one which takes explicitly into consideration the position of the sun at solstices (fig. 19).

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[688] Le Corbusier, *La Ville radieuse: éléments d'une doctrine d'urbanisme pour l'équipement de la civilisation*, Boulogne 1935, 159 in Harzallah et al. 2005, 3.
[689] Montavon 2010, 23.
[690] Montavon 2010, 23.
[691] Harzallah et al. 2005.
[692] Vinaccia's achievements were recently displayed in the *Italian Solar City Travelling Exhibition* by The Italian National Solar Energy History Project, in Silvi 2009.
[693] Barbolini 2014, 42.
[694] Vinaccia 1939a, 210.
[695] Vinaccia 1939a, 211.
[696] Vinaccia 1939b, 201.
[697] Vinaccia 1939a, 213.
[698] Sparavigna 2016a.

Heliothermic orientations	Winter solstice	Summer solstice
Façade parallel to the axis	460	3000
Façade perpendicular to the axis	1200	1900
Total	**1660**	**4900**
Equisolare Orientation	1100	2000
Façade parallel to the axis	850	1600
Total	**1950**	**3600**

Figure 18. Total calories/m calculated for four vertical facades as surface energy from exposure to the sun. From MONTAVON 2010, 21.

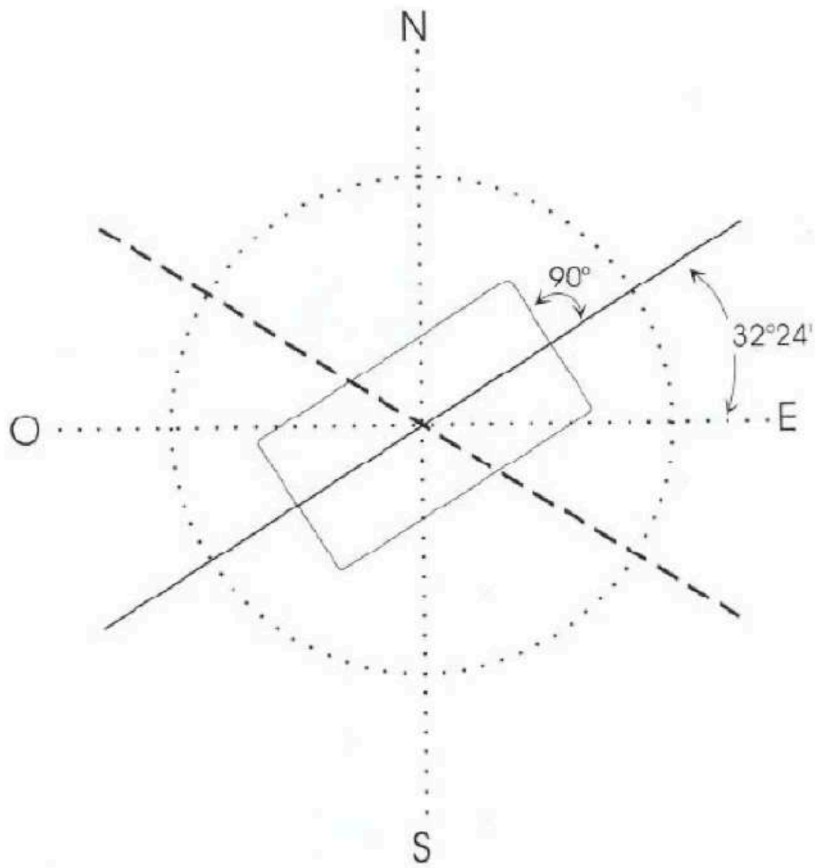

Figure 19. Gaetano Vinaccia's studies of orientation according to solstitial directions for Rome. From MONTAVON 2010, 22.

4.2.2 SUNRISE ON FOUNDATION DAY

Heinrich Nissen (1839-1912)'s theory, also called *Nissenschen Theorie*, stated that the axis of a temple or urban *decumanus* related the day of foundation to the position of the rising sun. Following

Nissen's theory, the anniversary of the foundation of a city, *natalis dies*, can be calculated using the alignment of the street grid with the sun's rising. This would lead to calculating two specular days when the sun rises from one single eastern direction[699]. From the two dates, the day which best accords with both the archaeological and anthropological evidence is proposed. For example, Francis Haverfield mentioned that, according to Walter Barthel, Timgad was oriented to the rising at the time of Trajan's birthday, on 18th September[700]. In Bononia, Manuela Incerti suggested that the *decumani* aligned with the day of the festivities of the *Terminalia* at the end of February[701]. With respect to Pavia, Ginafranco Tibiletti hypothesised a possible relationship with the rising sun on the day of the town's inauguration[702]. Monique Clavel-Lêveque and Pierre Levêque also suggested that a solar orientation is plausible for Roman colonies on their foundation days[703].

Some problematics issues with Nissen's theory have been brought to light. Giulio de Petra commented on Nissen's essay *Das Templum* (1869), emphasising the fact that, for Nissen, *Arx* and urban grid were always simultaneously built whereas in many cases they developed gradually following a stratification of events and actions. Joël Le Gall questioned Nissen's theory on a statistical basis, considering that the arc of the horizon when the sun can rise covers around 60°, depending on latitude. Starting from any direction of the sun's rising position, and developing a symmetrical cross-grid, as with a typical Roman town grid, there is not much part of the circle which is not covered. In statistical terms, with a uniform distribution, that is assuming that the *decumanus* was set by chance, the probability that this is found on a solar rising position is 72/90. Moreover, Le Gall mentioned that the disadvantage of this technique is that its verification could happen at the anniversary only[704]. It can be argued that such verification was not needed and, instead, the anniversary was predictable and practically convenient to be remembered and celebrated with a high degree of accuracy, especially if combined with a landmark. As an advantage, Le Gall mentioned the fact that the time of tracing the urban grid could happen on any day of the year[705]. For Le Gall, the theory that a relevant day, such as the founder or emperor's birthday, or a festivity, was precisely chosen is a logical idea but there are no literary sources to support it[706]. Indeed, Haverfield and Le Gall support the idea that territorial centuriation is the topic of the Gromatics corpus only, and it cannot be applied to Roman towns[707]. Amelia Sparavigna also suggested that, considering the impossibility of distinguishing between *cardo* and *decumanus* as possible directions of sunrise, from a statistical point of view the chance of the null hypothesis, that is to find a sunrise orientation by chance, is very high, as in the probability of 80%[708]. She mentioned that, when a non-uniform distribution is in evidence, local tradition should be

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[699] ROSADA 1991, 90.
[700] HAVERFIELD 1913, VIII.
[701] INCERTI 1999; 2010, 644.
[702] See G. Tibiletti, "La struttura topografica antica di Pavia", in L. Canepari - A. Peroni - G. Testa (ed. by), *Atti del Convegno di studio sul centro storico di Pavia, Pavia 4-5 luglio 1964*, Pavia 1968 cited in SPARAVIGNA 2020a.
[703] CLAVEL-LEVÊQUE - LEVÊQUE 1984, 104.
[704] LE GALL 1975, 307.
[705] LE GALL 1975, 307.
[706] LE GALL 1975, 307.
[707] HAVERFIELD 1913; LE GALL 1975.
[708] SPARAVIGNA 2020c.

considered[709]. Regarding the issue of distinguishing between *cardo* and *decumanus,* a different solution employed for archaeoastronomical purposes considered the *decumanus* the axis between 45°-135° towards the east and 225°-315° towards the west, after Hyginus' statement on its relationship with the sun's course[710], even though this correspondence is not always applicable. Apart from the orientation to solstices, equinoxes or cross quarter days, the precise identification of remaining solar dates in connection with local calendars remains problematic given the irregularity of the ancient luni-solar calendars[711]. Moreover, the foundation days of only a few Roman colonies is known: Saticula on 1st January, Brundisium on the 5th August, Placentia probably on the 31st May, and Bononia on 28th December[712].

Therefore, for Sparavigna it is not possible to calculate the day of foundation in relation to the sunrise position, since it is not known what ritual or functional actions the exact *natalis urbis* was based upon[713]. According to her analysis, only Brindisi may show a correspondence with the azimuth of the *decumanus* and the position of the rising sun on that day, but she emphasised the uncertainties of the correspondence as well[714]. Following Le Gall, Sparavigna concluded that urban orientation to sunrise does not necessarily imply sacral connotation, though that is plausible with temples and churches[715]. The symbolic interpretation of astral references in Roman urban grids has also been supported by Giulio Magli[716]. As stated by Eckstein, the Etruscans might have followed a similar procedure of foundations with the sun, even though the evidence is very scant, only inferred from the cases of Marzabotto and Pompei[717]. For the Greek world, similar practices are not witnessed, although the direction of the rising sun at the birth of Alexander was proposed to interpret the orientation of Alexandria by Luisa Ferro and Giulio Magli[718].

4.3 Wind Directions

A knowledge of winds was a fundamental tool for the orientation of spaces in relation to time, as main winds tend to blow from specific directions during the year (fig. 20)[719]. According to Daniela Coppola, in Hesiod and Homer the direction of winds does not correspond exactly with the cardinal points, even though a knowledge of them functions as a means to orient oneself in space[720]. In Varro's *Res Rusticae*, an episode is narrated where he changed the orientation of doors and windows to achieve better conditions for health. He stated the importance of building villas where «the situation

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709 Sparavigna 2020c.
710 Rodrìguez-Antòn 2017, 28.
711 de Petra 1869.
712 Eckstein 1979, 1.
713 Sparavigna 2020b.
714 Sparavigna 2020a, 6–7.
715 Sparavigna 2020c.
716 Magli 2008b; *Contra* J.-P. Adam, *Roman Building: Materials and Techniques*, London 1994.
717 Sassatelli - Govi 2010, 36; Gottarelli 2005, 123; Cristofaro - Silani 2021.
718 Ferro - Magli 2012.
719 Coppola 2010, 7, 35.
720 Coppola 2010, 97.

of the buildings, their size, the exposure of the galleries, the doors and the windows, are matters of the highest importance»[721]. Andrea Palladio wrote in the sixteenth century that wind directions contribute to the healthiness or propensity to illness of the inhabitants: the latter afflicted the city of Mytilene on the island of Lesbos[722]. According to Abraham Akkerman, «[s]ince archaic times and early antiquity, the Middle Ages and through the Renaissance, aspects of climate, much as all other atmospheric phenomena, have been considered celestial attributes»[723]. Gaetano Vinaccia in his work on urban microclimatology, represents a modern attempt to revisit Roman urban planning for modern purposes (fig. 21). As ancient sources suggested, Roman planning was highly determined by the flow of major winds. According to Vinaccia, 'annoying' ('molesti') winds from the north-west and 'unhealthy' ('malsani') from the south-east should be impeded from entering an urban space through an orthogonal pattern of orientation. He suggested a constant divergence of the *cardo maximus* from the cardinal north of 22.3° towards the east. Apart from this last argument, recent studies by Giovagnorio *et al.* supported Vinaccia's theory, but emphasised the need for a more localised treatment of each Roman settlements as based on an awareness of local wind directions and other environmental factors. In their study, the authors pointed out how the vicinity of high mountains affords protection by preventing wind flowing into the urban spaces, and «realizing grid orientation from local winds directions»[724]. The same research suggested an inverse functionality in the towns of Lucca and Florentia, both located on marshy land, where the humidity was minimised by actually channelling the prevailing winds through the urban space[725]. It is hard to prove whether a town is oriented according to wind direction, as there is a tendency to avoid prevailing wind flow. Nevertheless, statistically significant pattern of orientation may be analysed under Vitruvius's precept of deviating 22° from the prevailing wind direction[726].

[721] Varro *Rust.* 1.4.4, trans. W. D. Hooper and H. B. Ash, 1934.
[722] Andrea Palladio, *Quattro* III.2.
[723] AKKERMAN 2016, 3.
[724] GIOVAGNORIO ET AL. 2017, 50.
[725] GIOVAGNORIO ET AL. 2017, 51.
[726] Vitr. *De arch.* I.6.1–13.

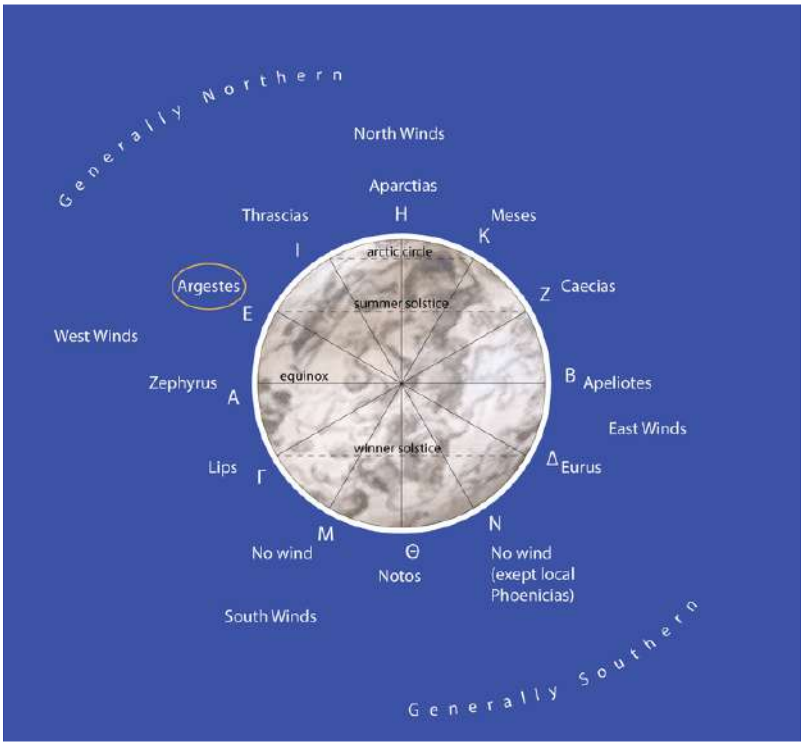

Figure 20. Orientation of winds in the 'Rose of the Winds', with twelve points based on Aristotle's Meteorology, 340 BC. From VALLESE 2014, 264[727].

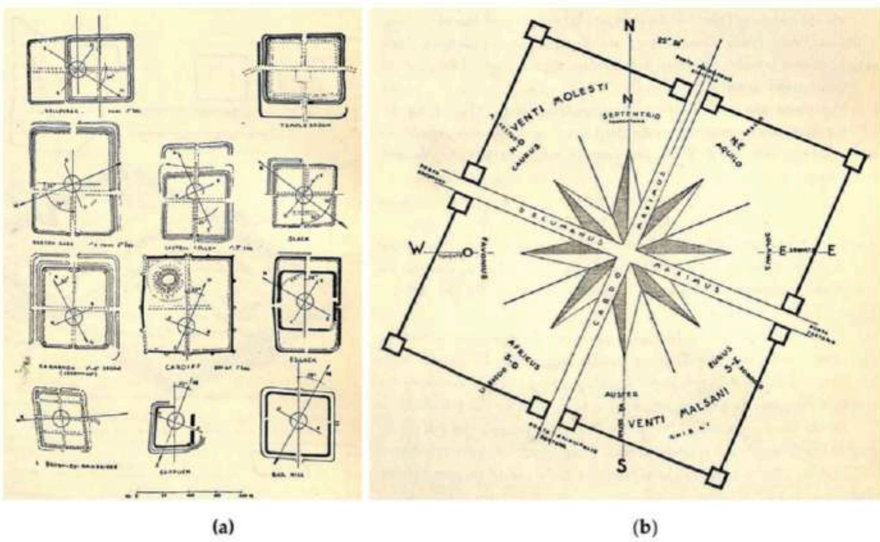

Figure 21. Analysis of Roman urban grids in Britannia (a) and orientation in relation to winds (b) by Gaetano Vinaccia. From VINACCIA 1939b.

[727] VALLESE 2014, 264.

CHAPTER THREE. THE SKY AND THE SACRED

1. ASTRAL RELIGION

The delineation of an history of religions in ancient Italy and Campania remains problematic due to the multi-coloured picture of its ethnic composition[728]. The degree of the presence of cosmogony in indigenous Italic religion is very difficult to ascertain. The complex relationship between Italic religion, on the one hand, and Romanisation, on the other, has been briefly summarised by Massimiliano Di Fazio[729]. The influence of Greek and Phoenician religion is another aspect to be considered[730]. From a history of religion perspective, the main problem is the classicist approach to such religions, in that Roman and Greek frameworks were applied to them, and where any certainty is rendered more difficult to achieve by the scarcity of primary material evidence and the lack of unambiguous interpretations of epigraphic texts[731]. The diachronic evolution of divinities also suffers from a lack of evidence[732]. The following discussion will focus on an overview of the celestial connotations of those components of ancient religions which might have shape cultic activities in ancient Campania.

1.1 Celestial light

The celestial *templum*, abode of the celestial gods, is possibly represented in Etruscan art with a unique decorative solution, as depicted in the *cippus* from Perugia (second quarter of the 5th cent. BC) or in Prometheus's liberation in a mirror from Vulci (second half of the 5th cent. BC)[733]. Amongst several examples of Etruscan art, Witold Dobrowolski recognised the division between sky and Earth in the form of a sinuous line[734]. The hypothesis that the sky is the object of such convex lines is derived from the comparison with the laconic cup from Caere with Atlantes and Prometheus[735]. A delimitation between sky and Earth can thus be recognised, though these realms were believed to be in contact during sacrifices and in the passage of heroes in their search for immortality[736]. Michael Weiss suggested that sky and earth would have resulted from a primordial act of separation, from an undifferentiated whole, familiar to the cosmogony of Indo-European culture, and still evoked by the Latin word *caelum*[737]. Etymologically speaking, 'the celestial vault', *caelum,* was considered half of the whole, deriving from **kayd-(s)lo-*, the same root of the Latin word *caedō*, meaning 'to break, to cut'[738]. In the context of ancient Campania, Paolo Poccetti discussed an Oscan inscription from the stadium of Cumae, with a dedication to a divinity, with the epithet *di[vi]úí*, about the sky and the

728 PROSDOCIMI 1989, 447.
729 DI FAZIO 2016.
730 PROSDOCIMI 1989, 498.
731 DI FAZIO 2017, 419–420.
732 DI FAZIO 2017, 420.
733 DOBROWOLSKI 1991, 1, 4.
734 DOBROWOLSKI 1991.
735 DOBROWOLSKI 1991, 3.
736 DOBROWOLSKI 1991, 1223–1227.
737 WEISS 2016.
738 WEISS 2016.

celestial light[739]. Following Aldo Prosdocimi, the attribute of the Italic Jupiter is *fides*, the sacral guarantee of treaty and which has celestial connotations as confirmed by Varro[740]. Indeed, the passage by Varro stated the importance of having an opening on the roof of the temple of *Dius Fidius,* explicitly explaining that oaths should not be effected in closed spaces[741]. It might be possible to further question the role of Jupiter on a high top and its proximity to the sky and the celestial light. According to Paolo Poccetti, in the Roman, Sabin, and Italic world *Dius Fides* relates the celestial light indissolubly with the *fides*[742]. Indeed, more evidence in the Oscan context attests the combination between *Pidieí (or Pidiuí)* and *Di[v]iúí / Diíviai*, which is related etymologically with the Latin *dīus, dīvus*, the Greek διος and ancient Indian *divyá-*, all sharing the same Indo-European root meaning 'sky, skylight'[743]. The Oscan word for 'to swear', **deiuaom*, appearing in the *Tabula Osca Bantina* derived from the same root[744]. Thus, the divinity in charge of vows is strictly related to Jupiter the Father as the maximum divinity related to the celestial light[745]. This explanation would fit with the location of the *Iuppiter* sanctuaries as mapped by Di Fazio[746].

1.2 The Sun

Worship of celestial bodies in the Greek pantheon is a controversial subject. Late nineteenth and early twentieth centuries theories, with Wilhelm Heinrich Roscher (1845–1923) being one of the last scholars advocating for this theory, hold that gods were the embodiment of natural elements[747]. In the Greek tragedies by Sophocles, the sun is often regarded as the overseeing deity[748] or, at times, the greatest among the divinities[749]. The immortal gods appeared from above, as with Athena in Euripides' tragedy which opines «what god is revealing a countenance as bright as the sun»[750]. In a passage from Aristophanes' *Peace*[751], the barbarians were the ones who worship the Sun and the Moon[752]. In more general terms, Plato affirmed that the sun and the moon are gods without any doubt:

> at the rising and setting of the sun and moon they heard and saw the prostrations and devotions of all the Greeks and barbarians, under all conditions of adversity and prosperity, directed to these luminaries, not as though they were not gods, but as though they most certainly were gods beyond the shadow of a doubt—all this evidence is contemned by these people, and that for no sufficient reason, as everyone endowed with a grain of sense would affirm; and so they are now forcing us to enter on our present argument[753].

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739 POCCETTI 2016b.
740 PROSDOCIMI 1989, 526.
741 «Nam olim Diovis et Diespiter dictus, id est dies pater, a quo dicti qui inde et dius et divum, unde sub divo, Dius Fidius. Itaque inde eius perforatum tectum, ut ea videatur divum, id est caelum. Quidam negant sub tecto per hunc deierare oportere» Varro *Ling*. 5.66.
742 POCCETTI 2016b, 587.
743 POCCETTI 2016b, 582.
744 POCCETTI 2016b, 587.
745 POCCETTI 2016b, 587.
746 DI FAZIO 2012b.
747 KONARIS 2010, 483–487.
748 Soph. *Trach.*, 94-102.
749 Soph. *OT*, 661.
750 Eur. *Ion*, 1549, trans. R. Potter 1938.
751 Ar. *Pax* 406–13.
752 DAVIDSON 2007, 205.
753 Pl. *Leg.*, 10.887d-e, trans. Bury 1967–8.

A strong criticism came from Lewis Richard Farnell (1856–1934) at the turn of the twentieth century. Farnell was strongly opposed to any solar attributes for Apollo, as explicitly indicated by Roscher in all Apollo's epithets[754]. In respect to the epithet Ἑῷος (Hêoios) 'of dawn', Farnell explained that this has no solar significance, but «may have arisen from the eastward position of his statue or temple which caught the first rays of the morning or from a sacrifice offered to him at dawn»[755]. Moreoever, Apollo's solar connotations have been largely dismissed in the scholarship since 1975 after Walter Burkert's study *Apellai und Apollon*, and especially for the Archaic period[756]. In contrast, however, the aetiological myth of the journey to Hyperborea has been used as evidence for Apollo's solar character. Tomislav Bilić argued that a calendric meaning can be found described within this myth, even if with local dissimilarities[757]. Bilić brought to bear the evidence of Plato mentioning τροπὰς ἡλίου τὰς ἐκ θέρους εἰς χειμῶνα, referring to «common precincts of Helios and Apollo»[758] in relation to a summer solstice festival[759]. Moreover, Pierre Boyancé showed that the equivalence between Helios and Apollo could be the result of speculations of Pythagorean origins[760]. In Plato, the identification of Apollo with Helios and the sun is repeatedly mentioned, where «the postulated worship of the heavenly body is thus taken at the centre of the city, yet still veiled with the double name»[761]. An organised cult of Helios in Greece is attested as only starting from the end of the 5th cent. BC at Rhodes[762]. The equivalence Apollo and Helios is attested since the 5th cent. BC and can be traced from the Pythagorean tradition. If, in Greece, the presence of a solar cult is scant, in Etruria the representations of the sun god are frequent and present original attributes.

In the second half of the 6th century BC in Etruria, a passage from the aniconical and, possibly Italic, representation of the sun was attested to be an anthropomorphisation[763]. The first indications of this transition are attested by mirror 1300 from the *Bibliothèque Nationale* and two amphoras from *Gruppo de La Tolfa*[764]. In a depiction of the sun, *Usil* appears as a winged masculine figure, in around 525 BC in Etruria[765]. According to Margherita Tirelli, the solar divinity is extraneous to the Greek pantheon in terms of representation, due the ancient chronology and the pre-Indo-European terms by which he is referred to as *Usil* and as *Cath/Ca(u)tha*[766]. Tirelli concluded that the solar Etruscan divinity is autochthonous[767]. Similarly, for Ingrid Krauskopf, this solar Etruscan iconography appears

754 KONARIS 2010, 485.
755 FARNELL 2010, 139.
756 BURKERT 1975; 1985, 144–145; BILIĆ 2016, 275–259.
757 BILIĆ 2021.
758 Pl. *Leg.* 12.945e, trans. Bury 1967–8.
759 BILIĆ 2012, 513.
760 BOYANCÉ 1966.
761 BURKERT 1985, 336.
762 TIRELLI 1981, 49.
763 TIRELLI 1981, 48–49; KRAUSKOPF 1991, 1264.
764 PIZZIRANI 2005, 258–259.
765 PIZZIRANI 2005, 258.
766 TIRELLI 1981, 48–49.
767 TIRELLI 1981, 49.

to anticipate the Greek[768]. The style of depiction is oriental, with *Usil* running, kneeling, over the sea or as having a rayed head between two figures[769].

From the 6th to the 5th century BC, a different imagery became dominant, such as where the goddess *Thesan* is running over the sea carrying a masculine figure who embraces her neck with his arms, where death and love are tied together in the solar journey across the sea[770]. The sun would seem in its underworld passage to be represented by *Thesan*, since a typical scene for the Etruscan representation of the sun is a marine one according to Chiara Pizzirani[771]. For Nancy Thomson de Grummond, «Thesan is often compared with the Greek Eos and the Roman Aurora», even though there are some connections with the 'White Goddess' *Leukothea* with its strict connection with the sea, and the Roman *Mater Matuta* of dawn and motherhood[772]. Indeed, the underwater journey of the sun was a model for the afterlife trip of the Etruscan deceased, and this should be considered an ontological journey more than a geographical one[773]. In the Etruscan mirror from Orvieto (first half of the 5th cent. BC) now at the Minneapolis Institute of Arts[774], the disk of the sun rising is represented behind a male figure holding two rayed spheres on both hands, possibly representing sunrise and sunset, or two opposite positions of the sun across day or season. The scene is embedded within waving lines and a marine context, again emphasising the role of water in the solar journey. Thus, the mythical cycle of *Leucotea*-*Thesan*, also corresponding to *Mater Matutina*, according to the reading by Coarelli of the Italic and Roman supernatural being[775], might be related to the solar image of death, related to love ecstasy[776]. The *Thesan* and *Kephalos* antefixes were present in Fondo Patturelli sanctuary in the necropolis at Capua[777], as well as in the 20-celled building at Pyrgi[778]. In the latter, the goddess was represented with four wings, as in other mirror representations[779]. In the Hellenistic period, *Thesan* on a quadriga rising from the sea is depicted on Etruscan cinerary urns[780]. De Grummod recognised the solar deity on Etruscan mirrors dated between 325-275 BC coming from Orvieto, Cerveteri, and Praeneste[781].

Another mode of representation of the sun is attested, in Bronze-Age central Europe, by decorated disks and solar barque models, according to Mario Torelli, and is still present in the

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768 KRAUSKOPF 1991, 1264.
769 KRAUSKOPF 1991, 1264.
770 PIZZIRANI 2005, 259.
771 PIZZIRANI 2005, 259.
772 DE GRUMMOND 2006b, 107.
773 PIZZIRANI 2005, 259–260.
774 DOBROWOLSKI 1991, 5.
775 See F. Coarelli, *Il foro Boario*, Roma 1988, pp. 247-253.
776 D'AGOSTINO - CERCHIAI 1999, 60, 81; PIZZIRANI 2005, 260.
777 COARELLI 1995b, 372; D'AGOSTINO - CERCHIAI 1999, 103; PIZZIRANI 2005, 260.
778 DE GRUMMOND 2008, 107–108.
779 COLONNA 2012, 54.
780 See M. Cristofani (a cura di), *Corpus delle urne etrusche di età ellenistica. II. Il Museo Guarnacci*, Firenze 1977, pp-66-67; PIZZIRANI 2005, 267.
781 DE GRUMMOND 2008, 111.

religious systems of Archaic Italy and Rome[782]. For instance, monoliths dedicated to the solar cult in Etruria can be attested at the sanctuary at Pieve a Socana[783]. Torelli traced a relationship between Sol and the mythical ancestor of the human group, the astral incarnation of the progenitor[784]. The correlation between *Inuus/Indiges* with *Sōl* in its chthonic nature, according to Torelli, is reflected in the orientation of the structures at *Castrum Inui* at Ardea, with altars directed towards the rising and setting sun[785]. For Torelli, *Sōl*, the sun, assumed a chthonic character in central Italy, especially in Rome and Lavinum, as attested by the epithet *Indiges*, the mythical ancestors of the Latins[786]. Vanessa Micco studied the etymology of the name of the god *Inuus* pointing out a correlation with the generative power of the sun[787]. Moreover, Torelli individuated a list of coastal Etruscan and Italic sanctuaries in Latium with similar characteristics in being near the sea or the mouths of rivers; at Pyrgi, Gravisca, Ostia, Pratica di Mare, the presence of a cult of the sun can be traced, dual in its ritual architectonic forms, focused on an assimilation between the sun and the ancestors[788]. Thus, there is an overlapping of the figure of the divinised ancestor and *Sōl* in the funerary sphere[789]. Torelli identified such overlapping in the stone at the *heroon* of Aenea at Lavinium, in a long tradition that developed into the Imperial cult of divinized emperors and the *Sol Invictus*[790]. In Rome, two festivities dedicated to the *Sol Indiges* were recorded as occurring on the 9th August and 11th December. The former was celebrated in Colle Quirinale, specifically at the *pulvinar Solis* in front of the temple of *Quirino*[791]. The latter was explicitly to an *Agonalia* dedicated to Sol Indiges. The relationship between the gens *Aurelia* and the cult of the sun was examined by Jean-Claud Richard in the context of the etymology attributed by Verrius Flaccus[792].

1.3 The Moon

Veneration of the moon in Greek religion is a contested matter. The moon has been iconographically recognised in the Eleusis attic vase, and as possibly related to cultic activities[793]. The Archaic Greek poet Sappho mentioned that «the moon rose full, and as around an altar, stood the women»[794], suggesting a relationship between ritual and the full moon. In the context of the Greek pantheon, indications of Artemis's connection with the moon can be attested in the cult of *Mounichia* at Pireo[795]. According to Philokhoros (4th-3rd cent. BC), in a fragment of Περί ήμερων, when the sky is lit by

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782 TORELLI 2011, 217; RAFANELLI 2021, 65.
783 See A. Cherici, 'Sui dischi-donario di Monte Melonta, Orvieto, Pieve a Sòcana e sulla via del Falterona', in *AnnFaina* IX, 2002, 581-584; TORELLI 2011, 223.
784 TORELLI 2011, 217.
785 TORELLI 2011; 2016.
786 TORELLI 2011, 212–216.
787 MICCO 2016.
788 TORELLI 2011, 217–222.
789 TORELLI 2011, 227–228.
790 TORELLI 2011, 227–228.
791 TORELLI 2011, 228.
792 RICHARD 1976.
793 DALLAS 2018.
794 Sappho, fr. Cox 49.
795 VISCARDI 2010; 2015b.

both sides, by the sun and the moon, this is ἀμφιφῶς (*amphiphôs*)[796]. As reported by Atheneaus, «on the day when the moon is overtaken at its setting by the rising of the sun; and so, the heaven is ἀμφιφῶς, or all over light»[797]. This happens during the full moon, around the sixteenth of the month[798], when the moon rises at sunset and sets at sunrise, creating a symmetry between the two celestial bodies. Philochorus intimated that, during this day, circular cakes called *amphiphôntes* where offered to Artemis at her temples and at crossroads of three streets[799]. Felix Jacoby explained that the name of the cakes can be interpreted as «a representation of the conjunction of sun and moon and therefore etymologised the word as 'double light'» from how this conjunction is described by Philokhoros, or as 'shining round about' from Apollodoros[800]. Such symmetry, maybe just described in symbolic terms, is also depicted in the Parthenon's east pediment, with the sun god chariot rising and the moon god chariot declining. According to Eva Parisinou, the association of the cakes with the moon is suggested by the lighted torches added to them, their round shape, the timing and spatiality of the ritual also recalling the moon-goddess Hecate venerated at cross-roads, as mentioned by Atheneaus[801]. Luigi Caliò referred to this citation in connection with the urban layout of the Pireo and the cult of Artemis *Phosphoros*[802]. For some scholars this ritual action is pertinent to the festival *Mounichia* of *Mounichion* or, according to Felix Jacoby, this offering was practised every month[803].

The Etruscan word for moon is *tivr*, *tiu*, or *tiiur* as is known from several inscriptions, such as one on the back of the Piacenza Liver[804]. The word also appears inscribed in a bronze crescent of uncertain origin, now at the Vatican Museum[805]. There is no obvious goddess of the moon in the Etruscan pantheon. Some proposals have been made for there being such. Of the moon goddess *Tiur*, her only known representation is in a second-half 4th cent. BC mirror in a tripartite figuration together with *Lasa* and *Turan*[806]. Stibbe-Twiest identified a moon goddess in the Chianciano Terme fragmentary bronze group[807]. Nancy Thomson De Grummod recognised a Moon goddess at Pyrgi with the name of *Catha/Cav(a)tha*[808]. Her hypothesis derived from a bronze crescent inscription, where the moon word *tiur* appears together with the epithet akin to *Catha*[809]. However, for Giovanni Colonna, *Catha* at Pyrgi has a solar relationship; indeed, *Catha* was named as 'daughter of the sun' or 'eye of the sun' since the main cult at Pyrgi was *Śuri*, identified as *Apollo Soranos*[810]. The cult of

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796 Jacoby, *FGrHist* 328 F 86=Ath. xiv, 645a.
797 Ath. xiv, 645a, trans. C. D. Yonge 2017.
798 Mheallaigh 2020, 15.
799 Ath. xiv, 645a.
800 Jacoby 1954, 370.
801 Parisinou 2000, 153–154.
802 Caliò 2020, 313.
803 Jacoby 1954, 370; Mikalson 1975, 21.
804 de Grummond 2008, 421.
805 Sannibale 2019.
806 Sannibale 2019, 181; Rafanelli 2021, 68.
807 See A.G.E. Stibbe-Twiest, "The Moon-Goddess from Chianciano Terme", in *Meded. van het Ned. Inst. te Rome* 39, 1977: 19–28.
808 de Grummond 2008; Sannibale 2019, 180–187.
809 de Grummond 2008, 421–422.
810 Colonna 2000, 267.

Catha at Pyrgi was recognised by De Grummod in the group of antefixes from the 20-celled sanctuary building, where she is flanked by two horses[811]. There are Roman and Greek analogies in the form of a moon goddess driving a two-horsed chariot[812]. According to De Grummod, *Catha* is the consort of *Śuri*, goddess of the sea and moon, and possibly of childbirth[813]. Colonna identified in the theonym *Śuri*, epigraphically attested from the end of the 4th to the 2nd cent. BC, «a deity at once chthonic and solar» and similar to *Aplu/Apulu*[814], who was strictly associated with the goddess *Cav(a)tha*, herself referred to with the epithet of wife or daughter of Helios[815]. If *Śuri* does correspond to the *Pater Soranus* of the Faliscans, apart from Apollo, it can be associated with the Roman *Dies Pater* and to the Greek Hades[816]. The feminine companion *Cav(a)tha* can thus be Persephone/Proserpina[817], who is equivalent to the moon in some literary sources[818]. For Adriano Maggiani, *Cav(a)th* can be identified with Hekate [819], whereas, for De Grummod, she can be recognised as a moon goddess[820].

[811] DE GRUMMOND 2008, 425.
[812] LIMC 7:706-15, esp. 711-12, v. 'Selene, Luna'; DE GRUMMOND 2008, 423.
[813] DE GRUMMOND 2008, 419.
[814] COLONNA 2006, 134; LIMC 7: 823-824, v. 'Suri'.
[815] COLONNA 2006, 139; 2012, 583.
[816] COLONNA 2006, 139–140; LIMC 7: 823-824, v. 'Suri'.
[817] COLONNA 2006, 140; RAFANELLI 2021, 67.
[818] SANNIBALE 2019, 187.
[819] MAGGIANI 1998, 46–47.
[820] DE GRUMMOND 2008, 419.

2. TEMPLE ORIENTATION

The setting of a sanctuary was influenced by a wide range of socio-political and topographical factors[821]. Temples imposed a specific spatiality within the environment, linking the divine realm to the earth as a permanent representation of the sacred[822]. When establishing new colonial Greek foundations, «[a] range of considerations must have loomed as important to the early settlers, such as how the landscape affected their perception of the sacred, social, and political conditions, the intended use of adjacent lands, and visibility»[823]. Decisions about the specific site and orientation of the sanctuary were influenced by these considerations[824]. The choice of a site was often dependent on the availability or limitation of local resources, connectivity or restriction of access. How the sanctuary might have looked from a distance was also a crucial factor in terms of political spatial organisation, for example, with respect to border control for rural sanctuaries or integration within public areas for urban ones[825]. The sacredness of a place could be evoked by multiple layers of meanings, such as naturalistic features or the presence of memorial places[826]. For instance, Vincent Scully contextualised Greek sanctuaries within the natural environment[827], while Ingrid Edlund-Berry argued that temples and sanctuaries were often located at special naturalistic sites or in relation to the spatiality of urban settlements[828]. The orientation of a temple could align with culturally important landscape or skyscape features, sacred or memorial places[829].

Skyscape archaeology applied to sacred architecture is based on three lines of investigation. First, temples are places of encounter between the gods and the community. The inner temenos offers a view of the outside, where a celestial body rising or setting may be seen. In a Greek temple, the doors open towards the inside of the cella, where the statue of the god was placed[830]. According to Rita Sassu, the organisation and placement of a sanctuary are chosen to direct participants' attention to specific points relevant for the liturgical procedures[831]. Second, the interaction between the temple's inner space and natural light is analysed. By exploring the anthropology of light and lightscapes, Mikkel Bille and Tim Flohr Sørensen, suggested that «the continuous process of manipulation and orchestration of the world by means of light is an active component of social life in every culture»[832]. Third, this kind of analysis can inform the temporality of ritual activities at the temple[833]. Alignments of temples with cyclical celestial periods created temporal registers of sanctuary attendance,

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821 For the placement of Greek temples also see S.E. Alcock - R. Osborne, *Placing the Gods: Sanctuaries and Sacred Space in Ancient Greece*, Oxford 2004.
822 DE POLIGNAC 1995, 20.
823 MILES 2016b, 206.
824 MILES 2016a, 152.
825 BURKERT 1988; MILES 2016a.
826 COLE 2004, 57–64; MILES 2016a, 152.
827 SCULLY 2013; 1993.
828 EDLUND-BERRY 1987, 29.
829 MILES 2016a, 152.
830 PARTIDA 2020, 180.
831 SASSU 2018, 448.
832 BILLE - SØRENSEN 2007, 280.
833 PARISI 2020.

depending on the seasonality. Indeed, the seasonal meteorological changes constrained the labour and economic possibilities of an entire community, and this temporality was best organised within a cultic framework.

The preferred orientation of temples and altars was widely discussed in ancient literary sources. This literary evidence is here briefly reported. In particular, the terms 'statue-facing' and 'prayers-facing' are here adopted to indicate respectively the 'front' and the 'back' of a temple. Vitruvius preferred the eastern prayers-facing direction, resulting in a western facing temple, as expressed here:

Now the regions that the sacred dwelling of immortal gods should face should be established so that, if there is no impediment and there is unrestricted power to choose, both the temple and the cult statue which is to be housed in the cella should face the western regions of the heavens, so that those who approach with offerings and sacrifices will look toward the image within the temple beneath the eastern part of the heavens; and thus when they are raising their prayers, they will view both the temple and the rising heaven[834].

Implicitly commenting on Vitruvius' statement, Clement of Alexandria (2nd–3rd cent. AD) also stated that most ancient temples faced west, even though «people might be taught to turn to the east when facing the image»[835]. Frontinus, in a fragmentary passage on the origins of limites from the *Etrusca Disciplina*, stated that some architects have noted that temples should face west[836]. Hyginus further explained on the orientation of temples:

Limites are aligned according to the practice of ancient times. Therefore not every land measurement system faces east rather than west. 'Facing east' means in the sense of the orientation of sacred buildings. Now, architects in ancient times wrote that *templa* correctly faced west. Later on it was decided to make every religious building face that part of the sky from which the earth is lit up. So, *limites* too are established to face east[837].

In contrast with Vitruvius, Plutarch favoured an eastern statue-facing perspective, stating that «the worshipper who enters a temple, since temples face the east and the sun, has his back towards the sunrise»[838]. According to Sharon Herbert, Plutarch and Lucian are the only two ancient sources who explicitly mentioned the eastern orientation of temples[839]. Indeed, Lucian wrote that «[t]he eastern aspect, procuring us, as in the temples of old, that first welcome peep of the sun in his new-born glory»[840]. There is also a passage from Porphyry which can possibly be added to Herbert's list of those favouring the eastern orientation of temples: in his comment on the *On the Cave of the Nymphs*, he stated that «nearly all temples have the statues and the entrances turned toward the East, so that

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834 Vitr. *De arch*. IV.5.1, trans. Rowland 1999.
835 Clem. Al. *Strom.* VII,535, trans. Coxe 2001.
836 Front. *De Lim.* L 28.1-2 = C 8. 26-27.
837 «Secundum antiquam consuetudinem limites diriguntur. quare non omnis agrorum mensura in orientem potius quam in occidentem spectat. in orientem sicut aedes sacrae. nam antiqui architecti in occidentem templa recte spectare scripserunt: postea placuit omnem religionem eo conuertere, ex qua parte caeli terra inluminatur. sic et limites in orientem constituuntur», Hyg. *Const. Lim.*, L 169. 14-20 = C 137.16-20.
838 Plut. *Vit. Num.* 14.4, trans. Perrin 1914.
839 HERBERT 1984, 31–32.
840 Lucian *De Domo* 6, trans. Fowler 1905.

those who enter face the West when they stand face to face with the statues, bringing their prayers and worship to the gods»[841].

It can be suggested that the discussion should focus on the underlying reasons for such suggestions rather than on the east/west dichotomy itself. All sources suggested the prevalence of the eastern direction over the western one, with the only difference being which perspective was considered the most important: the statue-facing direction or the prayers-facing one. Vitruvius eloquently explained that the western direction of temples was a result of having devotees facing both the cella and the rising sun. Similarly, Apuleius wrote that «he turned himself unto the East, and made silently certain orisons unto the proud and rising sun, which caused all the people to marvel greatly at the sight of this solemn acting, and to look for the strange miracle that should happen»[842]. Indeed, for Vitruvius, only the eastward direction was preferred for altars[843]. Thus, when the human experience is considered as primary, the result is that temples face west, since worshippers should look at the temple while facing east. On the other hand, when the view of the god's statue is the most relevant perspective, temples tended to face east. It is also true that the dynamic experience of temples should be emphasised, as Plutarch's recounting of the life of Numa and his Pythagorean legacy suggests. Among his precepts were to «'Turn round as you worship'; and 'Sit down after worship'» since «the worshippers' turning round is said to be an imitation of the rotatory motion of the universe»[844]. For Burkert, «[m]any festivals take place in the morning; this makes people turn their faces, while praying and sacrificing, towards the rising sun, the rays of which would reach the image through the temple door at the same time»[845].Thus, Burkert interpreted that «worship means to 'come', to 'turn to' the gods (*hiketeia, prostropé*)»[846]. Plutarch also mentioned that he:

> would rather think that the worshipper who enters a temple, since temples face the east and the Sun, has his back towards the sunrise, and therefore turns himself half round in the direction, and then wheels fully round to face the god of the temple, thus making a complete circle, and linking the fulfilment of his prayer with both deities[847].

Plutarch's example, even if this is a later source, shows the dynamic experience of sacred space, highlighting the contrast and incompatibly between the direction of prayer, at the same time, towards the sunrise and the god. In this context, Ioannis Mylonopoupulos argued against temples as empty, contemplative spaces, questioning the fixed interpretation of scholars versus a more dynamic participant experience[848]. For Mylonopoupulos, Greek temple spaces were smelly, noisy, and filled with paraphernalia. Thus, to achieve an unbiased analysis, it is important to remember that ancient

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[841] Porph. *De antr. nymph.* 3, 5-10, trans. Lamberton 1983.
[842] «tune orientem obversus incrementa solis augusti tacitus imprecatus venerabilis scaenae facie studia praesentium ad miraculum tantum certatim arrexit» Apul. Met. II, 28, ed. Gaselee 1924.
[843] Vitr. *De arch.* IV.5.1.
[844] Plut. *Vit. Num.* 14.3-4, trans. Perrin 1914.
[845] BURKERT 1988, 37.
[846] BURKERT 1988, 35.
[847] Plut. *Vit. Num.* 14.4, trans. Perrin 1914.
[848] MYLONOPOULOS 2011.

Greek architecture was not one of contemplative, static objects but rather one of dynamic spaces, also generated by the movement of people and of light across these spaces. In summary, this orientation issue arising from reading of the sources suggests that more than one object of cult was present in a temple: the area of the rising sun together with the tutelary deity of the cult embodied within the statue in the cella. East was the preferred direction for orientation, even though it could also be expressed in the back-facing direction of the temple to enhance the devotees' experience.

These disagreements on orientation are reflected in recent scholarship on skyscape archaeology, in terms of which direction should be considered the most important in a sacred building: the direction towards the entrance or the direction looking at cella? As discussed by ancient authors, any preferential choices can be doubtful and contestable. Often, this issue in the scholarship is sadly underestimated, and different researchers adopt different assumptions often without critical argumentation for a specific choice in a particular socio-historical context. Among the scholars who prefer to measure the orientation towards the entrance or cult statue-facing direction are Efrosyni Boutsikas, Antonio Pernigotti, and Franco Ruggieri[849]. Others, such as George Pantazis and Evangelia Lambrou, considered the prayers-facing direction the most important[850]. Friedhelm Prayon, in his analysis of Etruscan temple orientation, considered both directions to be discerned in relation to their accordance with other sources[851]. Finally, Marcello Ranieri has studied the orientation of sacred structures in relation to their diagonal axis[852]. As mentioned earlier, in this research, the terminology used for temple orientation embraces both perspectives: the 'statue-facing' or 'front' and the 'prayers-facing' or 'back' of temple indicate one or another way of interpreting the main axis direction of a temple (fig. 22).

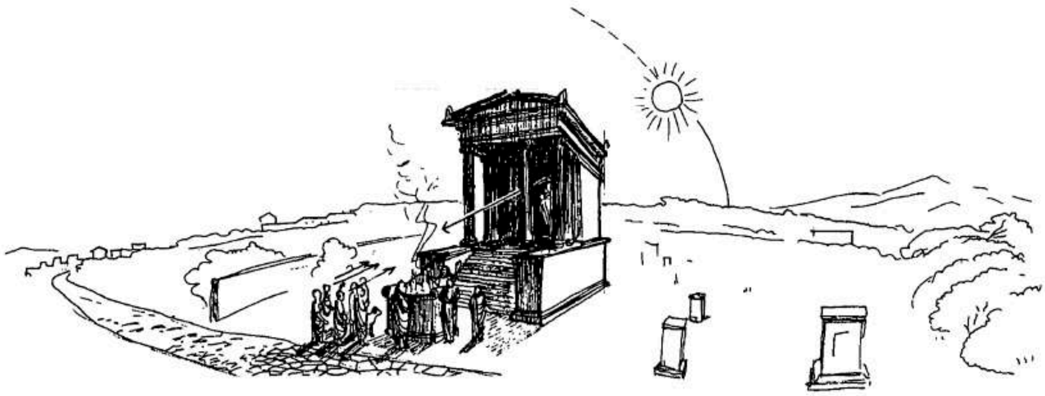

Figure 22. Drawing of a temple with the 'statue-facing' or 'prayers-facing' directions as indicated by arrows. Illustration by Thomas Noble Howe in ROWLAND - HOWE 1999, 230.

[849] BOUTSIKAS 2020; PERNIGOTTI 2019; RUGGIERI - CANDURRO 2014.
[850] PANTAZIS ET AL. 2009.
[851] PRAYON 1991.
[852] RANIERI 2010.

2.1 The Greek World

In the modern archaeological literature, the idea that Greek temples generally face east towards the rising sun is widely accepted[853]. Richard Stillwell cited «a principle so well known that it need scarcely be mentioned: orientation, in which practically every Greek temple, Bassae excepted, faces east or slightly north of east so that the rising sun may, at the proper season, shine on the cult statue»[854]. As evidence of the importance of the rising sun in Greek temples, Aeschylus in the *Agamemnon*, for instance, mentioned δαίμονές τ᾽ἀντήλιοι, translated as 'deities sun-fronting' or 'divinities that face the sun', since statues in temples are frequently opposite to the sun[855]. However, according to Herbert, though this is the only literary source contemporary to the building of Greek temples, it should be interpreted within its proper context as the «statues of the gods standing in front of the palace of Mycenae, the position of which would seem to have little relevance to the orientation of Greek temples»[856]. Herbert also noted the many exceptions to a supposed rule of Greek temple eastern orientation, with the dogma being more consistently followed in the Classical period[857].

Within early archaeoastronomical studies of Greek temples, Walter Penrose attempted to date the year of a temple's foundation by using astronomy, orientations, and festivities, but his calculations did not collimate at all with the archaeological data, with his often proposing a prehistoric timeframe for a building's foundation, at odds with the archaeological data[858]. Subsequently, at the beginning of the 20th century, Heinrich Nissen calculated the season of festivals based on the temple axis orientation. This led many scholars to think that the main temple axes were aligned according to the direction of the rising sun on a special day, such as the deity's birthday, or the sanctuary festival day[859]. This tradition of study informed the seasonality of rituals implied by the day and year of temple foundation. These assumptions tend to reflect Egyptian temple orientation, such as the orientation of the temple of Ramesses II at Abu Simbel orientation, where the sun at dawn on the 22nd February and 22nd October illuminates three of the four statue; these dates are thought to be important in Ramesses' life, possibly his birthday or coronation[860]. Thirty years later, using a more complete methodology but with the same assumptions, William Dinsmoor measured the orientation of 110 Greek temples and found that 73 per cent of his sample faced east within a 60° arc[861]. 8 per cent of the total faced west within a 60° sky arc, with a remaining 19 per cent outside the solar rising or setting arc[862]. These data were published in 1939, anticipated by the statement that «[i]n the actual fact, the axes of Greek temples box the entire compass; but more than 80 per cent run, if not exactly

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853 BURKERT 1988, 34; MIKALSON 2010, 18.
854 STILLWELL 1954, 4.
855 Aesch. *Ag.* 519, trans. respectively by ROBERT BROWNING 1889 and HERBERT WEIR SMYTH 1926.
856 HERBERT 1984, 31.
857 HERBERT 1984, 33.
858 PENROSE 1893, 380–383.
859 NISSEN 1869; PENROSE 1893; DINSMOOR 1939; NISSEN 1906.
860 SHALTOUT - BELMONTE 2005, 291–293; BELMONTE 2015; MILES 2016b, 206.
861 DINSMOOR 1939, 115.
862 DINSMOOR 1939, 115.

east-and-west, at least within the arc formed on the horizon between the sunrise directions at the summer and winter solstices. It seems that most temples were laid out to face the sunrise on the actual day of their foundation, presumably on the festival day of the divinity; a minority faced in other directions for special reasons of site, tradition, or relation to other buildings»[863]. Dinsmoor proposed that the Old Parthenon in Athens was founded on a specific day, *Hekatombaion* 27/28, to celebrate Athena's birthday and the *Panathenaia* festival[864]. He calculated that the year of foundation, within the archaeological timeframe 490-480 BC, was 488 BC[865]. Robert Hannan recently revisited this hypothesis and studied the visibility of the constellations mythically related to Athena in the context of the starry sky at the time of the *Panathenaia* festival[866]. Also in the recent years, the hypothesis of determining a foundation day and festival after orientation was further examined by Pantazis *et al.* using very accurate geodetic and astrogeodetic data measurement and analysis[867]. Among their findings, they noted the orientation divergence of the nearby (106 m apart) temples of Zeus and Hera in Olympia. Their main axes of these two temples, which face north-east, differ by 3° 19', causing their axes to converge towards the skyline. According to the scholars, the sun would have risen at this point twice a year, aligning with the temple axes within a 7-day interval that marks the duration of the festivals. Initially, at the time of the autumnal *Heraia* Olympia festival, the sun rose in line with the Heraion axis and, after 7 days, it aligned with the axis of the temple of Zeus[868]. Pantazis and Lambrou believe that the orientations of these temples were deliberate to mark the duration of this important festival at Olympia[869].

Research on a larger statistical sample has provided new insights into the role of Greek temple orientations in cult practice (fig. 23)[870]. In a study of 51 temple orientations in Magna Grecia and Sicily, Anthony Aveni and Giuliano Romano found that axial orientations of temples varied by region[871]. In the broadest such sample to date and covering 232 religious structures (including temples, fifteen altars and three *stoas*, from the Mycenaean to the Roman period located in the regions of Greece, Sicily, Asia Minor and Cyprus), Boutsikas found that 55.7% structures faced east within the solar arc, with few differences over time[872]. Within her sample, 9.3% of structures, mainly in Asia Minor and Delos, faced west within the setting positions of the sun[873]. In total, within the sunrise and sunset arc, 65% of religious structures faced within the sunrise and sunset arc [874]. Boutsikas found no evidence of fundamental solar directions, such as the solstitial or equinoctial ones[875], and therefore

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863 DINSMOOR 1975 [1902], 49.
864 DINSMOOR 1939, 119–123; 1934, 441–448.
865 DINSMOOR 1939, 122.
866 HANNAH 2013, 435–439.
867 PANTAZIS ET AL. 2009; PANTAZIS - LAMBROU 2018, 24.
868 PANTAZIS - LAMBROU 2018, 27.
869 PANTAZIS - LAMBROU 2018, 27.
870 BOUTSIKAS - RUGGLES 2011.
871 AVENI - ROMANO 2000.
872 BOUTSIKAS 2020, 36, 48.
873 BOUTSIKAS 2020, 36.
874 BOUTSIKAS 2020, 36.
875 BOUTSIKAS 2020, 40; 2021, 204.

dismissed the rising sun as a significant factor in temple foundations. Instead, she proposed a more nuanced case-by-case approach, focusing on the movements of the night sky and stars[876]. In Sicily, temples do show a clear preference for the eastern direction within the solar range, with the exception of two temples at Selinous and one at Akragas that faced north, thus indicating a difference between the motherland and the colonies[877]. Indeed, Alun Salt focused on Sicily and calculated that 40 out of 41 temples do face east[878]. In conclusion, according to Boutsikas, «the general statements in favour of temples and altars being oriented towards a specific cardinal point reflect another gross oversimplification of a much more complex practice»[879]. To add another perspective on this topic, it is worth mentioning Brady Kiesling, who posed the question of whether Greek temples were aligned with other sanctuaries or cult marks[880], suggesting that such practices may have been common in other contexts [881]. Kiesling's conclusions were restated by Andrew Stewart *et al.* in the context of the interpretation of a frieze at the temple of Athena *Pallenis* at Pallene/Stavros, in a cult connected with the Delian Apollo; the temple was indeed oriented towards the island of Delos and shared this orientation with other temples, such as the Apollo *Daphnephoros* at Eretria, the Apollo *Zoster* in southern Attica, and the Apollo temple at Aigina. [882]. Local topographical features also played a role in the orientation of temples at Akragas and Selinunte[883]. Finally, Pantazis and Lambrou pointed out how the orientation (prayers-facing) of the Temple of Poseidon at Cape Sounio (azimuth 104° 12'), on the southern coastal extremity of Attica, had both topographical and astronomical significance, as it was directed towards the sacred island of Delos, as well towards the rising sun on the festival Athenian *Poseidia* in the ancient Attic month of *Pyanepsion*[884].

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[876] BOUTSIKAS 2007; BOUTSIKAS - HANNAH 2011; 2012; BOUTSIKAS 2020, 40–42.
[877] BOUTSIKAS 2020; 2021; SALT 2009.
[878] SALT 2009.
[879] BOUTSIKAS 2020, 70.
[880] KIESLING 2018.
[881] This might have been a common practice in ancient Egypt. Few scholars put in evidence the presence of many sacred structures in the third millennium BC Old Kingdom in Egypt pointed towards Heliopolis, the city of the Sun God (JEFFREYS 1998; SHALTOUT - BELMONTE - FEKR 2005, 420–421). For D. Jeffreys in the Fourth Dynasty an inter-visibility condition between built pyramids and the city of Heliopolis was evident to emphasis the sacral and political aspect of the royal ideology (JEFFREYS 1998). For Massimiliano Nuzzolo and Jaromír Krejčí there are many morphological conditions which hide visibility, at least in case of Abusir, suggesting a more symbolic use of the direction in respect to real visibility (NUZZOLO - KREJČÍ 2017, 366). According to Shaltout *et al.* the location of the solar temples at Abu Ghurob and the pyramids of Abu Roash, Giza, Zawiyet el Aryan, and Abusir were set in accordance to Heliopolis, as well to main solar and stellar events (SHALTOUT - BELMONTE - FEKR 2005, 420–421). The topographical importance of Heliopolis for other sanctuaries was thus emphasised in this mentioned research.
[882] STEWART ET AL. 2019, 637-638,691,695-697.
[883] HANNAH - MAGLI - ORLANDO 2016.
[884] PANTAZIS - LAMBROU 2018, 26.

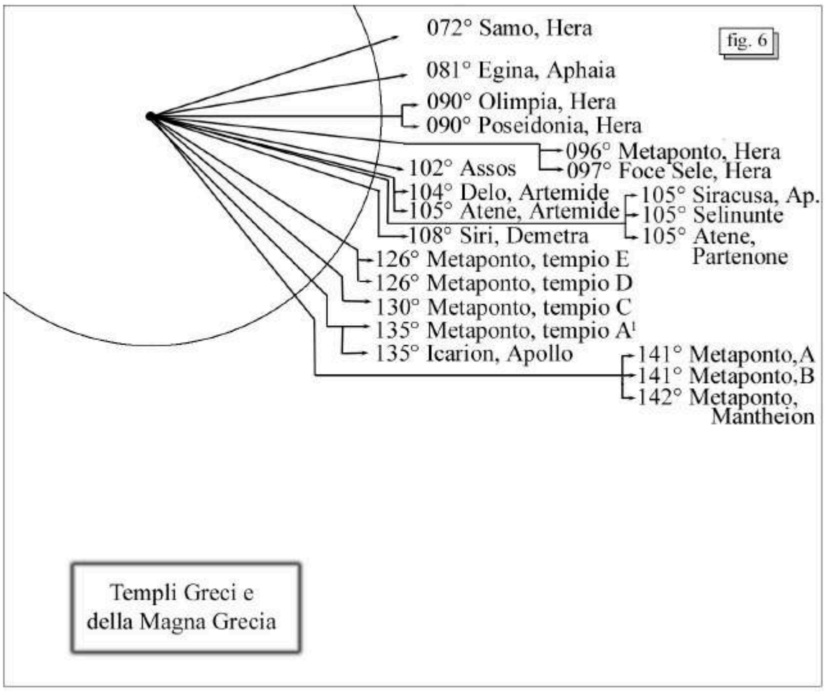

Figure 23. Orientations of a small sample of Greek Temples in Greece and Magna Graecia. After PAGANO – RUGGIERO 2011, 103.

2.1.1 *NATURAL ILLUMINATION IN GREEK TEMPLES: DOORS AND WINDOWS*

Within this area of study of Greek temples, the relationship between temple orientation and the reconstruction of inner temple illumination through the motion of the sun is a significant topic[885]. In her investigation of temple interiors, Margaret M. Miles stated that the illumination within a temple is closely related to its orientation[886]. According to Elena Partida, «[s]unlight held a dominant position in ancient Greek religion and architectural design»[887]. First of all, the peristyle provided shade for those using the building for their practice. Additionally, the placement of doors and windows in the temple helped to bring light into the inner space, thanks to their planned position and the overall orientation of the building.

Doors

The front door of the temple was the main entrance for people and light and, so, a direct relationship can be drawn between natural illumination and orientation[888]. According to Walter Burkert, Greek festivals used to take place in the morning, so that the rising sun would have illuminated the cult statue[889]. Thus, Burkert stated, this made «the huge door in the *nāos*, turned towards the rising sun,

[885] WILLIAMSON 1993, 23–24.
[886] MILES 2016b, 206–207.
[887] PARTIDA 2020, 177.
[888] MILES 2016b, 207.
[889] BURKERT 1988.

normally the only source of light for the interior»[890]. However, doors also provided a monumental frame over and above their functional role of allowing the entrance of light and people. According to Mylonopoulos «the architectural design of Greek temples leaves no doubt that visual contact between the community and the divinity was of great importance in the performance of rituals»[891].

Christina Williamson emphasised the evolution, from the 7th to the 2nd cent. BC, of the role of natural illumination in Greek temple cellae, noting a progressively increasing amount of light due to the ever-shorter length of cellae and the increasingly higher doors[892]. In the Archaic period, there were two main types of temples: the long temple, usually in the Doric order, and the more quadrangular Ionic building[893]. She stated that «the importance of the morning sun piercing the long interiors seems to have waned with the long temples themselves»[894]. Williamson found that, within archaic Doric temples with long cellae, the illumination was granted by an accurate orientation to the sun, which caused relative darkness for most of the year apart from on the chosen days[895]. In contrast, Ionic quadratic insular temples were more evenly illuminated throughout the year. This finding by Williamson is consistent with temple orientation statistics produced by Boutsikas, when she analysed Greek temples by architectural orders: Doric temples face predominantly east (67% of the sample), while Ionic temples tend to be oriented towards the south (40.6%)[896]. In the Hellenistic period, shorter cellae allowed for more light to enter the inner space, possibly due to the need to see the added ornamentation of the inner sacred spaces[897]. At this stage, the orientation may have been based on other civic or religious structures rather than the sun, Williamson suggested[898]. More variegated architectonic forms appeared, such as *tholoi* and additional fenestration. Also, windows and side doors were added to enhance visibility, circulation in the inner space, illumination, and ventilation.

The function of the lateral side doors can vary, such as providing access to a fountain or facilitating the circulation of devotees around the sanctuary. It has been argued that they might have also served to create light epiphanies at dawn, such as in the Temple of Apollo *Epikourios* at Bassae[899]. With the peculiar orientation of this temple facing north, Vincent Scully suggested that this unique side door looking out towards the east may have been intended to open on Mt. Lykaion and the rising sun at Apollo's feast day[900]. Audrey Dubernet studied temples with several doors[901]. In the case of temples with two doors on different sides, nine examples were identified by Dubernet; examples of a main door on the short side plus a secondary lateral one can be cited at the temples at

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890 Burkert 1988, 34.
891 Mylonopoulos 2011, 270.
892 Williamson 1993, 13.
893 Williamson 1993, 28.
894 Williamson 1993, 24.
895 Williamson 1993, 28.
896 Boutsikas 2021, 204–205.
897 Williamson 1993, 29.
898 Williamson 1993, 24.
899 Cooper 1968, 106–111; Miles 2016b, 207; 2016a, 154–155.
900 Scully 1993, 101–103.
901 See A. Dubernet, *Ouvrir et fermer la maison du dieu: les portes des temples en Grèce égéenne de l'époque archaïque aux Antonins*, thèse de doctorat, École doctorale Montaigne-Humanités - Ausonius-Institut de recherche sur l'Antiquité et le Moyen âge, Bordeaux 3, 2017.

Bassai, Delphi, Karthaia, Lousoi Artémis Hemera, Lykosoura Desponia sanctuary, Néa Roda-Sanè, Soros, the temple of Alea at Tegea, and Messene[902]. Of temples with two doors on the same side, five examples have been identified, datable from the proto-Archaic and Archaic period. These examples are Mitropolis, at Thermos the Temple C and the Temple of Apollo Lyseios, Kalapodi North Temple, Isthmia (Poseidon and Aphrodite). A double-fronted door can be related to there being a central colonnade, but this is not a general rule. More multiple doors have been confirmed at the temple at Didyma, the Pythion GT at Selinus, and the Hieron on Samothrace, possibly as required by ritual procedures[903]. Hypaethral temples or those with an opening, or ὀπαῖον[904], provided a different light design in the sacred area[905].

Windows

Windows allowed the penetration of sunlight, often in a way that could induce the perception that they were placed to intentionally produce epiphanies of a god or goddess. In her doctoral thesis, Marietta Dromain investigated the use of openings for lighting and ventilation in Greek temples[906]. The number of openings, their location, the possible function of the opening, the system of ventilation, and natural and artificial illumination are all explored. Windows in some temples, such as the Pythion in Delos, were meant to evacuate smoke from the sacred fire. Thus, ventilation is one of the main explanations for windows. The windows in the east cella wall in the Parthenon have been suggested to have been used to evacuate smoke from burning offerings and incense, or from the inextinguishable sacred fire within the sanctuary[907]. However, it can be argued that the Parthenon is a treasury and there was no altar or fire inside. In the Parthenon, the two windows in its façade placed very high up the wall opened towards the front colonnade and, in the morning when the sun rises, there is one moment when it shines directly into the temple[908], though the sunlight would have directly hit the ceiling not the building. For Dromain, the windows in the Parthenon are problematic, unless they are understood to have probably been for decoration only[909]. Regarding temples without an altar or fire, such as the Aphaia Temple at Aegina, very narrow slit-windows can be reckoned to have been functional, for allowing light in or for evacuating the smoke of lanterns[910]. In Egyptian temples, these slit-windows were decorated with geoglyphic signs for sunlight, suggesting that illumination was the primary concern. Indeed, slit-windows can be found also on staircases. By their structure, slit-windows do not allow a view into an inner temple.

Further reasons for openings near the roof of temples were the need to ensure proper ventilation in the ceiling timberwork, as well as the need to relieve the load on superposed

[902] PARTIDA 2020, 179.
[903] PARTIDA 2020, 179.
[904] Plut. *Per.* 13.5.
[905] PARTIDA 2020, 181–183.
[906] DROMAIN 2016a.
[907] WILLIAMSON 1993, 25; PARTIDA 2020, 179–181.
[908] See M. Korres - G.A. Panetsos - T. Seki, *Ho Parthenōn: architektonikē kai syntērēsē*, Athēna 1996.
[909] DROMAIN 2016b.
[910] See H. Bankel, *Der spätarchaische Tempel der Aphaia auf Aegina*, Berlin 1993, 58, fig. 29.

architectural courses with a gable-aperture, such as the triangular void typical of Mycenaean funerary *tholoi*[911]. The gable opening at the temple of Artemis at Magnesia ad Meander has been suggested by Anthony Spawforth to create a lit appearance of the goddess, but this hypothesis has not been properly tested to advance it as a statement[912]. Skylight-tiles, or pierced-tiles, are roof tiles with a hole; these can have many shapes allowing the evacuation of smoke or to light the space. The oldest known examples of these pierced-tiles are at the Artemis Temple, Korkyra, Corfu, dating from the 6th-5th cent. BC. A differentiation between a light-well (φωτοθυρίς) and an air-hole (ἀεραγωγός) can be attempted on the basis of the position within the temple design and the technical details of the opening[913]. Other reflective effects could be created in the relative positions of the cult statue, a pool of water, and a skylight-tile. At Olympia, in the Temple of Zeus, the elliptical piece of pierced-tile found there may have been used to enhance an epiphanic experience[914]. Arnd Hennemeyer argued that the pool below the statue received light from an opening in the roof creating the illusion of the statue moving, adding to the 'aliveness' of the god/goddess[915]. The reflective effects of light might well have rendered temple more dynamic; in the temple of Zeus at Olympia, the reflection of water, light and curtains might well have produced a more sensorial impressions as participants moved across the sanctuary. These many variants of the entrance of light from various directions rather question the assumption that the position of the sun when rising and the main axis orientation of a temple are in a biunivocal relationship; this question on temple illumination is very complex and needs further unravelling[916].

2.2 The Etruscan World

The study of Etruscan temple orientations has rested upon the attempt to reconcile the sixteen Etruscan gods known from the Piacenza's liver with the sixteen divisions of the sky by Martianus Capella (5th cent. AD) described in his text *De nuptiis Philologiae et Mercurii*[917]. After Massimo Pallottino's work in 1956 on the celestial regions, or *deorum sedes*, of Etruscan gods, the hypothesis of a possible relationship between these regions and temple orientation arose from Ragna Enking's study[918]. In 1991, Friedhelm Prayon attempted the first systematic orientation analysis of 18 Etruscan temples[919]. In his sample, the temples were earlier than 500 BC since, for the scholar in the 5th cent. BC onwards, temples had to be adapted to the urban orthogonal layout[920]. As a result of the comparison between orientation and *deorum sedes*, temples dedicated to Uni/Juno clustered in region 10 or 11 (south-west); however, since the posterior regions corresponding to region 1–4 or of *summa*

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[911] PARTIDA 2020, 185.
[912] SPAWFORTH 2006, 85.
[913] PARTIDA 2020, 185.
[914] ADLER ET AL. 1892, 10.
[915] HENNEMEYER 2011; 2015; Paus. 5.23.1.
[916] BOUTSIKAS 2020, 34.
[917] DUMÉZIL 1996, 684–691.
[918] PALLOTTINO 1956; See Enking, R. (1957). *Zur Orientierung der etruskischen Tempel. Studi Etruschi*, 25, 541–544.
[919] PRAYON 1991.
[920] PRAYON 1991, 1286.

felicitas[921], were better adapted to a feminine divinity, the worshipped deities were considered to be at the back of the temple and not at the front[922]. With similar reasoning, Tina/Jupiter region 7 would correspond to region 15 of the *deorum sedes*[923]. Subsequently, Castagnoli mapped the orientation of temples and altars in Latium and Etruria, publishing a polar diagram that emphasised the south-east and south-west as the major direction in which temples were facing[924]. In a subsequent fieldwork season, Anthony Aveni and Giuliano Romano measured 32 structures, realising how previous published measurements were wrong since most of the temples aligned within 140°–240° with some exceptions pointing at 95°–120°[925]. In 2011, Alfredo Guarino considered that the sample of 33 temples were directed at azimuth 180°–230°, symmetrical to the south, within an asymmetrical celestial cross due to a calculation error in the measurement of the equinox[926]. The orientation of altars in Etruria was further examined by Silvia Menichelli and, more recently, by Diana Pavel, although in both cases general quadrants were used to indicate orientation with no quantitative data on azimuth[927]. Finally, Antonio Pernigotti analysed 40 sacred Etruscan structures in 16 different locations, ranging from the 7th to the 2nd century BC (fig. 24)[928]. The data clustered around four areas. Ten temples open towards the east and would have received dawn sunlight for a couple of days a year. The majority, around 65%, face the southern sky in the arc within the winter solstices rising and setting; according to Pernigotti, this orientation trend may be related to the desire to have the front of the sacred building illuminated by the sun and to the role of the sun in divination rituals[929]. It is also true that southern-facing temples did not get direct solar illumination into the cella, which would have remained in permanent darkness, whereas eastern-facing temples did allow penetration of the sun's rays at specific times of the year at sunrise[930]. Only two temples were oriented to the west, not far from the position of the setting sun at the winter solstice, and two other temples were oriented to the north, never illuminated by the sun; these are the Tuscan temple of Vigna Parrocchiale at Cervetri and the *sacellum Gamma* at Pyrgi, and their orientation may be coherent with a chthonic nature[931]. The Temple of Vigna Parrocchiale is unique in relation to other Etruscan temples due to its orientation facing north-west[932]. If for Mauro Cristofani the azimuth is 321°, for Pernigotti the corrected measurement is 317°.5[933]. According to Paola Moscati, the north-facing orientation can be read as a precise intention of placing the temple in a dominant position with respect to the urban fabric[934]. An elliptical building for public engagement, such as *ludi* or meetings, was constructed near the

921 Plin. *HN* 2.144.
922 PRAYON 1991, 1291.
923 PRAYON 1991, 1292.
924 CASTAGNOLI 1993, 231–233.
925 AVENI - ROMANO 1994.
926 GUARINO 2011.
927 MENICHELLI 2009, 13.
928 PERNIGOTTI 2021b.
929 PERNIGOTTI 2021a, 117.
930 PERNIGOTTI 2021a, 117.
931 PERNIGOTTI 2021a, 118.
932 MOSCATI 2010, 28.
933 MOSCATI 2010, 28; PERNIGOTTI 2019, 8.
934 MOSCATI 2010, 28.

temple[935]. According to visibility analysis, it was possible to gather some hints on the relational position of the temple, the urban area, and the necropolis[936]. According to Pernigotti's study, a correspondence between individual orientation and worshipped deities were found only for the case of Uni, Vei, and Heracle: therefore, no general statements between the orientations and the celestial dwellings of the deities were achieved as the issues are analytically complex (fig. 25)[937].

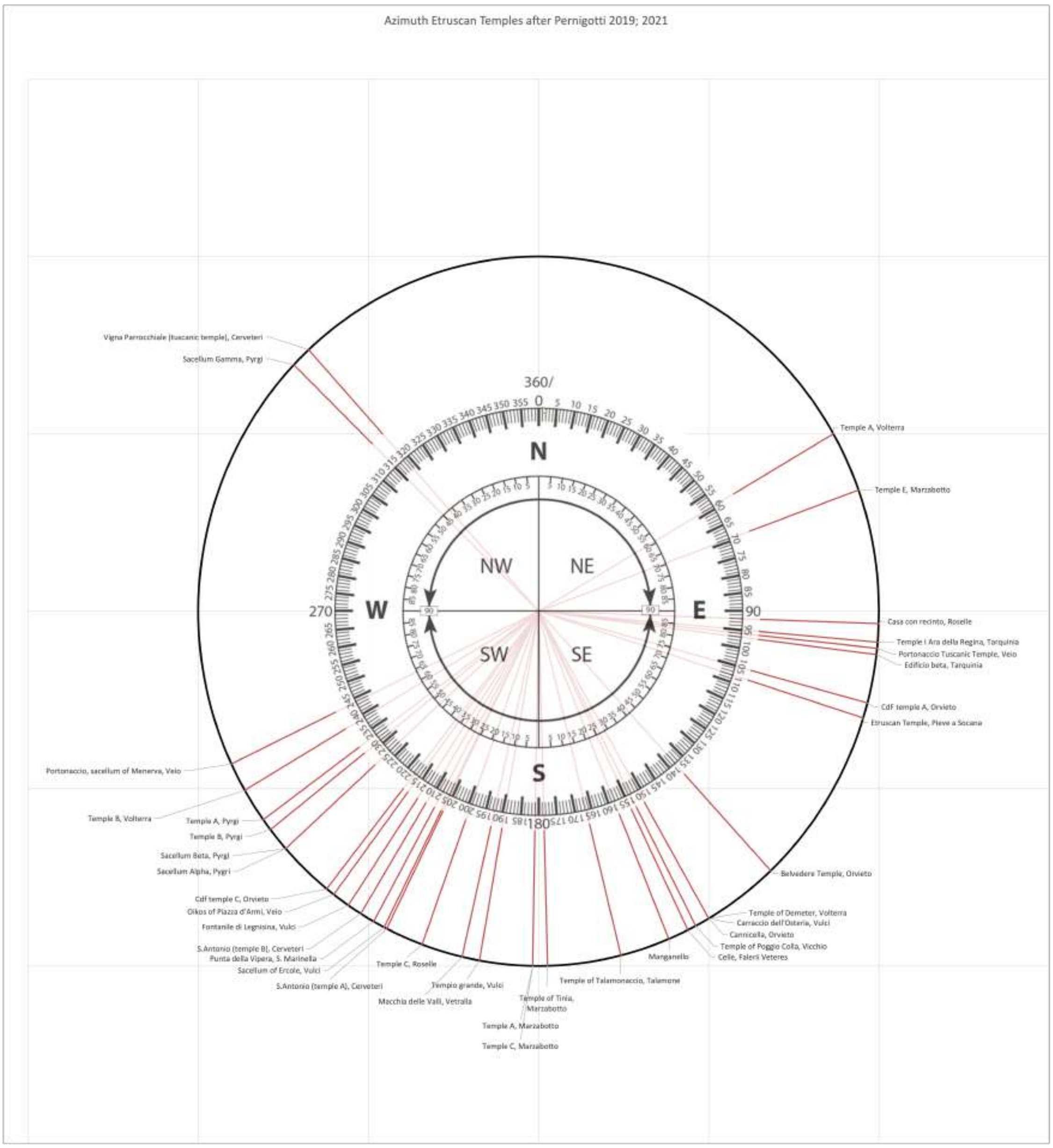

Figure 24. Polar Diagram of Etruscan Temple Orientations. Elaborated by the author after data from PERNIGOTTI 2019; 2021b.

[935] MOSCATI 2010, 29.
[936] MOSCATI 2010, 28–30.
[937] PERNIGOTTI 2018; 2021b.

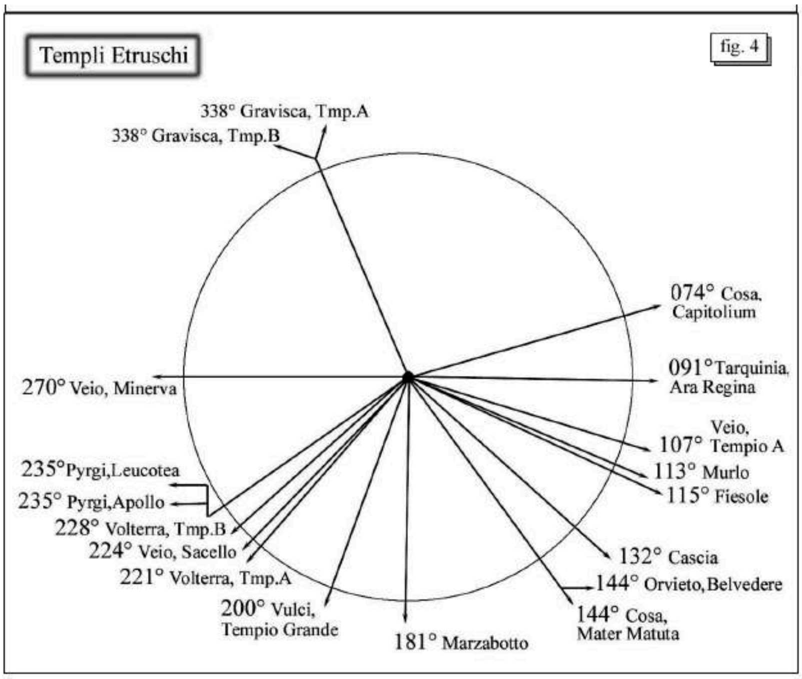

Figure 25. Orientations of Etruscan temples. After PAGANO – RUGGIERO 2011, 102.

Within the topic of the individual analyses of Etruscan temple orientations, the case of Pyrgi is pertinent to the present discussion. At Pyrgi, on the Tyrrhenian coast of southern Etruria, a sacred complex has emerged in the course of the 60-year field campaign conducted there by the Sapienza University of Rome. The construction of Temple B is datable to 510 BC, and it is possibly dedicated to *Uni* and *Astarte*. Temple B has an azimuth of 232°, at the entrance direction, or cult statue-facing direction towards the sea, and an opposite 52° azimuth towards the hinterland[938]. There, at the prayer-facing direction, the main axis of the temple seems to point at the Sassoni di Furbara (Sasso) site, two peaks with a history of habitation from the end of the Bronze Age to the Iron Age as revealed by nearby necropolises. Moreover, the declination (+28°.63 as measured by Horizon software) is very close to the lunar major standstill, with a midwinter full moon rising at that direction every 18.6 years. The topographical target of Sassoni di Furbara could be plausible but, from a viewshed analysis, there is no direct visibility between the archaeological site of Pyrgi and the peaks. Instead, where the temple is facing towards the sea, the orientation differs by a few degrees from the position of the moon standstill of *circa* 4° in azimuth. The position of the planet Venus as the evening star might also be considered relevant to the temple orientation here[939]. César Esteban and Daniel Iborra Pellín suggested that the orientation of Temple B is consistent with the southernmost position of the setting of Venus at a declination of -27° around the time of the construction of the temple (fig. 26)[940]. This

[938] PERNIGOTTI 2019, 9.
[939] ESTEBAN - PELLÍN 2016.
[940] ESTEBAN - PELLÍN 2016, 164.

theory gains support from the existence of Phoenician archaeological remains dedicated to the goddess Astarte, which can be found at El Carambolo temple (Camas, Province of Seville, Spain) and at the Temple of Baalat Gebal at Byblos (Lebanon); both of these face towards an open view of the western horizon with a very similar orientation[941]. Following Ivan Šprajc's analysis, the maximum extreme position of Venus occurs when it has an angular distance of 30° from the sun, making it fully visible as an evening star after sunset[942]. A variation of half a degree occurs on the extreme declination of the planet every 251 years[943]. The southernmost position of Venus has and had a strict seasonality, occurring around 40 days before the winter solstice by the end of the 6th cent. BC. If the archaeoastronomical analysis is consistent, it is probable that rituals were centred around that time of the year. Venus was named *Phosphoros* by the Greeks, *Lucifer* by the Romans, but there are no hints of her Etruscan name[944]. At the Venti Celle sanctuary at Pyrgi, a hypothesis was first proposed by O. W. Von Vacano that the antefixes with rooster heads carrying dew drops may be identified with Venus/*Phosphoros*/*Lucifer*[945].

Temple A was built a few decades later, around 470 BC, with a slight divergent azimuth of 234°[946]. The dedication to *Thesan* and/or *Cavatha* is suggested by a head of *Leukothea* that was found within a votive pit. According to Ranieri, Temple A at Pyrgi has its main diagonal aligned with the cardinal directions east-west[947], even though an error of at least 6° from the cardinal direction can be determined by using the Google Earth Pro ruler tool. The azimuth of 234° is beyond the arc of the setting of the sun and does not coincide with the major lunar standstill, missing it by 6° in azimuth. On the opposite side, at 54°, the lunar standstill diverges by 1° from the main axis of the temple (declination +27°.39 from the horizon). The layout of Temple A and B corresponds to a geometrical Pythagorean triple of 3:4:5 with respect to the meridian, even if this technique was used to avoid error over long distances[948]. It seems appropriate to consider that both sacred buildings were oriented towards the planet Venus, as the archaeological material evidence of the cult also suggests. Indeed, the inscription at Pyrgi was interpreted by Giovanni Pugliese Carratelli as indicating 'stars'[949]. In 1968, Giovanni Garbini suggested a reading «[and] the angles of the temple goddess' sacrarium have been oriented (?) like these stars», but this exegesis was later revised by the same author[950]. The relationship with stars, among which Venus can be included in an ancient perspective of thought, was explicitly indicated in the sanctuary at Pyrgi.

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[941] ESTEBAN - PELLÍN 2016, 163–164.
[942] ŠPRAJC 2015, 509.
[943] ŠPRAJC 2015, 511.
[944] COLONNA 2012, 52.
[945] COLONNA 2012, 571–573; RAFANELLI 2021, 71; See O.W. Von Vacano, "Überlungen zu einer Gruppe von Antefixen aus Pyrgi", in R. Krinzinger (ed. by), *Forschungen und Funde: Festschrift fur Bernhard Neutsch*, Innsbruck 1980: 463–475, 465–7.
[946] PERNIGOTTI 2019, 9.
[947] RANIERI 2010, 215.
[948] RODRÍGUEZ-ANTÓN ET AL. 2019, 115.
[949] CARRATELLI 1965, 303–305.
[950] «[e] gli angoli (?) del sacrario della dea del tempio sono stati orientati (?) come queste stelle» according to G. Garbini, "Scavi nel santuario etrusco di Pyrgi. Relazione preliminare della settima campagna, 1964, e scoperta di tre lamine d'oro inscritte in etrusco e in punico. L'iscrizione punica", in *Archeol. Class.* 16, 1964, 74, cited in RIBICHINI 1975, 42.

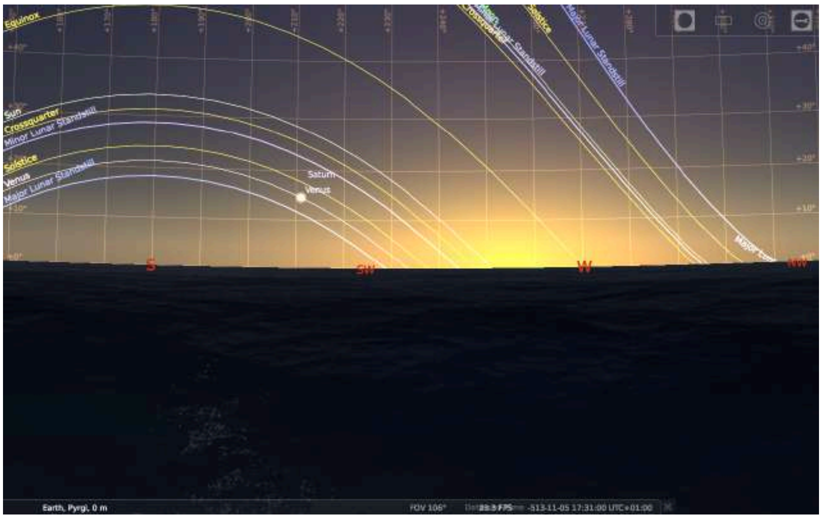

Figure 26. Venus setting seen from Temple B at Pyrgi. Elaboration by the author with Stellarium.

2.3 The Oscan World

Mario Pagano and Franco Ruggieri studied the orientations of temples in the Apennines, built by population groups known as the Pentri and Irpini and speaking the Oscan language[951]. The temples in the sample were built after the end of the 4th–3rd cent BC[952]. The results showed a clear trend towards south-east orientations, with angles ranging between 106° and 160° in a sky arc of only 54° (fig. 27)[953]. Even though no clear explanation was suggested by the authors for this trend[954], the importance of the solstices, with some temples oriented towards the winter sunrise if statue-facing or summer sunset if prayers-facing, is very apparent. Furthermore, some temples had a precise orientation towards the sun rising at winter solstices, such as at Ocriticum and San Pietro di Cantoni[955]. The sanctuary of Pietrabbondante, religious centre of the Samnites, also had a good level of approximation with the winter solstice sunrise. The Doric Temple in Pompei also exhibits a similar configuration in its orientation[956]. Furthermore, the analysis posited the role of the helical rising of stars to explain the trend, particularly in relation to sowing and agricultural activities[957]. Further investigation is needed to contextualise this interesting trend of temple orientations in the Oscan speaking world.

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951 PAGANO - RUGGIERI 2011.
952 PAGANO - RUGGIERI 2011.
953 PAGANO - RUGGIERI 2011.
954 RUGGIERI - PAGANO 2010, 231–233.
955 RUGGIERI - PAGANO 2010, 232.
956 CRISTOFARO 2022.
957 RUGGIERI - PAGANO 2010, 233; RUGGIERI - CANDURRO 2014.

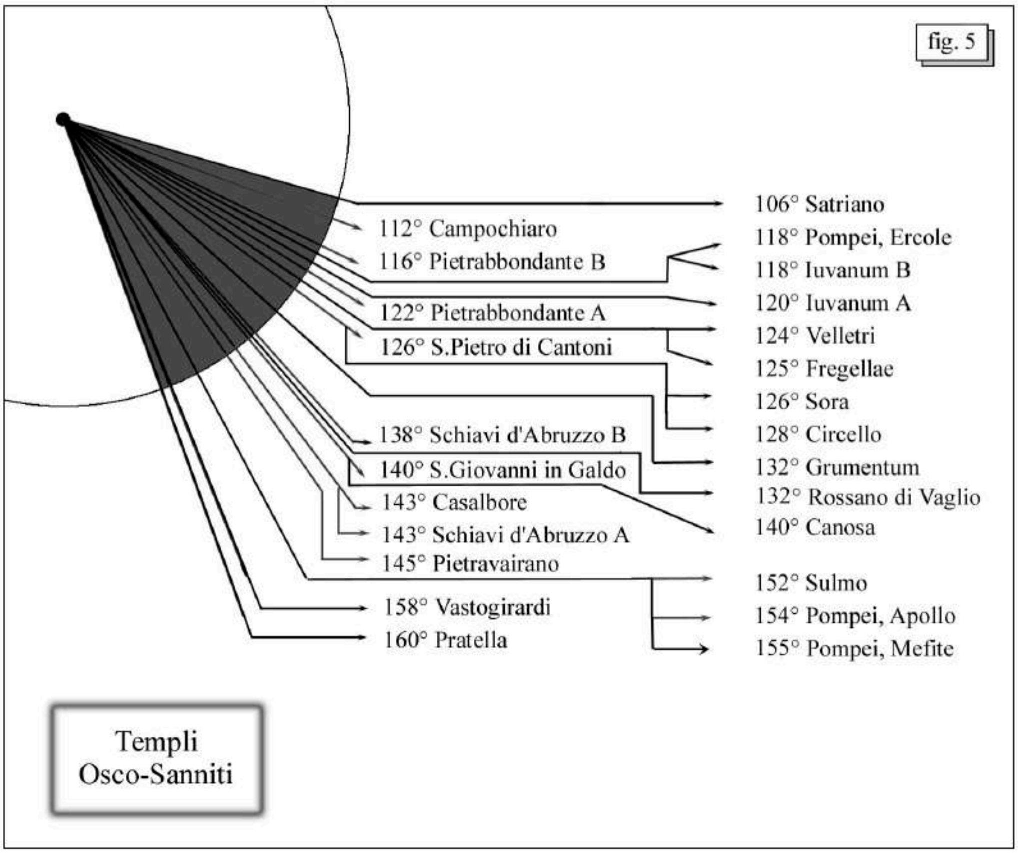

Figure 27. Orientation of Oscan-Samnite temple. After PAGANO – RUGGIERO 2011, 103.

2.4 The Latium and Roman World

The alignment of altars and temples in Latium and Rome (fig. 28) have been discussed by Claudia Moser with an emphasis on the changes that occurred in single case studies over time. For instance, she discussed the changing orientation of the altar during the 5th cent. BC at S. Omobono in Rome[958]. The first phase of the monumental archaic temple faced south at an azimuth of 199°.3. Set orthogonally with respect to the main axis of the temple, the archaic U-shaped altar had a direction of 109°.3 azimuth, pointing toward the Palatine hill at an altitude of 3°.6, near the place where the 2nd cent. BC temple of Magna Mater was built, itself near to the cultic place of the mythical Romulus's hut[959]. Moreover, Moser suggested that a winter sacrifice took place at the sacred site as evidenced by the age of the faunal remains and the orientation toward the head of the Scorpio constellation at the cross-quarter day between the autumn equinox and the winter solstice[960]. In the Republican phase of the temple after the 5th cent. BC, the twin temples were adapted to face directly south, whereas the

[958] MOSER 2014b, pp. 322–332.
[959] MOSER 2014b, 322–323.
[960] MOSER 2014b, 331.

altar was facing east at 90°. A precise intentional spatiality in the setting of sacred structures in Rome can be inferred from this example.

In the sanctuary of the Thirteen Altars at Laviunium, just south of Rome in Latium, a shift in the orientation of the built altars was observed as having occurred in the middle phase of construction[961]. From the first phase in the 6th cent. BC to the second phase in the mid-5th cent. BC, a deviation of 4°.3 is evident in the orientation of the altars; finally, in the last phases of the late 5th – mid 4th cent. BC and late 4th cent. BC, the new altars returned to the original orientation of the first phase[962]. Claudia Moser analysed this phenomenon using data from a vectoral AutoCAD survey plan[963]. The archaic altars show an azimuth of 72°, which corresponds to a 0°.3 altitude on the horizon[964]. Moser proposed that this orientation corresponded to the heliacal rising of the star Arcturus, α Boötes, some days before the autumn equinox in the 6th cent. BC, with the first light of the sun appearing below the Alban mountains[965]. There must be an error in the calculation since the rising of Arcturus happened there at 44° azimuth. Instead, the asterism that is most significant at that direction would be the Pleiades, rising around 73°azimuth. Due to precession, their rising position would have shifted northwards, not following the deviation southwards of the later altars. The sun would have risen in that direction around 60 days before and after the summer solstice in the 6th cent. BC. In fact, the topographical evidence seems a more plausible explanation of the altars' orientation, pointing towards the Lake of Nemi. Moser does not seem to support the idea of this being the topographical target, even though she provides evidence for such a conflation[966]. In the second phase of construction, five similar altars were added to the first three ones, with a slightly different orientation of 76°.3, on the same line but *circa* 8 metres apart[967]. Such deviation was interpreted by Moser as an adjustment to the calendric reform of the 5th cent. in Rome and the ritual scheduling of sacrifices for leap years[968]. A difference of 10-11 days in the orientation might be explained by some time reckoning issues, which tend to be difficult to reconstruct on the basis of the philological reconstruction of the archaic and classical calendars. Although this is a possible explanation, the topographical sacred target, which is also evident at Castrum Inui Temple A, seems to suggest a univocal mosaic of orientation in Archaic and Classic Latium.

At Ardea in the locality of Fosso dell'Incastro, on the coast of Latium south of Rome, specifically at the site of Castrum Inui, there are two altars from the 4th century BC facing in opposite directions, east and west, in front of temple B[969]. It is interesting to interpret this sacred topography in the context of a story recounted by Dionysius of Halicarnassus. He describes the arrival of Aeneas on the Latium coast and his sacrifices to the gods as thank-offerings for the fresh water he finds there.

961 MOSER 2014b, p. 347.
962 MOSER 2014b, p. 347.
963 MOSER 2014b, pp. 347–356.
964 MOSER 2014b, p. 347.
965 MOSER 2014b, p. 248.
966 MOSER 2014b, n. 103.
967 MOSER 2014b, n. 350.
968 MOSER 2014b, pp. 350–356.
969 TORELLI 2011, 216.

There was a spring, Dionysius of Halicarnassus continued, sacred to the sun, and nearby two altars were oriented one east, the other west[970]. In particular, with respect to the orientation of the altars, he mentioned their direction towards the rising and setting sun, ὁ μὲν πρὸς ἀνατολὰς τετραμμένος, ὁ δὲ πρὸς δύσεις[971]. Mario Torelli identified this place, as described by Dionysius of Halicarnassus, as Castrum Inui, at Ardea[972]. For Torelli, the altars represent the deep connection between the deity *Inuo/Indiges* and the course of the sun, especially in its chthonic passage[973]. The exact orientation of the altars was more precisely measured by Claudia Moser in order to gain a fuller understanding of the possible role indicated by their particular positions. The 4th cent. BC U-shaped altar in front of temple B is oriented (122°.7) towards the position of the winter solstice sunrise (121°.6)[974]. If one altar is oriented at 122°.7 towards the winter solstice sunrise, the second is directed 231°.9 azimuth, with its back to Temple B[975]. With the latter, Moser suggested the astronomical target was towards ε Canis Major, or in general to the setting of Sirius, the α star of that constellation[976]. However, in the case of Sirius, the star would have set at an azimuth of 247°.40, not in line with the altar orientation and, thus, this does not seem a plausible hypothesis[977]. Moser also took into account the other direction, the uncanonical prayer-facing direction, of 51°.9[978]. However, it is here argued that the sacred structures could be read as a playground for solar and lunar calendric synchronisation, with the U-shape altar dedicated to the sun and the rectangular one to the moon. To hypothesise ritual actions on the site, this double orientation reflects, at the time of the winter solstice, the sun's position rising at dawn in line with the U-shaped altar and, after some hours around sunset, the full moon rising in line with the rectangular altar and behind the temple, with a cyclicity of every 18.9 years at its major standstill position (around 50°.5 azimuth). Alternatively, by having its back to Temple B, the rectangular altar might have provided, with a flat view of the sea on the western horizon, a determination of the first crescent moon, again at the time of winter-solstice nightfall, though depending on visibility conditions, towards the direction of 231°.9. For instance, ideally, taking for example the day 04/01/-302 in Stellarium, in the year of major lunar standstill, the first crescent moon (illumination 0.5%), the new moon would have set at an azimuth of 231°.5, which would be a great marker for the new month, and possibly the new year if it was visible, if not the day after when it would have set at 236° azimuth. The first hypothesis would not suffer from visibility-condition issues and the view of the full moon would have had a more predictable rising position, but the second option has more sense from a calendric starting point with the new moon. If instead a summer ritual is considered, the moon might have played a role at dawn, with the major standstill full moon setting in line with the direction of the rectangular altar with its back to temple B, while the sun would have

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970 Dion. Hal. *Ant. Rom*., I.55.1-2.
971 Dion. Hal. *Ant. Rom*., I.55.2.
972 TORELLI 2011, 206–207.
973 TORELLI 2011, 216.
974 MOSER 2014b, 334.
975 MOSER 2014b, p. 341.
976 MOSER 2014b, p. 341.
977 SMITH 2020.
978 MOSER 2014b, 343.

started to rise above the Alban hills on the opposite side. But a topographical direction is also plausible for the rectangular altar's orientation, considering the presence of Mt. Algidus, just nearby the 4th cent BC temple of Diana Nemorensis at the Lake of Nemi. However, one interpretation does not necessarily exclude the other, when considering that the view of the rising full moon at winter solstice nightfall above Temple B and above the hills where the Diana Nemorensis sanctuary was located, might have had some significance to the ritual performed at Castrum Inui. A century later, in front of temple A, another hourglass-shape altar was built, in this case with an orientation of 46°.1, astronomically pointing towards Betelgeuse at the time of summer solstice, and with Castor rising around eight days after the summer solstice according to Moser's interpretation[979]. This time, the altar and the temple are facing towards the Alban hills[980], specifically towards the Diana Nemorensis sanctuary. Such ratification of orientation may also support the topographical target of the previous Temple B and rectangular altar. In conclusion, it can be stated that a dual ritual related to the sun and moon can explain the two adjacent and contemporaneous altars of the 4th cent. BC; moreover, the sacral importance of the *circa* 23 km distant Diana Nemorensis sanctuary was emphasised by the visual connection established through the orientation of the 3rd cent. BC Temple A and its altar.

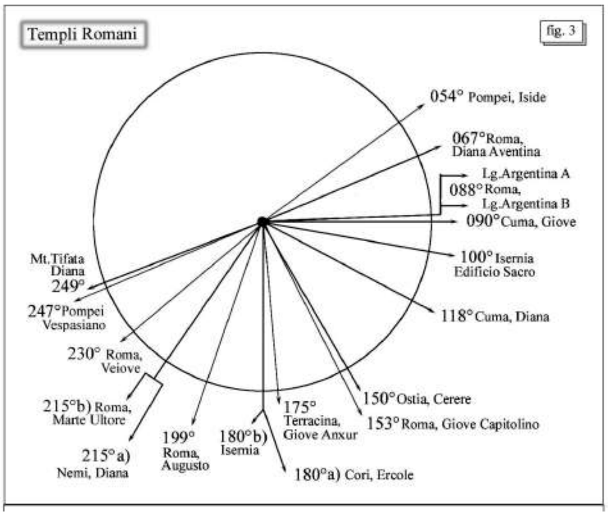

Figure 28. Orientation of Roman temples. After PAGANO – RUGGIERO 2011, 102.

979 MOSER 2014b, pp. 336–340.
980 MOSER 2014b, p. 337.

3. *Festivals and Calendars*

Temples and ritual actions are closely allied to the time and space of a feast[981]. As explained by Valeria Parisi, the feast is the full expression of a culture, encompassing its language, religion, and socio-political organisation[982]. The importance of festivities for the identarian development of social groups have been also reaffirmed by Mario Torelli[983]. In a calendar, stated Le Goff, everything is an anniversary[984]. Integrating these thoughts, James Davidson mentioned that «a calendar is a 'live' web of significances, not merely a useful index of events»[985]. Calendars were mainly religious in character[986] and, for this reason, they will be explored here within this chapter on the 'Sky and the Sacred' in relation to celestial events. The heliacal rising of stars were important markers of the year, but this varies depending on the latitude and altitude of the horizon[987]. Stars have the important characteristic of keeping synchronised with the solar year, except for the precession of the equinoxes, as the sidereal year agrees, to within 99.99 percent, with the annual course of the sun[988].

3.1 The Greek World

«Time in Greece is not an abstract entity, but the cycles of stars and luminaries», said James Davidson[989]. From Hesiod to Homer's description of the shield of Achilles, the celestial bodies have been mentioned in the earliest Greek literature as time markers and seasonal regulators for farmers and seafarers[990]. The arrival of different seasons was evident from the observation of nature, as a 6th cent. BC attic *pelike* suggests, where the sight of a swallow indicates the arrival of spring[991]. An annual sequence of constellations as timekeepers was depicted on a large Archaic skyphos dated to 625 BC, found in a votive pit of a sanctuary at Halai in East Lokris; it was decorated with a Corinthianising frieze of a series on animals, interpreted by John Barnes as constellation imagery and, in particular, «seasonal representations of the night sky» (fig. 29)[992].

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981 Parisi 2020, 291.
982 Parisi 2020, 285.
983 Torelli 2013, 43.
984 Le Goff 1982, 555.
985 Davidson 2007, 210.
986 Di Fazio 2017, 421.
987 Davidson 2007, 206.
988 Davidson 2007, 206.
989 Davidson 2007, 204.
990 Franzoni 2002, 141.
991 Franzoni 2002, 154.
992 Barnes 2014, 257.

Figure 29. The two sides of the Halai skyphos, ca. 625 BC, Lamia Archaeological Museum H91-648. From BARNES 2014, 261.

This vascular evidence can be compared with other pottery with figurative constellations, such as a Late Geometric krater from Pithekoussai featuring a possible representation of Bootes, and a 5th or 6th cent. fragment from Canosa with Taurus and Argo asterisms. However, the Halai skyphos seems unique in its depictions of a sense of seasonality as expressed by constellations and in the votive function it carried. Barnes recognised the constellations depicted and divided them according to their visibility, rising and setting at specific times of the year, forming four distinct seasonal groups[993]. The lack of a precise understanding of the calendar at Halai militates against any further consideration of the connection between local festivities and the decorative astral motifs but, following Barnes' interpretation, the skyphos can be considered the first iconographical testimony in ancient Greece of a true relationship between sacred time and the sky.

[993] BARNES 2014, 268–272.

3.1.1 Stars and Navigation

Stars were essential for navigation at night. This is demonstrated in the Homeric poems, when Odysseus used the constellations to navigate[994]. Homer mentioned the Pleiades, Boötes, the Bear, and Orion, and Calypso advised keeping the Bear on the left in order to navigate towards the east[995]. Another piece of textual evidence of the use of stars for orienting oneself on a journey is offered by Oedipus in Sophocles' tragedy, when he looked poetically up at the stars to orient himself in a new land, saying «I turned my back upon the land of Corinth; and I used the stars to steer well clear of that direction, somewhere where I could be sure I'd never see the shameful horrors of my evil oracle fulfilled»[996]. At Pithekoussai, a fragment of a Late Geometric krater (LG I) showing Euboean influences was interpreted as representing the constellation of Boötes (fig. 30)[997]. The identification of the pentagonal figure as the Boötes constellation is suggested by the presence of star symbols and the letter Beta, in the closed variant of the Chalcidian alphabet[998]. The brightest star of the constellation of Boötes is Arcturus. As Claudia Moser stated «[t]he importance of Arcturus in the astrometeorological texts of the archaic Graeco-Italic world is unquestionable»[999]. For instance, Hesiod mentions the rising of the star and how its setting was the marker of the beginning of the cold winter season[1000]. Thucydides affirmed it was a reliable indicator of the weather, and particularly for determining the appropriate time for war[1001]. In Aeschylus, Prometheus is thought to have taught men how to measure time by teaching them about the observation of the sky:

> They had no sign either of winter or of flowery spring or of fruitful summer, on which they could depend but managed everything without judgment, until I taught them to discern the risings of the stars and their settings, which are difficult to distinguish[1002].

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[994] Hom., *Od.* V, 270-279.
[995] Hom., *Od.* V, 270-279.
[996] Soph. *OT*,794-797, trans. O. Taplin 2015.
[997] Monti 1999, 127.
[998] Monti 1999, 130; Guarducci 1967, 89–90; 217.
[999] Moser 2014b, 329.
[1000] Hes. *Op.* 566.
[1001] Thuc. 2.78.2.
[1002] Aesch., *PV*, 454-459, trans. H. Weir Smyth 1926.

Figure 30. Fragment LG I Euboeanising krater locally produced, Santa Restituta church, Lacco Ameno, inv. Vol IV, p. 130, n. 1579. Incision identified with Boötes constellation, with pentagon stars and Beta symbol. Height 5.3 cm; width 4 cm. From MONTI 1996, 19.

In a long tradition starting from Hesiod, the constellation of Pleiades served as a temporal marker for the start and end of the navigational period, with its respectively achronycal setting and heliacal rising[1003]. The synchronisation with the movement of the stars and the blowing of the wind provided the timing for navigation in a secure environment. According to Daniela Coppola's study on winds in ancient Greece, in Hesiod this propitious time falls within the fifty days between the summer solstice to the end of summer[1004]. Tomislav Bilić suggests that the foundation myth of Cumae, in which a dove guides the founders as recounted by Velleius Paterculus and Statius, was related to astral navigation as well[1005]. The dove could refer to the Pleiades constellation, or *Peleiades*[1006]. It is worth noting that the observation of birds was also used as a clear marker for the direction to land, without necessarily implying the constellation. However, Athenaeus clearly argues that the heavenly *Peleiades* were transposed to the Pleiades constellation based on Homer's description of the Nestor Cup, which served as temporal symbolic indicators of sowing and harvesting[1007]. In the Forum of Cumae, the temple building A featured antefixes with architectural decorations depicting female figures, possibly representing the Pleiades[1008]. The importance of this constellation in Campania is further emphasised by the urban orientations in the region, as further discussed in the 'Data Analysis' section.

[1003] BILIĆ 2006, 40–41.
[1004] COPPOLA 2010, 103–104; Hes. *Op.* 663-675.
[1005] BILIĆ 2006; RESCIGNO - PARISI 2022.
[1006] BILIĆ 2006, 42.
[1007]Ath. *Depn*. XI, 489b-492e.
[1008] RESCIGNO 2006.

3.1.2 STARS AND AGRICULTURE

Ritual festivities and astral movements were often associated in ancient Greek thought. The heliacal rising of stars provided a tool for determining the generally appropriate time for individual festivals. Indeed, Greek religious festivals were typically held on a fixed day of the same month every year[1009]. This connection is explicitly stated in a primary text from Hellenistic Egypt, which noted the fundamental relationship between the local sacred calendar of festivities and the rising and setting of stars[1010], saying «[t]hey therefore keep most of the festivals annually on the same day, without alterations owing to the setting or rising of a star»[1011]. The strong association between agriculture, festivities, and astral cycles, is evident in the festival called *Proarktouria* by Hesychios, which was timed to precede the rising of the star Arktouros just before the ploughing season[1012]. On the agrarian seasonal cycle, the main topic of his *Work and Days*, Hesiod linked agricultural activities to the visibility of the Pleiades constellation: the time for harvesting, or «when first you sharpen your sickle», was marked by their heliacal rising, while the time for ploughing by their morning setting[1013].

The importance of the Pleiades in the agricultural cycle is literally and archaeologically documented in Campania. The cult at the temple of Diana Tifatina at Capua was mythically associated with the presence of a Nestor Cup, as Athenaeus remembered[1014], which dates to the Orientalising period[1015]. This 2nd century AD author stated that «a cup like this is on display today in the city of Capua in Campania; it is dedicated to Artemis, and the locals claims that it is actually Nestor's cup»[1016]. After associating the round shape with the form of the cosmos citing Asclepiades of Myrlia[1017], Athenaeus described with great accuracy the presence of the constellation of the Pleiades engraved on the cup with two stars beneath the base, giving a total of six stars, as the ones visible[1018]: «now that it has been demonstrated that the Pleiades were engraved on the cup, we must assume that there were two of them per handle, regardless of whether one wants to conceive of them as girls who resemble birds, or as having human shape but covered with stars»[1019]. He went on, stating that «(Homer) thus accurately engraved what is seen among the stars into the pattern visible (on Nestor's cup) »[1020]. Furthermore, he mentioned that «they mark the seasons for the production of dry foods» and that the Nestor's cup was used for drinking a mixture made of cheese and barley-groats, and that the Pleiades «fix the times for sowing and harvesting crops»[1021].

1009 DAVIDSON 2007, 205.
1010 FOWLER - TURNER 1983, 348.
1011 Hibeh papyrus I 27, lines 18-54, in FOWLER - TURNER 1983, p. 348.
1012 BOUTSIKAS 2020, 4, 165.
1013 Hes. *Op*. 383–84, trans. Evelyn-White 1914; Aratus *Phaen*. 254–67; for the technical terms used here see in Chapter One, 2.4 'Star Seasonal Phases: Heliacal Rising'.
1014 Ath. *Depn*. XI, 466d-e; 489b;
1015 CERCHIAI 1995, p. 157.
1016 Ath. *Depn*. XI, 489b-c.
1017 Ath. *Depn*. XI, 489c-d.
1018 Ath. *Depn*. XI, 489b-492e
1019 Ath. *Depn*. XI, 491e.
1020 Ath. *Depn*. XI, 492c.
1021 Ath. *Depn*. XI, 492d-e.

Around 430 BC, Hippocrates suggested a division of the year based upon the rising and setting of major stars, very similar to Hesiod's approach[1022]. If the agricultural seasons were synchronised with the movement of the sky, mainly the Pleiades, Arcturus, and Sirio, the year was reckoned to prove healthy.

By studying and observing after this fashion one may foresee most of the consequences of the changes. One should be especially on one's guard against the most violent changes of the seasons, and unless compelled one should neither purge, nor apply cautery or knife to the bowels, before at least ten days are past. The following are the four most violent changes and the most dangerous: both solstices, especially the summer solstice, both the equinoxes, so reckoned, especially the autumnal. One must also guard against the risings of the stars, especially of the Dog Star, then of Arcturus, and also of the setting of the Pleiades. For it is especially at these times that diseases come to a crisis. Some prove fatal, some come to an end, all others change to another form and another constitution[1023].

Claudio Franzoni proposed a synchronisation of the star phases with the Julian calendar, in line with Hippocrates' account[1024]:

Table 1

Seasons	Celestial Phenomena	Approximate correspondence Julian Calendar
Ploughing and sowing	The Pleiades sets at dawn	5 November
Winter	Solstice	26 December
Time of planting trees	Arcturus rises at sunset	27 February
Spring	Equinox	26 March
First summer part	The Pleiades rises at dawn	21 May
Second summer part	The Dog Star rises at dawn	28 July
Fall	Arcturus rises at dawn[1025]	21 September

Another one of the most important heliacal risings was that of Sirius, α Canis Majoris, the brightest star of the night sky, announcing the arrival of summer heat and the so-called «dog-days»[1026]. A passage by Apollonios mentioned the summer arrival of the star Sirius just before dawn[1027].

But when from heaven Sirius burned the Minoan islands, and for a long time there was no remedy for the inhabitants, then by the command of the Far-Shooter they summoned a protector from the plague. And at his father's command he left Phthia and settled in Keos, gathering together the Parrhasian people who are of the race of Lykaon, and he made a great altar to Zeus Ikmaios, and duly offered sacrifices on the mountains to that star Sirius, and to Zeus son of Kronos himself. And because of this the Etesian winds from Zeus cool the land for forty days, and in Keos even now priests offer sacrifices before the rising of the Dog-star [1028].

1022 Hippoc. *Aer*. 10-11, trans. Jones 1868.
1023 Hippoc. *Aer*. 10-11, trans. Jones 1868.
1024 DEL GRANDE 1959; FRANZONI 2002, 145.
1025 This differs from what reported by FRANZONI 2002, 145; see also Soph *OT*, 1137.
1026 Hes. *Op.* 582-588.
1027 DAVIDSON 2007, 207.
1028 Ap. Rhod. *Argon*. 2.516-27, trans. R.C. Seaton 1912.

The heliacal rising of Sirius is also mentioned in Euripides' *Iphigenia at Aulis*, with Agamemnon's sighting of the star before dawn – «'What is this star which makes its crossing?»[1029]. This information sets the action at a particular time of the year, late July/early August[1030].

3.1.3 Stars and Dance Rituals

Literary or epigraphic documentation of the role of stars in rituals at specific sanctuaries is very scant. Nevertheless, the helical rising of the Pleiades is also mentioned in a fragmentary text from Alcman's *Partheneion* 'Maidens' Song', performed in the form of a *khoros*, a dance-song ensemble or choral lyric composed in the late 7th cent. BC. In Alcman's *Partheneion*, and within a context of Spartan ritual festivity, Gloria Ferrari perceived a cosmic dance being evoked throughout the text, this being the archetypical dance for the chorus of the maidens, the *Partheneion*[1031]. Alcman's passage about the heliacal rising of Pleiades stated:

I say this because the Pleiades,
as we bring the sacred veil for the Dawn Goddess,
are passing through the ambrosial night, rising up over the horizon
like Sirius the star, to do battle with us[1032].

For Ferrari, this is a cosmic dance in a state festival intended to assure political order through reflecting the order of the universe[1033]. Efrosyni Boutsikas and Clive Ruggles analysed the spatial layout of the Sanctuary of Artemis *Orthia* in Sparta, also called *Parthenon Orthia*[1034]. They found that the orientation of the altars (δ=+13°), unvaried from Geometric to Roman times, fitted well with the rising point of the Pleaides (δ=+12° in 800 BC, δ=+15° in 150 BC)[1035]. The heliacal rising of the Pleiades would have happened around a month before the summer solstice, which suggests that the 'Procession of the Girls' festival took place at that time[1036]. For Ferrari, that «the constellations in the night sky are dancing choruses of maidens is commonplace in Greek thought and literary imagery. The Pleiades in particular are the archetypal dancers»[1037]. This view is confirmed by Plato, who described the movement of the stars as χορεία - in translation, the art of dancing and singing[1038]. The stars were seen dancing in the sky as this passage from Plato suggests «this is the nature of the stars, fairest to see, and passing along, dancing the fairest and most magnificent of all dances in the world, the make good the needs of all living creatures»[1039]. In some artefacts where dancers are portrayed,

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[1029] Eur. *IA*, 1-8.
[1030] Davidson 2007, 206.
[1031] Ferrari 2008, 1–18.
[1032] Alcman, *Partheneion* PGM1, 60-63, trans. G. Nagy.
[1033] Ferrari 2008, 17.
[1034] Boutsikas - Ruggles 2011, 60.
[1035] Boutsikas 2020.
[1036] Boutsikas 2020.
[1037] Ferrari 2008, 3.
[1038] Pl. *Ti.* 40c.; Pl. *Epin*. 982e.
[1039] Pl. *Epin*. 982e, trans. Lamb 1925.

these individuals have been interpreted as representing stars, such as with the Sotades Painter's *astragalos*, dated to the first half of the 5th cent. BC, which may depict the Pleiades and the Hyades[1040]. Indeed, these dancers, suspended in mid-air, have been interpreted as the asterism Pleiades and Hyades by O. M. von Stackelberg[1041]. Ferrari suggested that the male chorus-leader is Pythagoras. Similarly, according to Francisco Molina Moreno, the Pleiades were «the mythical bearers of cosmic music in early Pythagoreanism» and their role as chorus leaders should be placed within this philosophical tradition[1042]. Yet, in Euripides' tragedies, the theme of chorus, ritual, and astral dancing is also present[1043]. For Hyginus the «the Pleiades are thought to lead the circling dance for the stars»[1044]. According to Callimachus, the Pleiades were the first to institute the choral dance and nocturnal festivals[1045]. The image of the Pleiades as a choir of stars is widespread across Greek poetry.

In Campania, the orientation of Temple A at Cumae may be related to the Pleaides's 'morning setting': when it was early winter dawn in the 4th – 3rd cent. BC, the asterism was seen setting on the west, behind the acropolis. If the Temple opened to the west, as some scholars thought[1046], the celestial event was probably seen from within the temple. Depending on the temple elevation and inner space division, from the naos looking at the pronaos, the temple entrance framed the acropolis and the setting stars. On the opposite side, the sun was rising in the east behind Mount Grillo, starting a new day at the beginning of winter. Such sky drama might be evoked by the architectural fictile elements of Eos and the water carriers which decorated the temple roof.

3.1.4 LUNI-SOLAR CALENDARS

There is evidence that the Moon played an important role in time reckoning for the ancient Greeks. For instance, its phases were observed for various purposes, including the conduct of warfare, since a full moon or a new moon night would have made a difference in battle due to the illumination it could provide of the field. Herodotus recounted that during the Persians wars, according to a law, it was not permissible to set out on campaign unless the moon was full[1047], although, according to Ferrari, the occurrence of the *Carneia* festival might have been the reason for this rule[1048].

1040 LIMC 14716.
1041 See O. M. von Stackelberg, *Gräber der Hellenen*, Berlin, 1837, pl. 23; FERRARI 2008, 2.
1042 MOLINA MORENO 2013, 182.
1043 «In the center of the shield the sun's bright circle was shining on winged horses, and the heavenly chorus of stars, Pleiades, Hyades, bringing defeat to the eyes of Hector» Eur. *El.* 464-69, trans. E. P. Coleridge; «if he, the sleepless night watcher, shall see the torch procession on the twentieth day, beside the springs with lovely dances, when the starry sky of Zeus also joins in the dance, and the moon dances, and the fifty daughters of Nereus, in the sea and the swirls of ever-flowing rivers, celebrating in their dance the maiden with golden crown and her revered mother; where this vagabond of Phoebus' hopes to rule, entering upon the labor of others» Eur. *Ion.* 1075-85, trans. R. Potter.
1044 Hyg. *Poet. astr.* 2.21.3, trans. M. Grant.
1045 Callim. fr. 693 Pfeiffer.
1046 CAPUTO ET AL. 1996, 88.
1047 «they resolved to send help to the Athenians, but they could not do this immediately, for they were unwilling to break the law. It was the ninth day of the rising month, and they said that on the ninth they could not go out to war until the moon's circle was full». Hdt. 6.106.3, trans A.D. Godley.
1048 FERRARI 2008, 108.

> For the Spartans, Lycurgus drew from the sky his ordering of their whole polity and made it their law never […] to go to the war, before the moon should be at her full, for he thought that the potency of the moon is not the same when she waxes and when she wanes, and that all things are subject to her sway[1049].

This passage is cited in the context of a famous episode during the Persian wars when, on the eve of the battle of Marathon, the Spartans did not send in their troops to aid the Athenians since it was not full moon. For Ferrari, «the moon in particular seems to have played a most important role in the Spartan polity»[1050]. The moon made up the month starting from new moon and its D-shaped crescent[1051], and «the circle of the full moon which divides the month in two» quickly became a C-shaped crescent during its waxing phase[1052]. In Sparta's calendar, festivals were probably held during the full moon[1053]. Instead, the new moon was the time to collect debts and interest[1054].

The problem of intercalation and synchronisation between the lunar month and the solar year is due to the fact that a solar year does not consist of an integer number of lunar months, but rather more than 12 and less than 13. This led to the creation of a Great Year period, a unit of time which would repeat the movement of the sun, moon, and stars[1055]. In his *De die natali*, Censorinus briefly reported the topic and the many variations of the Great Year period, also known as the *annum magnum,* in which intercalary months were added to the third, fifth, or eighth years[1056]. This could take the form of an eight-year cycle called the *octaeteris*, adding three months each eight years[1057]. Censorinus mentioned that the Pythian Games at Delphi and other festivals in Greece were celebrated according to this eight-year cycle[1058]. This Great Year is half of the Metonic cycle of 18.6 years, when the sun, moon phases and stars return to the same position and relative correspondences[1059].

Enneateric festivals, held every ninth year, were also celebrated, corresponding to the new year after the eight-year cycle[1060]. The *Septeria* was an *enneateric* festival in which the Delphic *Daphnephoria*, celebrating Apollo's return from Tempe after purifying himself for the slaughter of Python, took place[1061]. The Theban *Daphnephoria* festival, as recounted by Proclus (5th cent. BC) and transmitted by Photius (9th cent AD), was given cosmological and calendric significance by the utilising of bronze globes attached to an olive tree branch with laurel and flowers, to be borne aloft in a procession; the central bronze globe symbolised the sun, and the other smaller ones the moon

[1049] Lucian, *Astrology* 25, trans, Harmon 1936.
[1050] Ferrari 2008, 108.
[1051] Davidson 2007, 205.
[1052] Eur., *Ion.* 1155–6.
[1053] Eur. *Alc*. 450.
[1054] For the calculation of interest and collection of debts at the new moon, see Ar. *Nub*. 16–18, 756, 1131-36, 1178-1200; Gainsford 2012, 27; Mheallaigh 2020.
[1055] Censorinus, *DN* 18.
[1056] Censorinus, *DN* 18.
[1057] Parker 2011.
[1058] Censorinus, *DN* 18.
[1059] Boutsikas 2020.
[1060] Censorinus, *DN*, 18.4.
[1061] Boutsikas 2020.

and stars; meanwhile, 365 red garlands represented the course of the year [1062]. In Sparta, the *enneateric* renewal of kingship was related to the observation of the stars, as Plutarch recounted[1063], and to the celestial *Dioskouroi*[1064]. The kingship was removed if a shooting star was observed[1065]. The role of the sky and the twin stars *Kastor* and *Polydeukes* acquired major significance for the Spartan army, as their appearance or disappearance were seen as decision-making agents respectively in the battle of Aegospotami and Leuktra[1066]. According to Ferrari «[i]n no actual polis did the observance of astral phenomena play a greater political role than at Sparta»[1067].

According to Robert Parker, *enneateric* festivals can be traced back to the Archaic period at least, together with *penteteris* festivals[1068]. For Censorinus, the revolution of four years and the *penteteris* festivals in the fifth year were the most common in Greece and were used to count the number of years form the last Olympiad[1069]. Such cyclicity would have reasserted the luni-solar calendar[1070]. The Olympic games were set according to the lunisolar calendar and probably happened on the full moon after the summer solstice. It has been suggested that Herakles was the hero who founded the Olympic games[1071]. In Sophocles' *The Trachiniae*, according to Simonetta Feraboli, the role of Herakles in relation to time reckoning and the 8-Great Year cycle can be read between the lines in the numerology of the story[1072]. Only two scholia annotating Pindar speak about the Olympic calendar. *Ol.* III 35 suggested the role of the full moon in determining the start of the games, every 29 or 50 months, in the Elean months of *Apollonois* and *Parthenios*. *Ol.* III 33 indicates that the games were related to the heliacal rising of Arcturus in the autumn[1073]. This is reminiscent of Pausanias' account of how the women of Elis on the appointed day when the Olympics Games began gazed at the setting sun: «[o]n an appointed day at the beginning of the festival, when the course of the sun is sinking towards the west, the Elean women do honor to Achilles, especially by bewailing him»[1074].

[1062] «The laurel-bringing (δαφνηφορία) is this: an olive branch is wrapped with laurels and flowers of various colors and a bronze sphere is attached to the tip of the branch, with smaller ones hanging off of it; around the middle of the branch they put smaller balls than the tip and fasten purple garlands; the ends of the branch they wrap with a saffron-colored robe. By these it is meant for the top-most sphere to represent the sun (which they ascribe to Apollo), the one below represents the moon, the attached balls represent the constellations and stars, and the garlands represent the course of a year: for they make 365 of these». Photios, *Bibliotheca*, 239: Proclus' *Grammatical Chrestomathy*, trans. by R Baumann.
[1063] «…he himself [Lysander], with his colleagues, proceeded to observe the traditional sign from heaven. This is observed as follows. Every ninth year the ephors select a clear and moonless night, and in silent session watch the face of the heavens. If, then, a star shoots across the sky, they decide that their kings have transgressed in their dealings with the gods, and suspend them from their office, until an oracle from Delphi or Olympia comes to the succour of the kings thus found guilty». Plut. *Vit. Ages.* 11.1-3, trans. by B. Perrin.
[1064] BOUTSIKAS 2020.
[1065] FERRARI 2008, 109; for the role of astrology in Spartan cosmos see N. Richer, *Les éphores: études sur l'historie et sur l'image de Sparte (VIIIe-IIIe siècle avant Jésus Christ)*, Paris 1988.
[1066] Paus. 4.26.6, 4.27.2-3; Plut. *Vit. Lys.* 12.1; SAHLINS 2011, 73; BOUTSIKAS 2020.
[1067] FERRARI 2008, 107.
[1068] PARKER 2011.
[1069] Censorinus, *DN* 18.12.
[1070] PARKER 2011.
[1071] FERABOLI 1986, 129.
[1072] FERABOLI 1986.
[1073] FERABOLI 1986, 129.
[1074] Paus. 6.23.3, trans. W.H.S. Jones, Litt.D., and H.A. Ormerod 1918.

The sacredness of the calendar is indicated by the names of its months, which often honoured a god in that specific month or was marked by a festival that was celebrated in that month[1075]. In one case, as recorded in inscriptions from western Greece, the name of the month indicated a seasonal event, summer solstice, thus *Haliotropios*[1076]. Only form the 2nd century BC were months named numerically[1077]. Additionally, specific days within each month were dedicated to particular gods; for instance, the day of the new moon and the seventh day were dedicated to Apollo and his birthday[1078]. The religious character of the Greek calendar was such to ensure the proper timing of rituals, sacrifices, and feasts according to nature. Although each city had its own calendar, the inclusion of intercalary months seems to have kept these aligned, through the adoption of various systems as described by Robert Hannah[1079]. The best known ancient Greek calendar is the Attic one. The year commenced on *Hekatombaiôn*, on the first sighting of the new moon after the summer solstice[1080]. This meant that, in the preceding month *Skirophoriôn*, the last month of the Athenian year, between *Thargeliôn* and *Hekatombaiôn*, summer solstice happened[1081]. In Athens, the New Year festivity was dedicated to Athena with the *Panathenaia*[1082]. The new order was marked by the dressing of the goddess in the first month of the year after summer solstice and during new moon nights[1083]. Nocturnal rites took place during the *Panathenaia*, such as the *Panathenaic* torch race; the fact that the festivities were performed on the 28th on the month allowed a greater visibility of the stars as there was no moonlight at that time. Other Greek calendars, such as the Boitian and the Elean calendar, began the year with the winter solstice[1084].

The western Greek colonies developed variant systems of festivities in contrast to those of the motherland[1085]. According to Mario Lombardo, the role of polyadic religion as a primary expression of the identity of the *polis* set the time and the rhythms of the community[1086]. The equilibrium of the *polis* is intricately related to time reckoning and the cycle of seasons[1087]. In Campania, there is evidence of the Dionysian cult of the *Lenee*. For instance, this can be inferred from the red figure stamnoi from Nuceria (420/410 BC) and from Capua (460 BC) in tomb 198[1088]. The main theme of

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1075 HANNAH 2005, 27.
1076 HANNAH 2005, 27–28.
1077 HANNAH 2005, 27.
1078 Hes. *Op.* 770-1; Hdt. 6.57.2; HANNAH 2005, 28.
1079 HANNAH 2005, 29–41; DAVIDSON 2007, 205.
1080 Pl. *Leg.*, 767c, 945e; BILIĆ 2012.
1081 In contrast to Plato, for Arist. *HA* 5.11.543b.11–12 the summer solstice happened in *Hekatombaiôn*; BILIĆ 2012, 514.
1082 GRAF 1996, 359.
1083 BRELICH 2015; BOUTSIKAS 2020.
1084 Plut. *Vit. Pel.* 24.1.
1085 PARISI 2020, p. 288; *contra* colonial cults were usually constructed reflecting motherland in NIETZSCHE 2012, 71.
1086 LOMBARDO 1999, 9.
1087 «They should learn whatever is useful, for these same purposes, of what pertains to the revolutions of the divine things, the stars and the sun and the moon: they should learn about the arrangements every city needs to make in respect to these things. But just what are we referring to? What we mean is the ordering of the days into the revolutions of the months, and the months in each year, so that each of the seasons, sacrifices, and festivals will receive its due for itself according to the sequence of nature [kata phusin], will keep the city alive and awake will render honours to the gods, and will make the humans more prudent in these matters» Pl., *Leg.*, 809c-e.
1088 FRESA - FRESA 1974, 160–167; JOHANNOWSKY 1989, 176–179.

the representation is diffuse in Greece and Etruria[1089]. The central wooden pillar has a chiton decorated with astral motifs[1090]. Olga Elia interpreted the figuration as a chthonic-agrarian cult consecrated to Dionysus[1091]. Other scholars identified the representation as one of specific Attic festivals, such as the *Anthesteria* in the month of *Anthesterion*. But, most scholars have accepted the identification of the festivity as the *Lenaea*, occurring on the 12th day of the month of *Gamelion*, as originally suggested by August Frickenhaus[1092]. The latter would fall on the full moon just after the winter solstice. Indeed, Hesiod associated the month of *Gamelion* with the wind Boreas[1093]. The festivity was celebrated during a long winter night, as evidenced by the presence of torches, and involved the consumption of fresh wine. The presence of this festivity in Campania can be placed within the context of the Attic propaganda during the second half of the 5th cent. with the valorisation of Demetra and Dionysus[1094]. The two divinities, related to the cycle of nature and mystery religions, may have been imported from Athens as civilising powers related to wheat and wine production[1095]. At Kyme, at the end of the 6th cent. BC, mystery religion is already evident in funerary inscriptions[1096].

A ritual torch race, *Lampadodromia*, took place annually in Neapolis in honour of the siren Parthenope. Apart from the literary accounts on the torch race, coins issued by the city around 435 BC, a small figurine with a torch is depicted next to the profile of Parthenope. According to Alfonso Mele, this celebration had the characteristics of a renewal festival[1097]. Mele suggests that the Neapolitan lampadodromia took place in the month when the temple of Parthenope was adorned with the harvested wheat sheaf[1098]. This type of festival was common in Athens. Indeed, the torch race at Neapolis was promoted by the Athenian Diotimo at the will of an oracle[1099]. At the end of the race, the torches were thrown into the sea[1100]. In Athens the new annual order was marked by the dressing of the goddess in the first month of the year after the summer solstice, during new moon nights[1101]. This New Year festivity was dedicated to Athena with the *Panathenaia*[1102]. During the *Panathenaia*, nocturnal rites took place; the fact that the festivities occurred on the 28th on the month *Hekatombaiôn* allowed for a greater visibility of the stars. A Panathenaic torch race took place on that occasion. For Erika Simon, «[t]he ritual significance of the torch-race was the transfer of sacred fire for the offerings at the altar»[1103]. It has been suggested that the torch race continued until the Augustan period as part of the Isolimpic Games[1104]. During the excavations at Piazza Nicola Amore in Neapolis, a

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1089 Elia 1964, 84–85.
1090 Elia 1964, 82.
1091 Elia 1964, 91.
1092 Frickenhaus 1912, 14–16; Cerchiai 1995, 190–191.
1093 Hes. *Op.* 504-505.
1094 Cerchiai 1995, 190–191.
1095 Cerchiai 1995, 190–191.
1096 Jiménez San Cristóbal 2007, 110.
1097 Mele 2014, 183–184.
1098 Mele 2007a, 261–262.
1099 Tim. *FGrHist* 566 F 98; Lycoph. *Alex.* 720-721.
1100 Mele 2014, 183.
1101 Brelich 2015; Boutsikas 2020.
1102 Graf 1996, 359.
1103 Simon Erika 1983, 64.
1104 Parisi 2020, 285–286.

monumental complex was discovered, believed to be the sanctuary for the Isolimpic Games[1105]. There, fragmentary inscriptions revealed the names of the winners of the *Italika Rhomaia Sebasta Isolympia* during the 1st cent AD[1106]. One of these competitions was the *lampas* for Augustus, which would seem to commemorate the 4th–3rd cent. torch-race in honour of Parthenope. The temple at Piazza Nicola Amore faced west[1107]. Below a structure from the Imperial period, the stratigraphic excavation revealed two structures from the end of the 4th cent. with a road between them[1108]. From the same stratum, locally produced Greek-Italic amphoras decorated with a wreath were discovered; this symbol indicates they may have been connected with a cult of the siren from the Hellenistic period[1109]. The cult of Parthenope in the area has been dated to the end of the 4th cent BC[1110]. Although the continuity of the ritual from the Athenian institution to the Augustan *Sebasta* is debatable, Elena Miranda De Martino pointed out that the prize for the *Sebasta* winners was a wheat wreath[1111]. This fact tends to support the hypothesis of there being a connection between the race and the Demetra cult, already evident at the Neapolis acropolis. According to the scholar, the relationship between the siren Parthenope and Demetra brings to mind a version of the myth where the sirens are the maids who searched the sea when looking for Persephone. Alfonso Mele alluded to a similar interpretation[1112]. Sirens can be related to Aphrodite, Hera, or Demetra and Persephone[1113]. For example, at the sanctuary of Artemis *Orthia* at Sparta, lead statuettes of sirens were found[1114]. In the case of Neapolis and Athens, the cult of the Sirens had a Demetriac character, at least according to Luisa Breglia Pulci Doria[1115]. The torch race for Parthenope may be seen, according to the scholar, as a mimesis of the search for Persephone by the sirens.

3.2 The Etruscan World

Among the direct sources for Etruscan timekeeping, the Tabula Capuana is a local Etruscan ritual calendar from Capua written in *circa* 470 BC, soon after the Second battle of Cumae. Its writing in that particular historical context can been read as a means of reaffirming the persisting and deeply rooted identity of the Etruscan religion in Campania just after the Greek-Etruscan conflict and the fall of Aristodemus[1116]. It was found at Quattordici Ponti in Capua, and it was probably originally fixed to a wall[1117]. In total, the calendar appears to be divided into ten sections, although it is possible that a part of the tablet is missing. According to Mauro Cristofani, the ten sections suggest a division of

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1105 Bragantini et al. 2010; Cavalieri Manasse - Giampaola - Roncella 2017.
1106 Miranda De Martino 2016.
1107 Cavalieri Manasse - Giampaola - Roncella 2017, 208.
1108 Cavalieri Manasse - Giampaola - Roncella 2017, 203.
1109 Cavalieri Manasse - Giampaola - Roncella 2017, 203.
1110 See L. Pugliese, *Anfore greco-italiche neapolitane (IV-III sec. a.C.)*, Roma 2014; Cavalieri Manasse - Giampaola - Roncella 2017, 209-210; Miranda De Martino 2017, 358.
1111 De Martino 2017, 358.
1112 Mele 2014, 159,171,183-184.
1113 Breglia Pulci Doria 1990, 78.
1114 Breglia Pulci Doria 1987, 75.
1115 Breglia Pulci Doria 1987, 80.
1116 Cristofani 1998, 173.
1117 Cristofani 1998, 170.

the year into a ten-month lunar calendar[1118]. For Jean MacIntosh Turfa, if the Tabula Capuana and the 2nd cent. BC Zagreb *Leber linteus* «are understood as nearly complete and thus close to their original lengths and sizes», it is possible that a ten-month year was indeed adopted[1119]. Dates from March, possibly the first month of the year, to October are preserved[1120]. In the calendar, only a few specific days are mentioned: the first are usually the *iśveita*, the Ides, followed by the days *celuta*, *tiniana*, and *aperta*. Festivities (*ilucu*) and rites (*vacil*) are prescribed and dedicated to different divinities, with indications of specific offerings and sacrifices required[1121]. This Etruscan inscribed calendar, known as Tabula Capuana, might have been connected with the Fondo Pattuarelli sanctuary[1122]. At the Ides of April, the text gives instructions for a celebration of the cult of *Lethams* at Hamae sanctuary[1123], near Kyme[1124]. The divinity *Lethams* appears several times and seems central to the text[1125]. According to Cristofani, the festivity described for the Ides of April may correspond to the one recounted by Livy[1126] during the second Punic war in 215 BC when all Campanians were gathering at the Hamae sanctuary for a nocturnal rite[1127]. This would suggest the existence of huge territorial control, in the 5th cent. BC, of Capua in the Campanian plain towards the Phlegraean Fields and the Hamae border sanctuary, as well as a continuation of the cult from the Etruscan period to the Campanian period [1128].

Current understanding of Etruscan time reckoning relies on analogies and assumptions, although the direct but scarce evidence of Etruscan calendars may give some hints. More indirect evidence is gained from the study of later Latin literature. For instance, according to Servius, the new day began at dawn in Etruria [1129]. Etruscan time reckoning in Volsinii with the ritual of the *calvus annalis* was recounted by Livy[1130]. A similar act is depicted on a mirror from Perugia where the ritual of the nail is performed by *Atropos* (*Athrpa*). According to Armando Cherici, the report by Livy can be interpreted as showing the sacerdotal pertinency of time reckoning and that this is the ritual that was effected in the temple of Nortia, as well as the necessity to make the changing of the year public due to the rotation of civil magistrates [1131]. However, it is not known when this celebration was performed[1132]. Giovanni Colonna highlighted the relationship in the Pyrgi lamina of the Etruscan word for *clavis annalis*, *pulumχva* and the Phoenician word for 'stars'[1133].

1118 CRISTOFANI 1998, 170.
1119 TURFA 2012, 107.
1120 CRISTOFANI 1995, 60.
1121 CRISTOFANI 1998, 170.
1122 CERCHIAI 1995, 161; SAMPAOLO 2011, 14.
1123 The sanctuary has not yet been topographically situated but it was probably somewhere between Kyme and Capua.
1124 CRISTOFANI 1995.
1125 CRISTOFANI 1998, 170.
1126 Liv. 13 35.3-14.
1127 CRISTOFANI 1998, 169–170.
1128 CRISTOFANI 1998, 171.
1129 Serv. *ad Aen*. 5.738, 6.535.
1130 Liv. 7 3.5-8.
1131 CHERICI 2006, 16.
1132 CHERICI 2006, 19.
1133 VAN DER MEER 2011, 28; COLONNA 2012, 42.

The development of writing served as a method of keeping track of time, as «[t]his nail served, they say, in those days of little writing, to mark the number of years»[1134]. Massimiliano Di Fazio notes that «the organization of time was one of the main features of Etruscan religion» and was achieved by means of writing[1135]. Cherici has suggested the possibility of an important Etruscan effort to organise time in a calendar based on the partly lost discussion in John the Lydian's treatise *De mensibus*[1136]. In particular, the reduction of the days in February would have been an Etruscan idea, February being the last month of the year and dedicated to the Etruscan infernal god *Februus*[1137]. Thus, February, being the last month before March, the New Year, was subject to adjustments in order to keep the calendar aligned with both seasons and months[1138]. The name of the month seems also related to purification rituals[1139].

3.3 The Oscan World

The Etruscan Tabula Capuana calendric structure from Capua can be compared to the time reckoning system used by the Oscan *iúvilas*, where rituality is articulated in days that are named not on a numerical sequence but on the basis of lunar phases[1140]. The mention of specific lunar days, a 10-month lunar year and a succession of festival days called the Ides support the analogy[1141]. The Ides, dedicated to Jupiter in the Roman calendar, may be referred to as *eídúís* or *iúvíais* in the calendar[1142]. Another festival that appears repeatedly in a few months is called *púmperias/púmperiais.* This may be etymologically related to the number five, as the day of the meeting 'of the five', a five-day festival, or a festivity five days after the Ides and somehow related the lunar month[1143]. Annalisa Franchi De Bellis suggested an etymological link with the Greek πομπά/πομπή, which would signify a festivity with a procession as its main element[1144]. The term *fiísíais* should be interpreted as the generical name for a festivity, similar to *feriae,* with the name of the month usually appearing after that of the festival, while *fiísíais* is placed at the beginning of a sentence[1145]. Apart from *vehiianasùm* and its uncertain interpretation as a festival of wagons[1146], the most mentioned *feriae* is *vesullias/vesulliais,* probably related to the gens Vesullia according to Heurgon[1147]. The *Iuvilas* texts provide no more than a list of months and festival names and in no clear order[1148]. However, it is worth noting that the *Iuvilas* texts suggest that there was a practice of deriving the name of the month

1134 Liv. 7 3.6, trans. by W. Heinemann 1924.
1135 Di Fazio 2020a, 141.
1136 Cherici 2013, 690; Lydus*, Mag.* 1.1W.
1137 Cherici 2013; Lydus, *Mens.* 1. 618, 3.10, 4.25.
1138 Macr., *Sat.*, I, 13,14 s.; Cherici 2006, 18.
1139 Varro*, Ling.* VI, 13; Ov., *Fast.*, II, 31 ss.
1140 Cristofani 1995, 64.
1141 Cristofani 1995, 64.
1142 Franchi De Bellis 1981, 55.
1143 Franchi De Bellis 1981, 57.
1144 Franchi De Bellis 1981, 57.
1145 Franchi De Bellis 1981, 54–55; Heurgon 1970, 63.
1146 Franchi De Bellis 1981, 60.
1147 Heurgon 1970, 79.
1148 Franchi De Bellis 1981, 49.

from that of a god[1149], thus indicating the sacrality of the calendar. Later literary sources mention irregular months in the Italic calendar[1150]. It was comprised of 10 or 12 months, reflecting the 10 months of the Sabine or Romulan year of 304 days[1151], or the Roman Numan calendar of 355 days, from the middle of the 5th cent. BC[1152]. For Adolfo Zavaroni the *Iuvilas* texts are coherent with a cyclical annual cult of re-generation of the dead; indeed, a solar deity can be recognised in the radiant head, disks and circles represented on few *Iuvilas*[1153].

Paolo Poccetti identified the Oscan word for sun and moon in a *Iuvilas* text (inv. 319973) recently found at the Fondo Patturelli sanctuary (fig. 31) [1154]. The inscriptions, datable to the early 3rd century BC, are concerned with religious festivals of the local aristocracy in pre-roman Capua. The texts use standardised formulas as preferred by single family groups[1155]. According to Poccetti, the Oscan word *minnaris* has the alternative meanings of 'related to the moon, lunar' and 'monthly'. In the context of the text, *fisiais minnaris* should probably be interpreted as 'lunar festival' since it gives a more precise indication in the calendar than 'monthly festival'[1156]. The phrase *suleis bias* has the literal meaning of 'sun strength' and therefore *prs suleis bias* is given as 'before the strength/vigor of the sun'[1157]. Poccetti suggested that this should be interpreted in terms of seasons as a designation of summertime and, given the very specific calendric timeframe of the other Iuvilas texts, it should be interpreted as 'summer solstice'[1158]. Indeed, in the *Iuvilas* texts, all the references to festivals are in relation to time of the year and not the day[1159]. He suggested that *fisiais minnaris pas prs suleis bias nessimas fusent* should be translated as «during the moon festivals, which should/would take place before the summer solstice» [1160]. The *Iuvilas* texts provide information about a local calendar with periodic cults across the year, although within a private and aristocratic context[1161]. If it is assumed that the festivity took place at the summer solstice full moon, the lunar disk moon would have been in the southern position, rising in the south-east and setting in the south-west[1162]. At the Doric sanctuary in Pompei, this event would have been very appreciated, considering that the axis of the temple was aligned north-west/south-east at the summer solstice sunset on one side and, contemporaneously, at midsummer full moon on the other, exactly facing the temple every 18.6 years.

1149 FRANCHI DE BELLIS 1981, 50.
1150 Censorinus, *DN* 22.6; 19.6.
1151 Plut. *Vit. Numa* 18.1-4; Lydus, *Mens.* 1.16-17.
1152 FRANCHI DE BELLIS 1981, 50.
1153 ZAVARONI 2006, 43–47; for the radiant head as solar deity see J. Heurgon, *Étude sur les Inscriptions osques de Capoue dites iúvilas*, Paris 1942, 38; R. Mowat, "Inscriptions osques ornées d'images de monnaies", in *Rev. Archéologique* 9, 1887: 273–285, 282.
1154 POCCETTI 2016a.
1155 POCCETTI - SAMPAOLO 2014, 146.
1156 POCCETTI 2016a.
1157 POCCETTI - SAMPAOLO 2014, 146.
1158 POCCETTI 2016a.
1159 POCCETTI - SAMPAOLO 2014, 146.
1160 POCCETTI 2016a.
1161 SIRANO 2018.
1162 RUGGLES 2015a, 468.

Figure 31. Iovila text with Oscan *minnaris* 'lunar' and *suleis* 'sun'. Inv. 319973. Santa Maria Capua Vetere Archaeological Museum. In POCCETTI – SAMPAOLO 2014, 148.

In order to align the lunar cycle with the seasons [1163], the Oscan calendar likely included intercalation[1164]. According to Franchi De Bellis, it is probable that the Oscan year started with the month of *Mamertio*[1165]. Indeed, the first month of the year, *Mamertio,* often appears in the *Iuvilas* texts, this being the one of the celebrations at the *lucus* of the Sanctuary at Fondo Pattuarelli[1166]. March was probably the first month of the year in Italic calendars and in Rome before the Caesarean reform[1167]. Even before the reform by Numa, the numeral names of the month in Rome from *Quintilis* to *December* were preceded by four months, *Martius, Aprilis, Maius, Iunius*[1168]. Numa added *Ianuaris* and *Februarius* after the numeral months. Angelo Brelich suggested that the beginning of the year in March was connected to the consumption of spelt[1169]. Such seasonal activities were fundamental for agricultural societies; moreover, the start of spring marked the beginning of the war season. The evidence of the importance of *Mamertio* as a temporal reference point and the beginning of the year is indicated by the circumlocution 'before Mamertio' to refer to the unnameable month dedicated to the dead, thought to be the last month of the year[1170]. For Robert Seymour Conway, this circumlocution might indicate the intercalary month, but Franchi De Bellis disagreed suggesting a

[1163] Censorinus, *DN* 20.6.
[1164] FRANCHI DE BELLIS 1981, 51.
[1165] FRANCHI DE BELLIS 1981, p. 49; *contra* HEURGON 1970, p. 74.
[1166] COARELLI 1995a, 378; FRANCHI DE BELLIS 1981, 49.
[1167] BRELICH 2015, 224.
[1168] FRANCHI DE BELLIS 1981, 51.
[1169] BRELICH 2015.
[1170] FRANCHI DE BELLIS 1981, 52.

proper month associated with a taboo typical of a cult of the dead[1171]. Indeed, the commemoration of deceased preceded the New Year as the burial of seeds forerun the new harvest. In the Roman Archaic calendar, the month dedicated to the deceased was February, with the Terminalia festival marking the end of the year.

3.4 The Roman World

The structure of the Roman Archaic calendar remains obscure, as do the religious practices and festivities connected to it. As Jörg Rüpke noted, «any reconstruction of the earliest Roman calendar system must begin with Late-Republican and Imperial-Period accounts and theories regarding its development»[1172]. However, the study of an Archaic process should start from evidence from that period itself, since the original contribution of Roman religion to the calendar ended after the 1st cent. BC. Moreover, later versions of the agricultural and astral calendar by Pliny and Columella, based solely on literature, are not as reliable as Hesiod's one, which was based on first-person experience of land cultivation and celestial observation. For Theodor Mommsen, the epigraphic *Fasti* calendars from the Imperial period show a homogeneous and invariable core written in capital letters which can be dated back to the 7th-5th cent. BC[1173]. The calendar of Rome was probably a variant of Italic calendars[1174]. The first Romulean calendar had ten months for a total of 304 days[1175]. Numa Pompilius (715-673 BC) is credited with the first calendric reform, with the institution of *dies fasti*, lawful days, or *nefasti*, unfawful, plus the addition of two more months and an intercalation system. However, a solar-lunar pre-Julian calendar may have existed as early as the 5th cent. BC[1176]. Such a calendar, named the Republican or Decemviral calendar, it was attributed to the *decemviri* in the 450 BC reform in connection with the drafting of the Twelve Tables[1177]. Although, in Rüpke's view, it should be dated to a much later period[1178].

According to literary and epigraphic sources, the most important divisions of the months, *menses*, were the 'Ides', dedicated to Jupiter; these are the full moon days and in the middle of the month, possibly of Etruscan origin named 'Itis' or 'Itus'[1179]. The *kalendae* would mark the new moon, and in particular, the first sight of the new waxing moon, and they were dedicated to Juno[1180]. During the ritual of the *kalendae*, the *rex sacrorum* announced the *feriae* of that month[1181]. In particular, the days of the *nonae* were proclaimed, five or seven days after the *kalendae*[1182]. The term *nonae* is

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1171 R.S. Conway, *The Italie Dialects*, Cambridge 1897, cited in FRANCHI DE BELLIS 1981, 52–53.
1172 RÜPKE 2011, 23.
1173 MOMMSEN 1863; BRELICH 2015, 207–210.
1174 RÜPKE 2011, 30–31.
1175 Ov. *Fast*. 2.47-54.
1176 HANNAH 2005.
1177 Cic. *Att.* 6.1.8; Macrob. *Sat*. 1.15.9; Liv. 9.46.5; Ov. *Fast.* 2.47-54.
1178 RÜPKE 2011, 5.
1179 Varro, *Ling*. 6.28; Macrob. *Sat.* 1.15.14–16; for the etymology of Ides see also Plut. *Quaest. Rom.* 24.
1180 Macrob. *Sat.* 1.15.5; Plut. *Quaest. Rom.* 24.
1181 RÜPKE 2011, 24–25.
1182 Varro, *Ling*. 6.27; Macrob. *Sat*. 1.15.10; RÜPKE 2011, 24–27.

explained as *ante diem nonum idus*, thus falling on the ninth day counting inclusively from the Ides, but with a period of seven days if reckoning exclusively[1183]. Rüpke recognised a similar day to the *nonae* but symmetrically placed in the second half of the month and related to the waning moon[1184]. In summary, the Roman month was divided into nundinal intervals, nine-day periods starting from the waxing moon *nonae*, through the full moon Ides, to the waning moon with the *Tubilustrium*, and culminating with the next *kalendae*[1185]. Thus, the actual observation of the sky happened once a month, with the *kalendae*, whereas the other dates were based on estimates[1186]. The variable length of the interval between the *kalendae* and the *nonae* ensured the correct synchronisation with the lunar cycle for the rest of the month, since the exact day of the new moon was, and is, not a visible occurrence. Furthermore, the sighting of the first crescent, which would have always appeared low in the sky looking west just setting after the sun[1187], might have been subject to meteorological and astronomical conditions[1188]. Thus, «the pontifical aid could estimate the period to the next full moon by observing the size of the lunar crescent, and set the date of the Nones accordingly, so that, nine days (inclusive reckoning) later, the Ides would coincide with the full moon»[1189]. In Rome, the public announcement of the beginning of the month was made by the Pontefix, who determined the dates for Nones and Ides[1190]. In conclusion, the new moon was observed in the sky once a month by looking west at sunset, even though the exact determination of the beginning of the month could be subject to error due to local meteorological conditions.

[1183] RÜPKE 2011, 25–26; Isid. *Etym.* 5.33.14.
[1184] RÜPKE 2011, 26–29.
[1185] RÜPKE 2011, 30.
[1186] Macrob. *Sat.* 1.15.6; Plut. *Quaest. Rom.* 24.
[1187] RUGGLES 2015a, 466.
[1188] «Quia non continuo evenit ut eodem die semper appareat, sed modo tardius modo celerius ex certis causis videri solet», «[n]ow the new moon does not always appear regularly on the same day of the month, but for definite reasons its reappearance sometimes comes more slowly and sometimes more quickly» Macrob. *Sat.* 1.15.6, trans. P.V. Davies 1969.
[1189] RÜPKE 2011, 31.
[1190] Varro, *Ling*. 6.27.

CHAPTER FOUR. CASE STUDIES

I. CAPUA

The Town

Introduction

The ancient town of Capua rose where are now situated the modern towns of Santa Maria Capua Vetere, Curti and Prisco. Maria Bonghi Jovino highlighted some of the issues still in debate regarding pre-Roman Capua; these are mostly to do with its foundation date, the ethnicity of its inhabitants, the socio-anthropological make-up of the community, and the layout and topography of the settlement[1191]. Two main theories have been proposed to address the questions of foundation and ethnicity. According to one tradition, Capua developed as an Opician settlement, yet with a Hellenic and Etruscan character similar to that evident in the centre of Rome, until its occupation by the Etruscans after the first battle of Kyme[1192]. Indeed, a Villanovian character typical of Iron Age Etruscan centres is apparent in Capua[1193]. For the second interpretation, Etruscan influences can be perceived in the area from the end of the Iron Age around the end of the 8th cent. BC, suggesting that Capua played a central role in a continuous process of urbanisation of Etruscan Campania[1194]. After a study of the material culture of the necropolis, Bruno d'Agostino suggested that Etruscans groups might have migrated from the coast of southern Etruria (Veio, Tarquinia, Vulci) to the Capua plateau around the end of the 10th cent. BC in the Late Bronze Age[1195]. However, the dating of the city walls indicates that they were not built until the second half of the 6th cent. BC[1196], despite evidence from the necropolis pointing to a stable Iron Age urbanisation.

Proto-Urban Capua

The concentration of the sparse villages in this area into a unified urban organisation may have happened around the second half of the 9th cent. BC[1197]. At this time, Capua had the characteristics of a proto-urban centre; according to Colin Renfrew, a proto-urban centre can be defined as showing demographic agglomeration, the presence of religious places for periodic meetings, and a central area

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[1191] BONGHI JOVINO 2010, 129.
[1192] COLONNA 1991, 36; 2022.
[1193] COLONNA 1991, 36; D'AGOSTINO 2011, 69.
[1194] BONGHI JOVINO 2010, 129; See M. Bonghi Jovino, "L'espansione degli Etruschi in Campania", in M. Torelli (ed. by), *Gli Etruschi. Catalogo della Mostra di Venezia, Palazzo Grassi, 26 novembre 2000 -1 luglio 2001*, Milano 2000: 157–167; B. d'Agostino, "Le genti della Campania antica", in *Italia omnium terrarum parens. La civiltà degli Enotri, Choni, Ausoni, Sanniti, Lucani, Bretti, Sicani, Siculi, Elimi*, Milano 1988: 531–589.
[1195] D'AGOSTINO 2011, 71; Similarly see M. Bonghi Jovino, "L'espansione degli Etruschi in Campania", in M. Torelli (ed. by), *Gli Etruschi*, Milano 2000, 157 ss.
[1196] BONGHI JOVINO 2010; ALLEGRO - SANTANIELLO - BEDINI 2008; See also N. Allegro, "Necropoli sannitica in loc. Curti (prop. Colorizio). Insediamento arcaico e necropoli sannitica presso l'Alveo Marotta", in *Santa Maria Capua Vetere (Caserta)*, 1984: 514–517.
[1197] BONGHI JOVINO 2010, 130.

for the distribution of goods and service[1198]. According to Gianluca Melandri, these characteristics were evident in Capua at least by the end of the 9th cent. BC[1199], with different housing clusters unified by a shared cultural and ethnic identity, and a central village that acted as a catalyst for the aggregation process[1200]. The village of the Fornaci necropolis is believed to be the site of this historical Capua[1201]. The area originally destined for settlement was never used for funerary purposes, suggesting an early form of planning intention, according to Bruno d'Agostino's interpretation[1202]. The archaeological evidence points to the presence of four settlement nuclei in the LBA and the beginning of the EIA[1203]. A first settlement at Monte dei Lupi on the slope of Tifata is characterised by the sparse occupation of two or three housing clusters on the plateau sharing an ethnic unity as indicated by funerary customs[1204]. The abandonment of this first housing cluster and the reduced interest in the area of Nuovo Mattatoio, in favour of the extension in the 8th cent. BC of the Fornaci nucleus, together with the area of Cappuccini, indicate a progressive transformation of Capua into an urban centre[1205]. The territory controlled by the community extended to a supposed radius of 18–25 km. A demographic boom is evident from the middle of the 8th cent. BC, an exponential growth explicable only by the mobility of indigenous groups. Among the causes of the synoecism, Melandri emphasised that these were the need for a wider area for agriculture and crafts, control over commercial routes, military equilibrium, and the role of Capua as an intermediary between the foreign Greeks and local groups[1206]. Indeed, Capua was open towards the Greek world, as well as to Sardinia and Pontecagnano, as indicated by imported vases related to the consumption of wine and the *symposion*[1207]. The only trace of route orientation identified for this phase was at the nucleus of Nuovo Mattatoio in the Parisi locality, where, in 2005–2006, a beaten-earth road running in a SW/NE direction pointing towards Mt. Tifata was discovered. This was used only in this early phase, being later covered by tombs datable to between the 9th and the 8th cent. BC[1208].

The Etruscan Archaic Town

Around the mid-7th cent. BC, there was an influx of luxurious material culture from Etruria[1209]. To this phase, the earliest Etruscan inscription found in Campania can also be dated. According to Luca Cerchiai and Bruno d'Agostino, this material evidence is thought to be connected with the emergence

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1198 C. Renfrew, "Trade as Action at a Distance: Questions of Integration and Communication", in J.A. Sabloff - C.C. Lamberg-Karlovsky (ed. by), *Ancient Civilisation and Trade*, Albuquerque 1975: 3–59, discussed in GUIDI 1982, 281; RENFREW 1986; MANDOLESI 1999, 86; MELANDRI 2012, 1.
1199 MELANDRI 2012, 1.
1200 «con diversi piccoli addensamenti insediativi caratterizzati da una condivisa unità culturale ed etnica ed un villaggio trainante, più attivo e ricco, che tende a centralizzare e a governare il processo aggregativo e che porterà agli esiti formativi della Capua storica», in MELANDRI 2011, 58.
1201 MELANDRI 2011, 12–13; NIZZO 2016, 135.
1202 D'AGOSTINO 1985, 44; PACCIARELLI 2001, 120; MELANDRI 2011, 13.
1203 MELANDRI 2012, 487.
1204 MELANDRI 2012, 501.
1205 MELANDRI 2012, 503–504.
1206 MELANDRI 2012, 503–505.
1207 D'AGOSTINO 2006, 215–217; 2011, 74.
1208 MELANDRI 2012, 497.
1209 D'AGOSTINO 2011, 77.

of an Etruscan aristocracy, which also can be regarded as the catalyst of an urbanisation process and the planned restructuring of settlements[1210]. In Capua, evidence of planned and rationalised spaces in the town are clearly evident starting from the end of the 7th and the beginning of the 6th cent. BC, although the data from the necropolis suggests an earlier period of urbanisation[1211].

Excavation, directed by Cristina Regis, at Siepone in the north-east of Capua (6th–5th cent. BC) has uncovered evidence of living quarters with stone foundations over an area of 1100 m^2 (fig. 32)[1212]. There, four *insulae* with stone-built houses were exposed as forming part of a residential quarter, with structures no more than 60 m long[1213]. The excavation revealed a structured neighbourhood with regular planimetry, along with straight and largely orthogonal, or almost orthogonal, roads[1214]. According to Francesco Sirano, the urban plan during this phase is regular but not orthogonal in its design[1215]. Indeed, the east-west axes of this neighbourhood, where measurements are constrained by the limited extent to which the structures have been recovered, appear to be rotated a few degrees clockwise; where an orthogonal layout would result in 65°–70° (looking east), these structures point instead towards 75° of azimuth. The sector is stratigraphically coherent and enclosed within the traces of an urban perimeter wall, a *pomerium*, known as the 'Siepone', which is 1.20 m wide. The materials found from this phase are homogenous and clear, indicating a chronology corresponding to an action of ground levelling of the area, which was already in use, but structured in the Archaic period during the 6th cent. BC and first part of the 5th cent. BC, and with a continuity until the 3rd century BC[1216]. The main road called α, 3.5 m wide and 30 m long, is oriented in line with the buildings, with an axis diverging from the cardinal directions, corresponding to an azimuth of 155°–160° (SE) and 335°–340° (NW)[1217]. A continuation of this road was also found 250 m away to the south-east by Nunzio Allegro in the area of Merola property[1218]. According to Valeria Sampaolo, the structures at Siepone can be seen as synchronic to those at Alveo Marotta, where a workshop furnace for terracotta production was found. The Archaic evidence found at Siepone and Alveo Marotta were thus part of a single Archaic urban system[1219]. The area was abandoned around the first quarter of the 5th cent. BC[1220]. West of Fondo Patturelli at Petrara Locality, traces of Archaic houses were also found[1221]. In summary, the Etruscan city of Capua had residential neighbourhoods, artisan quarters just outside the city, a necropolis and sanctuaries[1222]. According to

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1210 CERCHIAI 1995, 99–104; D'AGOSTINO 2011, 77.
1211 SIRANO 2014a, 112.
1212 SAMPAOLO 2008, 474; REGIS 2011.
1213 SAMPAOLO 1999, 139.
1214 SAMPAOLO 2005, 671–672; MINOJA 2011, 15–16.
1215 SIRANO 2014a, 112.
1216 SAMPAOLO 2005, 671–672; ZEVI 2004, 866–868.
1217 SAMPAOLO 2008, 474; SIRANO 2014b, 112.
1218 ALLEGRO - SVANERA 1996; ZEVI 2004.
1219 SAMPAOLO 2008, 478–479; CERCHIAI 2008, 409.
1220 SAMPAOLO 2008, 478.
1221 ALLEGRO - SANTANIELLO - BEDINI 2008, 24; See D. Giampaola, "S. Maria Capua Vetere. Abitato. Settore orientale. Esplorazioni in loc. Petrara", in *Stud. Etruschi* 52–MCMLXXX, 1986: 521.
1222 Minoja 2011, p. 20.

Valeria Sampaolo, the whole extent of the settlement during this Archaic phase can be estimated as being 4300 m^2 large [1223].

This research has recognised that there are more traces with this same orientation in this area, possibly to be understood as part of a coherent system[1224]. The few topographical remains of Fondo Patturelli sanctuary can be integrated within the Archaic urban morphology, as well as more remains at Via Giacinto Bosco. An extra urban road with the same orientation (157°/337°azimuth), existed in nearby Masseria D'Addio, Via Annibale Barca, Via Primo Ottobre 1860, reaching towards the Temple of Diana Tifatina. That same temple has the same orientation as the Siepone urban neighbourhood, the Fondo Patturelli wall, and may have been part of a unique planned design for organising this whole sacral and residential space (fig. 33). Indeed, at the time of the development of the Archaic settlement, the temple of Diana and the Fondo Patturelli, together with the one in Via Campana, were the main sanctuaries of Capua[1225].

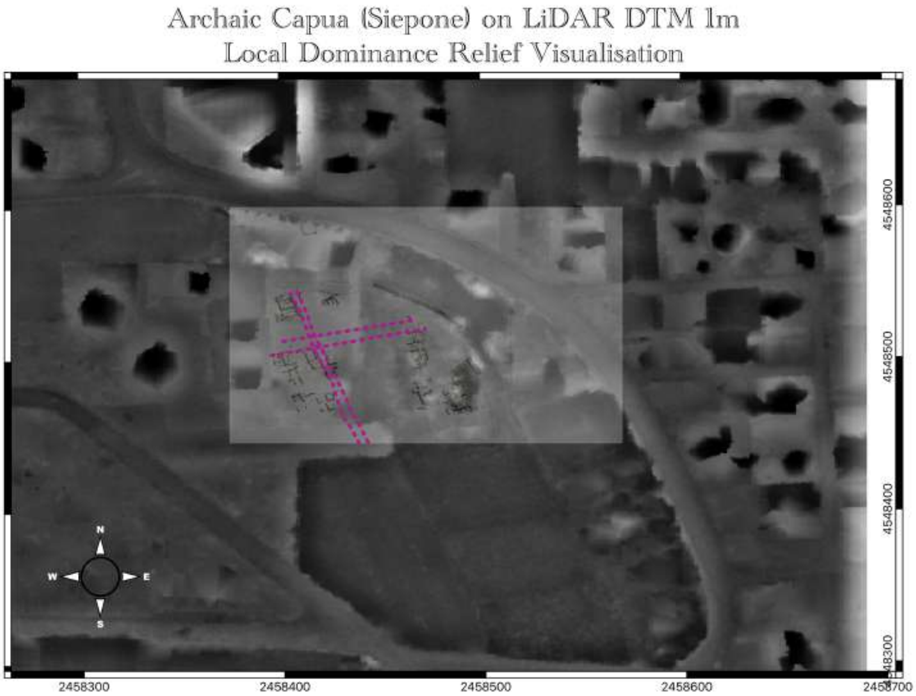

Figure 32. Street layout of Archaic Capua (Siepone neighbourhood) with the georeferenced plan from Sampaolo 2008, 475 superimposed on LiDAR DTM 1m resolution with Local Dominance Relief Visualisation. Elaborated by the author.

1223 Sampaolo 2008, 478.
1224 Wagner 2019, 296.
1225 Allegro - Santaniello - Bedini 2008, 29; Sirano 2014a, 113.

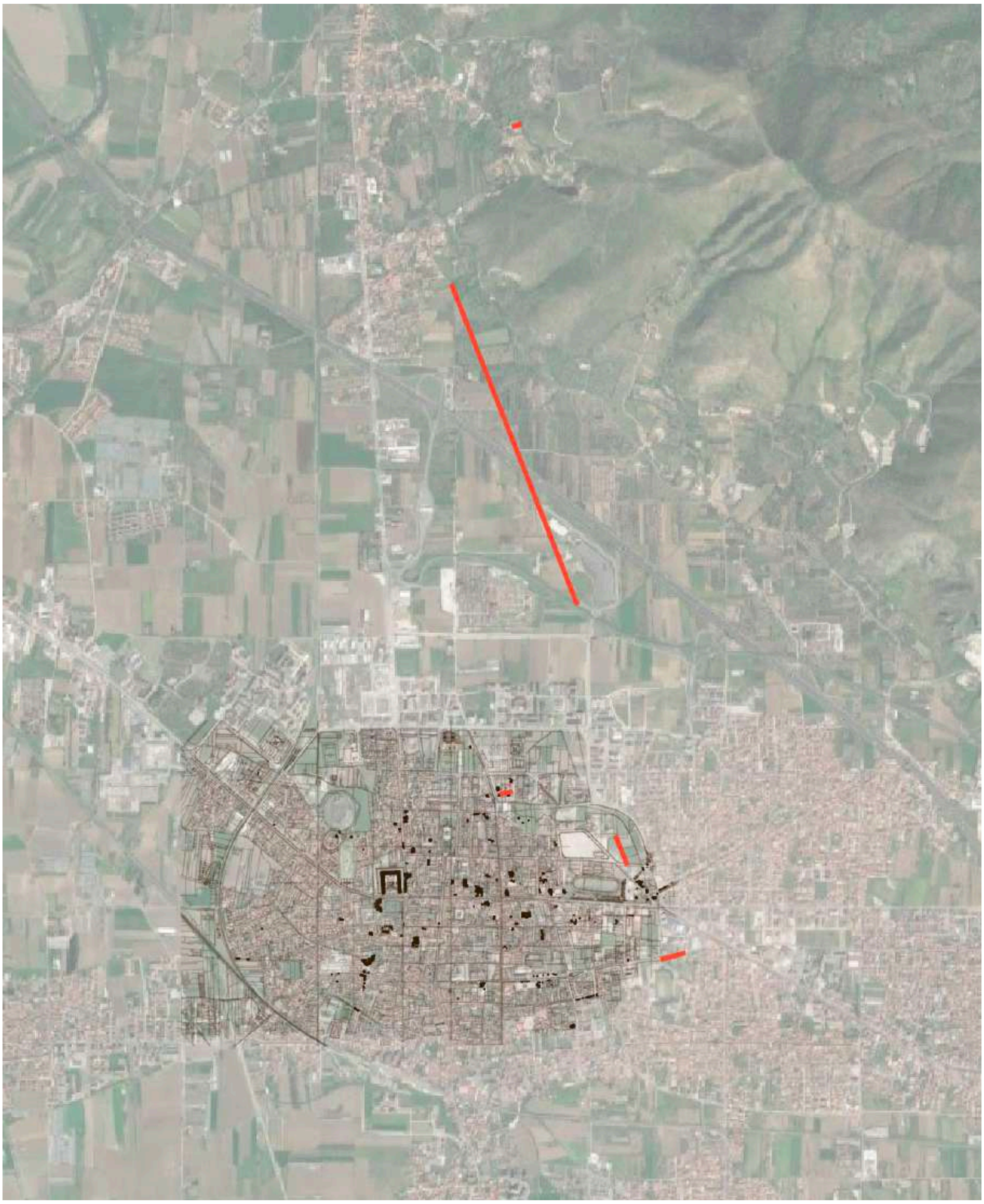

Figure 33. Archaic orientation system (in red) including the Siepone neighbourhood, the Fondo Patturelli sanctuary and the Diana Tifatina temple. Elaborated by the author.

The Oscan Town

A crisis of the Etruscan urban grid is confirmed archaeologically to have occurred in the first quarter of the 5th cent. BC[1226]. After the battle of Kyme, a gradual weakening of Etruscan political influence was followed by the rise of the Campanians' *ethnos*. Velleius Paterculus rejected Marcus Cato mention of the 'foundation' of Capua in 471 BC, but Cato was probably referring to a re-foundation, as Livy mentioned[1227]. According to Livy, the Etruscans from Capua accepted the Samnites *in societatem urbis agrorumque*, that is in «a joint occupancy of the city and its territory», but the Samnites became dominant in the city afterwards[1228]. The Samnite presence started with a *synoikismos* and the distribution of houses and land to the newcomers[1229]. According to Livy, it is in this moment that Capua acquired its name from the Etruscan city of Volturnus[1230]. Diodorus Siculus set the year 438 BC for the ethnos of the Campanians, the *Kampanòi/Kappanòi*, the inhabitants of Capua[1231]. Subsequently, the coinage in the area began to follow Greek standards giving testimony to the transformation of social, political, and economic relationships, such as the mercenary phenomenon[1232]. In the Capuan Samnite pantheon, there are epigraphically affirmed the divinities of Jupiter Flagio, Martes/Mamerco, Mercury, Cerere Arenticia (*Keri Arentikai*), and Iuno Gaura identified as the focus of worship at the sanctuary of *Hamae*[1233].

Romanisation

During the process of Samnitisation of Campania, the political landscape changed from the middle of the 4th cent. BC, when Capua, together with Teanum, allied with Rome during the First Samnite War (343–341BC) and the Latin War, when Latins and Campanians fought against the Romans and Samnites. The pantheon of Roman Capua included Jupiter, *Tifatinus* and *Optimus Maximus*, and *compagus*, as well as Venus, Cerere, the Dioscuri, Lares, Hercoles, and Diana Tifatina[1234]. After the second Punic war, a new centuriation system was set up, with an orientation almost exactly north-south[1235]. In 312 BC, the construction of the Appia Way passing though Capua was adjusted to align with the urban cardinal morphology by deviating from its straight path. For this reason, the orthogonal and cardinal urban morphology must predate the Via Appia construction[1236]. There is the possibility that the cardinal orientation, which can still be seen in the urban grid today, was already in use in the Etruscan plan, as De Caro suggested[1237].

[1226] SAMPAOLO 2008; MELE 2014, 133.
[1227] Vell. Pat. I.7; Liv. IV.37.1–2.
[1228] Liv. IV.37.1–2, trans. C. Roberts 1912.
[1229] MELE 2014, 133.
[1230] Liv. IV.37.1.
[1231] Diod. Sic. XII.31.1.
[1232] MELE 2014, 275.
[1233] SIRANO 2018, 305.
[1234] SIRANO 2018, 306.
[1235] ROSSI 2019c, 24.
[1236] BELOCH 1890.
[1237] DE CARO 2012, 70.

In the northern extra-urban area of the city, Sampaolo identified a street system oriented 45° east of north[1238]. This system includes the pozzolana beaten-earth trace (17 m long x 4 m wide) at Sandulli dating from the 3rd century BC (fig. 35.3)[1239]. A similar chronology and orientation are shared by the street (25 m long x 5 m wide) uncovered at the 'Mondo Nuovo' area (fig. 35.1), together with a perpendicular street in similar pozzolana beaten earth (45m long x 3m large) (fig. 35.4)[1240]. This 'Mondo Nuovo' road seems to continue along the modern route at San Prisco from Masseria Schettini to Masseria Bersaglio (fig. 35.2)[1241].

To the south, the 'Mondo Nuovo' road can be connected to the short stretch (20 m long x 5 m large) of urban street found near the cryptoporticus and Via Galatina, again oriented 45° east of north, with structures aligned in the same direction dating from the 2nd cent. BC to the 2nd cent. AD[1242]. In the 1950s, two different networks of orientation were highlighted by De Francisis in the area east of the cryptoporticus under Via Galatina[1243]. Traces of a cobblestoned road (2m wide) running east-west were discovered[1244]. Due to the presence of nearby co-existing structures with different orientations, De Francisis hypothesised they were from two different phases of the urban plan[1245]. According to Sampaolo, the cobblestoned road and the other structures recovered by De Francisis under Via Galatina are consistent with the ones found a few metres to the east[1246], although De Francisis indicated a cardinal east-west orientation for the short remnant of his road; however, the length of this road seems too short (no more 2 m from the published plan) to accurately determine the precise orientation[1247]. The 45° orientation supposed elsewhere for the urban grid seems partially plausible even for this archaeological record under Via Galatina. According to Sampaolo, this orientation seems to have been shared by the main axis of a previous amphitheatre built around 2nd–1st cent. BC[1248], as well as by a 2nd cent. AD unpublished structure found in Papa property south of Viale della Libertà[1249]. Recently, another stretch of street oriented 45° east of north, 87 m long and 5m wide, was uncovered at Orsi Immobiliare property connecting to a funerary monument, again near Via Galatina, but this time further north and just on the limits of the modern city[1250]. The dating would be again before the 2nd cent. BC. According to Sampaolo, traces of a whole route can be identified: from Via Galatina, joining the 'Mondo Nuovo' street, crossing the urban wall near the Di Tella property, and pointing towards Mt. Tifata (fig. 36) [1251]. This would be a *via Sacra*, connecting the forum with the temple of

[1238] SAMPAOLO 1996, 4.
[1239] SAMPAOLO 1996, 4.
[1240] SAMPAOLO 1996, 3–4; 1999, 143.
[1241] SAMPAOLO 1996, 4.
[1242] SAMPAOLO 1999, 140–142, 145.
[1243] DE FRANCISIS 1975, 51.
[1244] DE FRANCISIS 1975, 151.
[1245] DE FRANCISIS 1975, 51.
[1246] SAMPAOLO 1999, 145–146.
[1247] DE FRANCISIS 1975, 5.
[1248] SAMPAOLO 1996, 6.
[1249] SAMPAOLO 1999, 146.
[1250] TOMEO ET AL. 2021.
[1251] SAMPAOLO 1999, 146.

Jupiter[1252]. To the south-east, the same orientation was present in the road towards the coast, towards S. Tammaro, and reaching the area where the colony of Liternum came to be[1253]. Finally, the 2nd cent. AD cardinal centuriation of the *ager Campanus* established a north-south urban landscape, as is evident in modern-day Santa Maria Capua Vetere's road arrangements.

The requisition of land by Rome in the middle of the 2nd cent. BC was followed by a reorganization of land in the *ager Campanus* at the same time that this came under the jurisdiction of Rome as *ager publicus populi Romani*[1254]. The cities of Capua and its satellite urban settlements lost their independence. During this transition period, a systematic organisation of the countryside took place according to Roman agrimensory[1255]. This was probably effected by the consul A. Postumius Albinus in 173 BC[1256] and by the *praetor urbanus* P. Cornelius Lentulus in 165–162 BC[1257]. Marina Monaco suggests the organisation implemented a system of 20x20 actus (1 actus=35.48 m), with the unusual characteristic of having the *Decumanus* north-south and the *Kardo* east-west[1258]. This exception to the rule is attested by both literary and archaeological evidence. Hyginus and Frontinus mentioned the specific case of the *ager Campanus* in the corpus[1259]. According to Aldo Luigi Prosdocimi, the inversion of the orientation may be due to a wider misunderstanding in the tradition of practice carried out by agrimensores, in the factual sequence between *cardo* and *decumanus*[1260]. The cardo was assumed to be the fundamental line at a later stage whereas, for Prosdocimi, it was originally the *decumanus* to be cut off by the *cardo*[1261]. Stefano De Caro observed that such a disposition was present also at Cosenza, Vibo Valentia, Benevento, in the Vallo di Diano[1262]. One alternative explanation by Franciosi is that maybe be the intention was to follow the natural slope of the plain for drainage purposes, being longitudinal to the coast[1263].

Urban Orientation in Phases

Several orientations in pre-roman Capua seem visible, for at least three diachronic phases (fig. 34):

- The earliest street traces are at the 'Nuovo Mattatoio' with the beaten-earth road; according to Melandri, this orientation is coincident with the pre-roman road towards Mt. Tifata[1264].
- The neighbourhood of Siepone and Alveo Marotta, as discussed above, constitutes the earlier evidence of a planned urban system (table 2). After the study of orientations, this study has identified a wider coherent system spread the from few topographical remains of Fondo

[1252] SAMPAOLO 1999, 146.
[1253] SAMPAOLO 1999, 146.
[1254] By the consul A. Postumius Albinus in 173 BC recounted in Liv. LXII.1.6; LXII.19.1–2; the *praetor urbanus* P. Cornelius Lentulus in 165–162 BC in Cic. *Leg. agr*. 2.82.
[1255] DE CARO 2012, 69.
[1256] As recounted in Liv. LXII.1.6; LXII.19.1–2.
[1257] Cic. *Leg. agr*. 2.81–82 DE CARO 2012, 70.
[1258] MONACO 2004, 49–50.
[1259] Fron. *Lim.* 29.4-6 L=10.2–4 C; HygGr. *Const.* 17.14-16 L=136.25–27 C.
[1260] PROSDOCIMI 2009, 719.
[1261] PROSDOCIMI 2009, 717–719.
[1262] DE CARO 2012, 70.
[1263] DE CARO 2012, 70.
[1264] MELANDRI 2012, 497.

Patturelli to the Temple of Diana Tifatina. The sanctuary shares the same orientation with the Siepone urban neighbourhood, the Fondo Patturelli wall. For this reason, a unique planned design for organising this whole sacral and residential space may be inferred (fig. 33). This Archaic phase of Capua will be discussed through the skyscape analysis, since this is the first certain orientation pertinent to an urban layout.

- In the northern extra-urban area of the city, Sampaolo identified a street system oriented 45° east of north, urban system layout which includes Sandulli traces dating from the 3rd century BC (fig. 35.3). Parallel to the latter are the traces at the 'Mondo Nuovo' area (fig. 35.1), Via Galatina, the modern route at San Prisco from Masseria Schettini to Masseria Bersaglio (fig. 35.2), together with a perpendicular street in similar pozzolana beaten earth (fig. 35.4)[1265].

Figure 34. Diachronic urban orientation of Capua. Readapted by the author after MELANDRI 2012, 499.

[1265] SAMPAOLO 1996, 3–4; 1999, 143.

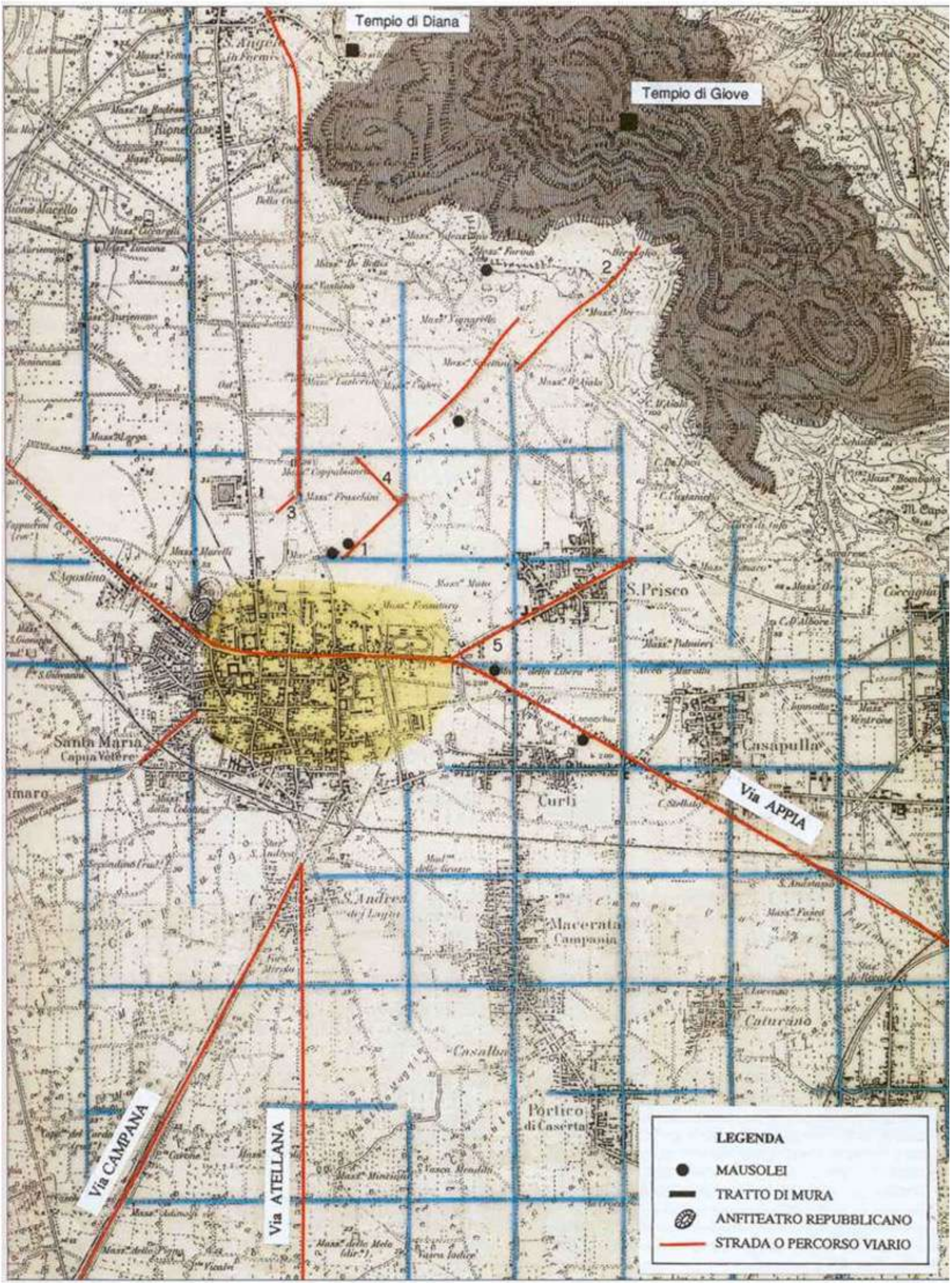

Figure 35. Reconstruction of the street system at Capua. From SAMPAOLO 1996.

Figure 36. The Orsi Immobiliare road pointing towards Mt. Tifata. Photo by the author, September 2022.

Table 2

Phase	Data	Reference System	Data Source	Azimuth
9th – 8th cent. BC	65° azimuth	Geographic	Nuovo Mattatoio (Google Satellite)	65° (±5°)
7th – 6th cent. BC	20–25° NW	Cartographic	Siepone SAMPAOLO 2008, 474; SIRANO 2014a, 112.	337°.5 (±2.5°)
7th – 6th cent. BC	75°	Geographic	Siepone (Google Satellite)	75° (±2°)
5th – 4th cent. BC	/	/	/	/
3rd – 2nd cent. BC	45° NE	Cartographic	Via Galatina-Mondo Nuovo Orsi Immobiliare SIRANO 2014a, 112.	45° (±2°)

Skyscape Analysis of the Urban grid

According to Luca Cerchiai, recent excavations have revealed that the hypothesis of the cardinal orientation of the Etruscan urban grid, as reflected in the modern city, is incorrect. He is referring to the orientation of the Archaic quarter of Siepone and Alveo Marotta[1266]. There is no particular astronomical event in the direct line of the Siepone urban orientation, except for the coincidence with the Pleaides rising above Mt. Virgo, *circa* 9.6 km away (fig. 37). The Pleaides would have risen at dawn in the period corresponding to mid-May. Also, they would have been seen rising during sunset around the middle of October. Alternatively, it is conceivable that the sanctuary of Diana Tifatina with its astronomical orientation towards the March new moon might be related to the origin of the urban layout itself, as supported by the continuity of the cult in the Imperial epoch, when other extra-urban sanctuaries tended towards decline[1267].

Figure 37. Landscape and skyscape visibility from Etruscan Capua in the Archaic period. Elaborated by the author with Horizon© Andrew Smith 2022. See Plate I.

Table 3

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
Siepone	E	600 BC	41.08	75	3	+13.25	Mt. Virgo (9.6 km away)	Sun rising 60 days before/after summer solstice or Pleiades rising (δ = +12.9° in 600 BC) (heliacal rising 14 days later)
	W	600 BC	41.08	255	0.7	-10.78		the second new moon at setting sun 40 days before/after winter solstice
Siepone	N	600 BC	41.08	337.5	2.5	+46.42	Slope Mt. Cima (18 km far)	
	S	600 BC	41.08	157.5	1.3	-42.95	Mt. Lattari - Mt. San Michele (53 km far)	

[1266] Cerchiai 2008, 409.
[1267] Johannowsky 1989, 28.

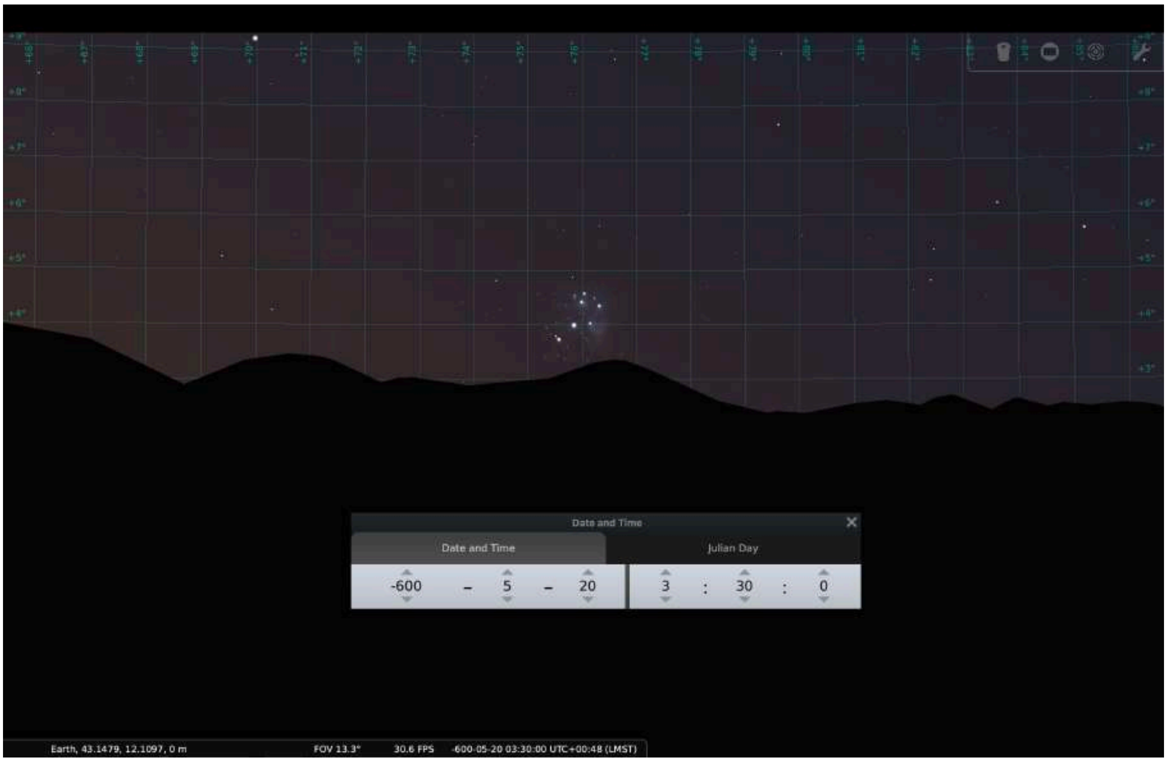

Figure 38. The Pleiades rising in early summer above Mt. Virgo as seen from Capua, in the direction of the urban system of Siepone, towards 75° azimuth. Elaborated by the author using Stellarium v.22.2.

The Temple of Diana

The temple of Diana is located on the hillside of Monte Tifata, in Sant'Angelo in Formis. It is at the border with the countryside of Capua, dominating this stretch of the river Volturno and the plain[1268]. The natural environment is characterised by mountains, forests, and thermal springs, all contributing to a sense that the place is imbedded with divinity[1269]. The literary source of the Trojan tradition referred to the importance of a doe, *famula Dianae*, in the foundation of the city by the mythical founder Capys[1270]. The white deer was sacred to Diana and the *lumen loci* of Capua and venerated until 211 BC, when the Romans conquered the city and sacrificed the deer to Latona. Giovanni Colonna interpreted such sanctuaries as being perceived already in ancient times as a relic of a bygone age[1271]. The temple is now replaced by an 11th century AD Benedictine church. The most ancient and monumental architectonic phase of the sanctuary is dated to the 6th cent. BC, with renovations in the

[1268] CERCHIAI 1995, p. 1957.
[1269] CERCHIAI 1995, p. 157.
[1270] Sil. It. *Pun.* XIII, 115-137.
[1271] COLONNA 1985, 127.

4th–3rd cent. BC that included an Etruscan-Italic temple and a huge *peribolos* around the temple[1272]. The 2nd cent. BC podium is still recognisable as such within the present-day church. According to some scholars, the Diana cult must be more ancient than the Hellenistic temple. Fragments of Late Archaic terracotta found at the site may offer the possibility of dating the temple, but their exact provenance remains uncertain. Findings from the 8th century BC and even the Orientalising period in the whole area of the hillside of Monte dei Lupi confirm the continuous occupation of the site: already in the LBA and at the beginning of the IA, this area on the slope of Mt. Tifata has been identified as one of the residential nuclei of proto-urban Capua[1273]. The main axis of the temple, when looking in the direction of the cella (azimuth 75°, on north-east), points towards the plateau of Monte dei Lupi about 1 km away, although this may just be a coincidence. Massimiliano De Fazio pointed out how the study of the natural, spatial, and environmental context of a pre-roman cult site can be helpful in enabling a better understanding of its cultural, political, and socio-economic functions. In his study of the Italic goddesses Feronia, he found many similarities with the cult of Diana, especially in the location of the sanctuaries[1274]. These were often located in the countryside, often combined with a specific natural place such as a sacred wood or woods, and with a body of water nearby. Their function seems to have been to serve as gathering places for different communities with access to road networks and markets[1275]. The combination of a male sanctuary, mainly dedicated to Jupiter but with Apolline characters, on the top of a mountain and one dedicated to a feminine divinity, Feronia or Diana, on the slopes of it or on a nearby plateau has many Italic equivalents[1276]. The cult at Capua shows similarity with the Latin sanctuary of Diana Nemorensis at the lake of Nemi, and the cult of Artemis at Cumae. The goddess *Tifatina* is also named ‘*Triviae*’ and connected to a ‘*nemus*’, a wood, as ‘Tifata’ means a holm oak forest in Oscan language[1277]. The absence of Apollo with the goddess suggests that the cult developed outside the Hellenic influence[1278]. It must be pointed out that the Diana is not Artemis, but and Italic goddess presiding over extra-urban sacred groves places in Latium and Campania[1279]. Finally, it is worth mentioning that the Lavinium Thirteen Altars (6th to 4th cent. BC) were similarly oriented at 72°–76° azimuth, yet facing the few kilometres away peaks around the Lake of Nemi[1280].

The temple of Diana opens towards the west with a spectacular view of the Campanian plateau. When considering the orientation of the temple (254/255° azimuth), Franco Ruggieri and Luigi Candurro suggested the heliacal setting of the constellation of Orion could be seen to be in line with the temple[1281], as also restated by Mario Pagano and Antonella Tomeo[1282]. However, it is here

[1272] SIRANO 2018, 306.
[1273] MELANDRI 2012, 487–493.
[1274] DI FAZIO 2020b, 220; 2012b, 397.
[1275] DI FAZIO 2020b, 220.
[1276] DI FAZIO 2012c, 386; for the role of Jupiter Tifatinus and Mt. Tifata as reference point see SIRANO 2018, 309.
[1277] An explication of Diana as ‘Trivia’ is found in Serv. *Aen* IV.511.
[1278] DE FRANCISIS 1956, 343.
[1279] GLINSTER 2020, 48, 51; MASTROCINQUE 2021, 215; DUMÉZIL 1996, 407–412.
[1280] MOSER 2014b, 347–351; see section 2.4 ‘The Latin and Roman World’ in ‘Temple Orientation’, Chapter Three.
[1281] See http://www.righel40.altervista.org/S.AngeloFormis/AA-SAF.htm [accessed December 2022].
[1282] PAGANO - TOMEO 2021, 130.

suggested that the celestial event that aligns the most with the axis of the temple is the second *novilunium* after the winter solstice (fig. 39). Generally, a new moon corresponds to the end of a lunar month and the beginning of a new one: then, the moon is not visible because it is too close to the sun as seen from the Earth. After the new moon, the astral body appears in the form of a thin crescent. The first crescents are usually adopted as calendric markers for the start of a new month, even though their observation can shift by one or two days due to astronomical and meteorological conditions[1283]. The first crescents set just after the sun since a waxing moon always follow the sun. As reported by the sources, the first crescents are typically observed in the west, at sunset, when the diffuse light decreases and the moon is illuminated by the sun and shining in the twilight with its typical crescent D-shape[1284]. They are not well visible at sunrise as, when the moon rises, the sun has already risen higher in the sky and its diffused light prevents a clear observation of a thin crescent. Given the orientation of the temple (254/255° azimuth), the crescent moon would have set at the end of winter and the beginning of spring in that direction. The temple's open view allows for the observation of every new moon of the year, so it is possible that the administration of Capua's calendar was performed at the sanctuary. Alfonso de Francisis defined the temple the greatest sanctuary of Campania, so it is possible that the calculation of moon phases and calendar for the whole Campania was regulated there[1285]. The importance of the moon at the sanctuary can be read in the poetic words by Silius Italicus regarding the sacred doe, which «renew its whiteness by bathing it in the river»[1286], recalling the cyclical renewal of the moon in the celestial waters. Diana Tifatina temple faced the setting sun on a day 60 days after and before the winter solstice sunset, that is almost two months. This day may correspond to the beginning of March but, given the poor evidence on calendric time reckoning for the period, it is not easy to say[1287]. The Capuan Etruscan calendar is regarded of ten months starting from March[1288]. For the Samnite period, the *Iuvilas* texts found at the Fondo Patturelli sanctuary often refer to the first month of the year, *Mamertio*[1289]. Yet, the Diana at Mt. Tifata had a cult resonance at the *lucus* at the Fondo Patturelli sanctuary in her chthonic aspect, also identifiable with Mefite[1290]. The Fondo Patturelli sanctuary shows indeed the same orientation as Diana Tifatina when what remains of the fragmentary topography of the sanctuary is assessed. The temple of Diana Tifatina and Fondo Patturelli sanctuary, therefore, might have oriented to the kalends in March, or the month before it. According to Angelo Brelich, the beginning of the Roman Archaic calendar was officially the 1st of March[1291]. In those days, fires were left to wane and new fires were lit. That day was sacred to Iuno and was called *Martronalia*[1292]. In Rome, all temples dedicated to Juno celebrated

[1283] Macrob. *Sat.* 1.15.6; Plut. *Quaest. Rom.* 24; see in Chapter Three, 'Festival and Calendar', in particular the end of section 3.4 'The Roman World'.
[1284] Macrob. *Sat.* 1.15.6; Plut. *Quaest. Rom.* 24.
[1285] DE FRANCISIS 1956, 312.
[1286] Sil. It. *Pun.* XIII.123, trans. by J. D. Duff 1934.
[1287] In this context on the orientation of Etruscan temples and the month of March see GUARINO 2011, 215.
[1288] CRISTOFANI 1998, 170.
[1289] COARELLI 1995a, 378; FRANCHI DE BELLIS 1981, 49.
[1290] SAMPAOLO 2011, 15; RESCIGNO 2017, 214–216.
[1291] BRELICH 2015, 224.
[1292] BRELICH 2015, 224.

their *dies natalis* on a kalends day[1293]. Juno was honoured with a on the kalends «since it was the custum of our ancestors to begin the month with the first appearance of the moon, they rightly assigned the Kalends to Juno, for they identified her with the moon»[1294]. At the same time, Diana shows some correspondence with Juno Lucina[1295].

The sphere of influence of Italic Diana included the moonlight and the moon itself: as such she governs over time[1296]. Her connection with the moon is emphasised in the Late Republican writers[1297]. Her epithet Trivia was explained by Varro as 'she is said to be the Moon, which moves in the sky in three ways (*tres viae*), upwards, sideways and onwards'[1298]. The triform moon is also represented by Proserpina when she is below the earth, Juno Lucina or Luna when she is over the earth, and Diana when she is on the earth[1299]. In Horace and Catullus, Diana is referred to as aid in childbirth, *triformis*, and with lunar connotations:

Tu Lucina dolentibus
Iuno dicta puerperis
Tu potens Trivia et notho es
Dicta lumine Luna.
Tu cursu, dea, menstruo
Metiens iter annuum,
Rustica agricolae bonis
tecta frugibus exples[1300].

You are called Juno Lucina by
mothers in the pangs of childbirth,
you are called mightily Trivia and
Luna with counterfeit light.
You, goddess, measure out by monthly
course the path of the year; you
fill with precious fruits the
rustic farmer's home[1301].

Patricia A. Johnston recalled previous interpretation by Wissowa and Turca, where the primary role of the Italic Diana was protectress of nativity. Her epiclesis '*Lucina*', as Juno, is a reference to 'bright to light' and therefore 'goddess of childbirth'[1302]. This ambit is coherent with the great quantity of *matres* found at Capua, especially at Fondo Patturelli. According to Johnston 'the *matres* who hold the infants represent *ex voto* statues, propitiatory offerings and the expression of thanks for the

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1293 BRELICH 2015, 212.
1294 Macrob. *Sat.* 1.15.20, trans. by P.V. Davies 1969.
1295 JOHNSTON 2021, 279.
1296 GLINSTER 2020, 47.
1297 Cic. *Nat. D.* 2.68; Varro, *Ling.* 5.68–9; 7.16.
1298 Varro, *Ling.* 7.16 in GLINSTER 2020, 48-49.
1299 Serv, Aen IV.511 discussed in MASTROCINQUE 2021, 221; Varro, *Ling.* 7.16 discussed in GLINSTER 2020, 48.
1300 Cat. 34, 13-20.
1301 JOHNSTON 2021, 283–284.
1302 JOHNSTON 2021, 283–284.

concession of fertility'[1303]. According to Françoise-Hélène Pairault, Diana, as the moon governs both religious, civil, and biological time. In the word of the scholar, «Diana-Lucina apporte au monde une nouvelle lumière, et fait naître à la lumière l'enfant, espoir de l'humanité»[1304]. Thus, the fertility of women was primary matter for the whole community and its legacy[1305]. The superimposition of Diana with Juno is spread over Campania and Latium, also coherent with the iso-orientation of the sanctuary of Diana Tifatina and the Lavinium thirteen altars[1306]. At Diana Tifatina sanctuary, the observation of *novilunium* was guarantee by the exposition of the temple towards the west, and its open view on the plain, and its orientation towards the first new moon on the year: this evidence suggests that the local luni-solar calendar was probably regulated from this location.

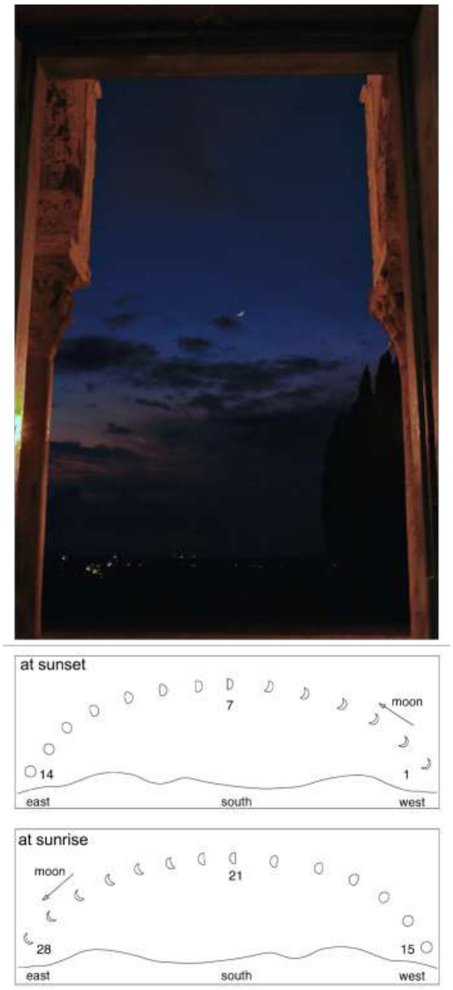

Figure 39. Above. Crescent moon in early spring, the sign of the beginning of the Archaic calendar at the Temple of Diana Tifatina. Looking west from inside. Photo by the author, 4th March 2022, 18:26 local time. Below. Visibility of the moon according to days of the month at sunset and sunrise. Adapted from MAGINI 2015, 29.

[1303] JOHNSTON 2021, 284.
[1304] PAIRAULT 1969, 436.
[1305] PAIRAULT 1969, 434–438; GLINSTER 2020, 53.
[1306] It must be pointed out that the altars are positioned in a way that the officers look east, whilst Diana Tifatina temple is opened towards the east.

The Fondo Patturelli Sanctuary

In 1845, Carlo Patturelli accidentally recovered a monumental staircase with terraces on both sides featuring sphinxes[1307]. The staircase led to a quadrangular open-air pavement, where a small altar was located[1308]. All this evidence was destroyed by the excavator. There are not many indications of the topography of the sacred area, known since as 'Fondo Patturelli', nor of the context of the material remains considering the poor execution of the excavations which followed in 1873[1309]. According to Paola Carafa, the sanctuary can be deduced to have had a monumental altar with a staircase on the east side, twelve steps, and a podium measuring 8.20 m x 6.50 m[1310]. More altars might have been present, as indicated by the tuff-blocks altar found in 2007 in Ciarmiello property[1311]. A perimeter wall was found, whose orientation is matched by the present road, Via Volturno, oriented similarly to the Siepone Archaic urban neighbourhood. When this orientation (circa 74° azimuth (±2°) is taken into account, there is a similarity with the orientation of Diana Tifatina Temple (fig. 33 and 40). There is no indication as to in which direction the sanctuary faced, but the March new moon would have been visible from this sanctuary when looking west. A well, probably a *bothros,* was also recovered to the north of the monumental altar. Certainly, the so-called Fondo Patturelli sanctuary had a funerary aspect, being placed within a necropolis area just on the eastern edge of ancient Capua[1312]. The presence of a *lucus*, a sacred wood, is attested in later Oscan sources[1313].

The first monumental architecture in the area is evidenced by architectonic terracotta dating from the end of the 7th or beginning of the 6th cent. BC during the Etruscan phase[1314]. The first antefixes are datable to 580–570 BC with their palmettes and elements cast in moulds[1315]. From 550 BC, more complex antefixes document an archaic cult of a goddess associated with natural forces[1316], governing vital cycles and rites of passage[1317]. Filippo Coarelli suggested that an antefix with geese[1318] could be attributed to Hera-*Uni*, whereas those of a military character could be connected with Hera-Aphrodite, a twofold deity (both maternal and warrior) typical of emporia sanctuaries, even though the maternal aspect is the prevailing one at Capua[1319]. The group of *Eos* and *Kephalos* depicted on an antefix might add a dawning, chthonic and maternal aspect to the goddess[1320], where the myth of the loving kidnapping assures immortality[1321]. Also, the presence of Heracle is evident at Fondo

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1307 Carafa 2008, 91.
1308 Carafa 2008, 91.
1309 Poccetti - Sampaolo 2014, 144; Coarelli 1995a, 372; Carafa 2008, 92.
1310 Carafa 2008, 92.
1311 Sampaolo 2010, 6; Pagano - Tomeo 2021, 100.
1312 Coarelli 1995a, 373.
1313 Cerchiai 1995, 159.
1314 Coarelli 1995a, 372.
1315 Cerchiai 1995, 148.
1316 Cerchiai 1995, fig. xxi. l-2.
1317 Cerchiai 1995, pp. 159–160.
1318 Cerchiai 1995, xxi.1.
1319 Coarelli 1995a, 375.
1320 Cerchiai 1995, fig. xxxii.1.
1321 Cerchiai 1995, p. 160.

Patturelli from the middle of the 6th cent BC, depicted in the act of killing the Nemean lion[1322]. For Maria Bonghi Jovino, the ambiguity of the cult could be seen as a process of permeability in the sphere of action of each single divinity, suggesting the presence of a *Menrva kourotrophoi,* as revealed by the recent discovery of a statue with an enlarged power in the chthonic world, birth, and pregnancy, together with *Uni*[1323].

By the end of the Archaic period, the maternal aspect of the deity tended to overshadow the warrior one[1324]. Luca Cerchiai attributed the Etruscan inscribed calendar known as Tabula Capuana to the Fondo Patturelli sanctuary[1325]. This calendar was elaborated between the end of the 6th and the beginning of the 5th cent BC and inscribed on the tile during the 5th cent BC. The Tabula Capuana is a copy of the liturgical calendar of a sanctuary; ordered in days and months, it provides a list of the succession of rites to be accomplished. It mentions the deities of the Etruscan pantheon, such as the celestial *Uni* (Hera), *Tinia* (Iuppiter), *Laran* (Mars), *Lethams* (Fortuna?) and the chthonic deity *Calus*[1326].

The documentation continues throughout the 5th century BC, when the sanctuary seems to have included a temple with a tuff basement and a *bothros* filled with red and black figure vases[1327]. By the last quarter of the 5th cent. BC, significant political changes affected the cult's organisation in the sanctuary, with the Campanians acquiring enough power to reformulate the religious system above that of the Etruscan community[1328]. Capuan fictile workshops focused on the production of votive offerings in a standardised form: tuff or terracotta *kourotrophoi* statuettes known as 'madri', depicting mothers in the act of breastfeeding their babies. Due to the many 'mothers', it was thought that the sanctuary was dedicated to a goddess. A huge group of around 150 statues of *matres* with new-borns were recovered in the area, connoting the maternal character of the cult[1329]. The chronology of the *matres* dates from the end of the 5th to the 2nd cent. BC and covers the Samnite phase of the city, with some hints of rites of passage involving the initiation masking of both sexes[1330]. Around 25 types and 500 exemplars of statuettes have been found in total. Anatomic ex-voto statuettes of theatrical actors and acrobats, tangerines, figures of Bes (from the Hellenistic period), are all part of the fictile material from the Fondo Patturelli sanctuary and now preserved at the Museo Campano. Simultaneously with the production of *matres*, a series of *stelae* were produced; known as *iúvilas*, these were inscribed in Oscan language[1331]. However, their chronology is restricted to a period from the end of the 5th BC to the middle of the 3rd cent BC[1332]. Among the 26 *stelae* found, these are generally characterised by a figurative circular element at the top, such as a feminine face, piglet, or

[1322] CERCHIAI 1995, 160–161; CARAFA 2008, 93.
[1323] BONGHI JOVINO 2011a, 26–27.
[1324] COARELLI 1995a, 375.
[1325] CERCHIAI 1995, 161; SAMPAOLO 2011, 14.
[1326] CERCHIAI 1995, 162.
[1327] CERCHIAI 1995, 159.
[1328] BONGHI JOVINO 2011a, 28.
[1329] COARELLI 1995a, 373.
[1330] COARELLI 1995a, 374.
[1331] COARELLI 1995a, 373.
[1332] COARELLI 1995a, 376.

abstract tripartite element, corresponding respectively to the image of the divinity, the fierce sacrifice, or the ritual offering of flat bread[1333]. These inscriptions are notifications of the sacralisation of the *stelae* according to the rituals[1334]. According to Coarelli, such inscriptions seem to be related to the public funerary practices with prominent people buried at the extra-urban sanctuary dedicated to a feminine goddess[1335]. In the inscriptions, this goddess is indicated to be the divinity *Ceres Arentika*, related to the sphere of Demetra. Thus, the passage from private death to the public cult, within a religious calendar and in the presence of the *meddix*, might have been a permeable process in this context[1336]. The Oscan calendar probably started with the month of *Mamertio*, March, preceded by a month named with the periphrasis 'pre-March' possibly dedicated to the dead and the ancestors, very similar to February in the Roman calendar[1337]. As Franchi De Bellis stated, the life of the new-born was based upon the commemoration of the dead; after the fact of seeds arising from being buried in the ground[1338], the cult of the sanctuary at Fondo Patturelli might have been based upon this principle, where the funerary practice and the *matres* were related to the cycle of life and death as implicit in the calendar. According to Coarelli, the end of the cult of *matres* and the functioning of the sanctuary can be fixed as occurring in the late 2nd and beginning of the 1st cent. BC, which would correspond to the foundation of the Caesarian colony in 59 BC along with the introduction of monumental mausolea in response to new funerary needs[1339].

After a possible dedication at the sanctuary to the Etruscan *Uni*, there might have followed the Italic Diana, Fortuna or Venus Iovia during the Samnite period[1340]. Indeed, the Etruscan *Uni* does not necessarily correspond the Latin Juno[1341]. Bonghi Jovino suggested the Archaic *Uni* of the Etruscans was substituted by a goddess with a sphere of action centred on fertility and reproduction, who can be associated with Mater Matuta-*Uni* and, within a Roman context, to Juno Lucina and Venus Libitina[1342]. Coarelli identified the sanctuary with the temple of Fortuna mentioned by Livy, and proposed a process of transition from Fortuna to Venus Iovia within the sphere of the Oscan *Herentas*[1343]. To support this interpretation, Coarelli added numismatic evidence in the form of a divinity with a diadem on the front and two veiled female busts on the back, within the context of a twofold cult similar to the Roman Fortuna-Mater Matuta[1344]. The presence of Fortuna at Capua was compared, by Cerchiai, with the Praeneste sanctuary, where she is represented as a *kourotrophos* with

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[1333] COARELLI 1995a, 376.
[1334] FRANCHI DE BELLIS 1981, 61.
[1335] COARELLI 1995a, 377.
[1336] FRANCHI DE BELLIS 1981, 61.
[1337] FRANCHI DE BELLIS 1981, 51–54.
[1338] FRANCHI DE BELLIS 1981, 53.
[1339] COARELLI 1995a, 373.
[1340] POCCETTI - SAMPAOLO 2014, 144.
[1341] COARELLI 1995a, 377.
[1342] BONGHI JOVINO 2011a, 28; On recent discussions of Libitina see D. Miano, "Love, death, and funerals in ancient Rome: on the goddess Libitina", in *Mortality* 27, 2, 2022: 159–170.
[1343] COARELLI 1995a, 379.
[1344] COARELLI 1995a, 379–380.

the new-born *Iuppiter* and Juno[1345]. Some passages from Livy suggest the presence of a temple of Fortuna at Capua[1346]. Cristofani hypothesised the identification of the temple of *Fortuna* as being at the Quattordici Ponti site, where the *Tabula Capuana* was found[1347]. The temple of Fortuna at Capua is said to have been hit by a thunderbolt, as described here: *«[i]n Albano monte tacta de caelo erant…et Capuae murus Fortunaeque aedis»*[1348] and *«[e]t ex Campania nuntiata erant Capuae duas aedes, Fortunae et Martis et sepulcra aliquot de caelo tacta»*[1349]. Jacqueline Champeaux has not drawn any particular conclusions about the topographical or theological presence of a cult to Fortuna at Capua; instead, she opted for the divinity *Iuno Gaura* as having been worshipped there[1350].

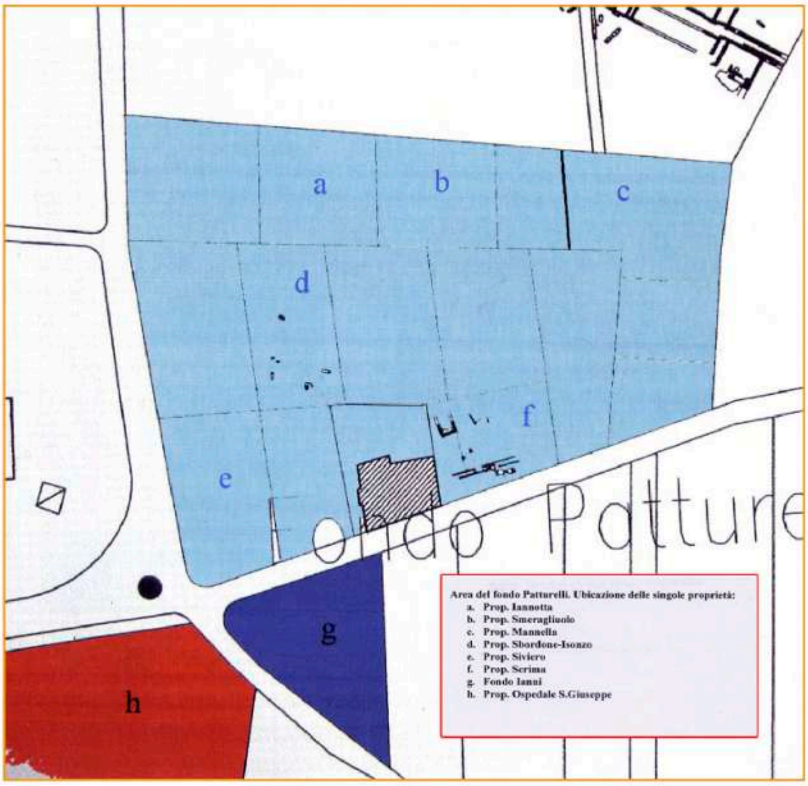

Figure 40. The fragmentary topographical layout of Fondo Patturelli sanctuary. After SAMPAOLO 2010, 5.

[1345] CERCHIAI 1995, 162.
[1346] CHAMPEAUX 1892, 188.
[1347] CRISTOFANI 1998, 171–172.
[1348] Liv. 27.11.2.
[1349] Liv. 27.23.2.
[1350] CHAMPEAUX 1892, 188.

II. CALATIA

Introduction

Calatia was a small settlement and part of a territorial system dependant on Capua[1351]. The site is located within the modern centres of Maddaloni (CE) and S. Nicola la Strada (CE) The archaeological data of the area of Calatia has been compromised by agricultural activities and clandestine excavations[1352]. However, the emergence of materials all over the territory has been mapped in recent research conducted by the Università 'Vanvitelli', previously 'Seconda Università degli Studi di Napoli'[1353]. A domus, a few streets, and part of the urban wall were uncovered within the settlement of Calatia, in an attempt to understand the urban morphology over different phases of the city[1354].

The Proto-Urban Settlement

For the IA period, the organisation of the settlement of the living can be inferred from the necropolis. Starting from the funerary area, ther is evidence, from the mid-8th cent. BC, of the appearance of a settlement with social and aristocratic divisions. The data from the NE funerary areas have revealed family groups with rich grave goods and within an enclosure, that can be placed between the end of the 7th cent. and the beginning of the 6th cent. BC[1355].

The Archaic Town

The distribution of the necropolis confirmed that the settlement occupied an area of circa 12 hectares[1356]. Moreover, materials discovered during recent excavations, such as bucchero ceramics and an Etruscan inscription on a fragment, suggest the vitality of this archaic settlement. A limestone dry wall was also uncovered, being probably the defensive system of the settlement, and postholes on a beaten earth ground, suggesting the one-time presence of a hut[1357]. It is possible that the perimeter of the settlement was traced in this period.

Romanisation

After the period of calm in the 5th cent. BC, a new occupation model emerged between the 4th and the 3rd cent. BC, when the archaeological data indicates significant demographic growth and capillary settling in the territory, although with a high dispersion in its spatial distribution which can be interpreted as indicative of farms[1358]. The disposition of structures started to follow a cardinal orientation, which was perpetuated in the later centuries[1359]. By the end of the 4th cent. BC and in the

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[1351] CERCHIAI 1995, 140.
[1352] LUISI 2001, 183.
[1353] QUILICI GIGLI - RESCIGNO 2000; LUISI 2001; RESCIGNO 2002; PETACCO - RESCIGNO 2005; ARENELLA 2001.
[1354] RESCIGNO 2002, 99.
[1355] LUISI 2001, 187.
[1356] RESCIGNO 2002, 100.
[1357] RESCIGNO 2002, 100.
[1358] LUISI 2001, 188.
[1359] LUISI 2001, 190.

first half of the 3rd cent. BC, the urban organisation of the area acquired a regular layout, with at least two streets found during the excavation campaigns: a north-south segment and a part of the Appia Way urban transit, *decumanus maximus* of the urban morphology[1360]. The monumentalisation of private and public buildings is attested for this chronological phase, reflecting the Romanisation of the area at the time of the Samnite Wars and the granting of *civitas sine suffragio* status[1361]. The regular Hellenistic layout adapted itself to the Archaic wall perimeter, as evidenced by the attempt to regularise the modular layout to the circular perimeter on the south-west[1362].

Urban Orientation in Phases

While the perimeter of the settlement can be dated in the Archaic phase, the regular layout might have been implemented between the 4th and the 3rd cent. BC (fig. 41)[1363]. A section of the *decumanus maximus* emerged during the 2003 excavations. The axis corresponds to that of the modern road, although the latter has a more sinusoidal shape since it had to join with the Appia Way and its orientation. The solution adopted for the integration of the Appia Way into the urban area is similar to the layout still visible at Capua[1364]. The archaeological data points towards a chronology of the urban design in the 4th–3rd cent. BC[1365]. Thus, the implementation of the urban orthogonal grid must be placed before the construction of the Appia Way, as evident in a divergence in their orientation [1366]. The urban orientation of Calatia value is derived from previous excavation data (Table 4). This is differing of several degrees from the cardinal centuriation, the latter to be dated indeed to a later period. There is also a divergence in the connection between the urban and the extra-urban axes, which confirm the chronological independency of their structuration[1367]. Instead, the Via Popilia on the west, inaugurated around the second half of the 2nd cent. BC, seems to follow the lines of *centuriae*.

Table 4

Phase	Data	Reference System	Data Source	Azimuth
4th – 3rd cent. BC	Beyond N 5° W	Cartographic	Quilici-Gigli 2002, 99.	85°
4th – 3rd cent. BC	N 4° W	Cartographic	Rescigno-Senatore 2009, 426.	86°

[1360] Rescigno 2002, 100.
[1361] Rescigno 2002, 101.
[1362] Rescigno 2002, 12.
[1363] Rescigno 2002, 102.
[1364] Rescigno 2002, 104.
[1365] Mereu 2021, 46.
[1366] Quilici Gigli 2002, 99; Quilici Gigli - Rescigno 1996, 95.
[1367] Quilici Gigli 2002, 99.

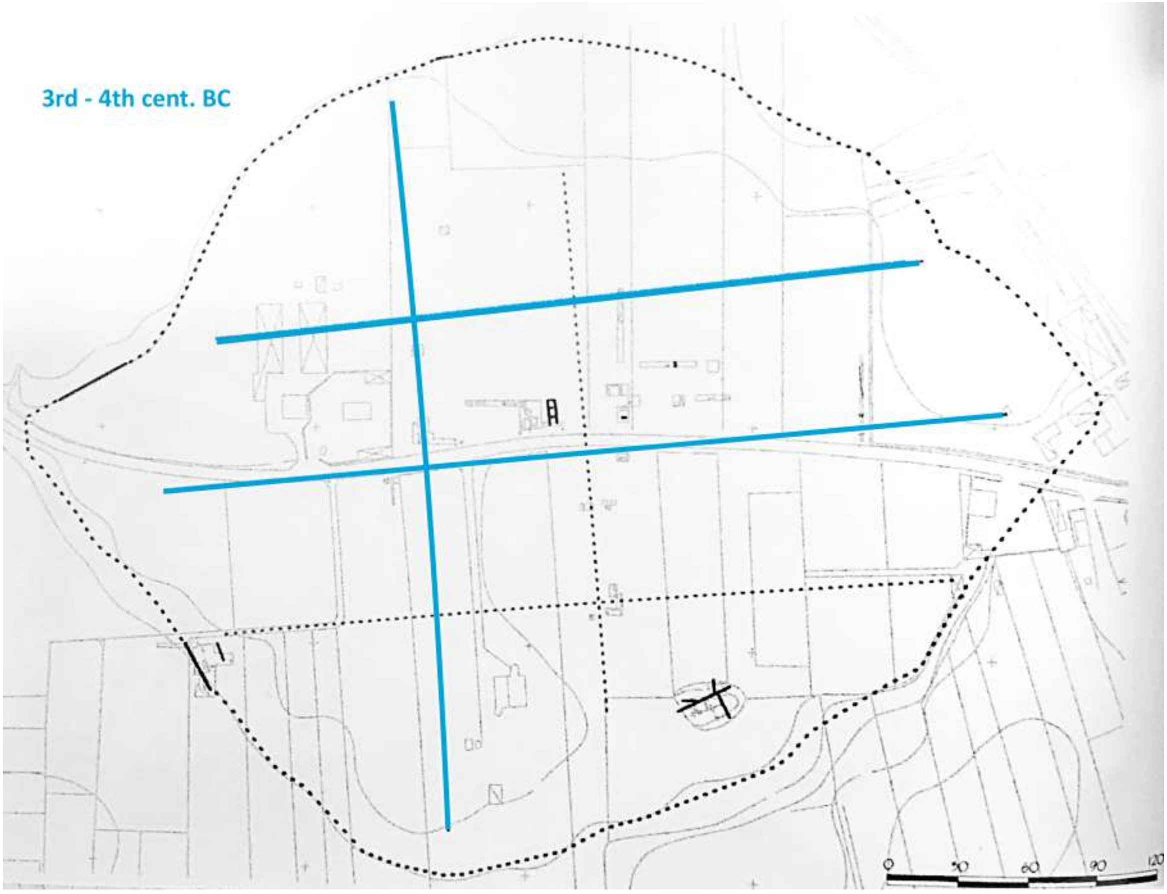

Figure 41.Calatia urban grid hypothetical reconstruction. Adapted after MEREU 2021.

Skyscape Analysis of the Urban grid

The orientation of the urban grid points towards the rising sun around the time of the equinox, even though with an error of at least 5° (fig. 42). This discrepancy can be measured as being 15 days before and after the astronomical equinox. The sun would have rose in the direction of Calatia's urban grid around 80 days before and after summer solstice (April/September). This is unusual if compared to other Campanian towns: the lack of a clear topographical picture of Calatia's urban design may compromise its full understanding.

Figure 42. Landscape and skyscape visibility from Calatia in line with the urban axes. Elaborated by the author with Horizon© ANDREW SMITH 2022. See Plate II.

Table 5

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
	E	300 BC	40.04	85	4	+6.39	Southern slope of Mt. San Michele (2.7 km far)	Equinox? Altair rising (δ = +5.8°)
	W	300 BC	40.04	265	0.1	-3.7	open towards the Campanian plain	
	N	300 BC	40.04	355	3	+51.69	Montagne Baccalà (6.8 km far)	
	S	300 BC	40.04	175	0.6	-48.11	Southern slope of Mt. Somma-Vesuvius (24 km far)	

III. SUESSULA

Introduction

At the site of Casina Spinelli, the settlement of Suessula has been identified on a light slope tuff plateau, delimited on the north and south side by some paleochannels[1368]. Geomorphological analysis and the interpretation of aerial photographs have contributed to the definition of the size of the urban settlement indicating that it covers an area of around 40 hectares[1369]. The area appears roughly rectangular in shape, encircled within a defensive system on the north and east sides[1370].

The Proto-Urban Settlement

Archaeological evidence confirms the frequentation of the area since the Late Iron Age[1371]. The presence of a few necropolises, surrounding the later urban area on three sides, suggested the presence of a single centred settlement from the 8th cent. BC. At Cappelluccia, italic-geometric impasto pottery fragments have emerged, as well as post-holes[1372]. Alongside the burials, a 3.5 m wide beaten earth street was also found with evidence of use, starting from the end of 8th–early 7th cent. to the 3rd–2nd cent. BC, indicating the first road orientation in the area[1373]. Late Iron Age evidence of frequentation is present underneath the area of the forum, synchronic to the materials in the Spinelli collection excavated from the necropolis on the south-east side of Suessula[1374]. According to Fabrizio Ruffo, an urban planning was already started in the Iron Age[1375]. A sacred continuity of use of this central area is suggested by the recovery of a cup of significant dimensions, dated between the end of the 8th cent. BC and beginning of the 6th cent. BC; this large cup has been compared by Marco Minoja with specialised shaped cups from Fondo Patturelli at Capua, and he has posited that it was possibly for ceremonial usage[1376].

The Archaic Town

Late Archaic terracotta fragments have emerged from below the forum area[1377]. According to Daniela Giampaola and Amedeo Rossi, this evidence confirms an urbanisation and monumentalisation of the area where the later Roman public buildings were placed, indicating a continuity of public and sacred practice from the 6th or early 5th cent. BC[1378]. In particular, remains of animal sacrifices were recovered on the east side of the basilica. A tuff-blocks structure oriented north-south, though slightly

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1368 ROSSI 2011, 305.
1369 ROSSI 2011, 305.
1370 ROSSI 2019a, 11.
1371 GIAMPAOLA - ROSSI 2011, 455.
1372 GIAMPAOLA - ROSSI 2011, 456.
1373 DE CARO 1994, 650.
1374 GIAMPAOLA - ROSSI 2011, 456.
1375 RUFFO 2010, 219–220.
1376 MINOJA 2006.
1377 GIAMPAOLA - ROSSI 2011, 457.
1378 GIAMPAOLA - ROSSI 2011, 457.

tending towards the west, was unearthed together with bucchero and impasto pottery from the middle of the 6th cent. BC. Remains of an orthostates tuff wall were found on the north-eastern side of the area (fig. 43), datable to between the end of the 6th to the early 4th cent BC being resonant with similar evidence found at Neapolis and Cumae[1379]. The more recent chronology for the wall was preferred by Cerchiai[1380]. The wall has an orientation N 18° W[1381]. This is reflected in the agrarian organisation with similarly oriented drainage channels found at Madonna delle Grazie, just 5 km south-west of Suessula, near to modern Acerra, itself datable from the 6th to the 5th cent. BC[1382]. Since the foundation of Acerrae is ascribable to the late 6th cent. BC, such agrarian territory was of competency of Suessula, as evinced by the alignment between the walls and the drainage system[1383]. This is the most ancient system of territorial organisation at Suessula, with an orientation of N 18° W according to a recent hypothesis by Amedeo Rossi[1384]. An orientation of N 17° W has also been contemplated[1385].

Figure 43. Northern wall of Suessula. Elaborated by the author after Google Earth Pro.

[1379] CAMARDO - ROSSI 2005, 167; ROSSI 2011, 306–308.
[1380] CERCHIAI 2019, 14.
[1381] ROSSI 2011, 318; CERCHIAI 2019, 14.
[1382] GIAMPAOLA 1997, 227–230; 2002, 167; CERCHIAI 2019, 14.
[1383] CERCHIAI 2019, 14.
[1384] ROSSI 2011, 319.
[1385] RESCIGNO - SENATORE 2009, 426.

Romanisation

From the end of the 4th and the starting of the 3rd cent. BC, after the *hiatus* period in the 5th cent. BC, the romanisation of the area gradually started. The city of Suessula received the *civitas sine suffragio* in 338 BC, together with Capua and Cumae[1386]. Indeed, the strategically significant position of the city might have caused it to play a crucial part in the Samnite and Hannibalic war[1387]. In the same area of the forum, the evidence of ritual remains, including a fictile uterus datable to the 4th or 3rd cent. BC., suggests a continued use of the area as a sacral sector of the city into the Roman period[1388]. At this stage, a system of centuriation was oriented N 28° W[1389]. This system spanned from Suessula to Neapolis, including Atella and Acerra[1390]. Such territorial organisation was recognised by Chouquer *et al.* as *Atella-Acerra I* but dated as of the Augustan Age by the French scholars[1391]. Recent excavation has uncovered swamp-reclamation channels (4th–3rd cent. BC) corresponding to the same orientation system, along with five male burials where these remains are interred with horses (early 3rd cent. BC)[1392]. Moreover, the wide and coherent parcelling of a vast area indicates a unity of planning[1393]. According to Rossi, this centuriation may reflect multiples of the italic foot (0.275 m) for lots of 2000 x 2000 feet (550 m), circa 15 *actus*[1394]. At the same time, the urban consolidation of nearby Acerrae and Atella is integrated with this system, with their urban axis extending as a continuation of the territory[1395]. Suessula's territory was integrated within this system, but it still maintained its urban lines from the Archaic period. The identification of administrative boundaries for the single communities was investigated by Rossi[1396]. The course of the river and the traces of a sanctuary (4th – 3rd cent. BC) in Pantano di Acerra and Parmiano might be relevant for such an identification[1397].

There followed the *deductio* of the colony by Sulla and its subsequent territorial organisation[1398]. A restructuring of the urban sector is evident from the monumental planning of the forum, with the definition of public buildings[1399]. A Capitolium was constructed with an almost north-south orientation[1400].This phase corresponds to the layout of N 10° W, as reflected in the urban orientation of the forum and the paved street[1401]. The orientation of the city was adapted to the

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1386 Liv. VIII, 14.
1387 Ruffo 2010, 221–223.
1388 Giampaola - Rossi 2011, 458–459.
1389 Rossi 2011, 319.
1390 Rossi 2019a, 10.
1391 Chouquer et al. 1987, 207–208, fig. 70.
1392 Giampaola 2002, 168.
1393 Cerchiai 2019, 17.
1394 Rossi 2019a, 8.
1395 Cerchiai 2019, 17.
1396 Rossi 2019a, 10.
1397 Rossi 2019a, 10–11.
1398 Lib. Col. L. 237, 5-7: *Suessula. oppidum, muro ducta. Lege Syllana est deducta. Ager eius veteranis limitibus Syllanis in iugeribus est adsignatus. iter populo non debetur.*
1399 Rossi 2011, 310–313.
1400 Ruffo 2010, 223.
1401 Rossi 2011, 320.

surrounding area using the already existing morphology[1402]. On the south-east side, a different orientation system was utilised, directed N 46° 30' E (*Nola IV-Sarnum*) and dating back to at least at the 3rd cent. BC[1403]. It also approached another centuriation (*Nola III*) which had an orientation of N 15° E datable to the Late-Republican Age[1404]. The form of the city was fully intertwined with the surrounding area[1405]. Dating it to the 2nd cent. BC, Ruffo reported another orientation of N 15° W shared among the northern buildings in the forum and the modern axis Acerra-Maddaloni, which may be identified with the Via Popilia [1406].

Urban Orientation in Phases

The oldest grid seems to respect an azimuth of 342°(N 18° W), as visible in the orthostates tuff wall on the north-eastern side of the urban area and datable to the end of the 6th or to the end of the 4th cent BC[1407]. This grid is orthogonal, and the direction can be calculated at 72° (Table 6). Looking in this direction, the Mt. Castello (562 m above mean sea level) is visible 12 km away at an altitude of 2.8°[1408]. Channels were recovered directed north-east to south-west according to the natural slope of the plateau, with a drainage function towards the *Clanis* river[1409]. Luca Cerchiai has emphasised the correspondence of orientation between 6th–5th cent. BC water channels at Madonna delle Grazie and the urban wall[1410]. Since the foundation of Acerrae can be dated only to the 4th cent. BC, such agrarian division of territory was probably dependent on Suessula in an earlier phase[1411]. The iso-orientation of the channels with the fortification may indicate an older chronology (6th cent BC) for this orientation system.

1402 ROSSI 2019b, 448.
1403 CHOUQUER ET AL. 1987, 212.
1404 RUFFO 2010, 100.
1405 ROSSI 2019a, 11.
1406 RUFFO 2010, 223.
1407 ROSSI 2011, 318; CERCHIAI 2019, 14.
1408 From PeakFinder web-service [access February 2022].
1409 ROSSI 2011, 314–315.
1410 GIAMPAOLA 1997, 227–230; 2002, 167; CERCHIAI 2020, 333.
1411 CERCHIAI 2020, 333.

Table 6

Phase	Data	Reference System	Data Source	Azimuth
9th – 8th cent. BC			DE CARO 1994, 650.	
6th – 5th cent. BC	N 18° W	Cartographic	North city Wall Madonna delle Grazie Locality ROSSI 2011, 319.	72°
	N 17° W	Cartographic	RESCIGNO - SENATORE 2009, 426.	73°
	72°	Geographic (Google Satellite)	North city Wall	72°
4th– 3rd cent. BC	N 28° W	Cartographic	ROSSI 2019a, 6.	62°

Skyscape Analysis of the Urban grid

The fragmentary and hypothetical reconstruction of the urban axes of Suessula is consistent with the urban axis of other Campanian settlements. The eastern axis pointed towards the rising sun 50 days before and after the summer solstice (fig. 44). This is when the Pleiades rise for the first time after a period of invisibility (fig. 45). They also rose very near the direction of the eastern axis of the town depending on the epoch. This astronomical coincidence better fits within a more extended chronological horizon, between the Iron Age and the Orientalising period when Suessula is believed to have been founded, even though the topographical evidence is quite scant for this epoch. Similarly to Capua, the heliacal rising of the constellation, as in when the constellation rises at dawn just before the sun, would have happened at the beginning of early summer, around May (figs. 45–46). In the opposite direction, the March new moon would have been seen setting with the sun. There are no other specific target reference points in the landscape or skyscape. To the south, the axis of the town would have pointed towards Mt. Somma-Vesuvius.

Figure 44. Landscape and skyscape visibility from Suessula in line with the urban axes. Elaborated by the author with Horizon©ANDREW SMITH 2022. See Plate III.

Table 7

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
Northern urban wall, and similarly oriented drainage channels found at Madonna delle Grazie locality	E	800 BC	40.99	72	2.6	+15.23	Mt. Castello/ Mt. Orni, Partenio Mountains (14 km far)	Sun rising 50 days before/after summer solstice= time of the heliacal rising of the Pleiades
	W	800 BC	40.99	252	0.2	-13.35	Open towards the Campanian plain	Rigel setting (δ= -13.5°)
	N	800 BC	40.99	342	1.5	+47.29	Montagne Baccalà (13 km far)	
	S	800 BC	40.99	162	1.2	-44.79	Mt. Somma - Vesuvius slope (16 km far)	

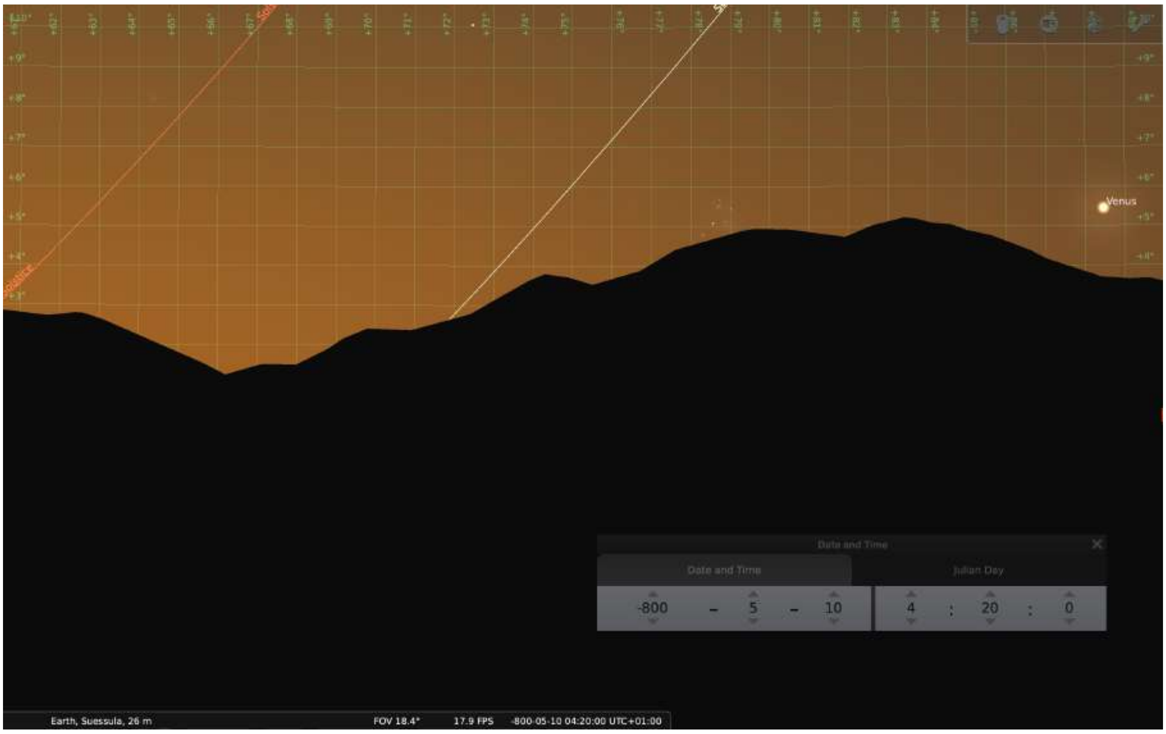

Figure 45. The sun (yellow line) will rise aligned with Suessula hypothetical urban axis at the time of the heliacal rising of the Pleiades, just rose above on mountains the right. Elaborated by the author after Stellarium V.22.2 and PeakFinder local landscape.

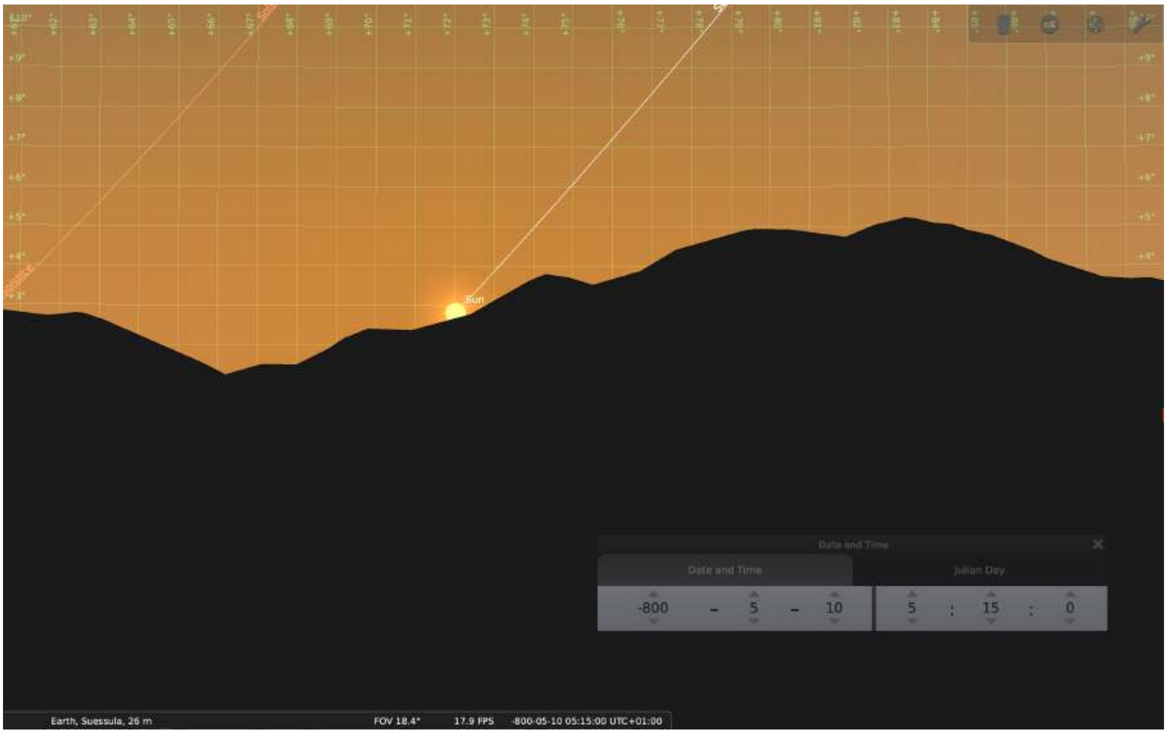

Figure 46. The sun (yellow line) is rising aligned with Suessula urban axis *circa* one hour after the heliacal rising of the Pleiades. Elaborated by the author after Stellarium V.22.2 and PeakFinder local landscape.

IV. ACERRAE

Introduction

The urban settlement of ancient Acerrae is located beneath the modern city of Acerra[1412]. For this reason, the archaeological evidence is minimal, due to there having only been occasional discoveries[1413]. The settlement was established on a mild plateau within a river bend of the *Clanis*. On the same plateau (27–32 m above sea level), further along to the north-east was the nearby settlement of Suessula[1414].

The Archaic Evidence

A pre-urban settlement of dispersed residential habitations constituted the picture of Acerrae between the Late Archaic and Classical period[1415]. Traces of an anthropic impact on the land are also evident, though not yet in a fully structured frequentation. Between the end of the 6th cent and the second half of the 4th cent. BC, ditches and beaten earth roads in the territory around Acerrae have been uncovered with an orientation of N 18° O – N 80° E in two different sites a half kilometre apart, specifically at Punzone-Messina and Edilcase. However, at Sapatiello, within the same period, there appears to be a land organisation system with different orientations, namely a road with a direction of N 35° O and orthogonal ditches at N 58° E that was in use until the end of the 4th cent. BC[1416]. Offering further analysis of countryside orientations, Sara Persichini has discussed pre-roman agrarian evidence at Acerrae[1417].

The Oscan Town

The urban design of Acerrae seems to have begun at the end of the 4th cent. BC with the construction of the urban wall[1418]. At this time, the agrarian system of N 28° W is the prevailing one and reflects the orientation of the town, extending out to Atella[1419]. The monumentalisation of the settlement can be dated to when the city received the status of *civitas sine suffragio* in 338 BC[1420]. Indeed, the urban wall, made of tuff blocks on a double curtain, can be dated between the end of the 4th and the beginning of the 3rd cent. BC[1421]. The recovered wall aligns with the modern street of Corso della Resistenza, the main east-west axis[1422]. The morphology of the city had a quadrilateral shape, with two orthogonal axes crossing in the middle (fig. 47)[1423]. Around the urban settlement, necropolises

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1412 GIAMPAOLA - RONGA - SICA 1997, 225.
1413 GIAMPAOLA - RONGA - SICA 1997, 225.
1414 GIAMPAOLA - RONGA - SICA 1997, 226.
1415 GIAMPAOLA - RONGA - SICA 1997, 227–230.
1416 GIAMPAOLA - RONGA - SICA 1997, 229–230.
1417 PERSICHINI 2004.
1418 GIAMPAOLA - RONGA - SICA 1997, 230–232.
1419 BENCIVENGA TRILLMICH 1984; LAFORGIA - DE FILIPPIS 2002; RESCIGNO - SENATORE 2009.
1420 RESCIGNO - SENATORE 2009, 431.
1421 GIAMPAOLA - RONGA - SICA 1997, 230.
1422 GIAMPAOLA - RONGA - SICA 1997, 230.
1423 GIAMPAOLA - RONGA - SICA 1997, 230.

were placed in the area often necessitating the infilling of previous Archaic ditches[1424]. The foundation of Acerrae was, indeed, part of the huge cadastre plan which covered the whole Campanian plateau, from Neapolis to Suessula[1425]. The centuriation unit used is 16x16 actus[1426]. The main orientation of this centuriation is directed at N 28° W (fig. 48). According to Giampaola, Ronga and Sica, such a system can be observed within the *Acerra-Atella I* of N 26° W recognised by Chouquer, Clavel-Lévéque and Favory[1427]. Indeed, according to Chouquer *et al.*, the orientation of the medieval and modern town is N 26° W reflecting the agrarian organisation named by the French scholars as *Acerrae-Atella I*[1428]. Thus, the contemporaneous organisation of the territory reflected the orientation of the urban grid[1429].

Urban Orientation in Phases

A discontinuity between the urban morphology with the Archaic organisational system of land division is evident (Table 8)[1430].

Table 8

Phase	Data	Reference System	Data Source	Azimuth
6th – 5th cent. BC	N 18° W N 80° E N 35° O N 58° E	Cartographic	GIAMPAOLA - RONGA - SICA 1997, 225; ROSSI 2019b, 448.	72° 80° 55° 58°
4th – 3rd cent. BC	N 30° W	Cartographic	RESCIGNO - SENATORE 2009, 426.	60°
4th – 3rd cent. BC	N 28° W	Cartographic	ROSSI 2019b, 448.	62°

1424 GIAMPAOLA - RONGA - SICA 1997, 231.
1425 ROSSI 2019a, 23.
1426 GIAMPAOLA - RONGA - SICA 1997, 231–232; GIAMPAOLA 2002, 167–169.
1427 GIAMPAOLA - RONGA - SICA 1997, 231; CHOUQUER ET AL. 1987, 207–227.
1428 CHOUQUER ET AL. 1987, 207.
1429 MONACO - CLAVEL-LÉVÊQUE 2004, 196.
1430 GIAMPAOLA - RONGA - SICA 1997, 231.

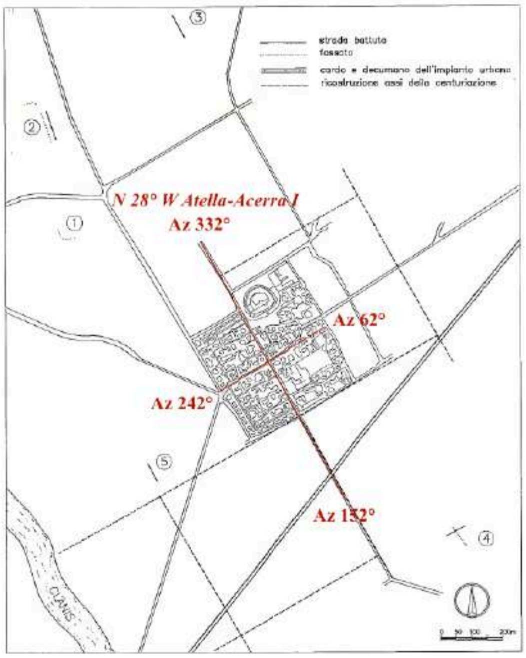

Figure 47. The urban orientations of Acerrae according to the system *Acerrae-Atella I* N 28° W converted into azimuth. Adapted after GIAMPAOLA – RONGA – SICA 1997, 228.

Geomorphological Constrictions

Pre-roman drainage systems are attested by Daniela Giampaola *et al*.; these are mostly with the aim of channelling meteoric water in minimally permeable soil[1431]. These are ditches, with different dimensions and characteristics, datable between the 6th and 4th cent. BC[1432]. The channels are directed north-east to south-west according to the natural slope of the plateau, with the function of supplying drainage towards the *Clanis* river[1433]. The river had a low flowing course tending to create marshy environments, as recounted by the Roman sources, which confirm the swampy nature of the area around Acerrae after the inundation of the *Clanis*[1434]. According to Giampaola, this can also be confirmed geologically in the area very near the river from the Imperial period onwards, whilst any traces of water stagnation being absent during the most ancient phases of the urban settlement[1435]. By contrast, the existence of a marshy area from prehistory is evident in the north-western area of Acerrae, in the localities of Pantano, Fassitelli, Sannereto[1436]. According to Marina Monaco, the river was a significant constraint on the orientation planning of the area[1437]. For Monaco and Clavel-Lévéque, the system of orientation follows the natural hydro-morphology of the river, with an evident

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[1431] GIAMPAOLA - RONGA - SICA 1997, 225–226.
[1432] GIAMPAOLA - RONGA - SICA 1997, 226.
[1433] ROSSI 2011, 314–315.
[1434] Verg. *G*. 2.223-225; Sil. *Pun.* 8.513.
[1435] GIAMPAOLA - RONGA - SICA 1997, 226.
[1436] GIAMPAOLA - RONGA - SICA 1997, 226.
[1437] MONACO - CLAVEL-LÉVÉQUE 2004, 198.

adaptation to the direction of the body of water[1438]. In particular, according to the scholars, the organisation north of Atella, north-east/south-west (4th–3rd cent. BC), is orthogonal to the *Clanis*, whereas the system north-west/south-east (3rd cent. BC) around Atella and Acerrae is parallel to it[1439].

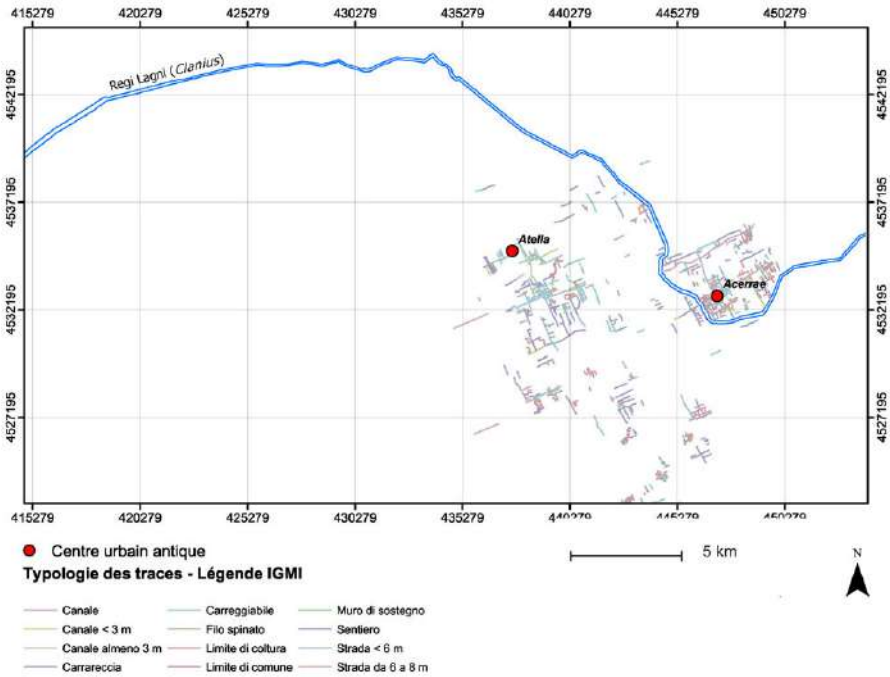

Figure 48. Planimetric traces oriented N 28° W/S 62° E, corresponding to the territorial structuration between Acerrae and Atella. Maps source: https://ista.univ-fcomte.fr/ [accessed October 2022]. From MONACO 2003, 60.

Skyscape Analysis of the Urban grid

The autoptic observation of the solstices from modern Acerra has not produced positive results for the summer solstice sunrise. The urban grid does not seem to be oriented towards the position of the rising sun at summer solstice, but deviates by a couple of degrees towards the south, corresponding to a position of the sun 20 days before/after summer solstice (fig. 49). At that time, the sun had entered the constellation of Gemini (fig. 50). If the orientation of 60° was the most accurate, the direction of Acerrae's axis would come closer to the rising sun's position[1440].

Figure 49. Landscape and skyscape visibility from Acerrae in line with the urban axes. Elaborated by the author with Horizon©ANDREW SMITH 2022. See Plate IV.

[1438] MONACO - CLAVEL-LÉVÊQUE 2004, 198.
[1439] MONACO - CLAVEL-LÉVÊQUE 2004, 198.
[1440] RESCIGNO - SENATORE 2009, 426.

Table 9

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
The urban wall made up of tuff blocks on a double curtain aligned to Corso della Resistenza	E	300 BC	40.94	62	2.7	+22.63	Mt. St. Angelo a Palombaro/ Mt. Chianola/ Ciglio Pedalino (12–17 km far)	Sun rising 20 days before/after summer solstice
	W	300 BC	40.94	242	1	-20.01	Camaldoli hill (17 km far)	
	N	300 BC	40.94	332	0.6	+42.36	Mt. Cima slope (36 km far)	
	S	300 BC	40.94	152	3.2	-39	Mt. Somma-Vesuvius (13 km far)	

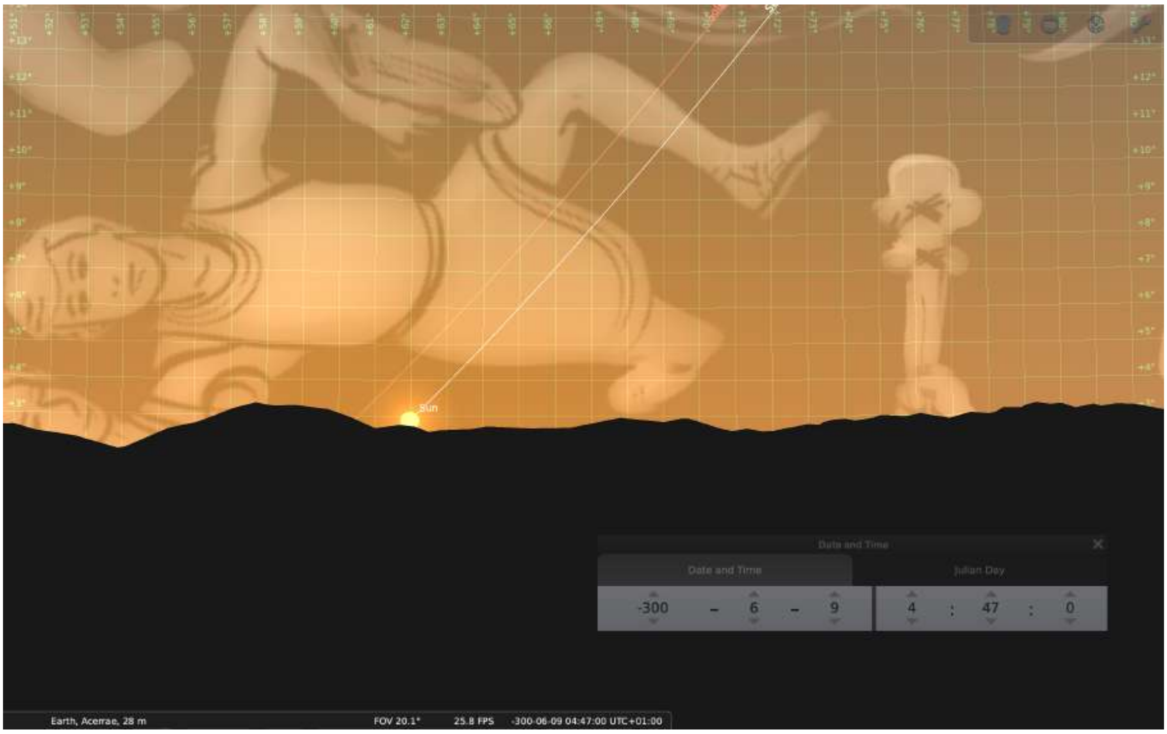

Figure 50. The sun rising 20 days before summer solstice in line with Acerrae urban axis. Elaborated by the author after Stellarium V.22.2 and PeakFinder local landscape.

V. ATELLA

Introduction

The ancient site of the city of Atella is located to the east of the town of St. Arpino, on the border with the towns of Succivo, Orta di Atella, and Frattaminore. The urban settlement was placed on a trapezoidal terrace, slightly higher in altitude than the surrounding area and a safe distance from the *Clanis* river. The urban centre of Oscan origin emerged in the 4th cent. BC in the southern part of the *ager Campanus*. There is no confirmed stable human frequentation of the area before the 4th cent. BC, thus differing from the nearby Acerrae pre-urban Archaic site use[1441]. Funerary remains in Lettiero can be dated to the end of the 5th cent. BC[1442], or dated further back to even the Orientalising and Archaic period[1443].

The Oscan Town

The urban foundation of the city can be dated to the 4th cent. BC[1444]. The fortification of the settlements is datable to between the end of the 4th and the beginning of the 3rd cent. BC, as is archaeologically evidenced at its southern limit[1445]. The structures of the wall mentioned were found at Masseria d'Orto dei Santi but are no longer visible, having been reburied after the excavation[1446]. The structure was composed of a wide moat and tuff blocks without mortar[1447]. From that evidence, it was possible to recognise the perimeter and to date the building of the perimeter urban wall of Atella to the end of the 4th – 3rd cent. BC[1448]. The urban perimeter is defined by the terrace with a trapezoidal shape and covering an area of circa 43 hectares (fig. 51)[1449]. The urban morphology of Atella is characterised by the *cardo maximus*, the *decumanus maximus* and other *decumani*, with an orientation differing from the later 2nd cent. centuriation[1450]. As early as 1908, the investigations by Giuseppe Castaldi identified the *decumanus* of the city, the so-called Strada Ferrumma, known today as Via Luigi Compagnone[1451]. The inner accessibility of the ancient city has been recognised in the current roads of the town of St. Arpino[1452]. The distances between two *decumani* were identified as 5 actus (600 Roman feet, 180m)[1453].

1441 BENCIVENGA TRILLMICH 1984, 20; RESCIGNO - SENATORE 2009, 429.
1442 DE CARO 1997, 419.
1443 See M. Affinito, *Per la carta archeologica di Atella e dell'ager atellanus. Il territorio del comune di S. Arpino*, Tesi di Laurea in Topografia Antica, Seconda Università degli studi di Napoli, 2001, 102.
1444 LAFORGIA - DE FILIPPIS 2002, 138.
1445 MONACO 2003, 119–120.
1446 ARENELLA 2001, 50.
1447 BENCIVENGA TRILLMICH 1984, 6.
1448 BENCIVENGA TRILLMICH 1984, 6.
1449 MONACO 2003, 119–120.
1450 BENCIVENGA TRILLMICH 1984.
1451 See G. Castaldi, "Atella, questioni di topografia storica della Campania", in *AttiAccNap* 25, 1908.
1452 MONACO 2003, 120.
1453 MONACO 2003, 120.

Romanisation

A new prosperity of the city is affirmed in the sources starting from the end of the Republic, and also is evidenced archaeologically in the form of thermal baths and well appointed domus[1454]. Atella was indeed an important network node between Capua and Neapolis, being accessible by the *via Capua-Neapolis*, or *via Atellana,* being at the conjunction of Capua-Atella and of Atella-Neapolis. It would have corresponded to the first *decumanus* east of the *maximus* one[1455]. In the territory around Atella, especially in the east of the city reaching towards Acerrae, the territorial organization system of *Acerrae-Atella I* (N 28° W/S 62° E) was identified[1456]. Here, the centuriation unit of 16x16 *actus* has been recognised as having been used[1457]. The area can be dated to the first half of the 3rd cent. BC[1458]. Elements of a regular management of the space seem closely related to the organisation of the ancient urban centre[1459]. The two urban settlements of Acerrae and Atella were delimited by a swampy passage zone; however, the two settlement networks seem to follow a unitary design plan and one dictated by the river *Clanis*, according to Monaco and Clavel-Léveque[1460]. This integrated scheme suggests that Atella's organisation dates back to before the expropriation of the *ager Campanus* in 211 BC[1461].

Urban Orientation in Phases

In the area north of Atella, a contrast of orientation systems can be observed[1462]. The route running towards the north-east, together with necropolis dating from the 4th cent. BC to the 1st cent. AD, provide a time-frame for a territorial organisation system. These necropolises extend along beside the current road from Casapuzzano to Marcianise and the route parallel to it. This can be interpreted as the ancient connection between Atella and Capua[1463]. According to Monaco and Clavel-Léveque, this territorial organisation system is less structured than other recognisable traces in the current landscape[1464]. It is possible that the landscape division here is particularly ancient and was developed in conjunction with the river crossing routes[1465]. Furthermore, Monaco identified traces of a theatre at the northern perimeter of the site through photointerpretation[1466]. According to Monaco and Clavel-Lévéque, «l'édifice constituait l'un des points forts du context urbain d'*Atella*», and it is oriented according to a grid system north-east/south-west, N 33° E, equivalent to an azimuth of 33°[1467].

[1454] Monaco 2003, 121–122.
[1455] Arenella 2001, 44.
[1456] Monaco - Clavel-Lévéque 2004, 196.
[1457] Giampaola - Ronga - Sica 1997, 231–232; Giampaola 2002, 167–169.
[1458] Monaco - Clavel-Lévéque 2004, 196.
[1459] Monaco - Clavel-Lévéque 2004, 197.
[1460] Monaco - Clavel-Lévéque 2004, 197.
[1461] Monaco - Clavel-Lévéque 2004, 197.
[1462] Monaco - Clavel-Lévéque 2004, 197.
[1463] Monaco 2003, 122–124.
[1464] Monaco - Clavel-Lévéque 2004, 198.
[1465] Monaco - Clavel-Lévéque 2004, 198.
[1466] Monaco 2003, 126.
[1467] Monaco - Clavel-Lévéque 2004, 192.

However, this statement is in contradiction with the plan of the theatre published by the same authors, which instead seems to match with the urban grid of 62°az. The date of construction of the theatre is later than that of the urban grid, probably after the 2nd cent. BC, but it is still valuable to notice how the building orientation followed a previous urban grid system. According to Monaco and Clavel-Lévéque, the river has played an important determining role in the orientation of the area and its anthropogenic organisation[1468]. The soil is indeed unstable. It is possible that the system of orientation follows the natural hydro-morphology of the river, with an evident adaptation to the direction of flow of the body of water[1469]. In particular, for the French scholars, the organisation north of Atella, being north-east/south-west (4th–3rd cent. BC), is orthogonal to the *Clanis*, whereas the system north-west/south-east (3rd cent. BC) around *Atella-Acerrae I* are parallel to it[1470].

Table 10

Phase	Data	Reference System	Data Source	Azimuth
4th–3rd cent. BC	N 28° W	Cartographic	MONACO - CLAVEL-LÉVÉQUE 2004, 196.	62°
4th–3rd cent. BC	N 25° W	Cartographic	RESCIGNO - SENATORE 2009, 426	65°
4th–3rd cent. BC	68.5°°±1° azimuth	Geographic	LiDAR DSM 1m	68.5°±1°
4thcent. BC–1st cent. AD	N 33° E	Cartographic	MONACO - CLAVEL-LÉVÉQUE 2004, 192.	33°

1468 MONACO - CLAVEL-LÉVÉQUE 2004, 198.
1469 MONACO - CLAVEL-LÉVÉQUE 2004, 198.
1470 MONACO - CLAVEL-LÉVÉQUE 2004, 198.

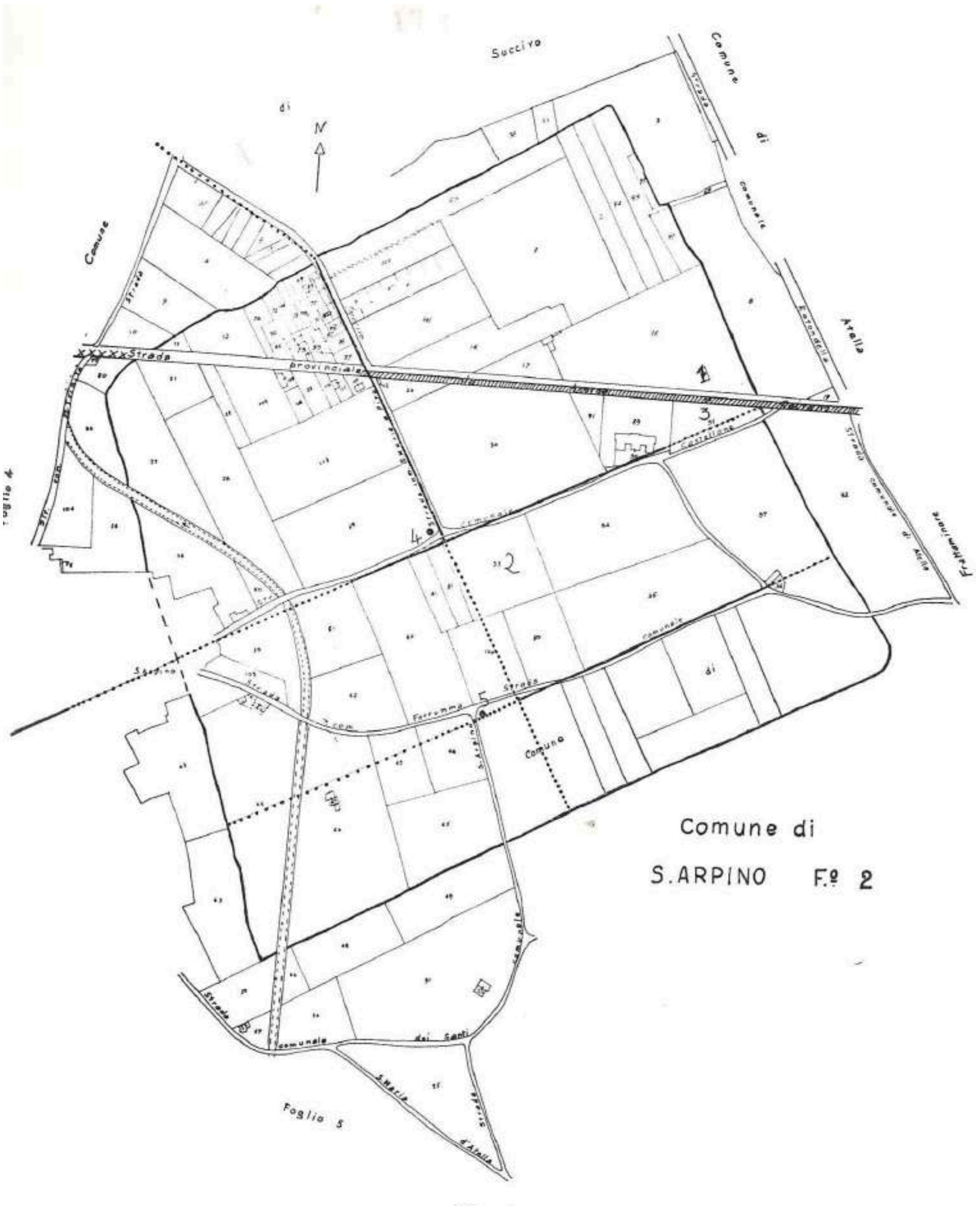

Figure 51. Reconstructed urban plan of Atella. After BENCIVENGA TRILLMICH 1984, tav. II.

Skyscape Analysis of the Urban grid

Even though the orientation system in the countryside nearby reflects that of Acerrae, the *decumanus* deviated further south to reach 67° of azimuth, thus being even further removed from aligning with the position of the summer solstice sunrise. However, it aligns well with the position of the rising sun around May and with the rising Pleaides (figs. 52-54). According to Clara Bencivenga Trillmich, the urban design of Atella tends towards Greek models, especially those at Neapolis. Her thesis is supported by the complex and gradual synoecism between Greeks and Samnites at Neapolis starting from the 5th cent. BC[1471]. Therefore, it is possible that the Neapolis model might have influenced Atella's urban design.

Figure 52. Landscape and skyscape visibility from Atella in line with the urban axes. Elaborated by the author with Horizon© ANDREW SMITH 2022. See Plate V.

Table 11

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
Via Compagnone	E	300 BC	40.96	68.5	1.3	+16.95	Mt. Tairano (26 km far)	Sun rising 45 days before/after summer solstice, or at the time of the heliacal rising of the Pleiades
	W	300 BC	40.96	248.5	0.4	-15.8	Open on the Campanian Plain	Sirius setting (δ = -17.6°)
	N	300 BC	40.96	355	0.7	+43.82	Mt. Tranquillo (98 km far)	
	S	300 BC	40.96	155	1	-42.29	Mt. Comune/ Lattari Mountains (41 km far)	

[1471] BENCIVENGA TRILLMICH 1984, 23.

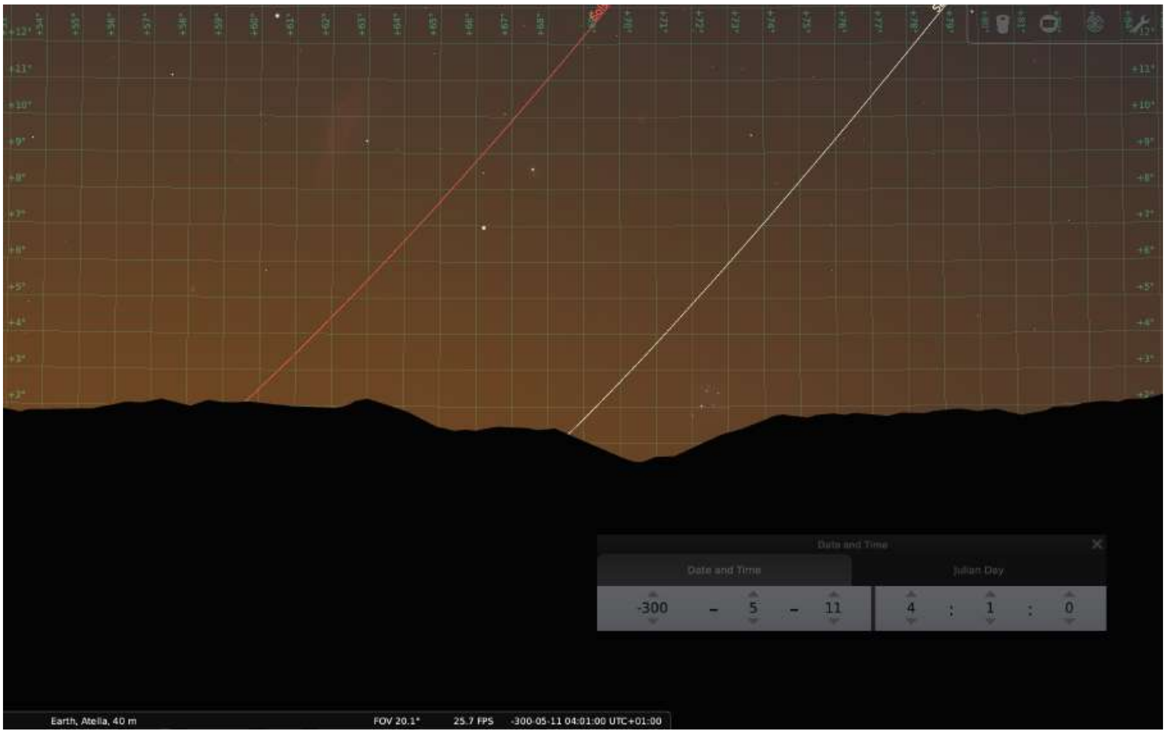

Figure 53. The sun (yellow line) rising aligned with the Atella urban axis at the time of the heliacal rising of the Pleiades on the right. Elaborated by the author after Stellarium V.22.2 and PeakFinder local landscape.

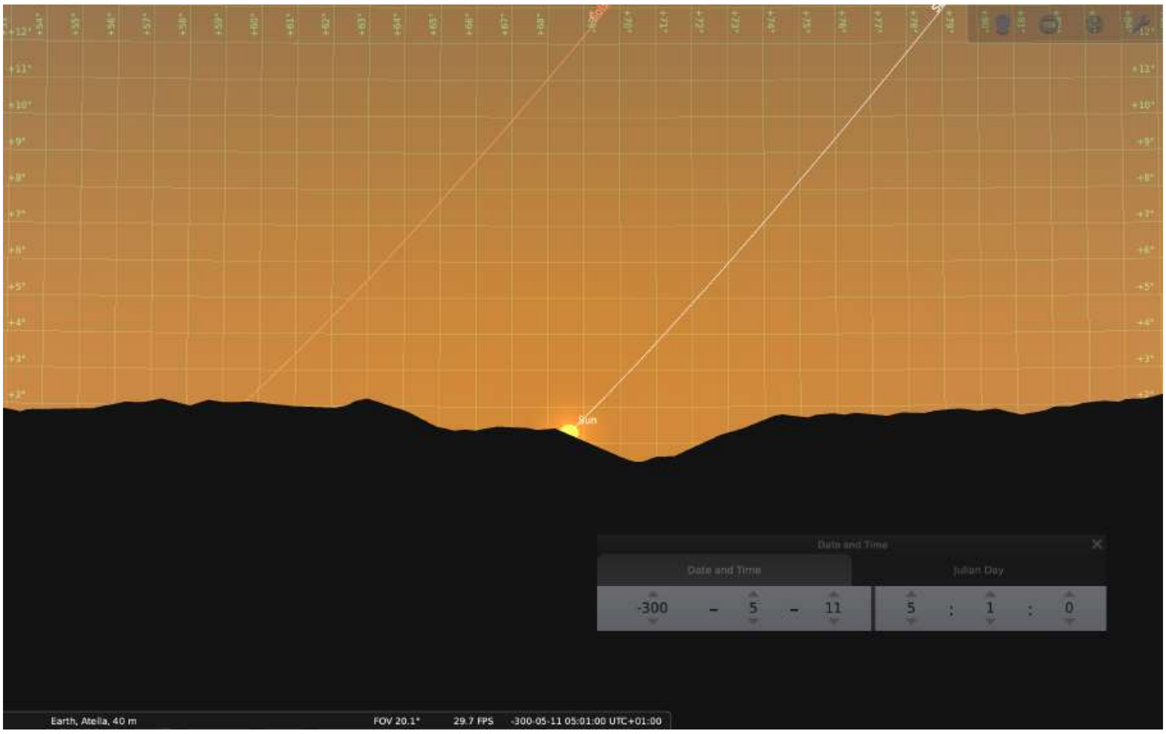

Figure 54. The sun rising in alignment with Atella's urban axis *circa* one hour after the heliacal rising of the Pleiades. Elaborated by the author after Stellarium V.22.2 and PeakFinder local landscape.

VI. ABELLA

Introduction

The original foundation of the settlement at Abella can be dated to between the end of the 7th cent. BC and the beginning of the 6th BC[1472]. The site is in partial spatial overlapping with that of modern Avella. It is situated on the southern slopes of the mountain ridge of Avella-Partenio, on a crucial network point at a natural location of access between the Campanian plain and the Apennines of *Samnium Hirpinum*. The river *Clanis* flows to the north of Abella/Avella.

The Proto-Urban Settlement

Archaeological exploration of the area in the 70's revealed areas of necropolises to the east in San Paolino-Molinello and to the west at San Nazzaro[1473]. The materials uncovered suggest a date of the second half of the 8th cent. BC, consistent with the funerary goods recovered in the Sarno Valley, at Nola, and Caudium[1474]. The two necropolis areas were in use contemporaneously between the Ancient Orientalizing period and Late Antiquity[1475]. It is plausible to hypothesise that the residential area was located in the middle between the two necropolises and that this is where the modern urban centre developed: there, indeed, coeval with the necropolises, traces of human activity were recovered[1476]. According to Teresa Cinquantaquattro, these elements indicate that there was a unified project of area planning during this early phase from the second half of the 8th cent. BC, probably reflecting political cohesion[1477]. Besides the hypothesised cohesion, sparse occupation nuclei can be noted a short distance away on nearby hills, for instance in the Bosco locality on the slope of Avella's castle.

The Archaic Town

Minimal material evidence has been recovered dating to the 6th–5th cent. BC[1478]. A pre-roman urban wall made of huge tuff stone blocks was found by W. Johannowsky in the '70s–'80s on the southern and eastern side of the urban area, but the existence of the perimeter on the northern and western sides is a matter of conjecture. To the east, the perimeter circuit followed the profile of the modern Via della Libertà. To the west, the limit of the town probably corresponded with the modern Via Roma where, indeed, the main urban axis of Corso Vittorio Emanuele, exiting from the town, deviated towards the south surrounded by the necropolis, there, an urban gate might have been placed[1479]. It

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1472 LUCIANO 1988, 89.
1473 D'HENRY 1973, 293; LAFORGIA 1988, 101.
1474 LAFORGIA 1988, 101–102.
1475 CINQUANTAQUATTRO 2000, 63.
1476 CINQUANTAQUATTRO 2000, 64.
1477 CINQUANTAQUATTRO 2000, 64–66.
1478 LAFORGIA 1988, 102.
1479 CINQUANTAQUATTRO 2000, 72.

seems that a ditch was present on the outer side of the perimeter, to the south of Via del Campo[1480]. The chronology of the wall is uncertain, but it was possibly already in use from the Archaic epoch[1481]. Only few sanctuary locations can be located on the basis of the materials recovered on site, and there seems to have been a habit of use of these areas from the Archaic period to the 3rd–4th cent. BC[1482]. At Semerario, it is reckoned to be present a sacred area after the recovery of votive objects related to feminine fecundity and *sanatio*[1483]. Other possible sanctuaries were located to the north of the urban centre at Campopiano on the southern slopes of the Avella mountains [1484], and at S. Candida[1485].

Urban Orientation in Phases

Abella would appear to have been designed on a regular orthogonal layout judging from the orientation of the slight archaeological data (fig. 55)[1486]. Corso Vittorio Emanuele reiterated the main axis of the town, together with its continuation at Via Anfiteatro, ex cupa S. Paolino[1487]. Part of a limestone-paved road was uncovered beside Via Anfiteatro; it was seen to run parallel with the modern street and can be dated to the first half of the 1st cent. BC, being abandoned in the 4th cent. AD[1488]. Below that road, a beaten-earth road was found and noted to be wider than the paved one. Parallel to this main urban axis, Via S. Croce and Via Filippo Vittoria can be recognised as east-west axes. Orthogonal to these, Via dei Mulini, Via Cancelli, Via San Nicola, Via Cardinale D'Avanzo can be identified as having an interaxle spacing of 3 *actus*[1489]. A *terminus ante quem* of the urban orientation is the amphitheatre, which does not follow the general town layout; according to Elena Laforgia, when it was built in the 1st cent. BC, it had to be adapted to fit with the pre-existing morphology[1490]. No data are available for the chronology of the urban layout: given the archaeological data from the necropolis and other evidence indicating the period of social-cultural vitality in the area, the town's foundation can be inferred to have occurred in the 7th–6th cent. BC[1491].

Table 12

Phase	Data	Reference System	Data Source	Azimuth
9th – 8th cent. BC	/	Geographic (Google Satellite)	/	/
7th – 6th cent. BC	74°	Cartographic	Corso Vittorio Emanule	74°
5th – 4th cent. BC	/	/	/	/

1480 Cinquantaquattro 2000, 72.
1481 Cinquantaquattro 2000, 36.
1482 Cinquantaquattro 2000, 71.
1483 Cinquantaquattro 2000, 69; Scatozza Höricht 2001; Cinquantaquattro 2013, 18–19.
1484 Cinquantaquattro 2013, 12–13.
1485 Cinquantaquattro 2000, 68; 2013, 16–17.
1486 Laforgia 1988, 105.
1487 Laforgia 1988, 104.
1488 Laforgia 1988, 104.
1489 Laforgia 1988, 105.
1490 Laforgia 1988, 105.
1491 Rescigno - Senatore 2009, 432.

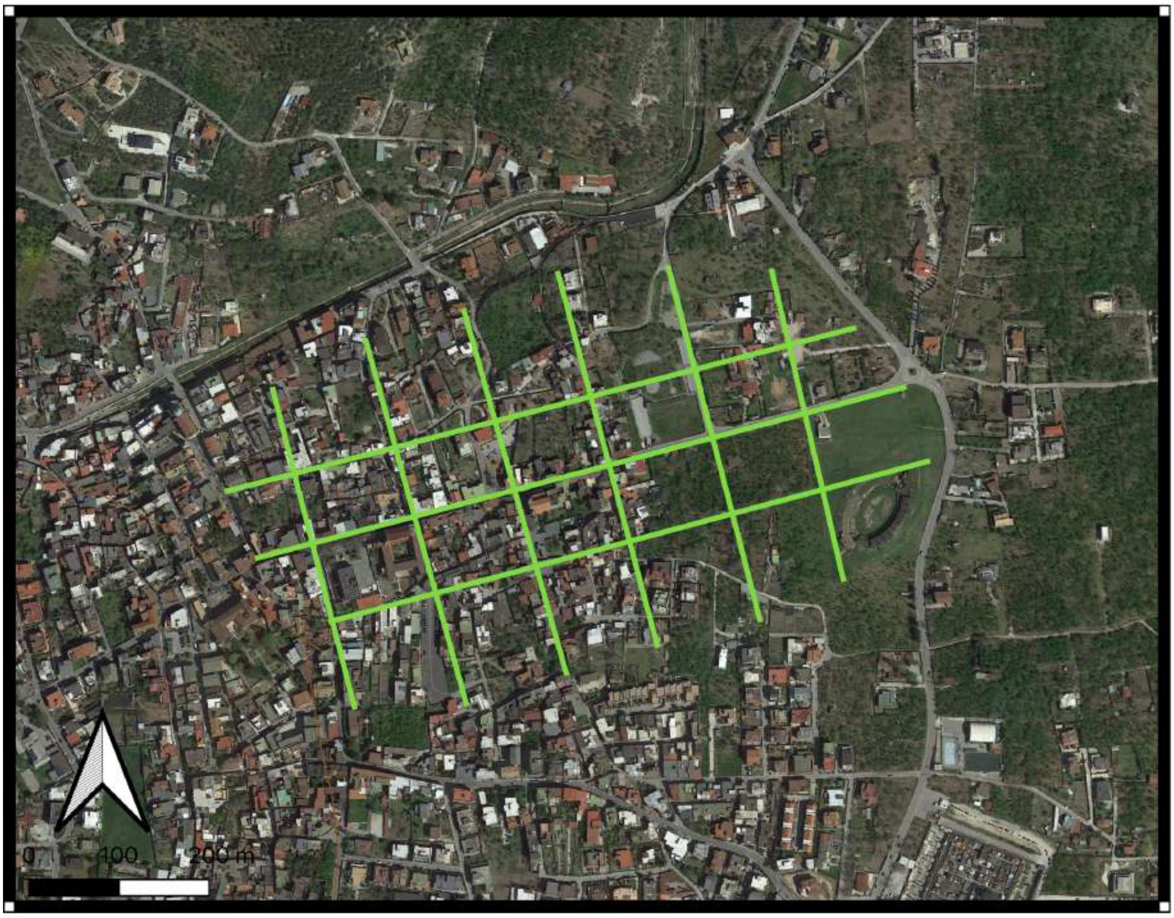

Figure 55. Abella reconstructed urban grid on Google Satellite Image. Adapted after CINQUANTAQUATTRO 2000, 69.

Skyscape Analysis of the Urban grid

There are no landscape targets worth mentioning that are visible as possible prompts for the urban orientation of Abella; the location of the main known sanctuaries are shown on the panorama but they do not seem relevant to the urban morphological lines (fig. 56). Instead, in the ancient skyscape, the urban east-west axis tends towards the position of the sun when rising 40 days before/after the summer solstice and also coincides with the minor lunar standstill (violet line in fig. 56, az. 75°). In addition, the axis points at the rising sun at the heliacal rising of the Pleaides, a moment in early summer when they started their visibility period after a period of invisibility lasting from the spring equinox (figs. 57-58). This astronomical orientation of Atella may be considered also relevant in relation to the orientation of other ancient Campanian settlements.

Figure 56. Landscape and skyscape visibility from Abella in line with the urban axes. Elaborated by the author with Horizon© ANDREW SMITH 2022. See Plate VI.

Table 13

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
Axis Nord-Est/South-West coincident with present streets Corso V.Emanuele, Via P. Vittoria, Via Anfiteatro.	E	600 BC	40.96	74	10.3	+18.78	Mt. Ciesco Bianco, Partenio Mountains (7.4 km far)	sun rising 40 days before/after summer solstice, or at the time of the heliacal rising of the Pleiades
as above	W	600 BC	40.96	254	0.2	-11.88	Towards the Phaelgrean Fields	
	N	600 BC	40.96	344	8.4	+54.48	Partenio Mountains (5 km far)	
	S	600 BC	40.96	164	4.7	-42.05	(3.5 km far)	

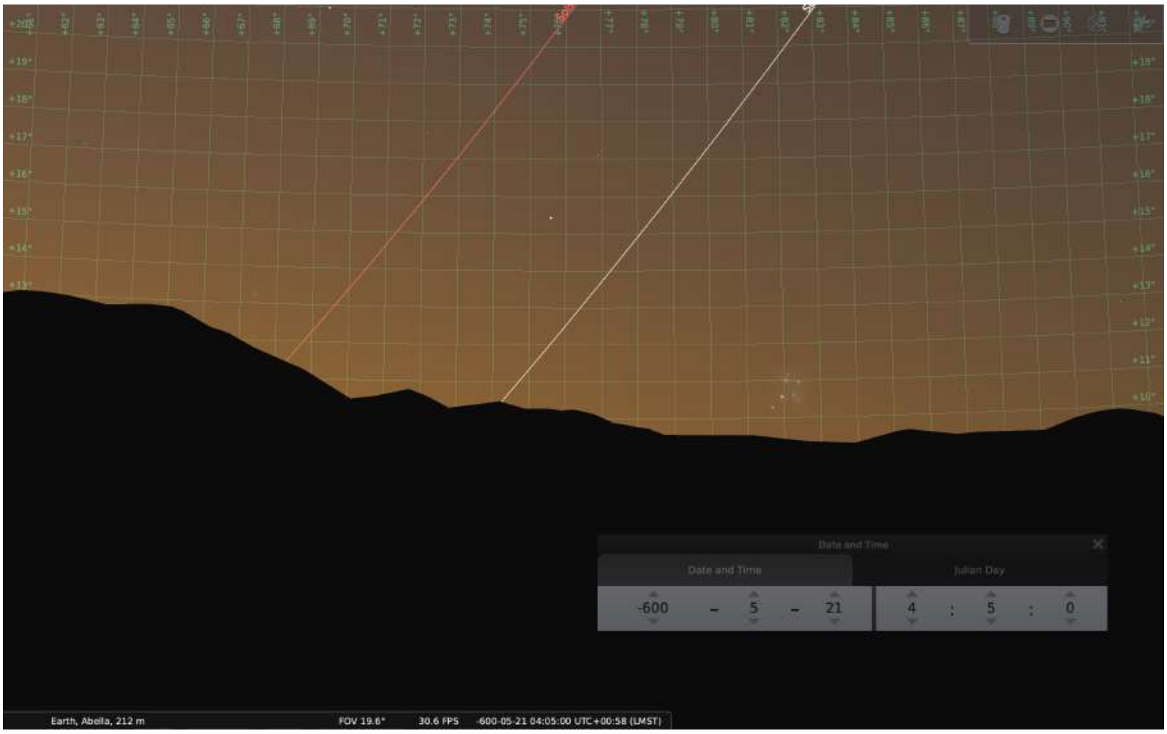

Figure 57. The sun (yellow line) rising aligned with Abella's urban axis at the time of the heliacal rising of the Pleiades. Elaborated by the author after Stellarium V.22.2 and PeakFinder local landscape.

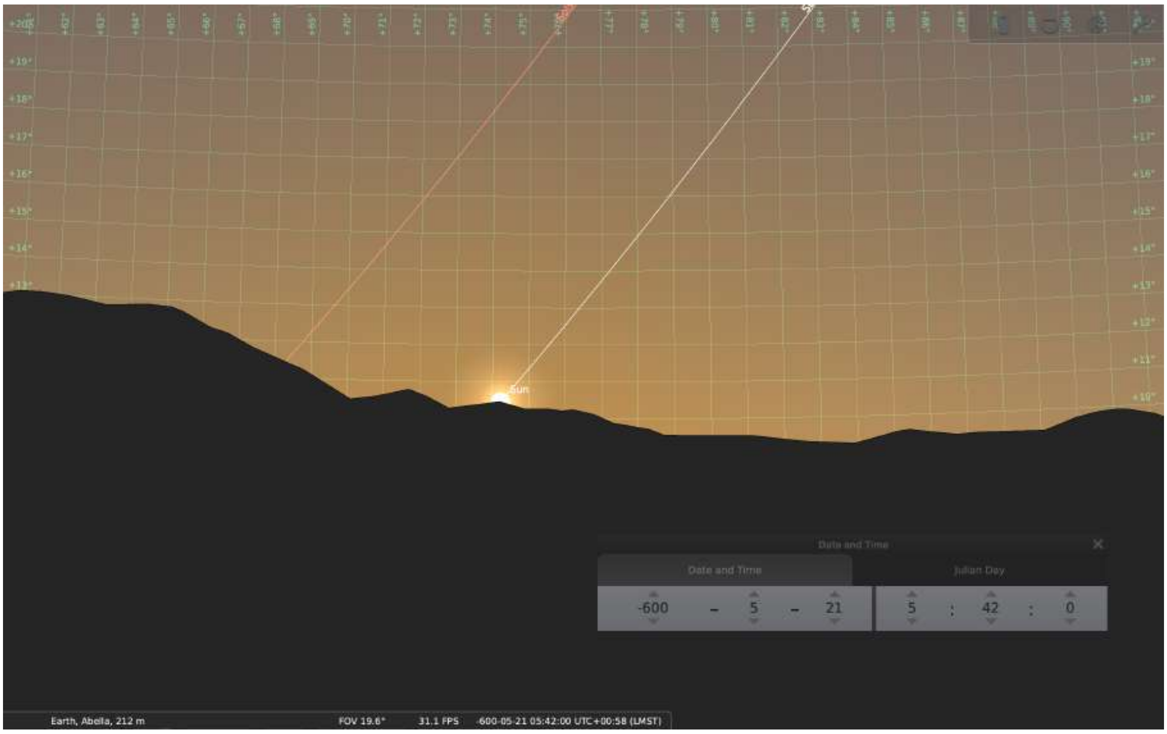

Figure 58. The sun rising in alignment with Abella's urban axis just after the heliacal rising of the Pleiades. Elaborated by the author after Stellarium V.22.2 and PeakFinder local landscape.

VII. NOLA

Introduction

The archaeological evidence at the settlement of Nola, from the Late Iron Age until the Hellenistic Period, is mainly in the form of funerary remains[1492]. The urban settlement developed around the 8th cent BC., with a further cultural development between the 7th and the 5th cent. BC fostered by contact with Greek and Etruscan peoples. According to Hecataeus of Miletus, writing towards the end of the 6th cent. BC, Nola was founded by Ausones, meaning it was founded by indigenous people. This information was supplied by merchants, as Hecataeus himself never saw the places he was describing[1493]. Hecataeus described Nola as a *polis*, thus ascribing to it the highest Greek political status for a settlement. After him, the foundation was attributed to the Etruscans by Polybius or the Chalcidian Greeks by Silius Italicus and Justin[1494].

The Proto-Urban Settlement

The earlier burials date from the second half of the 8th cent. BC[1495]. From the necropolis data, it is possible to deduce that the community of Nola started a process of urbanisation and political institutionalisation in the last thirty years of the 8th cent BC[1496]. The funerary area and the area for the living are clearly separate and the former may provide clues as to how life was lived in the settlement of the living (fig. 59)[1497]. The necropolises were located to the north of the living area, in a conventional functional model of the division of space and typical of other contemporaneous Campanian centres[1498]. The existence of family groups in the funerary space may reflect a similar status division of the living, within a highly organised community similar to coeval Etruscan-Italic urban systems[1499]. However, assumptions of a direct isomorphism between the dead and the living are debatable[1500]. Indeed, Ian Morris suggested that burial can be a representation or reconstruction of a society in an idealised or perceived form, more than a mere reflection of it[1501]. Having said that, social distinction in the necropolises is evident in the choice between earth-tombs and circular tombs delimited with lime-stone blocks and probably covered with a tumulus, even though the inhumation ritual is common to all[1502]. Beyond purely social distinctions, cultural changes with burials are evident as a direct result of contact with Greeks and Etruscans, starting with the interring of exotic objects to the artistic embodiment of behaviours such as ritual banquets and wine consumption[1503]. For example,

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1492 CESARANO 2011, 143.
1493 CESARANO 2018, 173.
1494 Polyb. II.17.1; Sil. *Pun.* XII.161; Just. *Epit.* XX.1.13.
1495 CERCHIAI - SALVADORI 2012.
1496 CERCHIAI - SALVADORI 2012, 452.
1497 CESARANO 2004, 24–25; CERCHIAI 1995, 28.
1498 CERCHIAI - SALVADORI 2012, 436.
1499 CESARANO 2004, 25.
1500 NIZZO 2016, 117.
1501 MORRIS 1987, 211.
1502 CESARANO 2018, 173.
1503 CESARANO 2018, 174.

in the case of male burials, a sword in a sheath reflects a custom typical of the Greek colony of Kyme[1504]. From this period, contact with the Aegean world is evident from pottery found in the tombs, both imported vases of Greek production and other local imitations of the Greek style. In the 7th cent. BC, luxurious imported objects increase in frequency as a way to celebrate the high status of the individual being buried[1505]. According to Mario Cesarano, in the Late Orientalising period, the auto-representation of the community in the necropolises fully reflects the complex articulation of the living socio-cultural groups, which were acquiring more and more Greek artefacts and practices, as evoked by the bronze cauldron found in the male tomb 266 at Torricelle denoting an aristocratic Greek hero[1506]. Similarly with the female tomb 66 at Torricelle from the mid 7th cent. BC, the incineration of the body is coherent with the habits typical of the Campanian Greeks[1507]. A huge quantity of locally produced bucchero is also present from the 7th cent. BC, indicating Etruscan influences.

The Archaic Town

From between the 7th and the 6th cent. BC, the burial goods from the necropolis show a neat cultural differentiation between the autochthonous Etruscan-italic tradition and Hellenic customs in sharply distinguished forms[1508]. Moreover, dating from the 6th cent. BC, fragments of a decorative roof system from a sanctuary were uncovered[1509].

The Classical and Hellenistic Town

Nola was in close dialogue with the city of Athens, which bought grain from the Campanian plain. Greek cultural influence was noted by Mario Cesarano in the funerary elements from the Nola necropolis with their indicative references to the social values embedded within the culture of the gymnasium and of athleticism, then widespread in Classical Athens[1510]. For example, five Panathenaic amphoras were found in Nola; these were amphoras containing olive oil given to the winners of the Panathenaic games. A massive commercial relationship with Athens developed during the 5th cent. BC[1511]. Athens started the production of coins to pay Nola's mercenaries with anthroposophic bull. Neapolis's mint forged bronze coins for Nola.

1504 Cesarano 2018, 174.
1505 Cesarano 2018, 174.
1506 Cesarano 2018, 175.
1507 Cesarano 2018, 175.
1508 Cesarano 2018, 176.
1509 Rescigno 1998, 300–303; Cesarano 2011, 144.
1510 Cesarano 2020.
1511 Cesarano 2018, 176.

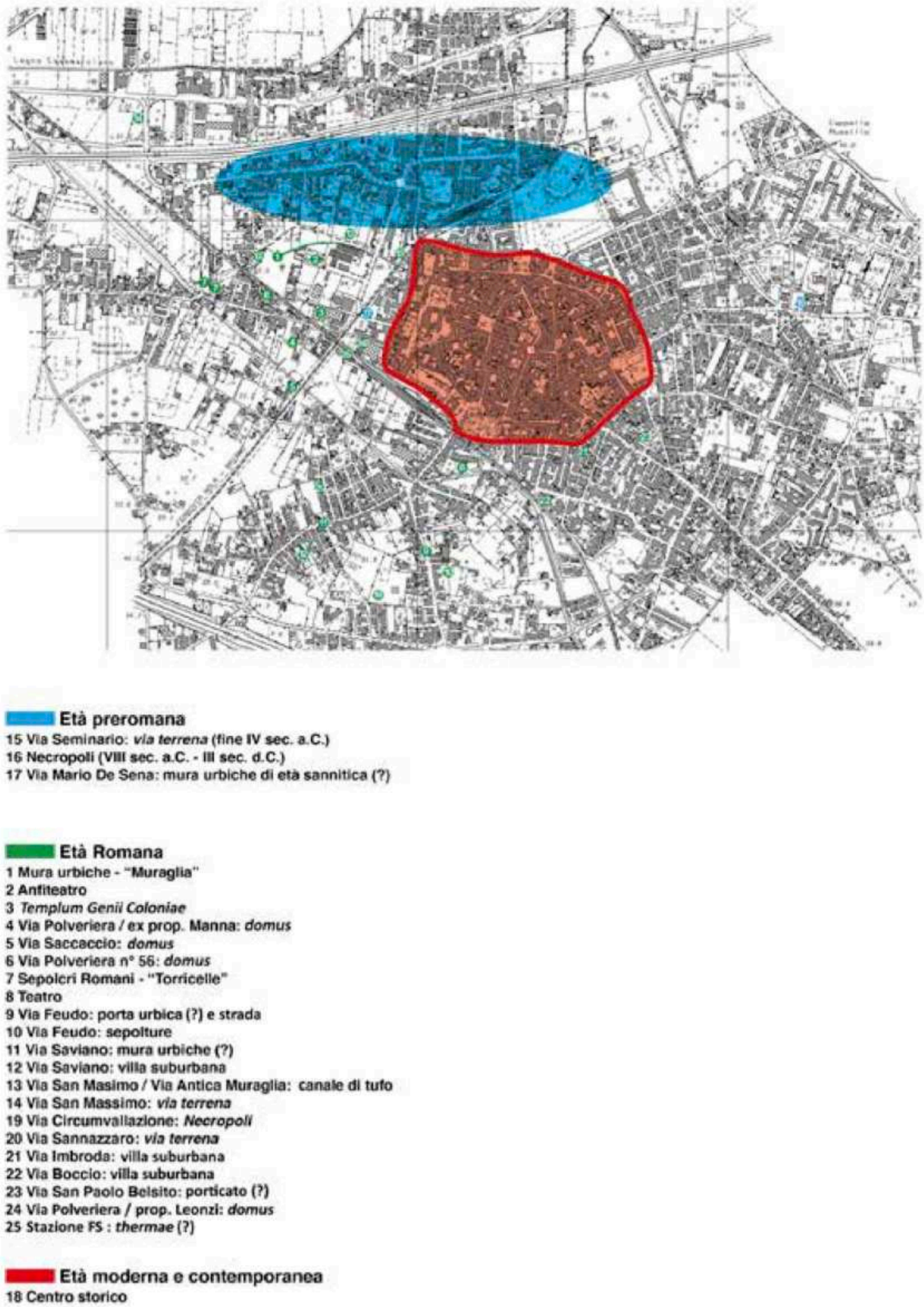

Figure 59. Archaeological evidence at Nola. From CESARANO 2021, 78.

Urban Orientation in Phases

The area of the urban settlement can be calculated to have been of around 35 hectares[1512]. From the Samnite Period, a beaten-ground road was identified in recent excavation as being perpendicular to the modern-day Via Seminario[1513]. This road is antecedent to the 3rd cent. BC and should probably be dated to the end of the 4th cent. BC[1514]. According to the GoogleEarthPro software package, Via Seminario has an orientation of 90° azimuth[1515], indicating that the perpendicular street had a north-south direction. Recent excavations on the west side of Via San Massimo have revealed another beaten-ground road oriented around N 30° W and used from the 2nd cent. BC[1516]. What was interpreted as a trace of the *decumanus* was recovered in Via Mario De Sena, 2.4 m. wide, plus a footpath of white limestone blocks oriented east-west (figs. 60–61)[1517]. The street connected the forum to the amphitheatre. A direct correlation between the centuriation known as *Nola III* and the main direction of the urban streets has been pointed out[1518]. *Nola III*'s orientation is N 15° E with a module of 20 x 20 actus but a chronological time frame is lacking due to poor archaeological documentation[1519]. According to Fabrizio Ruffo, at the present state of research it is plausible that the ancient urban area corresponded, at least partially, to the modern one[1520]. For Sommella, modules of 70 m x 70 m, a double squared *actus*, would fit with a city founded or re-founded in the 1st cent BC[1521].

From the beginning of the 3rd cent. BC, the centuriation system *Nola IV-Sarnum* was established, synchronously to the one in the north which included Neapolis, Acerrae, Atella and Suessula[1522]. The *Nola IV-Sarnum* has an orientation of N 46° E[1523]. For Rossi, it was based on plots of 15 x 15 actus[1524], whereas for Soricelli it had modules of 14 x 16 actus[1525]. Moreover, Soricelli opted for a later chronology in the Sillan age[1526]. According to Rossi, similar orientations were found at other structures, such as the sanctuary-theatre complex at Foce Sarno, as well as at the villa di Casa Canale at Nuceria, the villa 2 and villa 6 at Terzigno, and the villa in the Ceraso locality at Poggiomarino[1527]. According to Massimo Osanna, Via Stabiana at Pompei follows the same orientation[1528]. After the Punic wars, there followed a centuriation system oriented N 15° E of 20

1512 Sommella 1988, 37.
1513 Cesarano 2021, 85–86.
1514 Cesarano 2021, 85–86.
1515 Pointing approximately towards the Sanctuary of Monte Vergine where a temple of Cybele was located.
1516 Cesarano 2021, 87.
1517 De Caro 1999, 839; Rescigno - Senatore 2009, 140.
1518 Chouquer et al. 1987, 212; Ruffo 2012, 98.
1519 Ruffo 2012, 95.
1520 Ruffo 2012, 98–100.
1521 Sommella 1991, 158.
1522 Rossi 2019a, 23.
1523 Chouquer et al. 1987, 211–212.
1524 Rossi 2019c, 23.
1525 Soricelli 2019, 158.
1526 Soricelli 2019, 158.
1527 Rossi 2019c, 23.
1528 Osanna 2019a, 226–227.

actus[1529]. The archaeological evidence suggests a chronology of around the 2nd and 1st cent. BC[1530]. Due to the lack of evidence and the many orientations possible, it is not clear what the chronology of the layout is, nor its orientation at the time of its foundation.

Table 14

Phase	Data	Reference System	Data Source	Azimuth
/	*Nola III* Via San Felice Via San Paolino	Geographic	DSM LIDAR	 108°±2 20°±1
4th – 3rd cent. BC	Perpendicular to Via Seminario	Geographic (Google Satellite)	GoogleEarth Pro CESARANO 2021, 16.	90°
Post quem 2nd cent. BC – 1st cent CE	N30°W	Cartographic	CESARANO 2021, 87.	60°

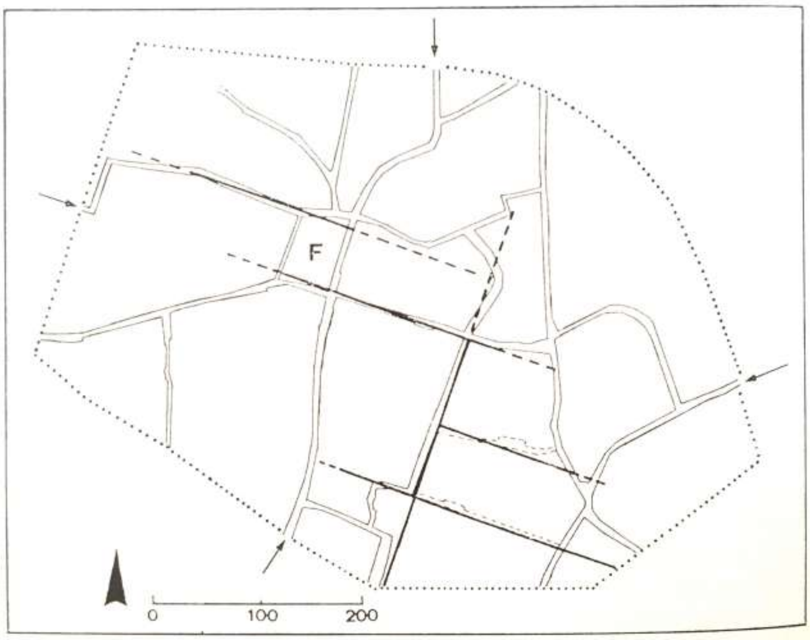

Figure 60. Urban layout of Nola according to SOMMELLA 1991, 172.

[1529] ROSSI 2019c, 24.
[1530] RUFFO 2012, 100.

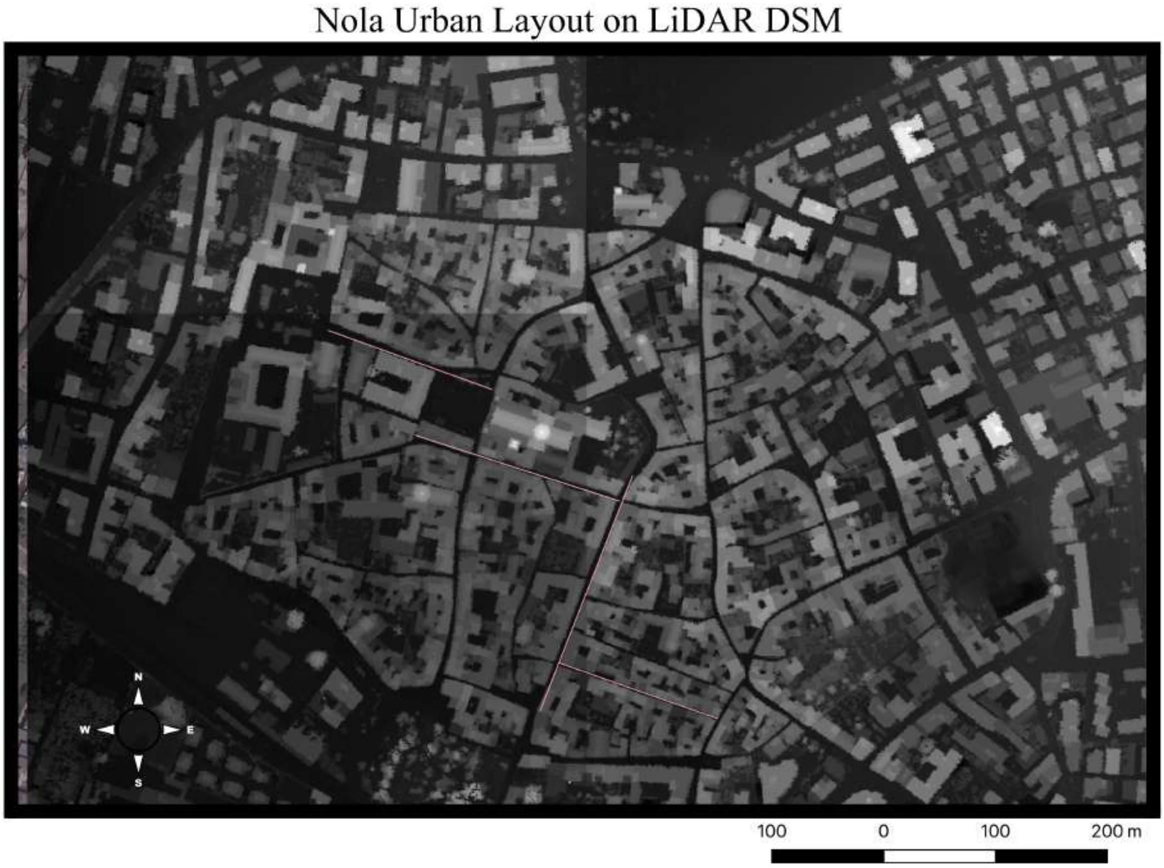

Figure 61. Hypothetical Nola urban layout after Sommella 1991, 172, on DSM LiDAR 1m. Elaborated by the author with QGIS.

Skyscape Analysis of the Urban Grid

Due to the relative lack of archaeological evidence and of a single orientation system, it is not possible to produce a convincing skyscape analysis in the case of Nola. With an orientation system based on 108°(±2°), the setting of the Pleiades would have been visible in a north-west direction (fig. 62). Nola's orientation appears very different from that of other Campanian settlement orientations, but this divergence may simply be due to the lack of clear evidence with respect to pre-Roman urbanism at the site.

Figure 62. Landscape and skyscape visibility from Nola in line with the hypothetical urban axes. Elaborated by the author with Horizon© Andrew Smith 2022. See Plate VII.

Table 15

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
	E	600 BC	40.93	108	5	-10.11	(3.5 km far)	
	W	600 BC	40.93	288	0	+13.5	towards the Campanian plain	setting Pleiades (δ = +14.5°)
	N	600 BC	40.93	20	5,6	+50.4	Partenio (9 km far) – Piano Maggiore	
	S	600 BC	40.93	200	0,7	-44.58	towards the Sarno Valley	

VIII. KYME

The Town

Introduction

The city of Cumae has not survived as a settlement to the present day, but memory of this ancient site has remained intact across the centuries. Book VI of Virgil's Aeneid framed the ancient site within a mythological and magical domain. The site now, under the protection of the Phlegraean Fields Archaeological Park, is located in the territory of Pozzuoli and Bacoli.

The Proto-Urban Pre-Hellenic Settlement

Excavations during the 18th and 19th century revealed a degree of Greek frequentation in the area where the *polis* of Kyme would have risen in the last quarter of the 8th cent. BC. Starting from the second quarter of the 9th cent. BC, a scattered pre-Greek indigenous settlement was confirmed to have existed from the study of the necropolis[1531]. Establishing themselves on the cliff of Mount Cuma and on the nearby plateaux along the littoral, the indigenous settlement was sparse and diffuse. This would have been organised over a wide area, including the plateau above which the urban area of Kyme developed[1532]. Pre-Hellenic funerary customs are common in the Fossakultur *facies*, including the inhumation of the deceased in ground ditches, although with small local variations[1533]. The necropolises were in use for some generations by consistent nuclei, probably parental groups. The pre-Hellenic community was a warrior elite and a commercially focused group importing Geometric ceramics from Euboea and Phoenicia. The settlement was transformed with the first phase of the Hellenic town, with an evident transformation of the use of space on the plateau from around the mid 8th cent BC.

The Hellenic Town

The *apoikia* settlement of Pithekoussai at Lacco Ameno, Ischia, was closely related to the foundation of Kyme, as demonstrated by the mutual visibility between the two places and their common material culture. A complete structuration of the settlement of Pithekoussai is evident in 770–750 BC. At Kyme, the arrival of the Greeks and their interactions with the indigenous population likely resulted in phenomena of integration, such as mixed marriages[1534], in parallel with imposition and estrangement slowing the first phase of a settling down of the Hellenic population with respect to Pithekoussai. Above the indigenous necropolis on the plateau, the Archaic Greek *apoikia* was established, thus marking a strong discontinuity in the use of the space. The first phase (LG I, 750–720 BC) of Hellenic Kyme remains mostly obscure due to the lack of any explored stratigraphy of

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[1531] CRISCUOLO - PACCIARELLI 2009, 331 ss.
[1532] TOCCO 1976, 487–488.
[1533] CRISCUOLO - PACCIARELLI 2009, 329.
[1534] See Tataie's lekythos, London, British Museum.

materials in primary position. Only a single household has been uncovered, with ceramics of Greek importation and of local production.

After a few generations, in the LG II (720–690 BC), the structural form of the urban grid seems to take shape, showing a certain discontinuity from the very first phase of urban organisation, including a house foundation ritually destroyed to be substituted by a *stenopoi.* The irregularity and non-orthogonal nature of the urban grid can be read as responding to a need to facilitate water drainage. Metallurgic work was found in the northern sector of the settlement. The necropolis shows evidence of a specific funerary cremation ritual typical of the Euboic aristocratic tradition (Eretria). The presence of Etruscan and Italic shields and fibulae shows an openness towards local autochthonous tradition, as is evident in tomb 104 of Fondo Artiaco (from the beginning 7th cent. BC).

A further process of arrangement seems to have happened by the end of the 7th cent. or the beginning of the 6th cent. BC with an ampliation and a raising of the planking level and a continuity of use until the end of the 6th cent. BC[1535]. The first urban perimeter wall can be dated to around 600 BC, circa 150 years after the foundation. The Greek city was already occupying the area of the Roman town, with an organised arrangement of the use of spaces. The monumentality of the sacred building is evidenced by architectural features, such as tuff columns with Doric capitals, wooden lintels, and polychrome decorative designs. From 700 to 500 BC, the road network shows a continuity of use and orientation. This orientation is visible in the northern sector of the wall[1536].

By the end of the 6th cent. BC, there was a total transformation of the plateau in the area of the future forum, with the removal of private spaces to give way to an organisational structure dedicated to providing space for public and sacred buildings only[1537]. The planking level is again raised up. The new monumental buildings display novel architectural techniques, such as squared tuff blocks and decorated architectonic terracotta. These have a different orientation from the previous Archaic arrangement[1538]. A continuity of usage can be attested all through the 5th cent. BC. After the period of the tyranny of Aristodemus, which ended around 485 BC, there follows a decline in Cumae's control of the gulf, even despite victory in the battle of 474 BC aided by the Syracusans against Etruscan marine expansion[1539]. Around this time, local coinage started to be issued[1540].

The Samnite Town

In 421 BC, the settlement was conquered by the Samnites. The destruction of the monumental buildings was accompanied by a new orientation, but the area retained its sacred-public function[1541]. The acropolis was reinforced with defensive constructions in anticipation of further conflicts. The

1535 GRECO 2011, 36.
1536 RESCIGNO - SENATORE 2009, 437.
1537 GRECO 2011, 36.
1538 GRECO 2011, 36.
1539 MELE 2014, 135–139.
1540 MELE 2014, 137.
1541 GRECO 2011, 39.

first phase of the Samnitisation of the town (from the end of the 5th to the beginning of the 4th cent. BC) is recognisable in a few architectural and decorative materials[1542]. From 421 BC, the numismatic evidence emphasised the importance of agriculture and cereal production for this community, since that the only symbol depicted on coins was the wheat spike. [1543]. Renata Cantilena is of the view that Kyme's own coin production did not stop with the arrival of the Samnites, but that there was a phase when coin production continued at Kyme and started at Neapolis, as is evident from the overlap between the Kyme series and the first Kampanos series[1544]. This shows an appropriation of the Greek institution by the Kampanos, with the need of establish a proper coin to be used in the same way it had been used by the conquered community.

Urban Orientation in Phases

The evidence suggests that the urban layout was regular with a canonical orthogonal morphology[1545]. The following data are based on recent cartography published in the volume *CUMA: Nuove forme di intervento per lo studio del sito antico* by Bruno d'Agostino and Andrea D'Andrea, and in particular on the chapter by Adele d'Onofrio. Measurement data are thus extrapolated from a cartographic raster georeferenced in QGIS (fig. 63)[1546].

A first, oldest coherent orthogonal layout might be adjudged to be based on an orientation of 113°/114°[1547], corresponding in alignment to Via Monte di Cuma and a street (G in fig. 63) to the south, Via Vicinale di Cuma to the north along with the structures of Porta Mediana, and repeated by the structures south of the Capitolium[1548]. The trapezoidal square at the south-west corner of the forum might be also included as evidence of this alignment[1549]. Orthogonally to this layout, other streets can be identified with an orientation of az. 23°/24°: the street A entering the city from Porta Mediana and, on its east side, the structures revealed through geophysical analysis[1550], as well as an orthogonal street intersecting Via Monte di Cuma and extending south. Extrapolating from the structures recovered from beneath the Capitolium *pronaos*, this grid might be dated to the Archaic period[1551]. Paolo Sommella interpreted the absence of a convergence point in the urban design to suggest that a typical Greek design was applied in the course of that phase[1552].

A second arrangement is based on an orientation of 106° with the new Capitolium, its lateral street E to the north, though following a curving line towards the Roman *crypta*. Orthogonally, streets B defined the space from the Forum to the Terme del Foro.

1542 RESCIGNO 2010b, 15.
1543 CANTILENA 2009, 153.
1544 CANTILENA 2009, 219–223.
1545 SOMMELLA 1991, 151.
1546 D'ONOFRIO 2002.
1547 Summarised already by RUFFO 2010, 300, even though he measured 110° bearing.
1548 RUFFO 2010, 300.
1549 PETACCO - RESCIGNO 2007, 76–78.
1550 D'ONOFRIO 2002.
1551 PETACCO - RESCIGNO 2007, 63.
1552 SOMMELLA 1991, 158.

Further orientations can be traced, though not fully compatible with the ones mentioned above. It can be observed, for example, that some structures aligned to an azimuth of 98°, such as the Tempio del Gigante and some structures identified at the midpoint between streets F and G when excavators were looking for a *stenopos*[1553]. In this area, on the slope of Mt. Grillo, the layout of the urban or extra-urban grid had to adapt to the contours of the hill. For Fabrizio Russo, a major axis can be seen in the alignment of a slab-stone street oriented north/south[1554], specifically at 10° az., reprised at Via Vecchia Licola at Palombara[1555]. Yet, according to Giuliana Tocco, the street C and its urban layout can be dated to the Roman period, when Cumae might have had a regular grid[1556]. Indeed, four other streets can be related, but not exactly orthogonally[1557], to the Via Vecchia Licola going in an east/west direction. Recently, two of these streets (F and G) have been excavated by the Istituto Universitario Orientale; however, given the difficulties of the excavations, no precise alignments could be ascertained[1558]. A beaten-earth street was also found beneath the east/west street G[1559]. The materials found there suggest that the oldest level of the street can be dated to the end of the 5th cent. or the beginning of the 4th cent. BC, with a permanence of use until the end of the 1st cent. AD, when the Arco Felice was built on the same axis[1560]. Using the cartography developed by D'Onofrio and D'Andrea, the street G was estimated as having an orientation of az. 107°.5, thus something halfway between the first and second urban layouts summarised above.
In the forum area, and specifically in the trench of the Capitolium *pronaos*, a 'snapshot' of the shift in orientation can be gained within the one trench. This issue is further analysed in the next section on the Temple in the forum, but a significant discontinuity can be highlighted here: according to Ruffo, after Petacco and Rescigno[1561], the political changes in Cumae can be read on the ground through a changing orientation of 12°, turning anti-clockwise[1562]. With this value, their intention was to consider the transformation which happened in the forum area excavated from beneath the Capitolium podium, the fulcrum of the city, where an Archaic public building was brought to light. At the beginning of the 3rd cent. BC, with the slowly changing political equilibrium, the central long and narrow forum was built, possibly in the area of the antecedent agora, with a new urban orientation[1563]. However, the accuracy of these measurements, which are based solely upon a few-metres-long trace of streets, is open to question since, when considering the whole urban plateau, it is possible to propose a different value of a lighter divergence of just 8° between the first and second phase. According to Giovanna Greco, several orientations in the central forum area of the town were present across the centuries: from the 8th cent. until the beginning of the 6th cent. BC, the structures

1553 D'Onofrio 2002, 140.
1554 Tocco 1976, 490.
1555 Ruffo 2010, 300.
1556 Tocco 1976, 490.
1557 Tocco 1976, 490.
1558 D'Onofrio 2002, 134.
1559 D'Onofrio 2002, 3.
1560 D'Onofrio 2002, 138.
1561 Petacco - Rescigno 2007, 33.
1562 Ruffo 2010, 302.
1563 Zevi et al. 2008, 247–248.

that were unearthed are oriented 115° clockwise from North; in the 6th cent, they progressively moved towards an alignment of 117° and, in the 5th and 4th cent, to 119°[1564]. Finally, in the 3rd cent, a drastic change in orientation preference resulted in a tendency towards an alignment of 106°[1565].

Table 16

Phase	Data	Reference System	Data Source	Azimuth
Archaic, 6th cent. BC	113°/114° (Or 115.3°-116° in D'ONOFRIO 2002) 23°/24°	Geographic	Via Monte di Cuma, street (G) on the south, Via Vicinale di Cuma on the north with the structures of Porta Mediana, and reiterated by the structures south of the Capitolium street (A); orthogonal street intersecting Via Monte di Cuma and extending on its south	114°±2° 24°±2°
Archaic, 6th cent. BC	N 28 E	Cartographic	Greek Archaic building below the Capitolium podium PETACCO - RESCIGNO 2007, 63.	28° (118° Orthogonal)
Second half of the 4th cent. BC	109°	Geographic	Staircase (Temple A)	109°

1564 GRECO 2011, 5.
1565 GRECO 2011, 5.

			PETACCO - RESCIGNO 2007, 66.	
	106°	Geographic	Capitolium, its lateral street (E) on the north, but following a curving line towards the Roman *crypta*. Orthogonally, streets B defined the space from the Forum to the Terme del Foro. PETACCO - RESCIGNO 2007, 66.	106°

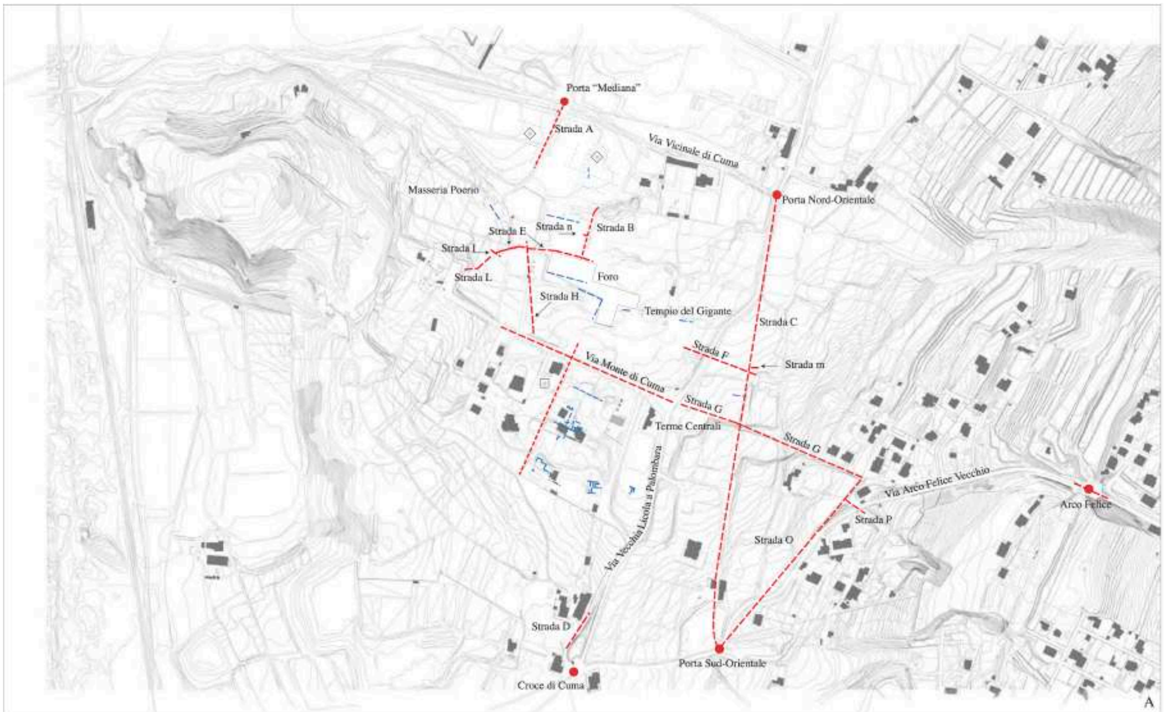

Figure 63. Reconstruction of the urban network at Kyme. After D'ONOFRIO 2002.

Skyscape Analysis of the Urban grid

According to Lucio Amato, Carmela Guastaferro and Aurora Lupio, the paleo-morphology of the site has a substratum morphological profile from north towards south[1566]. The Phlegraean area is subject to volcanic movements. Still, the area of Cumae is regarded as a stable site from a geomorphological perspective, but not its landscape and skyline[1567], which might have been subject to changes across millennia. Nevertheless, the reconstructed landscape together with the skyscape for the Archaic phase, from when the first urban system is dated, points at no specific astronomical events (fig. 64). To the east, in line with the urban roads, the sun would have been seen rising 60 days before and after the winter solstice. To the west, the Archaic axis would meet with the direction of the setting sun 30 days before and after the summer solstice. The orientation of Kyme, pointing towards the south-east, is distinct from the rest of the urban orientations in Campania. It is possible that swamp reclamation was a major issue for the health of the community in the city in its various phases of development and, therefore, a major constraint on feasible decisions on orientation.

Figure 64. Landscape and skyscape visibility from Kyme in line with the urban axes. Elaborated by the author with Horizon© ANDREW SMITH 2022. See Plate VIII.

Table 17

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
Via Monte di Cuma, street G to the south, Via Vicinale di Cuma to the north with the structures of Porta Mediana, and reiterated by the structures south of the Capitolium and the trapezoidal square	E	600 BC	40.85	115.5	6.1	-14.73	Mt. Grillo (0.7 km far)	sun rising 60 days before and after winter solstice/ Rigel rising (δ = -15°)
as above	W	600 BC	40.85	295.5	5	+22.42	Mt. di Cuma (0.5 km far)	sun setting 30 days before and after summer solstice/

1566 AMATO - GUASTAFERRO - LUPIO 2002, 104.
1567 AMATO - GUASTAFERRO - LUPIO 2002, 3.

								Regulus setting (δ =+22°)
The street (A) entering the city from Porta Mediana, and on its east the structures revealed with geophysical analysis, and an orthogonal street intersecting Via Monte di Cuma and extending south.	N	600 BC	40.85	24	1.1	+44.71	Mt. Crocetta - Punta Giulia (73 km far)	
as above	S	600 BC	40.85	204	3.2	-40.8	(0.4 km far)	

The Temple in the Forum

Excavations in the forum area, within the Capitolium infilling, have revealed the long history of the building from the Greek period onwards[1568]. From the 6th cent. BC, a tuff structure probably consistent with a significant Greek Archaic building was discovered[1569], whose monumental proportions and fine parietal plaster decoration suggest it had a public role[1570]. The orientation of this structure is 28° from north towards east[1571], which is consistent within ±5° with the orientation of the Porta Mediana to the north and other streets and structures, indicating the use of an Archaic urban grid[1572]. Orthogonally to the temple, an orientation of 119-220°/299-300° can be measured[1573]. This public building was abandoned, destroyed, and razed to the ground, coinciding with a historical period of transformation characterised by the arrival of the Samnites at the end of the 5th cent BC[1574]. Materials from the Archaic building were placed in votive pits and sealed. There follow a compact series of stratigraphic levels accumulated during the 5th cent. BC within beaten-earth ground strata, and then a new temple with its own foundations.

In the second half of the 4th cent. BC (at around 320 BC), in the area of the previous *agora*, an imposing new temple was built on a podium (Temple A), but it had a short life, only until shortly after the beginning of the 3rd cent. BC. The only topographical element investigated is a part of a tuff-stone external staircase made of six steps, covered with white plaster, which was probably derived

[1568] PETACCO - RESCIGNO 2007; RESCIGNO - SENATORE 2009, 437; AVERNA 2020, 17–18.
[1569] The so-called 'edificio arcaico'.
[1570] PETACCO - RESCIGNO 2007, 63–65.
[1571] This is in cartographic North, which corresponds to 26.5° azimuth.
[1572] PETACCO - RESCIGNO 2007, 63.
[1573] This orientation is comparable to that of the Doric Temple in Pompei, even though the lack of archaeological data prevents any comparisons of the role and function of the two buildings. A comparison can be drawn on the basis of architectonic decorations where Kymean models are reflected in the Doric temple at Pompei.
[1574] PETACCO - RESCIGNO 2007, 65–66; AVERNA 2020, 17.

from the Temple A structure. From its first phase, according to Carlo Gasparri, this temple faced to the east, even though an Oscan inscription at the west end of the temple raised the possibility that the Samnite temple opened towards the west[1575]. With this building, the introduction of a new orientation of 109° east from north is apparent[1576]. This orientation is not certain and, yet, not very dissimilar from the later Capitolium (106°) showing a difference of only 3°[1577]. According to Rescigno and Petacco, this intermediate orientation of 109° might be interpreted as relatively individual and not related to any correspondent urban arrangement but restricted to this monumental complex only[1578]. A second staircase, similar for structure and orientation, was recovered from beneath the so-called 'Fontana Imperiale', not far to the south[1579]. The two staircases might be interpreted as the altars or the podia of Samnite sanctuaries[1580]. The temple A appears at an important moment in the history of architecture, by being the first example of Hellenism in the south of Italy[1581]. The building had Tuscan-order columns and capitals, probably erected on a podium and made of yellow tuff in *opus quadratum*. To achieve the full planned extent of its construction, the building area was enlarged to the west[1582]. Topographical evidence of this building is lacking, but the orientation of the remaining staircases, if once part of that temple, would have aligned with the setting of the Pleiades: their achronycal setting would have happened around the time of the spring equinox, or their morning setting at the beginning of November. Most important, part of the roof decorative system of Temple A was recovered[1583], and its fronton was recently reconstructed by Andrea Averna[1584]. with a series of antefixes representing winged female figures holding a *stamnos* or *hydria*: either Thesan nymphs or the astral group of the Hyades or Pleiades are understood to be represented in these figures[1585]. The antefixes were produced in matrices, painted in pink for the skin, and white, red, and yellow for the vests, with light blue for the wings with yellow or red feathers, as well as a light blue for a vase. According to Rescigno, the vase can be interpreted as a *kadiskos*, as mentioned by Athenaeus, commemorating a ceremony where ambrosia was brought to Zeus. According to Herbert Koch, the winged figures can be interpreted as the Hyades, the bringers of rain[1586]. However, on deeper analysis on the vase shape and function, which is also a closed vase, does not appear a strict relationship with water and rain[1587]. Moreover, the orientation of the Temple A is comparable to the setting of the Pleiades asterism. Such spatial position in the landscape, defined by the prolongation of the temple main axis or, in other words, by the view framed by the temple entrance towards the west, can be

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[1575] Gasparri 1999, 132.
[1576] Petacco - Rescigno 2007, 66.
[1577] Petacco - Rescigno 2007, 66; Averna 2020, 20.
[1578] Petacco - Rescigno 2007, 63.
[1579] Petacco - Rescigno 2007, 67.
[1580] Petacco - Rescigno 2007, 74.
[1581] Rescigno 2010b.
[1582] Gasparri 1999, 131–132.
[1583] Petacco - Rescigno 2007, 61.
[1584] Averna 2020.
[1585] Bridjder - Lulof 1989; Krauskopf 1992; Rescigno 2006; Averna 2020, 65.
[1586] See H. Koch, *Dachterrakotten aus Campanien*, Berlin 1912, 17.
[1587] Rescigno 2006, 510.

related to an astral seasonal recurring calendar. Due to their regularity, these movements have been observed and recorded since Hesiod to set agricultural and navigational activity rhythms. The season of the setting of the Pleiades happens in March and November. If the morning setting in November would be coherent with water and rain, the achronycal setting of the Pleiades in March would recall the ambrosia cycle and spring celebrations as described by Georges Dumézil[1588]. Similar winged figures appear in Hellenistic art in connection with the act of extinguishing the fire of Herakles' apotheosis: in this case, the ambrosia is thrown on the purificatory fire to guarantee the immortality of the hero[1589]. Although the complex role of these astral figures needs further unveiling, it is here reminded that similar antefix fragment was found in the Major Terrace Temple of the acropolis[1590]. As already mentioned, after a short life of half a century, Temple A was destroyed by fire.

In the 3rd cent. BC (300–250 BC), a new sacred peripteral building (Temple B1) was built,[1591] using the *opus quadratum* technique on a high podium of around 5 m. in height. It had a plan with 6 x 12 columns, a long and narrow cella with a pronaos and opisthodomos[1592]. The design has a Hellenistic style similar to that of the Ara della Regina temple at Tranquinia. A new orientation is introduced in the public area with an unitarian arrangement, as can be recognised from the alignment of the southern porticos. According to Averna, the antefixes with Pleiades were probably also present on this temple roof, as revealed by the analysis of architectural elements, though with the identification of a variant: the position of the wings and smaller dimension of the fictile elements suggest a second series probably deriving from the originals in the Temple A prototype[1593]. The confirmed difference of the imbrices for the variant so seem to suggest that this variant may have been used on a different roof, possibly that of this Temple B structure[1594].

The Capitolium (Temple B2) was built in the first half of the 3rd cent. BC. using *opus caementicium*. Part of the older temple podium was cut and levelled to the ground. The construction served as a closure of the western short side of the forum, in an urban planning with a renovated orientation in the lower city (106° az.)[1595]. An access staircase on the eastern side in limestone, perhaps intended for altars, was also present[1596].

1588 DUMÉZIL 1924, 84–125.
1589 DUMÉZIL 1924, 93; In the fragmentary reconstruction of the architectonic decoration of Ara delle Regina (Temple III) at Tarquinia, Giovanna Bagnasco Gianni suggested that the apotheosis of Herakles was the main theme of the frontal decoration. From the fragments showing a closed vase and the inferior part of a female figure with a starry chiton, she reconstructed the figures extinguishing the fire of Herakles' apotheosis. Also, Hellenistic iconographic comparison was referred to the crater of Lycurgus painter, showing the apotheosis of Herakles on Mt. Oeta (image in AVERNA 2020). See G. Bagnasco Gianni, "I Cavalli Alati di Tarquinia. Una proposta di lettura", in M. Bonghi Jovino - F. Chiesa (ed. by), *L'Ara della Regina di Tarquinia, aree sacre, santuari mediterranei, Giornata di studio (Milano, 13 giugno 2007)*, Milano 2009: 93–139.
1590 PETACCO - RESCIGNO 2007, 75.
1591 PETACCO - RESCIGNO 2007, 74.
1592 PETACCO - RESCIGNO 2007, 53.
1593 AVERNA 2020, 65–69.
1594 AVERNA 2020, 68–69.
1595 PETACCO - RESCIGNO 2007, 56.
1596 PETACCO - RESCIGNO 2007, 54.

The Major Terrace Temple

Elements of the first layout of the sacred area can be inferred from the few ditches, levelling actions, terracing operations, and diggings. These elements suggest a construction in perishable materials; thus, the temple did not have yet a monumental aspect. This phase can be dated from the second half of the 8th cent. BC until the end of the 7th cent. BC within the first generation of colonists. Ceramic findings, that were recovered from foundations pits, were dated to the final phase of the Geometric Age. In this first period, lasting almost one century, the cultic practices are witnessed by the votive offerings: these are vases with recurring shapes, small but precious objects made of lead and gold and, remarkably, two unique bronze statuettes depicting a warrior and a female lyre player in the act of chanting.

The first monumental building in volcanic tuff stone was probably built between the end of the 7th and the beginning of the 6th cent. BC, when the terracing masonry was completed using mighty *opus quadratum* walls: thus, the peripteral tuff Doric temple was placed on that platform. The elevations are mostly not known due to successive massive restructuring, even though some proto-Archaic building blocks and capitals were found rearranged as part of the end of the 6th cent. BC cella floor.

About the life of the temple during the course of the 5th cent. BC not much is known, as probably no notable interventions happened during that period. An important divide can be noticed in the second half of the 4th cent. BC with an enlargement of the temple on the whole terrace: the materials recovered in the foundation pits and in the strata from the workings suggest a raising up of the planking level. This is concomitant with the construction of an impressive building with peristasis made of *opus quadratum* yellow tuff stones (25 x 40 m), still extensively discernible in its foundations. The floors were realised in *opus signinum* coating, with particular care in the cella, itself laid out above a levelling stratum made of tuff flakes and a setting layer realised with roof tiles pieces in fish bone design. The *opus signinum* coating was arranged with sparse tesserae on the edges, a white strip on the perimeter and a dotted motif at the centre. A lot of coroplast on animals and figurines was found pertinent to this phase. No significant portions of the elevations have been preserved until today, although, despite successive alterations, it is possible to imagine that the shape of the inner spaces would not have been particularly dissimilar from the Roman temple. Indeed, it is in this phase that the layout, embedding the pre-existing structures, becomes the definitive one. The Imperial Age and post-Antiquity interventions, even if in many cases quite destructive, did modify its plan but not its foundations nor its orientation.

The building endured almost unaltered until the first Imperial Age when, between Augustus and the Tiberius' first reign, it was destroyed and totally rebuilt. The fragment debris resulting from the destruction was used to enlarge the square: thus, the excavations carried out in the outdoors led to the discovery of many interesting fragments from the older Hellenistic temple. Among these, attention can be drawn to a plaster group coloured in a style comparable to the first Pompeian one, which could have been part of a portico decorative system or the temple walls and that was realised in the Late Republican Age. On these walls, prior to the Tiberian restructuring, devotees wrote their names, dates and short personal stories; these constitute a record of the people gathering together, especially during festivities, in front of the temple.

Finally, around 20 AD, a new temple was built above the foundations of the older one, made of Roman concrete, *opus reticulatum* and bricks, as was common at the time. The inner layout was composed of five naves, with four lines of columns in Roman bricks and a perimeter wall. The central and widest nave was divided in the following way: a pronaos, a cella with a central frontal entrance, a second cella at the back with two symmetrical lateral entryways, and a small posterior room. In the cella, there were niches where were portrayed the *pinakes* narrating the history of Cumae.

Among the key areas of contention are defining the temple's phases of evolution, as well as determining the tutelar divinity it was in devotion to and its function within the wider urban and architectonic context[1597]. The main issue within scholarly debate about the Kyme acropolis is the difficulty of identifying the titularity of the cults with the material remains recovered. The traditional attributions of the Temple of Apollo with the Inferior Terrace and the Temple of Jupiter with the Major Terrace can be dated back to Andrea de Jorio[1598]. Many excavation campaigns on the Major Temple, conducted by the Università della Campania 'Luigi Vanvitelli' and coordinated by Prof. Carlo Rescigno, have provided new clues prompting further reflection. Apollo is now considered the titularity divinity of the Major Terrace Temple[1599]. In particular, the slabs with inscriptions citing the *aedes Apollinis* are noteworthy, as are: the upside-down dolium covering a *bothros* with remains of mice skeletons among other things; the holed disks with no inscriptions comparable to the *sortes* and that were probably part of oracular practice; the spear top pointing down into the soil; the naked bronze female statuette holding a kithara; and the inscribed plaster fragments mentioning Ceres and Bacchus, Apollo, and performances probably held at the theatre and amphitheatre. Moreover, it should be remembered how, in the backdrop of the first cella of the temple, were found the podium with three bases for the statues of a triad, which may be the Delian one in reference to the Delian Archegetes Apollo introduced at Cumae by the Euboic colonial contingent.

The orientation of the temple is cardinal, facing the east cardinal direction at 90.5°. The altitude of the horizon in this direction is 1.4° (fig. 65). The rising sun around the spring and fall equinox would have been seen in front of the temple and illuminating the cella with light (fig. 66). Behind it, at 270.5°, the sun would have set during the same days of the year. Given the accuracy of this orientation, it is reasonable to suggest that gnomons were used to set the correct cardinal directions.

[1597] Rescigno - Sirleto 2011.
[1598] Camodeca 2012, 71–72.
[1599] Rescigno 2012.

Figure 65. View of the eastern landscape where the Major Terrace Temple is facing. Photo with UAV drone by the author, July 2022.

Figure 66. The cardinal orientation of Kyme Major Temple Terrace according to the landscape and skyscape in 600BC. Elaborated by the author with Horizon© ANDREW SMITH 2022.

The Inferior Terrace Temple

The Greek temple on the Inferior Terrace was built at the beginning of the 5th cent. BC[1600]. It was probably peripteral, with a basement with dimensions of circa 31 x 18.3 m constructed out of huge yellow tuff blocks[1601]. The inferior temple in the acropolis has been measured by Aveni and Romano as having an azimuth of 39.3° and a declination of 34°[1602]. Although, when considering the QGIS cartography made by D'Andrea and d'Agostino[1603], these values were corrected to 38.3°, with an altitude of 1.4° and a declination of 37.2°. This orientation does not show any astronomical targets: the sun does not rise or set for this declination, and the stars, which are only faint in this direction, may be disregarded[1604]. Surely, it would seem the orientation was constricted by the natural rock platform, steeply dropping towards the east. The cliff was an important constrained, but the temple does not follow exactly the line of the steep rock face, also because the terracing of the area would

[1600] CAPUTO ET AL. 1996, 88.
[1601] CAPUTO ET AL. 1996, 88.
[1602] AVENI - ROMANO 2000, S54.
[1603] CALCAGNO 2002.
[1604] For instance, the star Capella in 800 BC.

have allowed a wider margin of choice in its positioning. For sure questions arose regarding the reason of placing this temple at the eastern limit of the acropolis' hill, so near to a steep cliff. For sure it was well visible from the town on the lower plateau, but the opening of the temple towards the north, as suggested by some scholars, is unusual for a Greek temple, even though the example of Bassae should be kept in mind[1605]. In the first Imperial period, the temple entrance could have been rotated towards the east, facing the lower city and Mount Grillo. In this direction, no major astronomical events can be demonstrated, possibly because the altitude of the skyline is open to question due to the volcanic nature of the area. The temple assumed the plan of a transverse cella temple of the type cited by Vitruvius[1606]. It acquired an Ionic hexastyle pronaos at the south-east side entrance with a width longer than its length[1607]. According to Francesco Marcatilli, this peculiar transformation of the plan might be related to collective actions of purification or integration of marginal groups, such as slaves, probably involved in the construction of the nearby *portus Iulius*[1608].

The result of the orientation analysis suggest that the temple seems to point towards Mt. Tifata (within an error of 5°) and Capua, in line with the orientation of the Via Campana (figs. 67–68). Even though Mt. Tifata does not rise above the skyline, it is and was well visible from the acropolis on a clear day. On the opposite side (218.3°), the view opens towards the Tyrrhenian Sea and Ischia, where the ancient emporium of Pithekoussai was (fig. 69). The first of these options seems the more potentially significant. Indeed, it may be interesting to note how the orientation of the Hellenistic *Iuppiter Tifatinus* temple opens onto the Campanian plain with an orientation looking towards Monte di Cuma and its acropolis. This orientation may be related to the italic concept of *fides,* as discussed in the 'Celestial Light' 1.1 section in Chapter Three. In reality, from that area, many Oscan and Latin inscriptions in honour of *Iuppiter Flagius-Fulgurator* have also been recovered, and these inevitably evoke the presence of Zeus equipped with a thunderbolt striking the Giants in the Phlegraean Fields[1609]. Indeed, four of the seven inscriptions found at Cumae mentioning Jupiter *Flazus* or *Fulgator* were recovered at the Inferior Terrace[1610]. The recovery of materials of unclear provenance, such as the altar with the dedicatory inscription to *Apollini Cumano* by *Q. Tineius Rufus*, as well as the slabs decorated with kithara and birds from the Roman epoch, generated some confusion and brought to recognition the cult of Apollo in the inferior terrace[1611]. Mario Pagano suggested that the temple structure was dedicated to Diana[1612], a hypothesis which also fits well with the orientation of the temple towards the Mt. Tifata. If orientation can be read as embedded of any religious significance, the Kyme acropolis's Inferior Terrace Temple facing towards Mt. Tifata, with the

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[1605] Caputo et al. 1996, 88.
[1606] Vitr. *De Arch.* 4.8.4.
[1607] Marcattili 2017, 706.
[1608] Marcattili 2017, 730–734.
[1609] Camodeca 2012.
[1610] Camodeca 2012, 71.
[1611] Catucci - Jannelli - Sanesi Mastrocinque 2002, 109–119.
[1612] M. Pagano, "L'acropoli di Cuma e l'antro della Sibilla", in M. Gigante (ed. by), *Civiltà dei Campi Flegrei, Atti del Convegno Internazionale (Napoli 1990)*, Napoli 1992: 259–330, 319–322, in Catucci - Jannelli - Sanesi Mastrocinque 2002, 111.

temple of Diana Tifatina and Jupiter Tifatinus, might be coherent with the attribution of the temple to Diana/Artemis or Jupiter. Whatever was the divinity to whom the temple was dedicated, the orientation may put in emphasis a strict cultural relationship between Capua and Kyme.

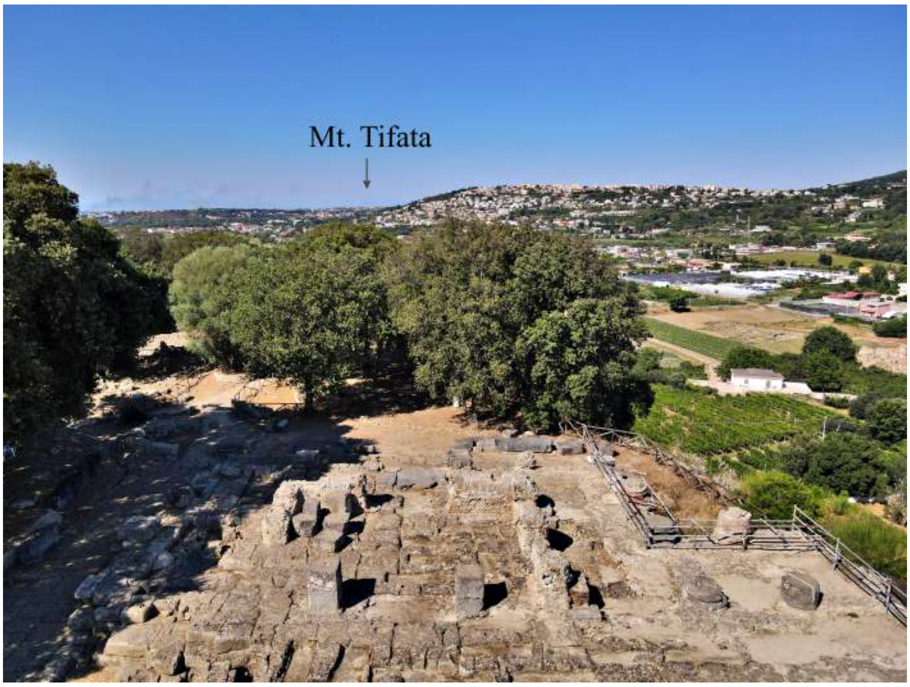

Figure 67. Orientation of Kyme acropolis inferior temple towards Mt. Tifata. Photo from UAV Mavic Mini by the author on 14th July 2022.

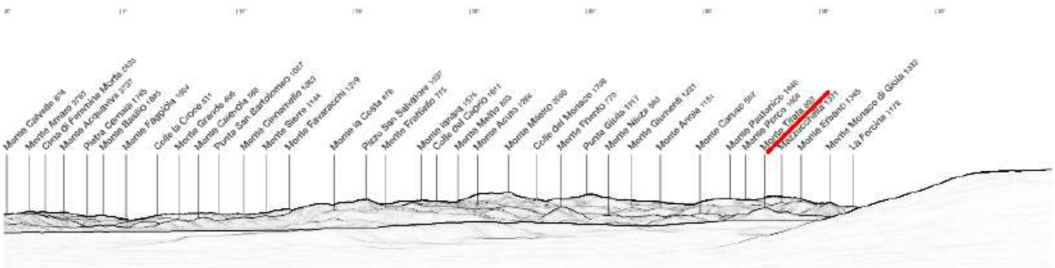

Figure 68. Landscape as seen from the Kyme Inferior Temple terrace towards the north-east and Mt. Tifata underlined in red. From Peak Finder 2022.

Figure 69. The orientation of the Kyme Inferior Terrace Temple in the context of ancient landscape and skyscape. Elaborated by the author with Horizon© ANDREW SMITH 2022.

IX. NEAPOLIS

The Town

Introduction

The history of the town of Neapolis started with the settlement of Parthenope on the Pizzofalcone promontory, including the island of Megaris, during the first half of the 7th cent. BC. Tradition would suggest that this settlement was founded by the Chalcidians from Kyme[1613]. In the last quarter of the 6th cent. BC, a new settlement was founded near this first Greek centre of Parthenope, occupying the area of the modern historical centre[1614]. The new centre was built on a massive plateau facing towards the sea. This plateau was characterised by deep differences in height and delimited by natural canyons. Literary sources are not explicit regarding the foundation of Neapolis nor its relationship with Parthenope[1615]. This was reckoned to be around 470 BC, but recent studies by Daniela Giampaola and Bruno d'Agostino suggest an older date than was previously thought, fixed sometime around 520 BC[1616]. On the basis of the materials recovered at the necropolis of Castelcapuano in relation to the materials connected with the settlement at Parthenope and with the deposit of Chiatamone at Vico Pallonetto at S. Lucia, the scholars suggested that the foundation of Neapolis should be set at some time between the end of the 6th and the beginning of the 5th cent. BC. Moreover, consideration of the recovered materials at the urban walls at Vico S. Domenico Maggiore, S. Aiello a Caponapoli, the complex of S. Marcellino, and Vico Sopramuro provide evidence of diffuse occupation already from the middle of the 6th cent. BC and an increase in population density at the end of the same century[1617].

The Classical Town

Soon after its foundation, Neapolis acquired great political importance due to the impact of the Battle of Kyme on both the Etruscan and Kyme communities[1618]. Neapolis also had a privileged position with Athens, marked by the expedition of the Athenian Diotimo around the middle of the 5th cent. BC[1619]. There was a religious aspect to this political relationship that was guaranteed by the institution of the nocturnal gymnastic agon in honour of the siren Parthenope with a reinvigorated cult with an Athenian imprint[1620]. The economic relationship between the two Mediterranean cities was centred on the supply of wheat from the whole Campanian plain intermediated by Neapolis on its way to Athens[1621]. Moreover, imported opulent vases and red-figure pottery were distributed to the local

1613 MELE 1985a, 103.
1614 GIAMPAOLA - D'AGOSTINO 2005.
1615 MELE 1985a, 103.
1616 GIAMPAOLA - D'AGOSTINO 2005; GRECO 2005, 114.
1617 GIAMPAOLA - D'AGOSTINO 2005.
1618 CERCHIAI 2010b, 96.
1619 MELE 2007a, 259–263.
1620 MELE 2007a, 259–263.
1621 CERCHIAI 2010b, 98.

inland communities, mainly Nola[1622]. Whereas, on the plain, the ethnos of Campanians was progressively shaped amid the violent conquests of towns, in Neapolis the integration of the Italic community was probably achieved more peacefully[1623]. The assimilation of a Campanian nucleus in Neapolis was so complete that some members reached the higher political magistratures. The Neapolitan mint started the issuance of coins with the indigenous community's ethnic names. The co-presence of such a mixed population in this phase of the town is confirmed by the grave goods found at Castel Capuano necropolis[1624].

The Hellenistic Town

In the context of the Samnite Wars, Neapolis first allied with the Samnite Nola and Taranto but, in 327 BC after one year of being besieged by Rome, the town gave up the Samnite alliance to open up a dialogue with Rome[1625]. The alliance was not easy since, in the previous years, the Samnites and Rome had both tried to win support from the cities of the area; the contingent supporting Rome prevailed and, as recounted by Livy, a door into the city was opened in the night allowing the Romans entry. In 326 BC, the *foedus aequum* alliance between Rome and Neapolis was negotiated, with the same dignity and sovereignty being granted to both sides, with agreements based on equity in matters of war and the economy. Neapolis and Rome became *socii navalis*[1626]. It follows that Neapolis continued to use Greek language and its own institutions.

Urban Orientation in Phases

The urban grid of Neapolis is the most important aspect of Neapolitan archaeology[1627]. The town has a regular plan following a Greek *per stringas* layout. The urban layout is mainly defined by three axes, 6 m wide *plateiai*, even if called incorrectly *decumani*, which correspond to the present-day Via Anticaglia, Via Tribunali, and Via San Bagio dei Librai. A series of orthogonal 3 m wide *stenopoi,* which number between 20 and 23 if read according to the modern grid, complement the resulting urban grid [1628]. The *insulae* have dimensions 35 m (120 foot) by 185 m (1 *stadion*) [1629], with a ratio of 1:5[1630]. Rampazzo has pointed out that the metrology of Neapolis' urban layout is similar to that of Selinuntes, Metaponto and Rodi, and also to the agrarian division of Emporion (Spain) and Pharos (Croatia)[1631]. As is common for Classical Greek urban grids, the central *plateia* are wider than the other ones reaching 13 to 16 m in width. The plateau descends towards the coastline, from north-west towards south-east, from the 70 m a.s.l. of Sant'Aniello a Caponapoli to the 15 m a.s.l. of the southern

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[1622] CERCHIAI 2010b, 98.
[1623] CERCHIAI 2010b, 105.
[1624] CERCHIAI 2010b, 106.
[1625] CERCHIAI 2010b, 118–119.
[1626] CERCHIAI 2010b, 119.
[1627] GRECO 2005, 115.
[1628] RUFFO 2011, 120.
[1629] For Herdotus, 1 *stadion* is equivalent to 600 hundred feet, Hdt. 2.149.3.
[1630] GRECO 2005, 115; RUFFO 2011, 120.
[1631] RAMPAZZO 2011, 214.

strongholds facing the coast[1632]. Huge works of terracing and levelling were employed to deal with the differences in altitude[1633]. Several natural canyons on the tuff bedrocks cut through the plateau. The urban wall perimeter can be recognised to its north in the modern Via Foria, to the east at Rampe Maria Longo towards Castel Capuano, to the south following the contours of Corso Umberto until turning at Via Mezzocannone to reach piazza S. Domenico Maggiore, Piazza Bellini, Via Constantinopoli to the west till the acropolis[1634]. In total, the urban wall measured 3.5 km[1635]. Two phases of the urban walls can be recognised, but following the same circuit: the first datable to the first half of the 5th cent. BC, and the second one century later to the end of the 4th cent. BC to reinforce the earlier one[1636]. The common explanation for Neapolis' orientation is that the urban grid was set parallel to the coastline[1637]. According to Ruffo, *plateiai* are assumed to be parallel to the coast[1638], even though this statement does not reflect the neat line of the sea in his figure[1639]. The coastline was recently reconstructed by Daniela Giampaola for various historical phases (fig. 70)[1640].

1632 GRECO 1994, 36.
1633 SOMMELLA 1991, 166.
1634 GRECO 2005, 114.
1635 GRECO 2005, 115.
1636 GIAMPAOLA 1996; GRECO 2005, 114–115.
1637 GRECO 2005, 112.
1638 RUFFO 2011, 120.
1639 Note the neat line of the sea traced in RUFFO 2011, p. 121.
1640 GIAMPAOLA ET AL. 2005, 48; GIAMPAOLA 2009, 38; See also Daniela Giampola, Ugo Carughi (eds.) *Napoli: la città e il mare. Piazza Bovio: tra Romani e Bizantini*, Napoli-Milano, 2010.

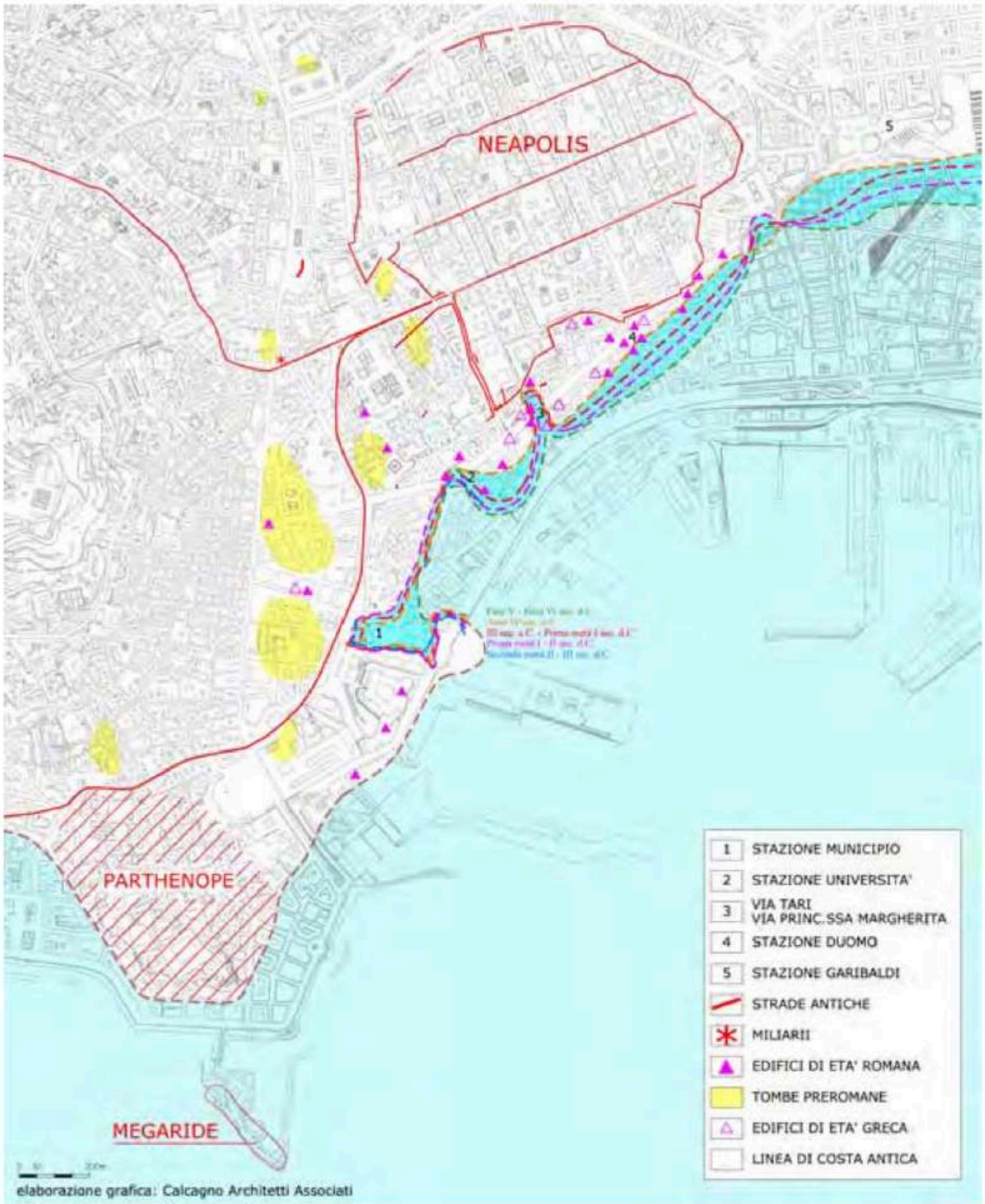

Figure 70. Reconstruction of the coastline from the town's foundation to Late Antiquity by GIAMPAOLA 2009, 38.

Here again, the orientation of the *plateiai* does not seems to strictly follow the coastline, but rather they appear adapted to the coastline and the local slope[1641]. Therefore, it is appropriate to investigate other factors that might have determined Neapolis' urban grid orientation. Indeed, a precise geometrical, theoretical, and practical plan can be read in the Neapolitan division of space[1642]. For a long time, this has been investigated in a tradition of studies on Neapolis urbanism in relationship to

[1641] HAMBERG 1965, 114.
[1642] GRECO 2005, 112.

Vitruvius' ideal city[1643]. Namely, Per Gustaf Hamberg studied Fra Giocondo of Verona's (1433–1515) illustrations on Vitruvius' theories on city planning taking account of winds[1644]. Hamberg recalled the classical method of using the gnomon to find the meridian line which, as further discussed here, seems to have been the fundamental line used for Neapolis' urban planning (fig. 71 above)[1645]. On a circle traced in the soil, the intersection with the shadow of the central gnomon was marked for before and after midday: «[t]he meridian will be found exactly halfway between the two marks and the land-surveyor has fixed the north and the south cardinal points of the compass»[1646]. The next step, for Hamberg, is that the land surveyors divided the circle into 16 parts, creating first an octagon using cords aligned to the cardinal points: in this way, the deviation of 22.5° from the cardinal orientation can be drawn[1647].

Fausto Longo and Teresa Tauro suggested a geometrical design for Neapolis urban layout based upon the circle and the square. In the central area of the town where the *agora*/forum was situated, a quadrangular figure can be traced, with the central point fixed on the Dioscuri temple[1648]. According to Longo and Tauro, this square might have been created by the land surveyors from S. Martino hill, which is a sight directly in line with the southern *plateia*. The next step is the division into a golden section of the southern *plateia* and the geometrical construction of the grid with square and compass, to mark Porta Furcilennsis, at the eastern limit of the town[1649]. Also, Nicola Scafetta and Adriano Mazzarella attempted the problem, assuming that « Sant'Elmo was a main geographical point of reference»[1650], even though there are no archaeological data confirming Greek frequentation on the hill. Longo and Tauro interpretation can explain the inner morphology of the town and proved archaeologically the geometrical intentions of the builders, even though this does not give a reason behind the choice of Neapolis *plateiai* orientation.

Returning to Hamberg and Fra Giocondo, it is important to note that the original line used in the creation of the Neapolis grid is the meridian line, probably passing through the centre of the town at the temple of Dioscuri. There are many possible scenarios as to how Greek land surveyors in the 6th–5th cent. BC might have used a geometric plan to create an organised urban layout. Of these, the first is the creation of an octagon and the setting of the gnomon obliquely, joining together two not subsequent vertices (fig. 71, above). As an alternative, it is reasonable to suggest that the use of a Pythagorean triangle of proportions 5:12:13 could have been used to determine the orientation of Neapolis (fig. 71, below). The orientation (azimuth) does not seem similar to Herculaneum's orientation, as has been previously affirmed[1651]: in the case of the Neapolis *plateai*, these have east-west axes where the azimuth is 66° whereas, at Herculaneaum, the axes are *circa* 60°. For the north-

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[1643] For a summary on the topic see Longo - Tauro 2016, p. 199.
[1644] Hamberg 1965.
[1645] Hamberg 1965, 116.
[1646] Hamberg 1965, 116.
[1647] Hamberg 1965, 116.
[1648] Longo - Tauro 2016, 201–204.
[1649] Longo - Tauro 2016, 208–209.
[1650] Scafetta - Mazzarella 2019, 33.
[1651] Pappalardo - Ciardiello 2005, 107.

south axes, the orientation of the streets in Neapolis is similar to that in *Regio VI* at Pompei, circa 334°/154°, as reflected in the same orientation shared by temple of Apollo at Pompeii and the temple of Dioscuri at Neapolis (fig. 75).

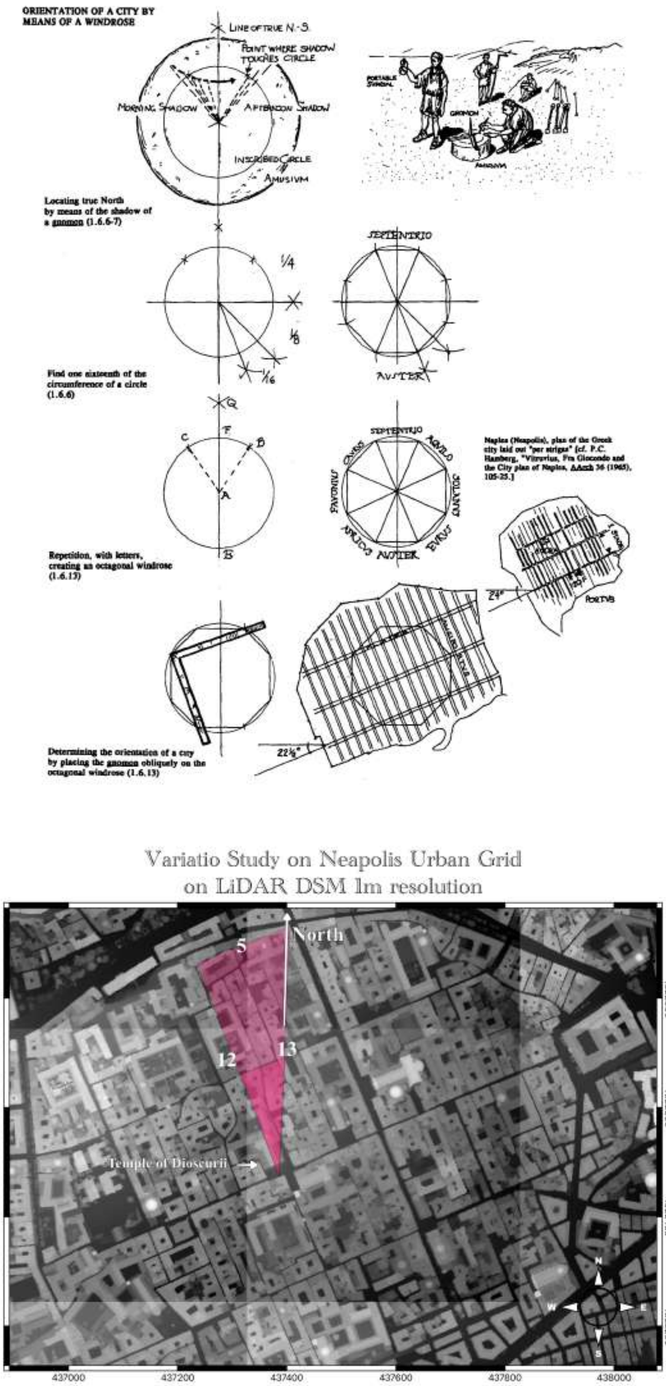

Figure 71. Above, the orientation of a city by means of a wind rose as described by Vitruvius (*De Arch.* 1.6.6–13), illustrated by Thomas Noble Howe in ROWLAND - HOWE 1999, 168. Below, Digital Surface Model of Neapolis (LiDAR 1m resolution) with superposition of the Pythagorean triangle 5:12:13 as possible alternative geometrical explanation for Neapolis's orientation. Elaborated by the author.

Table 18

Phase	Data	Reference System	Data Source	Azimuth
6^{th}–5^{th} cent. BC	66°	Geographic	LiDAR DSM 1m	66°

Skyscape Analysis of the Urban Grid

At that direction of 66° azimuth, the sun rose around 40 days before and after the summer solstice above the Partenio Mountains, specifically above Mt. Croce di Puntone 37 km away (with a height of 1495 m). At the time before the summer solstice, the sun rose within the constellation of Taurus, with its stars of the Pleaides also in their heliacal rising and visible just for a short time before dawn (figs. 72–74).

Figure 72. Landscape and skyscape visibility from Neapolis in line with the urban axes. Elaborated by the author with Horizon© ANDREW SMITH 2022. See Plate IX.

Table 19

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
pleateiai	E	500 BC	40.85	66	2.1	+19.36	Partenio Mountains, Mt. Croce di Puntone (37 km far)	sun rising 40 days before/after summer solstice
pleateiai	W	500 BC	40.85	246	6.3	-13.53	St. Elmo hill (1.7 km far)	Rigel setting (δ = -13.5°)
stenopoi	N	500 BC	40.85	336	3.3	+46.68	(2.3 km far)	
stenopoi	S	500 BC	40.85	156	0.8	-42.99	Mt. Lattari (29 km far)	Gacrux raising (δ =-43°.4)

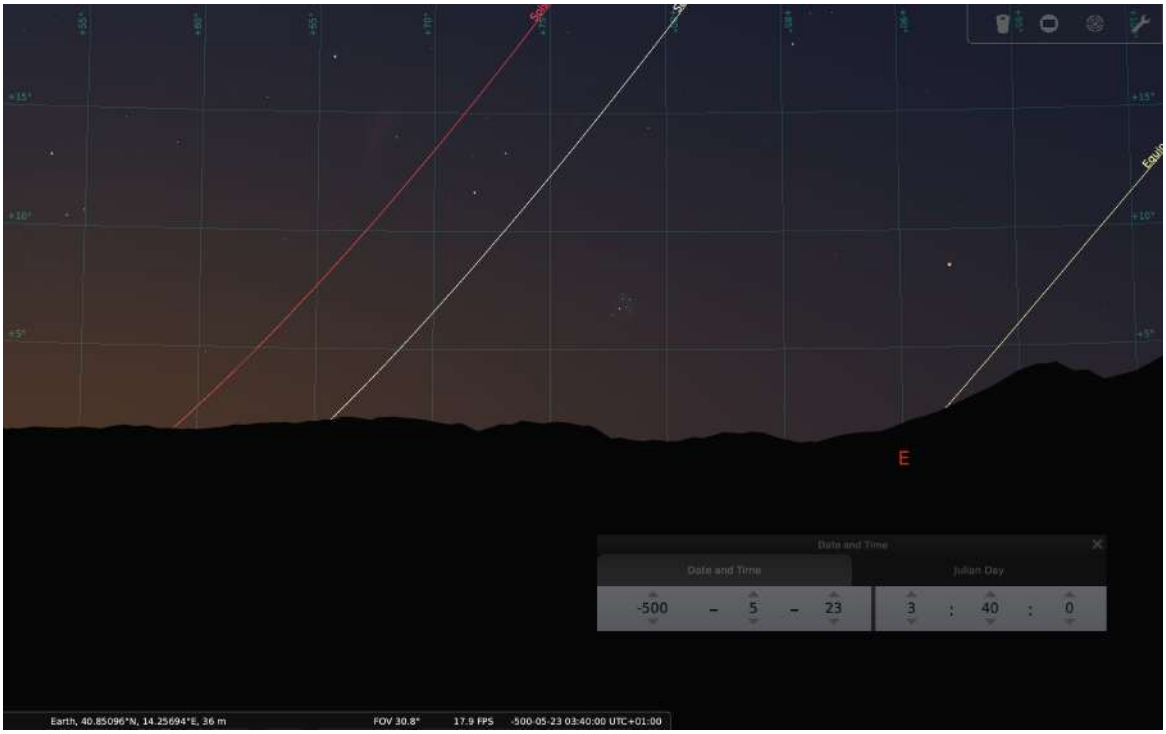

Figure 73. The sun (yellow line) rising aligned with Neapolis urban axis at the time of the heliacal rising of the Pleiades. Elaborated by the author after Stellarium V.22.2 and PeakFinder local landscape.

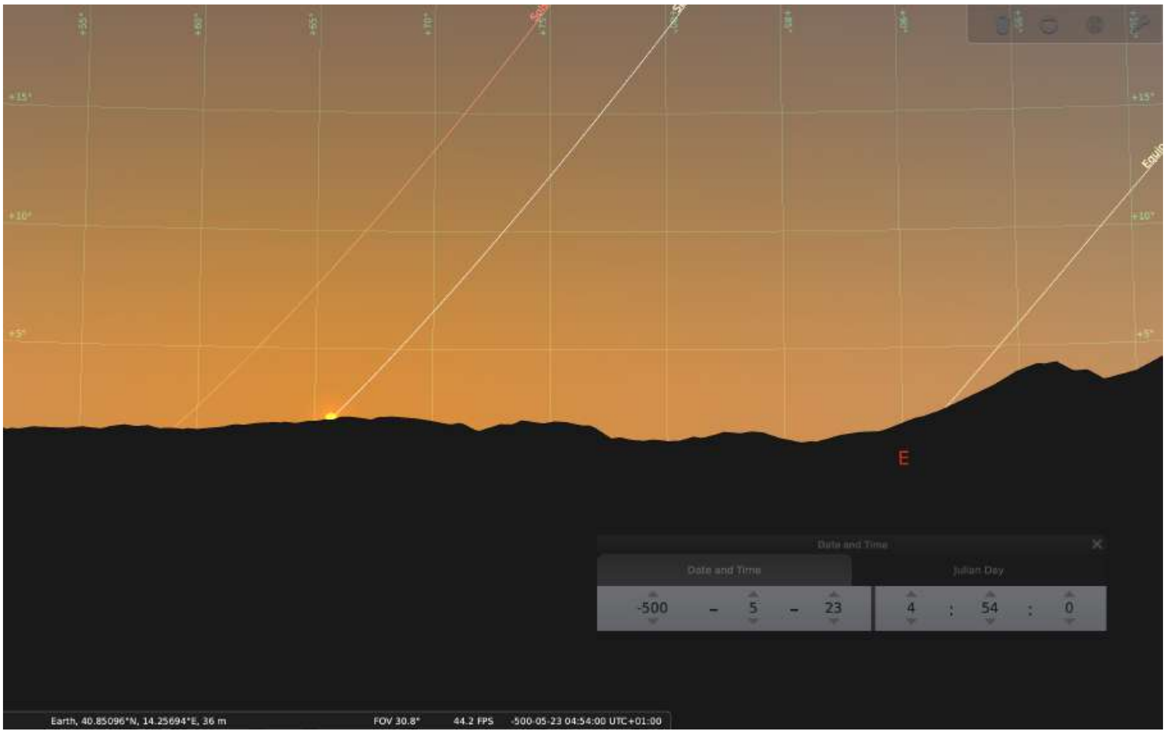

Figure 74. The sun rising above the Partenio Mountains in alignment with Neapolis urban axis just after the heliacal rising of the Pleiades. Elaborated by the author after Stellarium V.22.2 and PeakFinder local landscape.

The Acropolis

In the literary sources, Apollo, Demeter, and the Dioscuri were considered the polyadic gods of Neapolis by Statius (1 cent. AD), together with the siren Parthenope[1652]. If for Apollo and Parthenope there are not archaeological evidence, for Demeter and the Dioscuri there are attestations of the cult[1653]. On the north-western side the inhabited plateau the hill of Sant'Aniello a Caponapoli several votive objects (5th–3rd cent. BC) related to the sphere of Demeter were recovered. There, the acropolis of the Greek city was situated. The acropolis was delimited by the modern Via Foria to the north and Via Costantinopoli to the west. At the church of Sant'Aniello a Caponapoli and underneath the adjacent Villa Chiara, archaeological evidenced of structures of a wall from the 5th cent. BC were recovered, plus a 4th cent. wall reinforcement. At San Gaudioso convent (now the Symptomatologic Medical clinic) the acropolis sanctuary must have existed, probably dedicated to Demeter as suggested by a votive deposit with terracotta pieces pertinent to a chronology between 5th and the 3rd cent. BC. According to a passage from Statius, the *polis* goddess of Neapolis was Demeter *Actaea*. It had an Eleusinian character, probably including an initiation ritual[1654]. The rite was a silent nocturnal torch race for women '*mystae*' and men '*taciti*'. According to Alfonso Mele, the two cults of Demetra present at Neapolis should not be confounded[1655]. The former cult of Demetra *Actaea* is an archegetes cult deriving from an Attic-Eretria tradition. The archegetes nature of this cult of Demetra is related at Neapolis to the cult of Parthenope, the siren, which had a cereal connotation and involved a torch race procession. The other cult of is Demetra *Thesmophoros*, which is attested epigraphically, has a Thessalian-Aeolic matrix and is related to the importance of the Eumelides phratry[1656]. Demeter *Thesmophoros*, of *thesmoi* as *nomoi*, was only for women and had to do with the legitim offspring of the polis. Demeter *Actaea* was thus in a dialectic opposition with Demeter *Thesmophoros*. Unfortunately, the lack of a full picture of the possible topography of a sanctuary prevent any further skyscape analysis of this site.

The Siren Parthenope Cult

The cult of the siren Parthenope is strongly related to the city of Neapolis as a polyadic religion[1657]. Parthenope, as siren, is the eponym of a whole city, becoming its grantee and polyadic divinity. Elisabetta Moro described sirens are generatrix of towns, especially for the case study of Neapolis: the death and cult on the tomb of the siren Parthenope guarantee the life of the town of Neapolis[1658]. The cult of the sirens in the *Krater*, the ancient name for what came to be called the Gulf of Cuma and, then, the Gulf of Neapolis, can be dated back to the 7th cent. BC[1659]. In the numismatic evidence,

[1652] Stat. *Silv.* IV.8.45-51.
[1653] GIAMPAOLA 1994, 63.
[1654] GIANGIULIO 1985.
[1655] MELE 1985b, 157.
[1656] Stat. *Silv.* IV.8.45-51.
[1657] MELE 2014, 159.
[1658] MORO 2005; 2019.
[1659] MELE 2014, 235.

the coins showing the head of Parthenope and the front-facing bull are now seen by scholars as indicators of self-representation and of the stability of the political institutions in the city. These were in continuous supply from the end of the 5th cent. BC but without reference to Athens. The symbol of a young woman carrying a torch appears in the series of coins from around 326-310 BC. The presence of this symbol served as a system of control in the coins' production but was also an institutional celebration of the city's foundation, which was provided by showing the institutional significance of the torch-race procession. Indeed, a ritual torch race, *Lampadodromia*, took place annually in Neapolis in honour of the siren Parthenope, after being renovated by the Athenian navarch Diotimo. This rite may have continued though the Imperial Age, when the Isolimpic games were held at Neapolis every five years. These were called *Sebastà* and were probably celebrated around the *dies natalis* of Augustus, which occurred on the 23rd of September[1660]. Mele suggests that the Neapolitan lampadodromia took place in the month when the temple of Parthenope was adorned with the harvested wheat sheaf[1661].

According to Alfonso Mele, the sirens were divinities that were typically of interest to communities divided into different age groups and interested in the natural cycles[1662]. They have domain over the passage rite into adulthood, as well as over ritual and physical death. Thus, Mele emphasised Parthenope's correlation with *parthenìa*, explicit in the first part of her name and that describes the status of young women and girls within a precise age group: the *parthenos* is antecedent to marriage and motherhood. For this reason, this status is fully integrated within a ritual of passage: after her symbolic death, she is reborn as wife and mother. Parthenope's relationship with the fertility and cereals cultivation is affirmed in later literature[1663]. According to Maurizio Giangiulio, the sirens also had domain over the natural forces affecting navigation, such as meteorological events and, primarily, the wind[1664]. This is described in the Homeric episode about the sirens and a becalmed voyage[1665].

Sirens may show a superposition with the stars of the asterism of the Pleiades[1666]. Sirens and Pleiades are both related to agricultural cycles and to the dangerousness of navigation, they both are virgins with bird-like form, delving into the sea through a *kataponsismos*, thus assuming the fish-like characteristics. Sirens are transformed into white rocks when they died thrown into the sea[1667], for Maurizio Giangiulio this indicates some natural targets used as reference points during navigation[1668]. Stars were seen setting into the stream of Ocean in the west, somehow re-acting the ritual of the torches drawn in the water during the *Lampadodromia*. The lack of any topographical evidence on

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1660 ZEVI ET AL. 2008, 313.
1661 MELE 2007a, 261–262.
1662 MELE 2014, 242.
1663 MELE 2014, p. 159; Dionys. Per. 357-359; Prisc. *Perieg*. 351-353.
1664 GIANGIULIO 1985, 127.
1665 Hom. *Od.* XII, 168-169.
1666 MOLINA MORENO 2013.
1667 GIANGIULIO 1985, 128–130.
1668 GIANGIULIO 1985, 69.

the cult of the siren Parthenope at Neapolis prevent any further consideration in this sense for the moment.

The Temple of Dioscuri

Two residual columns at San Paolo Maggiore are probably remnants of the Roman temple of Dioscuri, which was built in the 1st cent. AD in the forum[1669]. It is possible that the Roman cult was an elaboration of an earlier Greek one[1670]. Tuff blocks were uncovered below the first Imperial age structure, although of uncertain chronology[1671]. The temple was probably situated in the Greek *agorà*, a public civic space where the theatre and the *odeion* might also have been located[1672]. The temple's dedication was to the Dioscuri, but also to the *Polis*, which can be identified with Parthenope herself[1673]. The Dioscuri each lived and died over one day, representing the universal harmony of the cycle of days and nights according to Pythagorean doctrine[1674], and as recalled by the Augustan ideology of *optimus princeps* that describes a restored harmony[1675]. It is worth noting that the orientation of the Temple of Dioscuri of 155° azimuth is very similar to that of the Temple of Apollo at Pompei of 154.5° azimuth (fig. 75). There are no astral events in that direction worth mentioning, but both temples fit within the urban grid: they both are placed in the central public area, at the centre of the towns' life. The iso-orientation between Neapolis' and Pompei's main temples is worth further investigation.

[1669] MUSCETTOLA 1985, 196.
[1670] GIAMPAOLA 1994, 64.
[1671] GIAMPAOLA 1994, 64.
[1672] GIAMPAOLA 1994, 65.
[1673] MUSCETTOLA 1985, 200.
[1674] MUSCETTOLA 1985, p. 203-204.
[1675] GIAMPAOLA 1994, 64.

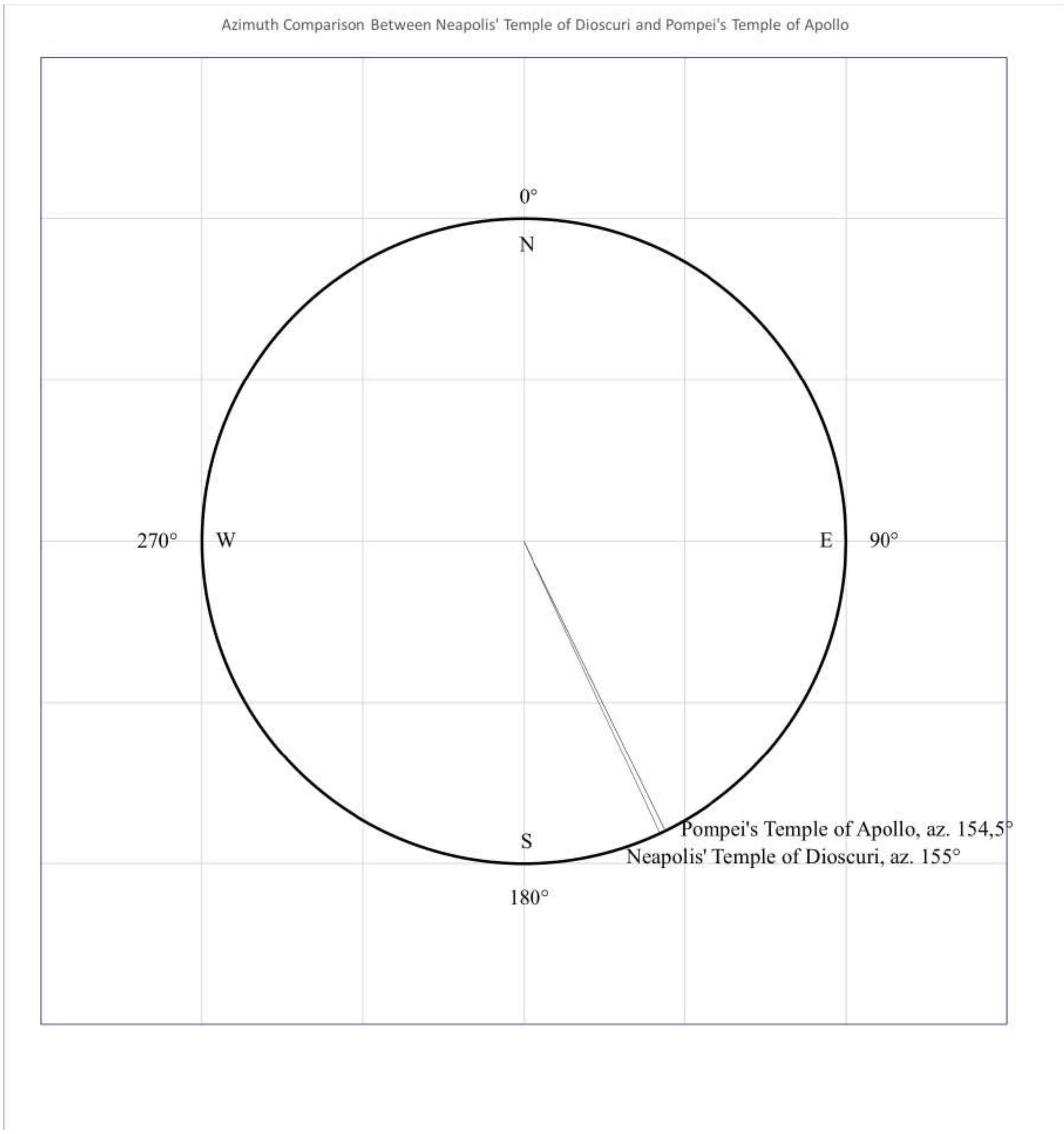

Figure 75. Azimuth Comparison Between Neapolis' Temple of Dioscuri and Pompei's Temple of Apollo. Elaborated by the author.

X. HERCULANEUM

Introduction

The urban settlement of Herculaneum covers an area of about twelve hectares, five of which have been excavated. The recovered parts of the site mainly consist of private residences[1676]. Werner Johannowsky has suggested that the forum and other public buildings could well be located in the area not yet excavated[1677]. In extent, it is approximately a fifth of the size of nearby Pompei, though the actual size of the settlement at Herculaneum is in some doubt. As with Pompei, Hercules was the mythical founder of the town as reported by Dionysius of Halicarnassus[1678]. According to Domenico Camardo and Sarah Court, there appears to have been a stable settlement in the area from the 3rd–2nd cent. BC, but not earlier[1679]. Evidence of a prior Archaic phase in Herculaneum is lacking, though some frequentation of the site has been confirmed as having occurred from the 5th cent. BC, with more evidence from the 4th cent. BC[1680]. A Nucerian *ethnos* is substantiated from the end of the 4th cent. BC in Herculaneum, Pompei, Stabiae, and Surrentum. After the Second Samnite War, Nuceria was conquered by the Romans in 308 BC, when Herculaneum was also occupied by the Romans. The Oscan identity of the city remained in place for a long time, even after the Roman occupation.

Urban Orientation in Phases

The urban grid of Herculaneum is regular and mainly orthogonal. The orientation (azimuth) is similar to Pompei's; it does not seem particularly similar to Neapolis' orientation as has been affirmed[1681]. According to Johannowsky, although the date for the urban arrangement of Herculaneum is not known, a comparison with the 5th–4th cent. BC Atella's grid suggests a Greek style of urbanism was employed in this location, differing from the 'astronomical' orientation typical of the Etruscan Campanian towns[1682]. In his words, «l'abitato, a pianta molto simile, di Atella, come ad Ercolano, non abbiamo l'orientamento astronomico tipico delle città campane che risalgono al periodo dell'egemonia etrusca ma un orientamento analogo a impianti greci relativamente recenti, come quello di Neapolis, dove gli στενοποί sono normali alla costa»[1683]. In total, three north-south axes (in Herculaneum these are usually referred to as '*decumani*') and five east-west ones (traditionally referred to as '*cardi*') can be recognised in the urban grid of the town. The 18th cent. AD explorations during a period when Napoli was controlled by the Bourbons suggest the presence of the third *decumanus* on the north-east side of the town, and two *cardines* towards *Neapolis*, for a total of sixteen *insulae*. The *insulae* measured 150 x 300 feet divided into areas of 30 x 75 feet with respect

1676 CAMARDO - COURT 2013, 1.
1677 JOHANNOWSKY 1982, 147.
1678 Dion. Hal. *Ant. Rom.* 1.35.
1679 CAMARDO - COURT 2013, 2.
1680 PAGANO 1990, 125–128; WALLACE-HADRILL 2012, 94; CAMARDO - COURT 2013, 2; GUZZO 2016, 88.
1681 PAPPALARDO - CIARDIELLO 2005, 107.
1682 JOHANNOWSKY 1982, 149; n.18.
1683 JOHANNOWSKY 1982, 149; n.18.

to the Attic-Chalcidian foot which, for Johannowsky, is the unit of measurement which correlates the best with the Herculaneum urban grid[1684]. Regarding the known *insulae*, these tend to get wider from east to west, which can be explained when considering the natural cliff present to the south[1685]. The urban plan is not perfectly orthogonal. For instance, on the south side, near the *palestra*, the *decumanus inferior* is not orthogonal with the streets that cross it[1686]. The orientation of the town may have followed the natural slope of the terrain[1687]. The tuff plateau on which Herculaneum was built was subjected to modification, since it was used as a source of construction materials in ancient times, and the terrace directly facing the sea was reconfigured. The original ancient coastline was modelled by Aldo Cinque and Giolinda Irollo, and this work indicated that there had been several alterations of the coastal landscape in front of the settlement[1688]. It is worth noticing the differing orientation of Villa dei Papiri, which can be telling for the study of the disposition of buildings along the coastline[1689].

Table 20

Phase	Data	Reference System	Data Source	Azimuth
4th–3rd cent. BC	60°	Geographic	LiDAR DSM 1m	60°

Skyscape Analysis of the Urban Grid

Herculaneum and Pompei do have the same orientation in terms of their east-west urban axes. However, the streets of Herculaneum and Pompei do not share the same declination value; this is due to the fact that Mt. Somma-Vesuvius are higher on the horizon (~8° altitude) than Monte Torrenone-Faitaldo (~2°–3° altitude). Therefore, the declination values are different. In Pompei, the rising midsummer sun is clearly visible in line with the streets, although with a slight divergence especially for Via di Nola, but in Herculaneum it is not. Indeed, a view of the midsummer sun rising above Mt. Somma-Vesuvius is delayed by the peak; when the sun appears, it is a few degrees south in relation to the orientation of the urban grid (fig. 76). By contrast, the winter solstice sunset visible out to sea is very neatly in line with the east-west urban axes of Herculaneum (fig. 77).

Figure 76. Landscape and skyscape visibility from Herculaneum in line with the urban axes. Elaborated by the author with Horizon© Andrew Smith 2022. See Plate X.

[1684] Johannowsky 1982, 148.
[1685] Johannowsky 1982, 148.
[1686] Johannowsky 1982, 148.
[1687] Camardo - Court 2013, 2.
[1688] Cinque - Irollo 2008, 431–437.
[1689] De Simone - Ruffo 2017.

Table 21

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
	E	300 BC	40.81	60	8.6?	?	Volcanic Complex Mt. Somma-Vesuvius (6.9 km far)	summer solstice sunrise?
	W	300 BC	40.81	240	0	-22.24	sea	winter solstice sunset
	N	300 BC	40.81	325	3.9	+41.53	(0.2 km far)	
	S	300 BC	40.81	145	3.2	-35.63	Mt. Lattari - Mt. Cerasulo (22 km far)	

Figure 77. Winter solstice sunset in line with Herculaneum's urban axis. Photo by the author 18th December 2021.

Reconstructing the Ancient Skyline

An analysis of Herculaneum's urban orientation in relation to the position of the sun has to be considered strictly in the context of the shape of the ancient skyline. In the north-east direction that aligns with the *decumani*, the Somma-Vesuvius complex is imposing on the skyline. Mt. Somma and Mt. Vesuvius belong to the same volcanic complex, the Somma-Vesuvius complex, consisting of an older volcano, Mt. Somma, embracing in its caldera a recent cone, Mt. Vesuvius, which arose during the AD 79 eruption[1690]. For the present analysis, as has been said, a fundamental issue is to determine the dimensions and shape of the volcano before the eruption in AD 79 (figs. 78-79). Girolamo Ferdinando De Simone has analysed this issue from an archaeological perspective, in parallel with the work of volcanologists[1691]. According to De Simone, «the different shape and dimensions of the volcano affect the distribution of the waters and the surface for exploitation, and therefore the settlement pattern», suggesting a further need to analyse this issue[1692]. One piece of evidence comes from the lararium of the *Casa del Centenario* at Pompei, where the god Dionysus is depicted on the slope of Vesuvius[1693]. In addition to this fresco, antiquarian research has focused on other similar figurations of the shape of the volcano before AD 79, and this has become a popular research topic in Pompeian studies[1694]. The idea developed of there having been a pre-AD 79, one-peak conic volcano. However, in antiquity, landscape painters were not particularly interested in achieving realistic depictions of a view[1695]. Indeed, according to De Simone, the peak in the afore-mentioned fresco should be understood as simply portraying the epiphany of the god Dionysus and not as a precise delineation of the mountain[1696]. However, a number of literary sources mention Mt. Vesuvius[1697]. The last of these witnessed the eruption in AD 203, describing its shape then as like that of a gigantic amphitheatre. According to De Simone and his reading of the sources, this ancient description best fits with a caldera volcano, having the shape of a cauldron, than with a single cone[1698]. Antonio Scherillo noticed two ellipses depicted on the slope of the mountain in the *Casa del Centenario* fresco, in the shape of the number eight, suggesting a similarity with the caldera volcano of Mt. Vulture in Lucania[1699]. From a volcanological perspective, the shape of the pre-eruption Somma-Vesuvius complex is still unclear. Recently Raffaello Cioni *et al.* suggested it was a caldera volcano[1700]. According to De Simone and Cioni's independent studies, Mt. Somma was already present before AD 79, with the rim higher on the north side. The asymmetrical shape is due to the westward collapse of an original cone 1600–1900m high, leaving a higher rim on its north-east

[1690] CIONI - SANTACROCE - SBRANA 1999, 207.
[1691] DE SIMONE 2016, 24–25.
[1692] DE SIMONE 2014, 201.
[1693] DE SIMONE 2011, 298–290.
[1694] RENNA 1992, 38–49.
[1695] GUZZO 2011; DE SIMONE 2011, 292.
[1696] DE SIMONE 2011, 292.
[1697] Strabo 5.4.8; Plut. *Vit. Crass.* 9; Flor. 2.8.13; Cass. Dio 77.2.
[1698] DE SIMONE 2014, 2002.
[1699] SCHERILLO 1982, 950.
[1700] CIONI - SANTACROCE - SBRANA 1999.

side[1701]. As stated, Mt. Vesuvius arose with the AD 79 eruption; it then displayed a periodic raising and collapsing of its peak in the centuries after.

From the data available, the angular elevation in the sightline of Herculaneum's axes can be roughly estimated. Indeed, towards the north-east, Herculaneum's urban axes are oriented with an azimuth of circa 60° and pointed towards the northern ridge of the Mt. Somma caldera. According to Cioni *et al.*, from the ca. 3400 BC Avellino Pumice eruption to before the AD 79 Pompei Pumice eruption, the northern ridge of Mt. Somma was 1200 m high[1702]. While, nowadays, the axes are directed towards the peak known as Cognoli di Sant'Anastasia, in the second half of the 1st millennium BC, the altitude above sea level of the ridge was around 1000 m high so that, at a distance of 7 km from Herculaneum, the angular elevation would have been about 8°. The sun would have been visible in line with the street only if the angular elevation of the local profile was about 3°, which would correspond, at the same distance, to an altitude above sea level of about 400 m. In summary, it is improbable that the rising sun would have been used as a target for setting Herculaneum urban axis, as appear evident in Pompei. Nevertheless, the winter solstice setting sun is in perfect line with the Herculaneum urban axis (fig. 77).

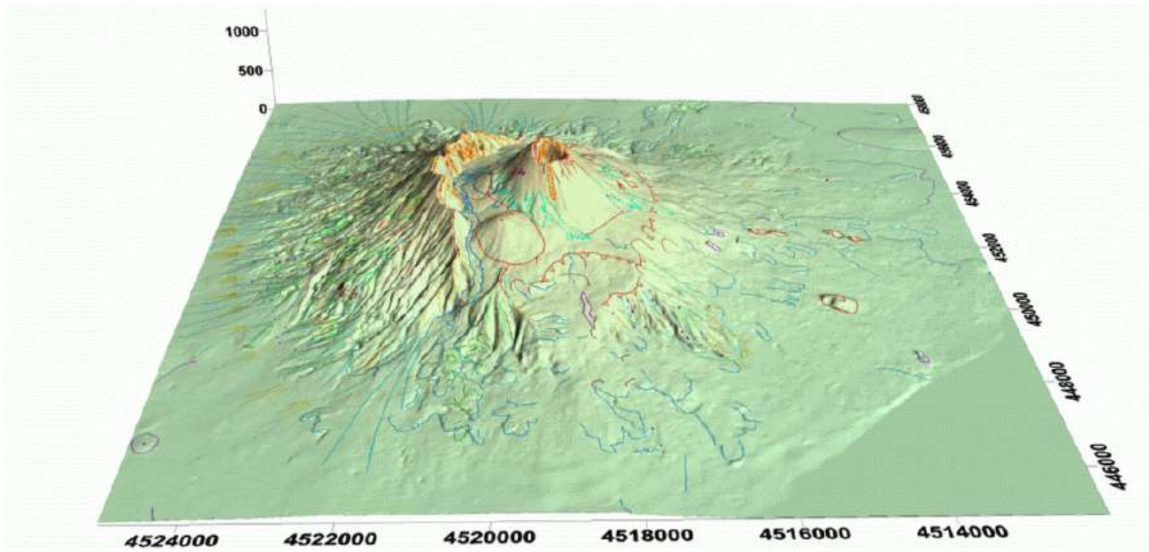

Figure 78. Present day Mt. Somma-Vesuvius 3D model. From ipf.ingv.it[1703].

[1701] CIONI - SANTACROCE - SBRANA 1999, 209.
[1702] CIONI - SANTACROCE - SBRANA 1999, 219.
[1703] http://ipf.ov.ingv.it/MorphoVesuvio_web/gallery/MorphoVesuvio_file/Gallery/Ves_Gallery.htm [accessed December 2021]

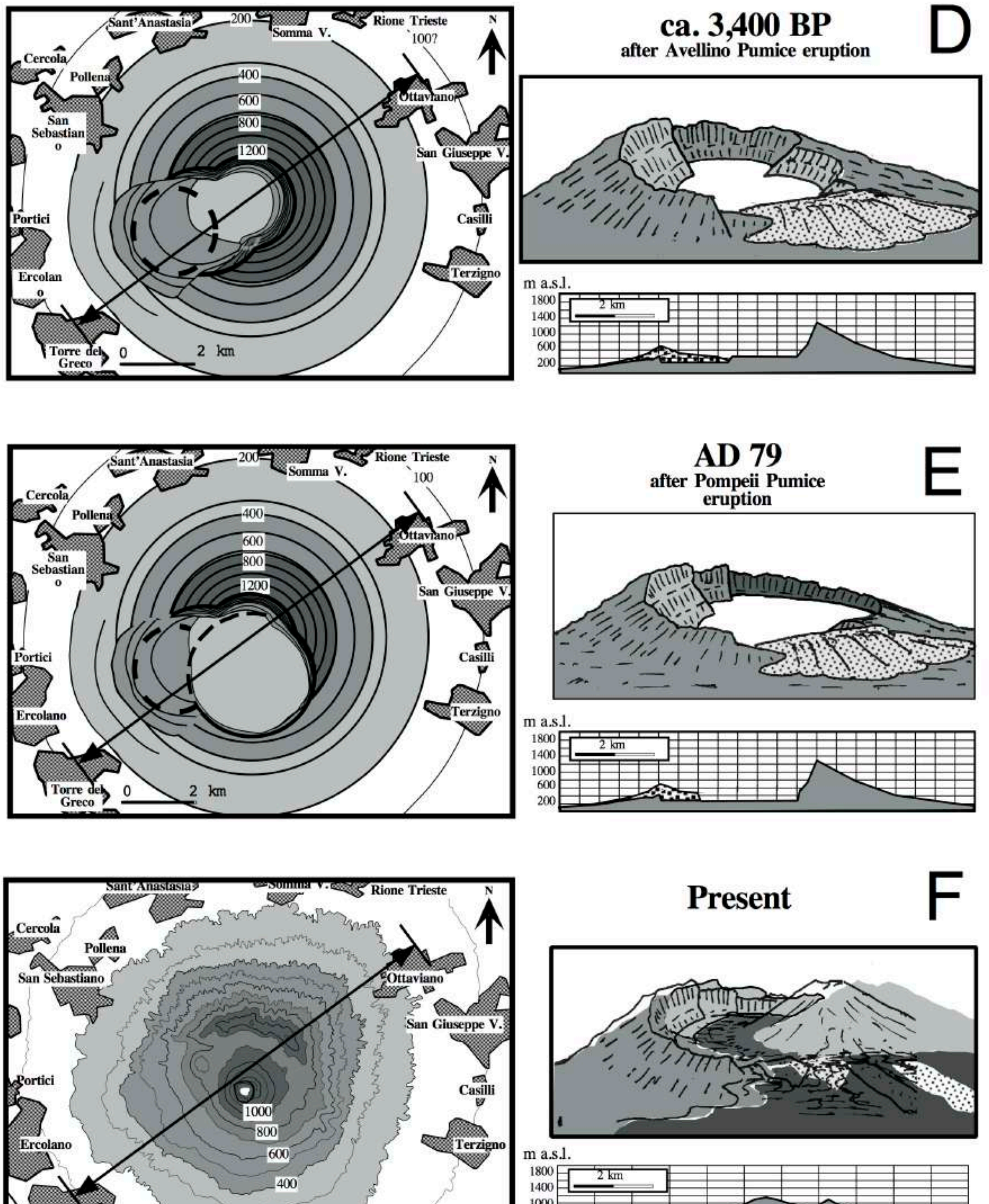

Figure 79. Morphological evolution of the Somma-Vesuvius complex considering Avellino Pumice Eruption (D), Pompei Pumice Eruption (E) and present day (F). After CIONI - SANTACROCE - SBRANA 1999, 2019.

XI. POMPEI

The Town

Introduction

There is no clear agreement about which population founded Pompei. Strabo recounts that the Opici and the Ausones, italic people of the Latino-Faliscan group, were the first inhabitants of the area; later, the city was occupied by Oscans, Cumaens, Samnites, and Romans[1704]. The lack of certainty about the original inhabitants is also attributable to the fact that the pre-Roman town has only been excavated in small pockets. From an archaeological perspective, in the whole area around Pompei, as in the Sarno Valley, funerary materials have revealed a strongly Etruscan character in the indigenous social communities in the first part of the 6th century BC[1705]. Indeed, very few Greek epigraphs were found in the Archaic, Classical, and Hellenistic periods [1706]. What is frequent is pottery in imitation of Greek styles, showing «clear signs of influence of acculturation deriving from contact with the Greek colonists of Cumae»[1707]. Pompei came into being as a result of a cultural, economic, and social transformation which happened in the area starting from the 7th–6th cent. BC, as evidenced by new forms of craft specialisation, imported materials, exchange routes, the co-existence of different alphabets, and the rise of the urban centres of Nocera and Stabiae[1708]. Cristofani summarised that «between the coast and the inland area through which the river Sarno runs, there emerges a sort of ethnic pluralism of literate classes who were presumably involved in a system of reciprocal hospitality»[1709].

The Archaic Town

It is possible to detect an Archaic-phase plan for Pompei based on limited archaeological finds, such as pottery fragments and foundation building materials in use in that period. For example, the presence of a specific building material called 'pappamonte', a soft dark-grey tuff-like stone used in the archaic period, is an eloquent indicator of this phase[1710]. A higher concentration of Archaic fragments was found in *Regio VII*, around the Temple of Apollo, the Basilica, and the Forum; in *Regio VIII,* mostly at the Doric Temple and the Ganymede's House; and in *Regio VI*, such as at the Houses of the Faun, the Large Fountain, and the Etruscan Column[1711]. In several of the archaeological excavations, parts of a city wall in pappamonte were uncovered; this would have run along the full perimeter, embracing the whole area of 66 hectares[1712]. This discovery put in question an initial

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1704 Strabo, V, 4, 3-8.
1705 FRANCIOSI 2009, 2.
1706 FRANCIOSI 2009, 2; OSANNA - RESCIGNO 2021, 220–221.
1707 CRISTOFANI 2009, 23.
1708 CRISTOFANI 2009, 20–24.
1709 CRISTOFANI 2009, 24.
1710 CRISTOFANI 2009, 26; AVAGLIANO 2018, 124.
1711 CRISTOFANI 2009, 25.
1712 DE CARO 1985, 75–79; 1992.

interpretation which reckoned that the city, then called the *Altstadt*, extended over a small area of 9 hectares in what is now recognised to be just the south-west corner of Pompei, prior to the later *Neustadt,* extending across the whole area of the city[1713]. After a re-examination of the data of recovered pappamonte wall sections described by Amedeo Maiuri[1714], and an assessment of new excavations carried out around the perimeter, Stefano De Caro hypothesised a whole city wall datable to the middle or first half of the 6th century BC[1715]. At the beginning of the 5th century BC, a stronger stone of white travertine, mined from the Sarno Valley, was added to the wall in an orthostatic and double barrage layout, probably attributable to the Etruscan phase of the city[1716]. The historical evolution of the city layout has been a matter of lengthy debate[1717]. Such diachronic evolution is greatly dictated by the interrelation between the outer wall and the urban street system. Therefore, the currently accepted theory for Archaic Pompei is that the whole 66-hectare area was occupied and urbanised and encircled within a wall but with few buildings and with a public area concentrated in the south-west corner, with much of the space dedicated to agricultural and rural activities[1718]. Recently, Alessandra Avagliano mapped the fragmentary archaeological remains of the archaic phase of Pompei, but some locations and orientations remain approximate[1719].

The Classical Town

There followed a period of low activity in the city, known as a hiatus. For approximately one and half centuries, Pompei became somewhat quiescent in terms of the vitality of the town. However, the site had to face the changes happening in the gulf, with the Greek-Etruscan conflicts and the foundation of Neapolis creating a new balance of power. The first new structures to be built were buildings for banquets at the *Casa delle Forme di Creta* (VII, 4, 62), datable to the end of the 4th century BC, and whose orientation follows that of the Vicolo degli Augustali[1720].

The Oscan Town

The Samnite phase of the city is difficult to determine in terms of any precise chronological definition. Salvatore Nappo, excavating at the intersection between the Via dell'Abbondanza and Via Stabiana, clarified some of the chronology based on Campana A pottery, with a *terminus ante quem* for the Samnite period in the 3rd century BC[1721]. Following the hypothesis posited by De Caro, Nappo stated that «we can now say that the whole SE area of the city had at the end of the 3rd c. B.C. been laid out on a scheme that took the via dell'Abbondanza and the via di Nocera as its axes»[1722]. For Larry Ball

[1713] HAVERFIELD 1913; VON GERKAN 1940; ESCHEBACH 1970; ZEVI 1982.
[1714] MAIURI 1929; 1939.
[1715] DE CARO 1985, 75–79; CHIARAMONTE TRERÉ 1986; DE CARO 1992.
[1716] CRISTOFANI 2009, 26; DE CARO 2009, 59.
[1717] GIGLIO 2016.
[1718] GEERTMAN 2001, 133.
[1719] AVAGLIANO 2018, 135.
[1720] GUIDOBALDI - PESANDO 2018, 213.
[1721] NAPPO 1997.
[1722] NAPPO 1997, 96.

and John Dobbins, this period marks the beginning of the town, as they state «[w]e start to see evidence of credible urban population elsewhere in the city, especially around the periphery, beginning in the late fourth and third centuries»[1723]. This statement should be contextualised by considering the silence of the Classical period: from the end of the 4th cent. BC a new impetus can be read in the town, maybe with a renovate urban morphology. In the Forum, an altar and a well constituted a sacred area in the middle of the square, later replaced by the Temple of Jupiter[1724].

Urban Orientation in Phases

The main orientation lines of the Archaic city remain unclear. Maria Bonghi Jovino has outlined the current state of research on the topic[1725]. In particular, by focusing on the orientation of the pappamonte structures, it is possible to infer two opposing interpretative tendencies: the first one suggests a continuity of orientation from the archaic to the republican city; the second tends towards indicating a discontinuity. The ambiguity in the research results is due to the generally low accuracy achievable when reporting the orientation of building fragments that are just a few metres long. Moreover, most of the Archaic finds are not located in the streets but are usually under houses and other buildings and, since the pre-roman town has been excavated to only a limited degree, reconstructing ancient networks and historicising the roads is rendered complex by the lack of data. In general, however, the orientation of the main axes of the town may have stayed constant since its foundation in the Archaic period or deviated by a maximum of only a few degrees.

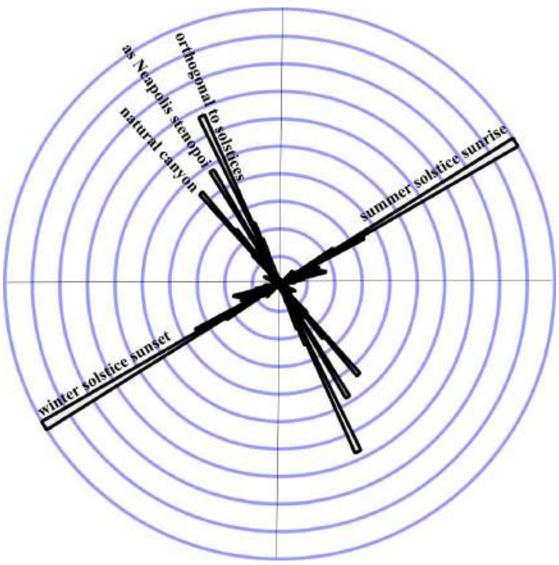

Figure 80. Pompei polar diagram with the possible orientation determining factors. Elaborated by the author with Line Direction Histogram plug-in in QGIS on vectors drawn on after MORICHI *et al.* 2018 cartography.

1723 BALL - DOBBINS 2013, 464.
1724 CARAFA 2011, 104–105.
1725 BONGHI JOVINO 2011b.

To map the various orientations evident in Pompei, a polar diagram has been plotted[1726]. The plot (fig. 80) illustrates the presence of at least three north-south axes of different orientation: Via di Mercurio, Via Stabiana, and Via Nocera. By contrast, the orientation of the east-west axes is relatively unvarying, divergent by a couple of degrees at most. The three different orientations of the north-south axes may correspond to three different chronological time-periods or to the need to adapt to the local geomorphological characteristics. In connection with the latter, the co-existence of several variant orientations in Pompei has brought into focus the idea that planning around the geomorphology was a typical approach in early Archaic urbanism in Campania and the South of Italy[1727]. Certainly, Via Stabiana follows the contours of a natural canyon[1728]. Horace Bushnell in an essay on city planning, seems to have described Pompei when considering that «there will be a sufficient natural drainage, if only it is taken due advantage of in the grade and location of streets. There will be some low grounds, if some avenue is laid along the depression, conforming, in a degree, to its sinuosities, there will be no difficulty in carrying off, by a main sewer under it, all that is brought down by a multitude of side sewers into the main which nature has provided for»[1729]. Excepting Via Stabiana, Herman Geertman stated that the orientation of all Pompei's main axes were «dictated by the altimetric condition of the terrain»[1730]. Geomorphological modifications were attempted in the Sarno Valley before 79AD[1731], and on the Pompeian plateau in the year 79AD[1732]. Maija Holappa and Eeva-MariaViitanen emphasised the copious evidence of anthropic adaptation of the shape of the plateau, with both levelling and filling operations[1733]. However, for these scholars, all the major axes were determined by the local terrain[1734]. For sure, the complex geomorphology of the site may have been a constraint diverting the urban design from having a purely geometric shape, although altimetric differences do not explain the so-called *altdstadt*[1735], which is indeed one of the flatter areas of the plateau. The natural ravine of Via Stabiana was the axis on which the eastern quadrangular *insulae* rest[1736]. However, this geomorphological orientation did not seem to have constrained the other main axis, where the lack of orthogonality may have resulted from a different motivation. For sure, a better understanding of Pompei's paleosurface may help to explain this complex urban design.

As a result of the different orientations, rhomboidal *insulae* are evident, at least at a later stage, being clearly visible in *Regio VI*, which has a *per stringas* layout[1737]. In order to suggest an interpretation of the general scheme of Archaic Pompei, it seems appropriate to start the discussion from *Regio VI*, where significant Archaic finds were recovered. This quarter was built on a main axis,

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1726 Tveite 2015.
1727 Osanna - Rescigno 2018, 184–184; Avagliano 2018, 90.
1728 Eschebach 1970, 21; Giglio 2016, 12.
1729 Bushnell 1864, 319.
1730 Geertman 2007, 86; Giglio 2016.
1731 Vogel - Märker 2010; Vogel - Michael - Seiler 2011.
1732 Holappa - Viitanen 2011.
1733 Holappa - Viitanen 2011, 172–173.
1734 Holappa - Viitanen 2011, 182.
1735 Avagliano 2018, 94.
1736 Geertman 2007, 87–88.
1737 Osanna - Rescigno - Silani 2022, 394.

Via di Mercurio, also Archaic in its foundations as confirmed by the excavations near Torre di Mercurio, which was previously a gate[1738]. Indeed, Alessandra Avagliano pointed out the presence of Archaic structures orthogonal to Via di Mercurio[1739]. Several in-house Archaic structures are parallel to the road, such as at *Casa di Faventino* (VI, 5, 16) and at *Casa di S. Pompeius Axiochus* (VI, 13, 19)[1740]. This road's precise orientation of 335°–155° azimuth is the same as that of the 18 m long archaic pappamonte wall on the west side of the Temple of Apollo and that of the recently excavated Via di Apollo[1741]. Moreover, the orientation of the *Regio VI* north-south axis is very similar to that of Neapolis. The axis of the Forum is again Archaic but deviates from the orientation of the Temple of Apollo by a few degrees[1742]. However, though the north-south direction seems constant in the layout of *Regio VI* across the centuries, the lack of an orthogonal angle with the crossing road is noticeable, particularly in the case of the axis of Via delle Terme and Via della Fortuna. Orthogonality is not a constant feature in the Archaic urban plans of Magna Graecia. An example of a non-orthogonal city from around the same time is the Greek colony of Megara Hyblaea in Sicily. It is possible that this situation characterised by a lack of orthogonality is a subsequent adaptation intended to enable greater ease of access to the inner city. For instance, the *Casa dei Banchetti* (VII, 4, 62), built between the end of the 4th and the beginning of the 3rd century BC, shows a clear divergence with respect to later buildings, such as the Temple of the Fortuna Augusta[1743]. The installation of this sacred building seems to be indicative of this divergence, since on the southern side of the building, a wall with a different orientation is present. In the *insula* 4, *Regio* VII, a hypothesis of viability was constructed between Via della Fortuna e Vicolo degli Augustali, on a continuation towards the south of vicolo del Labirinto, crossing Casa di Arianna (VII, 4, 50) e Casa dei Capitelli Figurati (VII, 4, 57) but further investigations will be needed to test this proposal[1744].

According to Orfilia Pons *et al.,* the use of Pythagorean triples can be recognised in the orientation of Pompei, known as *variatio*[1745]. This system is based on the use of the meridian line, the north-south cardinal direction, which is the base for the construction of right triangles. Three sets of Pythagorean triples were recognised in the orientation of Pompei by the Spanish scholars (fig. 81): the first 1:2 in the *Regio VI*, the second 3:5 in the eastern sector, and a module 5:12:13 for the *Altstadt*[1746]. These proposals need further analysis, including in relation to the phases of development of the town across the centuries. While, for the eastern sector of Pompei, specifically *Regio I*, the *variatio* seems a possible explanation of the layout though alternative to the astronomical evidence

[1738] MAIURI 1973, 152.
[1739] AVAGLIANO 2018, 35–39.
[1740] BONGHI JOVINO 2011b, 9; See also M. Verzár Bass, F.Oriolo,V.Provenzale,"Nuove ricerche archeologiche a Pompei", in P.G. Guzzo, M. Guidobaldi (a cura di), *Nuove ricerche archeologiche a Pompei ed Ercolano*, Roma, 2005 («Studi della Soprintendenza Archeologica di Pompei»,10), pp. 384-385, 191.
[1741] MAIURI 1973, 125–133; OSANNA - RESCIGNO 2018; OSANNA - RESCIGNO - SILANI 2022, 391–398.
[1742] OSANNA - RESCIGNO - SILANI 2022, 395.
[1743] D'AMBROSIO - DE CARO 1989; AVAGLIANO 2018, 39.
[1744] AVAGLIANO 2018, 33–35; See also M Bustamente - I. Escrivà - E. Huguet - A. Ribera - C. Albir, "La topografia urbana anterior a la Casa de Ariadna (VII, 4, 51-31) y su entorno", in *Vesuviana* 6, 2014: 111–144, fig. 15.
[1745] ORFILA PONS - CHÁVEZ ÁLVAREZ - SÁNCHEZ LÓPEZ 2014, 83–84.
[1746] ORFILA PONS - CHÁVEZ ÁLVAREZ - SÁNCHEZ LÓPEZ 2014, 83–84.

later discussed, for *Regio VI* it seems more appropriate to apply the triad 5:12:13 (fig. 82), which reflects Neapolis' orientation and gives some hints that might explain the iso-orientation between the Apollo temple at Pompei and the temple of Dioscuri at Neapolis[1747].

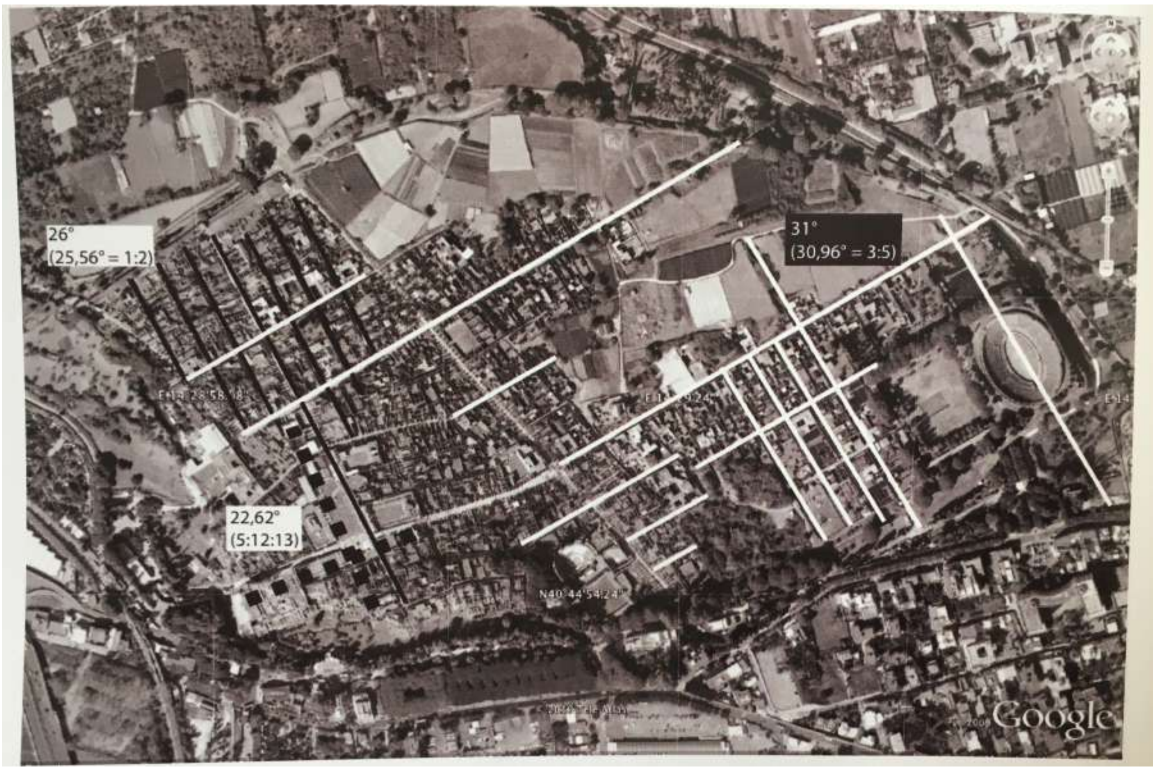

Figure 81. Pythagorean triads applied to Pompei. After ORFILA PONS - CHÁVEZ ÁLVAREZ - SÁNCHEZ LÓPEZ 2014, 84.

[1747] See the section 'X. Neapolis'.

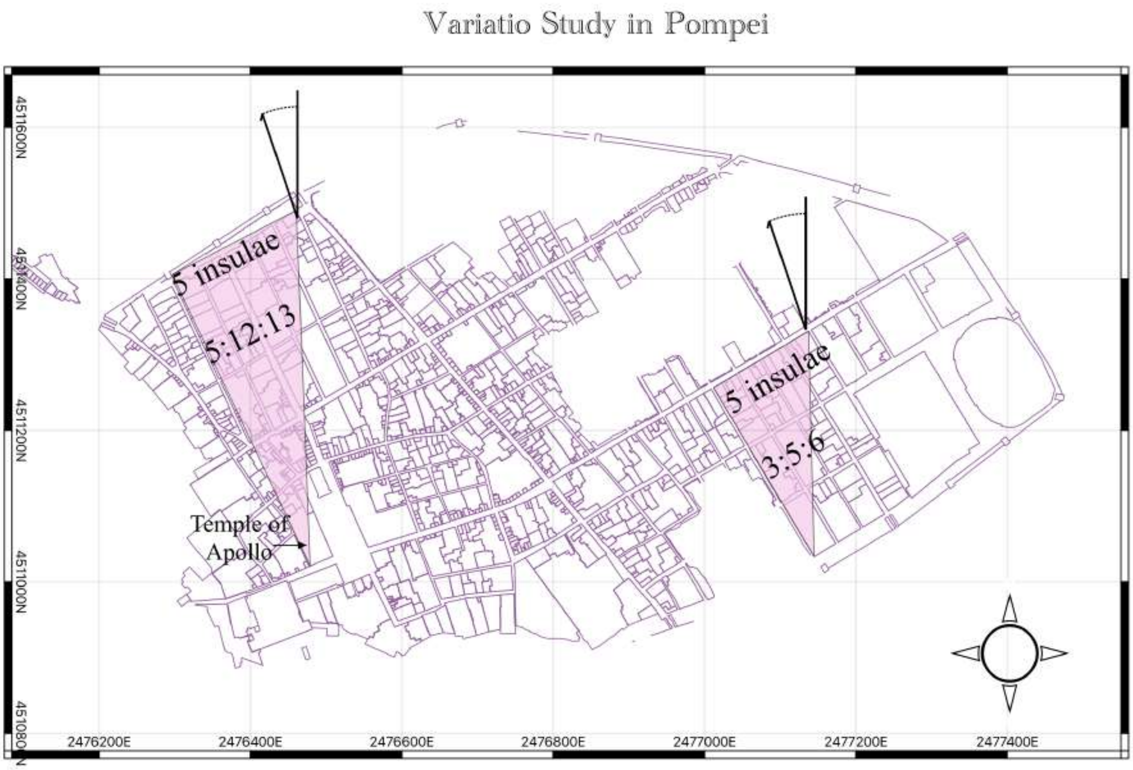

Figure 82. Pythagorean triads hypothetically applied at Pompei based on the meridian line. Elaborated by the author after MORICHI *ET AL* 2018.

A climatic approach to the possible explanation of Pompei's grid is worthy of consideration at this point. Wet and mild winters together with hot and dry summers are typical of the climate in Pompei nowadays[1748]. An analysis of wind directions shows the prevailing wind comes from the west, having the highest intensity and speed and bringing rainfall, followed by north-east and east winds (fig. 83)[1749]. An analysis of high atmosphere winds in the region has shown a seasonal component in wind directions. In particular, in the autumn and winter seasons, at an altitude of 20–40 km above the ground, the prevalent direction of the wind is from azimuth 260°, blowing towards the north-east[1750]. Whereas, in the summer, the prevailing wind blows from the east at 90° azimuth. In effect, there is a significant change in the azimuth of the prevailing winds between winter and summer in Pompei. Considering that the most wet and cold wind was coming from the sea in winter, the plan of the city with the east-west main axes at circa 240° was, in essence, blocking the direct entrance of this wind by 40° and, thus, avoiding it having easy access into the city.

[1748] TRAVERSETTI - F. BARTOLI - CANEVA 2018, 33.
[1749] TRAVERSETTI - F. BARTOLI - CANEVA 2018, 33.
[1750] ROLANDI ET AL. 2008, 90.

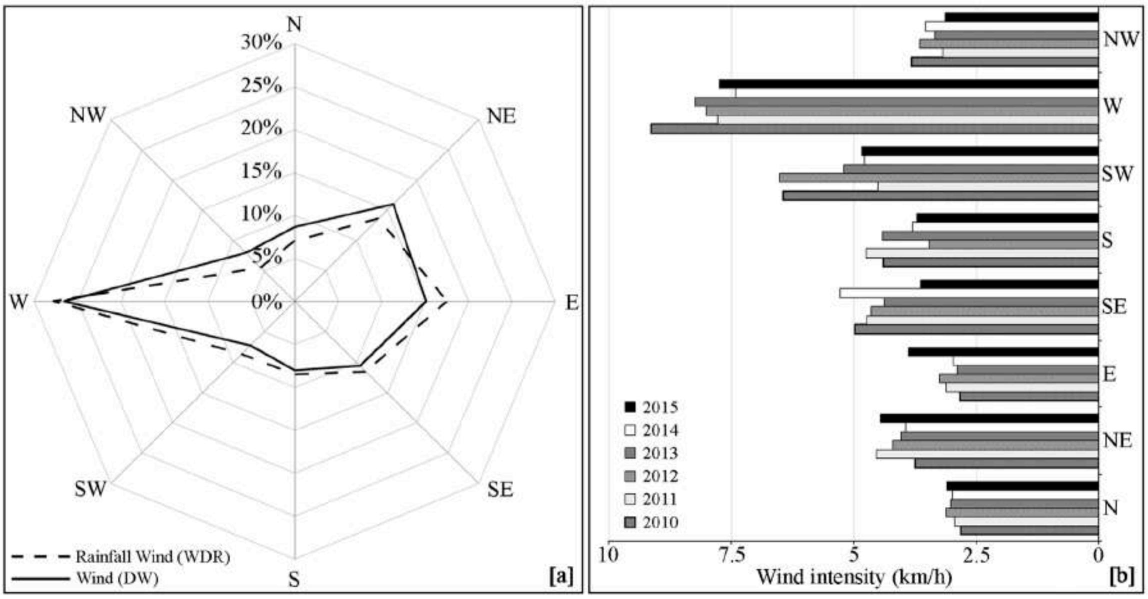

Figure 83. Direction and intensity of the prevailing winds in Pompei. Dominant Winds (DW) and Wind-Driven Rains (WDR) are plotted on the left rose diagram (a). On the right (b), annual mean wind intensity from modern data. After TRAVERSETTI - F. BARTOLI - CANEVA 2018, 35.

Skyscape Analysis of the Urban Grid

When considering the diachronic layout of Pompei, it is appropriate to consider the possible role of astronomical alignments that may have determined its orientation lines. The *Etrusca Disciplina*, used for setting boundaries, was also based on the observation of the sky, at least as far as the Latin legacy can testify. Therefore, it seems appropriate to apply skyscape archaeology to the urban plan of Pompei, where Etruscan influence on the Sarno Valley communities is evident. Heinrich Nissen proposed a summer solstice sunrise alignment for Via di Nola[1751]. He reported an empirical observation made by Robert Schöne, on 21st June 1867, in which he confirmed the alignment, but mentioned that the south side of the street was kept in shadow[1752]. Later, Hans Eschebach and Liesotte Eschebach restated the Nissen hypothesis, provoking a wider echo on scholars but they misinterpreted the original hypothesis[1753]. Indeed, the authors reported an astronomical alignment of Via Stabiana with the winter solstice sunrise, which has no sense at all but has been restated in recent scholarship[1754]. There followed a recent archaeoastronomical analysis by Francesco Vitale that concluded there was an intention to set the same street according to a medium value between the direction of the summer solstice sunrise, delayed by mountains, and the opposite winter sunset on the sea[1755]. However, this idea was not contextualised with related archaeological findings and the diachronicity of the city. The summer solstice hypothesis was also restated using digital methods, but

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1751 NISSEN 1906, 105–107.
1752 NISSEN 1906, 105–107.
1753 ESCHEBACH 1970, 50–51; ESCHEBACH - ESCHEBACH 1995, 56–58.
1754 OSANNA - VERGER 2017, 16–17.
1755 VITALE 2000, 24.

these did not consider changes in the skyline horizon[1756]. Nissen's and Vitale's hypotheses were tested in the field with a total station with a precision of 5", also using a georeferenced cartography and the astronomical software Stellarium[1757].

It can be noted that, in the second half of the 1st millennium BC when observing from Pompei, the sun would rise at summer solstice with an azimuth of 60.5° from behind the tip of Mount Faitaldo at 3° of altitude, with the peak just visible above the nearest sierra of Mt. Torrenone and Mt. La Foresta (fig. 84). In particular, when moving the place of observation around Pompei, it is noticeable that the sun rising at the summer solstice was seen on the right side of Monte Faitaldo from the crossroads at Via delle Terme-Via di Mercurio-Via della Fortuna, and on the left side of the same mountain if observing from the Forum. This sky-land event aligned to several structures. First, it aligned with the axis of Via delle Terme (fig. 85), and the last part of Via di Nola, although these arteries are difficult to historicise. Second, the same orientation is coincident with the wall (length 25m, azimuth 60.80°, 150–120 BC), built in *opera incerta* and constructed in Sarno limestone with an ending pappamonte stone at its extremity, situated to the north of the Forum and the Temple of Jupiter which are dated to the Hellenistic period[1758]. This wall was referred to, above, as indicative of the previous orientation of the Forum. Such orientation seems ascribable to the Hellenistic restructuring of the city by the end of the 2nd century BC and is also perpetuated in the east side of the city and later monumentalised with the construction of the Temple of Fortuna in 9 BC, whose main axis follows the same direction. But there are some hints which suggest that this choice was a perpetuation of the urban alignment existing from the Archaic period, especially for those structures oriented east-west; the pappamonte foundations below the *Casa dei Gladiatori* (V, 5, 1-3) and *Casa di Obelio Firmo* (IX, 14, 2-4) are approximately parallel with Via di Nola, as well as those found at house VII, 14, 40[1759]. Avagliano has suggested that the same orientation of Via delle Terme-Via della Fortuna-Via Nola is reflected in the archaic structures found below the *Casa della Soffitta* (V, 3, 3) and *Casa dei Gladiatori* (V, 5, 3)[1760]. Finally, the sanctuary of Fondo Iozzino (62°azimuth) also aligns with this astronomical event.

The outcome of this analysis is that several streets and temple structures were directed towards the position of the rising sun at summer solstice between the Archaic and the Hellenistic period, with a variable divergence of 1°-2°. The orientation of the *decumani* of Via dell'Abbondanza, Via di Nola, and Via delle Terme were compared to the position of the rising sun at summer solstice in the Archaic period above Monte Torrenone and Faitaldo. The best fit is with Via delle Terme, oriented with the solstitial sun within 0.5°, while Via dell'Abbondanza has 1.2° of error, and Via di Nola has a divergence error of 1.3°[1761]. The method of sighting the sun's appearance above the local horizon for

[1756] SPARAVIGNA 2016b, 5–6; ZANELLA 2019, 15.
[1757] CRISTOFARO - SILANI 2021.
[1758] MAIURI 1973, 121; AVAGLIANO 2018, 44.
[1759] BONGHI JOVINO 2011b, 9; OSANNA - RESCIGNO - SILANI 2022, 405.
[1760] AVAGLIANO 2018, 35.
[1761] CRISTOFARO - SILANI 2021.

determining the orienting of the *decumani* is confirmed in the writings of the Roman agrimensor Frontinus, though Hyginus suggested a practice that is not compatible with Pompei's urban grid.

The idea of assuring an equilibrate solar irradiation all through the year could be one explanation for the form of the urban grid, but that needs to be further investigated with the aid of virtual reality models[1762]. The precise choice of orientation may be interpreted through the lens of Gaetano Vinaccia's theory, where microclimatic aspects were decisional criteria in ancient planning. Pompei's urban grid reflects Vinaccia's equisolar axis for a temperate climate, with the equalisation of sunlight on all four sides of buildings being the rule for achieving an annual solar control in a way to guarantee the best solar irradiation even for the north-facing sides[1763]. Such considerations with respect to the orientation of Pompeian streets appeared appropriate for testing by combining a geo-referenced, 3D, archaeological model with the desktop planetarium software Stellarium Scenery3D[1764]. Insights can be achieved with virtual reality which are not possible through on-site visual inspection alone, because of the corrections needed for the greater tilt of the earth's axis in antiquity. Observing today's sky over old ruins does not show the sky that was contemporary with the dates of the buildings themselves. The long-term variability of the ecliptic obliquity from the city's foundation to nowadays was thus considered in the virtual reconstruction of past contours. The software Stellarium can cast light and shade on the Pompeian modelled streets from a virtual sun in its seasonal variation between the Archaic to the Hellenistic period. Thus, the 3D model is adopted for questioning the scientific interpretation achieved by numerical data, as well as for outreach purposes.

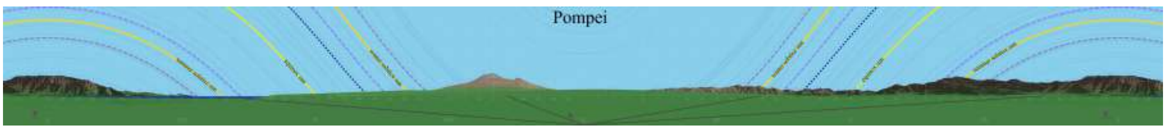

Figure 84. Landscape and skyscape visibility from Pompei in line with the urban axes. Elaborated by the author with Horizon© ANDREW SMITH 2022. See Plate XI.

1762 CRISTOFARO - SILANI - ZOTTI n.d.
1763 VINACCIA 1939b, 151–152.
1764 ZOTTI - SCHAUKOWITSCH - WIMMER 2018.

Figure 85. The sun rising at summer solstice perfectly in line with Via delle Terme. 21st June 2021. Photo by the author with Ntech ISTAR full dome camera.

The Temple of Apollo

Situated on the western side of the Forum, the temple of Apollo was one of the most important cultic places in the city from its foundation, together with the temple at the Triangular Forum. The orientation of the sanctuary, however, presents anomalies: in its junction with the Forum area, there appears to have been an attempt to mask a misalignment between temple and forum through the construction of a wall progressively increasing in size along its course. This difference in orientation might have been present since the Archaic period[1765]. Ritual activities in the Archaic phase of the sanctuary are confirmed as having occurred from the beginning of the 6th century BC from the many votive offerings in bronze and ceramics, often with Etruscan inscriptions and *symposion* scenes evoking sacrificial and banquet rites[1766]. The building material was probably soft grey tuff, or pappamonte, and yellow tuff stone as evident from the excavations and the re-use of some building blocks[1767]. The Archaic temple stood in the same place as the Hellenistic one, with an architectural monumentalisation typical of a Kyme influence[1768]. The Archaic phase of the temple was made evident by the excavation by Amedeo Maiuri[1769]. In particular, on the east side of the *Casa di Trittolemo* (VII, 7, 2), a wall separates a place of habitation from the temple. Under this wall, 30 cm below the planking level, Maiuri found a 17 m long structure in *opera quadrata* constructed in three rows of pappamonte and lava stone. This wall was probably the western limit of the Archaic Temple of Apollo[1770]. By contrast, Ball and Dobbins suggested that this high wall had nothing to do with the sanctuary, maintaining that the boundary wall of the temenos would have sufficed with one course of pappamonte foundation[1771]. Recently, excavations have brought to light a street on the west side of

[1765] OSANNA - RESCIGNO 2018, 181.
[1766] OSANNA - RESCIGNO 2018, 185.
[1767] RESCIGNO 2016, 65–66; OSANNA - RESCIGNO 2018, 186.
[1768] OSANNA - RESCIGNO 2018, 185–186.
[1769] MAIURI 1973.
[1770] AVAGLIANO 2018, 53, 173.
[1771] BALL - DOBBINS 2013, 476.

the sanctuary, named ‘Via di Apollo’[1772]. On the north side, Paul Arthur found a ditch beneath the forum’s western portico corresponding to the Archaic perimeter of the Apollo temple[1773]. This perimeter extended to the east into the forum portico. Arthur stated that the orientation of the ditch «ran on the same, apparently skewed, alignment as the temple proper»[1774]. However, Arthur’s assessment looks to have been called into question by later excavations which have not recovered any Archaic finds[1775]. To the south, the temenos of the sanctuary was dictated by Via Marina. In summary, the axis of the sanctuary has a divergence of a few degrees towards the west with respect to Via del Foro and its orthogonal street under Venus’ sanctuary[1776]. A preference to keep the temple in its original position is apparent from the progressive enlargement of the colonnade on the eastern side of the sanctuary, attempting to achieve an optical conjunction; this solution would have appeared as a slight turn clockwise of the temple, in line with the shape of the current forum.

The position of the altar in the temple reflects an attention to west or east, according to the transversal sanctuary axis. The transversal orientation of the altar might suggest that these directions were important in the celebration of the main rites. Nowadays, the altar and the transversal side of the temple point approximately at the point in the landscape where the sun rises one month after the summer solstice. This date is significant because the celebration of the *Ludi Apollinaris* happened in the sanctuary starting from the 2nd century BC, as attested by Aulo Clodio’s funerary inscription and the many terracotta votive offerings found on the eastern side of the sanctuary where workshops would have opened onto the forum. The *Ludi* were instituted in Rome during the Punic War at the end of the 3rd century BC and, from 208 BC, the annual festivity became a fixed event happening on the 13th of July[1777]. Therefore, a correlation between the orientation of the Pompeian Apolline altar and the position of the sun rising on the day of the celebration is possible. Moreover, the ten doors in the eastern wall might have been opened onto the forum during the celebration of the *Ludi* in order to receive natural light from the sun at dawn.

The Doric Temple at the Triangular Forum

The Sanctuary

The Doric Temple is situated on a promontory on the southern limit of the city, the so-called Triangular Forum, given the shape it acquired through the systematisation of the area over the centuries[1778]. The prominent position of the promontory above the mouth of the river, possibly a fluvial port, enhanced the visibility of the monumental structure across the whole Sorrentine peninsula. At the same time, the liminality of the area, being separate from the centre of the town, is

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1772 Osanna - Rescigno 2018, 181–183; Osanna - Rescigno - Silani 2022, 391–398.
1773 Arthur 1986, 34.
1774 Arthur 1986, 34.
1775 Avagliano 2018, 53; See also Sirano 2016; Osanna – Rescigno 2016, 35.
1776 Osanna - Rescigno - Silani 2022, 395.
1777 Sabbatucci 1988, 291–295.
1778 D’Alessio 2009, 22.

very peculiar for what was the oldest temple in Pompei. The sacral building was a periptery in Doric style, facing south-east. This architectural style is unique in the context of ancient Campania[1779]. Two phases in the construction of the building were revealed, with the first at the end of the 6th cent. (560 BC) and the second one in the late 4th cent. BC. The construction is antecedent by a few decades to that of the Apollo Temple[1780]. As well as the foundations built in local Sarno limestone, four tuff capitals[1781] were found during an excavation started in the 17th century[1782]. Architectonic terracotta with serpent heads and lion protomes substantiated the dating of the monumental form of the temple to the Archaic period[1783]. Greek and Etruscan-Campanian styles are both present in the architectural decoration of the Archaic temple, frustrating scholars from assigning it a definitive cultural model[1784]. J. de Waele excavated the area, recognising in the temple an Etruscan-Italic architectural plan with 7 x 11 columns, similar to Temple B at Pyrgi or Temple II at Satricum[1785]. Antefixes with Hercules and Minerva belong to the Hellenistic phase of the temple, most probably during the Samnite occupation[1786]. Similar antefixes of Minerva have been found at Privati locality at Stabiae and Punta della Campanella at Sorrentum [1787].

THE HEROON

As part of the aggrandisation of the sanctuary, the so-called *heroon* was placed in front of the Doric Temple, oriented in the same way but opening towards the temple, facing north-west[1788]. Recent excavations have proved problematic to interpret due to previous 18th cent. explorations and 2nd World War bombing[1789]. This is a rectangular structure (5.70 x 6.97 m) built in *opus incertum* limestone blocks, but with an uncertain chronology[1790]. This *temenos* probably corresponds to the late phase of the temple, although there are no precisely datable features[1791]. In the view of Osanna, it should be dated to the post-earthquake reconstruction of the temple in the year 62 AD[1792]. Within the structure, a smaller and more ancient rectangular foundation in *opus caementicium* is present in the form of three black lava stone *cippi* which, from corner to corner, delimited an area of 3.25 x 3.40 m[1793]. These *cippi* emerge 0.6 m above the ground and are below the earth by 0.30 m[1794]. According to Osanna, the inner structure was previously open towards the south-east, toward the *tholos* well[1795].

1779 RESCIGNO 2010b.
1780 D'ALESSIO 2009, 26.
1781 These capitals have been assimilated to the Poseidonia Basilica and Metapontum Tavole Palatine columns.
1782 D'ALESSIO 2009, 28.
1783 D'ALESSIO 2009, 24.
1784 D'AGOSTINO 2001, 335.
1785 D'ALESSIO 2009, 24.
1786 D'ALESSIO 2009, 24.
1787 D'ALESSIO 2009, 29.
1788 D'ALESSIO 2009, 22; DE WAELE ET AL. 2001, 315–321.
1789 DE WAELE ET AL. 2001, 321.
1790 D'ALESSIO 2009, p. 22; WAELE *ET AL* 2001, p. 315.
1791 D'ALESSIO 2009, 29.
1792 OSANNA 2016, 72.
1793 DE WAELE ET AL. 2001, 321.
1794 DE WAELE ET AL. 2001, 321.
1795 OSANNA 2016, 79.

At a later stage, it was closed on the south-east side using one of the *cippi*. The new inner walls were placed just above a huge circular cavity 2 m deep, with steps for a descent, later filled in with various building materials[1796]. Ritual pits with carbonised organic fruits were integrated into the restructuring of this sacred place in the 1st cent. AD[1797]. Jozef Arthur De Waele, Paolo Carafa, and Massimo Osanna followed the views of Franz Studniczka, who interpreted it as a *bothros* altar later reconstructed as the burial *heroon* of a foundation hero, who would have been Herakles/Hercules[1798]. At least, the hero cult suggests the possible presence of Hercules at the sanctuary[1799]. According to Mario Torelli, *heroon* structures tend to be oriented facing north in the Roman world. For divinised emperors, this applied with the Temple of Divo Giulio in the Roman Forum, facing north-east, and the Pantheon, facing exactly north[1800]. To this list can be added the north-facing Temple A at Castrum Inui, possibly dedicated to *Indiges* under the cult of Aeneas as well as the Late Orientalising tomb facing north-east, a place of a cult of ancestors from the Archaic period onwards and known as Aeneas' *heroon* at Lavinium[1801]. According to Torelli, there is a strong relationship between the cult of the divinised ancestors and the sun[1802]. Carafa added that an annual rite might have been performed there to re-enact the mythical procession by Hercules, as described in Servius' account[1803]. Paolo Carafa states that «[i]f the Triangular Forum was the sanctuary where the *heroon* of the founder was placed, one may suggest that the rites in his honor took place there, and that those rites annually re-enacted the triumphal procession that marked the origin of the town»[1804]. In Osanna's view, it should be interpreted as a place for sacrificial holocausts (*eschara*) more than as an altar/*bothros* or *heroon*[1805]. The quadrangular *cippi* delimitation is an early confirmation of ritual participation, even though support for this interpretation remains scant.

The Altars and Well

Three altars are placed near to the structure and considered a later feature than the inner *temenos*[1806]. The orientation of the altars reflects that of the *heroon* and the temple. They are placed in front of the temple, though somewhat to one side towards the north-east. They are built on a platform made of slabs, over a total area of m 2.60 x 1.70[1807]. The first altar is tripartite, suggesting a triadic cult, such as the Capitoline one[1808]. Osanna speculated that the altars might be dedicated to the Nymphs as these

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1796 Osanna 2016, 79.
1797 Osanna 2016, 80.
1798 De Waele et al. 2001, 321; Osanna 2016, 80; Carafa 2011, 97.
1799 D'Alessio 2009, 34.
1800 Torelli 2011, 224.
1801 Torelli 2011, 222–228.
1802 Torelli 2011, 227.
1803 Carafa 2011, 97–98.
1804 Carafa 2011, 98.
1805 Osanna 2014, 57.
1806 De Waele et al. 2001, 321.
1807 De Waele et al. 2001, 321.
1808 De Waele et al. 2001, 322.

often appear as three figures, giving a chthonic and prophetic character to the sanctuary[1809]. A circular well, a few metres distant from the temple, was protected by an eight-column *monopteros*, with an Oscan inscription dedicated to the *meddix* Numerio Trebio in the 2nd cent. BC, even though the well is more ancient[1810]. Since this is the only inscription by the highest town magistrate found in Pompei, Paolo Carafa suggested that the «the cult (or one of the cults) housed in the sanctuary had some kind of public importance» [1811] . Monika Vezar drew attention to the possibility of this being a monumentalizing of a *mundus*, a place of primary importance for the urban foundation[1812]. Although it is not possible to consider the cavity of the monumentalised well as a *mundus* or as an *umbilicus urbs* that corresponded with the geometric centre of the city, yet, according to Sabrina Batino's interpretation, it was a point of reference for the whole Pompeian community of the cyclical renewal of the welfare of the collective[1813]. In short, the evidence is complex and various when considering the hypotheses about initiatory practices for passage rites from childhood to maturity for young men and women, fostering their admission into accomplishing their civic titularity and into their facilitating the periodic regeneration of the community[1814].

THE ORIENTATION

On the prayers-facing side, looking towards the cella, the Doric Temple has its main axis aligned with good accuracy, to within less than 1°, with the summer solstice sunset with an azimuth of 300.25°, setting behind the city *plateau*, itself hiding the horizon of 1.7° (fig. 86). Meanwhile, on the opposite cult-statue facing side at 120.25°, the deviation from the position of the sun rising above the Lattari mountains at 6° of altitude, is *circa* 8°, which is too great to suggest the presence of an alignment. To the north-west, the prolongation of this axis would encounter another sacred building of the city, the Temple of Jupiter. It then runs to unite with Via Consolare, whose preceding axis is suggested by the arrangement and deformity of the nearby *insulae* VI, 1–4[1815]. Filippo Coarelli stated that there was a connection between the Doric temple axis and the *Salinae Herculeae* situated beyond *veru Sarinu*, the gate of *Porta Ercolano* on the north-west angle of the city[1816]. Coarelli hypothesises a network connection with regard to the cult of Herakles and the salt market. In particular, the protohistoric network of *viu sarinu*, or Via Consolare, whose orientation diverges from that of via di Mercurio, the axis generator of *Regio VI*, is instead coincident with the prolongation of the axis of the temple and the position of the summer solstice sunset as well. At the crossroads between Via delle Terme and the remaining remnants of Via Consolare, an angle of 120° is still evident[1817]. This axis passes through the centre of the forum and corresponds to the diagonal axis of the later Capitolium. This orientation,

1809 OSANNA 2015, 81.
1810 D'ALESSIO 2009, 22, 30; BATINO 2016, 198.
1811 CARAFA 2011, 97.
1812 See M. Verzar, "L'Umbelicus Urbis. Il mundus in età tardo-repubblicana", in *DdA* 9/10, 1976: 378–398.
1813 BATINO 2016, 203.
1814 BATINO 2016, 207.
1815 COARELLI 2001; 98; BARNABEI 2007, 31; *contra* AVAGLIANO 2018, 34
1816 COARELLI 2001, 98.
1817 CRISTOFARO - SILANI 2021.

if cross-referenced, also corresponds to the diagonal of the cella of the Temple of Apollo, built a few decades after the Doric temple. Furthermore, it does not seem a matter of chance that the Doric Temple, situated on the southern limit of the city, has its main axis aligned with the summer solstice sunset when the urban grid is aligned with the summer solstice sunrise. Indeed, the combined probability of finding two alignments in operation on the same day of the year is 2.94 σ in Gaussian statistics[1818]. Statistically, the co-presence of two built independent orientations pointing at the solstitial diagonals within a single site has a probability of happening by chance of 0.2%[1819].

The Cult

The chthonic character of this western orientation of the temple, if read from a perspective facing the front and the cella of the temple, resonated with the peculiarities of the cult. Excavation here has revealed that the form of the terrace was quite different from how it appears today. Below the terraces, hypogean structures were present. From the second half of the 2nd century BC, the cavities below the promontory of the Triangular Forum were filled in with rubble. Maria Teresa D'Alessio suggested the existence of a cult here that was dedicated to a female divinity from the Archaic period, due to the presence of female statuettes with *polos* and *kourotrophoi*, thus calling into question the significance of Herakles at the temple[1820]. For Osanna, the Hellenistic phase of the sanctuary with female busts with *polos* can be traced back to Demetra or Persephone, ascending from Ades in the act of *anodos*[1821]. Statuettes and busts with polos in connection with a quadrangular building have been recovered at Satriano in Lucania in a *Magna Grecia* context[1822]. The sanctuary can be related to the liminal passage of young women from *parthenia* to *nymphe* during marriage, as well as to young male education in the context of the Hercules cult as evinced by the nearby presence of the Samnite gymnasium and the statue of Marcello as *patronus iuventutis* in the Augustan age[1823]. Similarly, Sabrina Batino suggested the possibility of cults connected with the chthonic sphere and rites of passages, at least in the 4th–3rd century BC[1824]. In the area of Fondo Iozzino, a suburban sanctuary of Pompei, votive material with the effigy of Athena was recovered, suggesting a possible sequence of ritual actions across the cult places[1825]. The Sanctuary of Fondo Iozzino reflects the orientation of the urban grid and, therefore, shows an alignment with the summer solstice sunrise. It is reasonable to suggest that initiation and passage rituals took place at this specific time of the year. The distinction between 'rites of passage' and 'calendric rites' has been pointed out by Bell, even though Van Gennep included calendric rites within the category of rites of passage[1826]. According to Gloria Ferrari, rites

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[1818] SCHAEFER 2006; POLCARO ET AL. 2011; POLCARO 2016, 2.
[1819] CRISTOFARO - SILANI 2021.
[1820] D'ALESSIO 2009, 33.
[1821] OSANNA 2014, 57.
[1822] GRECO 1996, 272.
[1823] OSANNA 2014, 57–58.
[1824] BATINO 2016, 189.
[1825] BATINO 2016, 204.
[1826] BELL 1997, 102.

of passage in Sparta were performed in accord with the agricultural cycle, at the beginning of the ploughing season, and the movement of the stars, thus creating a break in the seemingly unvarying flow of time[1827].

At the top of the pediment, the decorative feature of serpents' heads was noticed, suggesting the mythical Hydra fighting against Herakles[1828]. Such mythological paradigms can also be found at Pyrgi temple B in Etruria, which shows similarities with the plan of the Doric temple in Pompei, although their orientations are not similar[1829]. Patricia Lulof analysed the political significance of terracotta acroteria representing Herakles and Minerva[1830]. In addition, the Etruscan mirror[1831], in which Herakles/Hercle is depicted with Minerva in the act of sacrificing a goat, may well echo some of the cult peculiarities of the Pompeian Doric Temple, in particular with the setting of the sun behind the scene and the Hesperid tree signifying the west-facing direction or location of the artist[1832]. The chthonic character of the cult of *Menrva* has been pointed out by Maria Bonghi Jovino in the context of the Archaic Etruscan pantheon at Capua and Portonaccio at Veio[1833]. At S. Omobono in Rome, the sanctuary was placed near to the Forum Boarium, where salt was a major trade product, as Torelli described.[1834] There, terracotta statues of Minerva and Hercules were found; their age is debated, although some time between 540–350 BC look to be possible dates, which would place these in the second phase of the archaic temple chronologically[1835]. Having been, once, probably placed as acroterial statues, they have been interpreted as displaying the apotheosis of the god to Olympus but, again, that interpretation is not completely accepted[1836]. In Rome, that temple was dedicated to Fortuna; the festivity of *Fors Fortuna* was celebrated on 24th June, on the occasion of the summer solstice. The introduction of the cult of Fortuna in Rome is attributed to Servio Tullio. It is important to underline here the similarities between the Minerva-Hercules group at the Temple of Fortuna at S. Omobono[1837] in Rome and at the Doric temple in Pompei, as both appear related by their orientation in relation to the summer solstice. For Mario Torelli, there is a strong relationship between the cult of the divinised ancestors and the Sun.[1838] Moreover, according to an Antiquarian tradition of studies, the apotheosis of Herakles through the vehicle of a pyre should occur at the time of the summer solstice. [1839] The evidence for this association is quite weak, however, apart from the mere astronomical association of the hero's labours with the twelve zodiacal constellations. Among

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[1827] FERRARI 2008, 106.
[1828] D'AGOSTINO 2001, 145–146.
[1829] D'AGOSTINO 2001, 144–146; CRISTOFANI 2009, 33.
[1830] LULOF 2000.
[1831] *LIMC* 5:225-26, no. 264; DE GRUMMOND 2006a, 25.
[1832] MASTROCINQUE 1993, 57.
[1833] BONGHI JOVINO 2011a, 26.
[1834] TORELLI 1993.
[1835] ADORNATO 2003, 819.
[1836] ADORNATO 2003, 827.
[1837] ADORNATO 2003, 826–833.
[1838] TORELLI 2011, 227.
[1839] MARMOCCHI 1837, 244–247.

possible comparisons in the east Mediterranean, the festivity related to death by fire and the resurrection of the god Melquart, identified with Herakles by the ancient Greeks, was celebrated on the days of the summer solstice[1840]. As stated, the presence of a cult of Herakles at the Triangular Forum Doric Temple is a matter of debate; nevertheless, this possibility looks plausible in the context of a foundation ritual coincident with solstice celebrations[1841].

The Inner Temple Natural Illumination

The study of the natural illumination of Greek temples needs to be drawn into the discussion at this point[1842], as well as the visual relationship between the divine statue and the devotees, as has been emphasised by others in the context of Greek cults[1843]. It does not seem that the Doric Temple was set to align with the winter solstice sunrise, since the mountains present on that side of the horizon delay the timing and position of the winter solstice rising sun[1844]. In the cella, a circular plinth for a cult statue was found in a non-central position with respect to the main temple axis[1845], which may be telling for our orientation analysis. A symmetrical cult-statue pedestal was conjectured to exist on the opposite side, but this has not been confirmed[1846]. The window of view of the cult-statue, that is the portion of the horizon which it is possible to see if the observation point is placed at the middle of the circular base, can be used to calculate the ingress of light at any specific time. In particular, the size of the cella door should be considered. In Greek temples, doors frame the view of the cult image. According to Elena Partida, «[t]he door leading into the cella of a temple was axially aligned with the cult statue, allowing the god to supervise sacrifices in his/her honour, performed on the altar outside» and usually opened towards the inside[1847]. At the Doric Temple in Pompei, the view that is available to the cult statue, that is the portion of the horizon which it is possible to see if the observation point is at the middle of the circular base, is 20°, from 114° to 134° azimuth. Even if the axis of the temple does not point at the position of the sun rising at winter solstice, the decentralised position of this base could be telling for it may indicate an attempt to override the orientation of the architecture so that the cult figure itself receives the first rays of the rising midwinter sun (fig. 87). The placement of the cult statue north-eastward of the main axis might be interpreted as deriving from a need to compensate for the altitude of the mountains. This suggests that the temple's position was set according to a different target, and that the positioning of the cult statue was determined by the need to allow the penetration of natural sunlight in winter onto the statue. Instead, the asymmetrical position of the cult statue with respect to the axis of the temple may be telling as it indicates an intention to reconfigure

[1840] Str. 3.5.9, Escacena Carrasco 2009, 112.
[1841] Cristofaro 2022.
[1842] Williamson 1993.
[1843] Mylonopoulos 2011, 270; Sassu 2018.
[1844] Summer solstice sunset and winter solstice sunrise are on the same line and on the opposite *versus* in any observation point. However, the presence of uneven skyline creates divergences in such symmetry.
[1845] D'Alessio 2009, 22.
[1846] D'Alessio 2009, 23.
[1847] Partida 2020, 180.

– possibly in a later phase – the sacred direction. The Lattari mountains would have obscured the winter solstice sun rising and moving further south, until its light would have finally emerged and shone above the skyline by entering the temple along a diagonal line, perfectly intersecting with the statue with its rays of light.

An alternative or, rather, complementary interpretation is worth mentioning at this point. At the time of the summer solstice, the full moon would have risen in front of the Doric Temple just in time with the sun setting on the opposite side of the temple[1848]. Furthermore, if the sunset aligned with the temple axis every year at summer solstice, the rising summer solstice full moon would match with the main axis of the temple once every 18.6 years, when the inclination of the moon's orbit with respect to the ecliptic was at its minimum; this occurrence is called a minor lunar standstill[1849]. The moon's position varies according to a cycle of 18.6 years: when the moon reached its minor extreme (declination -18.25°), the lunar disk was getting close to aligning with the temple axis to the south-east (azimuth 120.5°, altitude 6°, declination -18.48°). During the other summer solstices, the full moon would have risen further south within a range of 10° of azimuth on the local horizon, above the Lattari mountains. This combination of celestial events might have provided a cosmic justification for a possible nocturnal full moon festival, beginning with the view of the summer solstice sun setting behind the temple in synchronicity with the rising of the full moon in the opposite direction. Evidence of such a sun and moon association is found at the Fondo Patturelli sanctuary in nearby Capua, where an *Iuvila* inscription translates as 'during the moon festivals, which should/would take place before the summer solstice' from *siais minnaris pas prs suleis bias nessimas fusent*[1850]. Even though these inscriptions are concerned with religious festivals of local aristocracy in pre-roman Capua datable to the early 3rd century BC, they still bear witness to the observance of a summer solstice full moon festival in the region. As a symmetrical custom focused on the sun and the moon, at that precise time when the summer solstitial full moon was rising at sunset, the sky was considered to be ἀμφιφῶς, which means illuminated by both sides[1851].

[1848] RUGGLES 2015a, 468.
[1849] There are no classical written sources indicating the lunar standstills or lunistices; RUGGLES 2015a, 467.
[1850] POCCETTI 2016a, 261.
[1851] CALIÒ 2020, 313.

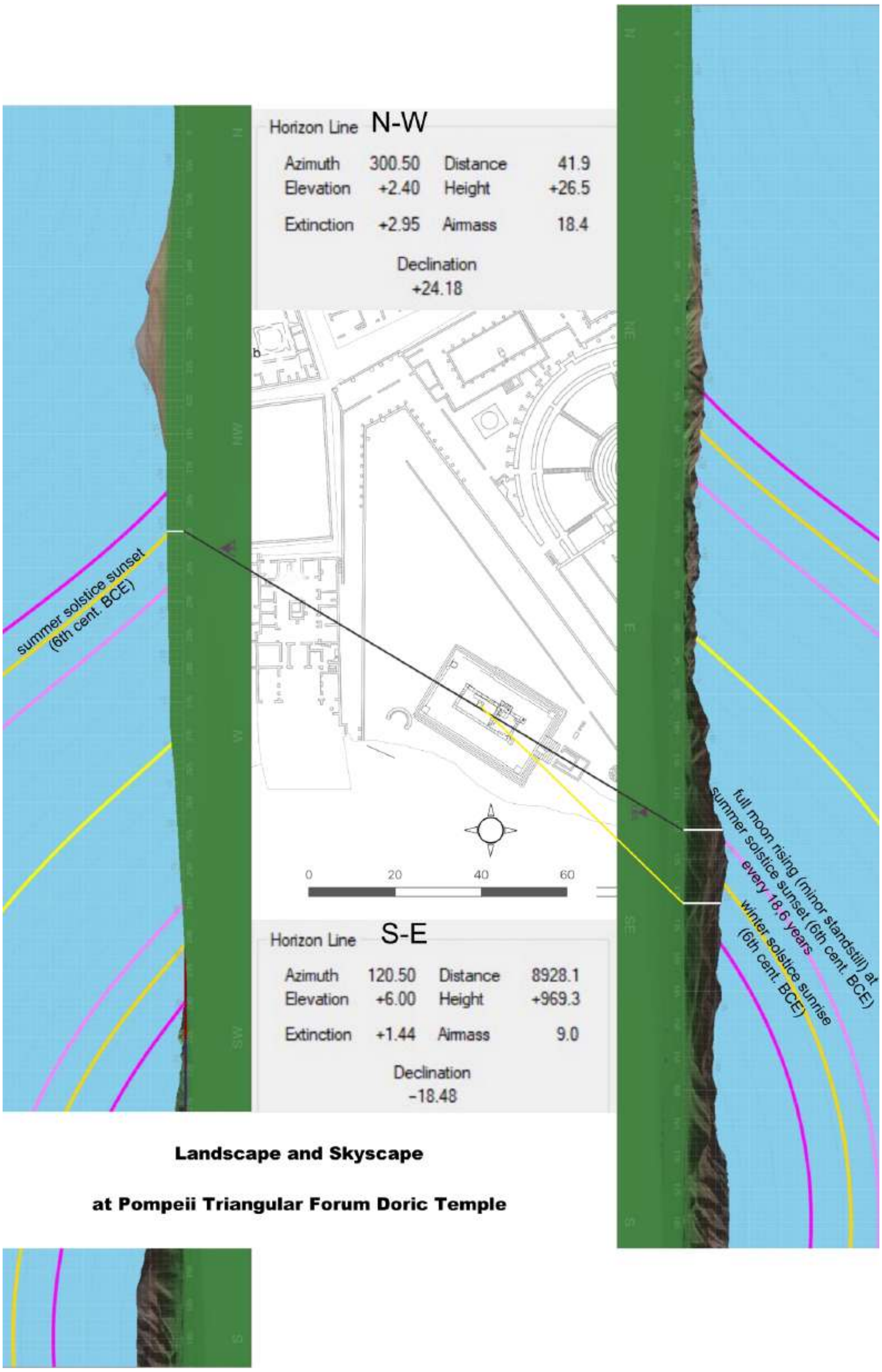

Figure 86. Skyscape and Landscape from Pompei Doric Temple. Elaborated by the author with Horizon© ANDREW SMITH 2022.

Figure 87. Virtual anastylosis of the Doric Temple cella illuminated by sunlight from the sun rising at winter solstice. The statue base is completely illuminated. Elaborated by the author after photogrammetric model with MetaShape Pro and Blender v.2.9.

Foundation Ritual

Nissen suggested that Pompei was a *templum*[1852], though I. M. J. Valeton, Thulin, Castagnoli, and Sommella contradicted that hypothesis[1853]. For Giulio De Petra, writing in 1869, the Samnite part of Pompei, that is the eastern part, according to the regularity of the grid, makes it evident that «la città italica conteneva una stretta applicazione del templum, ossia dei principii della limitazione che in questo si radicavano»[1854]. In the context of urbanisation in the Italic peninsula, Massimo Osanna and Stéphane Verger, in the introduction to their recent volume *Pompei e gli Etruschi*, suggested that an Etruscan settlement would look to have been centred on a viary axis which structured the urban space[1855]. According to the scholars, in Pompei the *spectio*, related to the main position of the sun, might have reproduced the first observation performed by the augurs to locate the city within a cosmos[1856].

In Pompei, this research has shown that the focus is on solstitial orientation; thus, all such matters are determined by the solar cycle independently of any calendric count; similarly, the town's foundation, probably with a strong Etruscan influence [1857], cannot be compared to any Roman calendric date. In past research, solstitial patterns in Roman colonies have been directly related to

[1852] NISSEN 1869.
[1853] CASTAGNOLI 1956b; SOMMELLA 1991, 180.
[1854] DE PETRA 1869.
[1855] OSANNA - VERGER 2017, 16.
[1856] The authors mentioned the direction of Via Stabiana possibly coincident with the observation of the winter solstice rising sun, but the difference is more than 15°. They might have referred to the drawing in the book of ESCHEBACH 1995, 56; OSANNA - VERGER 2017, 17.
[1857] OSANNA 2019b.

Roman festivities [1858]. Certainly, in Pompei in Roman times, a correspondence with the festivity of Fortuna can be detected, though confirmation of that is not antecedent to the 1st cent. BC, much later than the town's foundation. The construction of the Temple of Fortuna at Pompei was a private endorsement, but still placed at a central crossroads of the urban centre, where the public and private spheres seem to merge[1859]. The temple's orientation aligns perfectly with the sun's position at summer solstice, emphasising that the day of the summer solstice was dedicated to Fortuna, even though the cult building should be read as adapting its space on an already busy urban grid. Following Nissen's theory, it can be suggested that the foundation day of Pompei at the turn of the 7th cent. into the 6th cent. BC – or the restructuration day, for the Samnite period – may have happened on the summer solstice. However, there is a need to fully investigate the plausibility of this hypothesis within a correct chronological framework.

Beyond Nissen's theory of relating the east-west urban axes to foundation days, there is another matter needing to be considered in Pompei. The orientation of the Doric Temple at the Triangular Forum is very important for the present analysis and suggests the intention of 'planning for the sun'[1860]. Indeed, the solar orientation of Pompei to the solstices is statistically significant given the co-presence on site of two independent solstitial orientations [1861]. This calculation follows Schaefer[1862] and Vito Francesco Polcaro *et al.*[1863], who only considered the eight significant solar positions – four solstitial and four cardinal – within a 360° arc. In this regard, it may be possible to apply the idea of an augural *spectio* of the foundation rituals proper to an Etruscan cultural presence. As evidenced by archaeological remains from the Archaic period, the first phase of stratigraphy in the Pompei settlement is very rich of Etruscan inscriptions[1864]. In another Etruscan centre in the Po valley, Marzabotto, the diagonality of the *spectio* recalls the one suggested by the orientation of the Doric Temple with respect to the urban morphology of Pompei. This foundation *spectio* defined the built space but does not directly reflect the orientation of the streets; instead, it defined focal points of the urban grid within an intangible configuration. The built environment, thus, incorporates this augural axis in a subtler way. In Marzabotto, according to Giuseppe Sassatelli and Elisabetta Govi, the *auguratio* and *inauguratio* ritual acts had two different locations, functions, and fates. The former received a monumental structure in the *Arx* and, later, a pebble with a *decussis* was buried under the planking level of the main crossroads[1865]. Based on their interpretation, the annual celebration of the town's foundation was embedded in the disposition of buildings in the acropolis [1866].

Similarly, in Pompei, the liminal 'acropolis' of the Doric temple might have acted as an Etruscan-Italic *auguraculum*. Due to the poor state of conservation of the area, it is not possible to

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[1858] GONZÁLEZ-GARCÍA - RODRÍGUEZ-ANTÓN - BELMONTE 2014, 116.
[1859] At the cross-road between Via della Fortuna, Via delle Teme, Via di Mercurio, and Via del Foro.
[1860] CRISTOFARO - SILANI 2021.
[1861] CRISTOFARO - SILANI 2021.
[1862] SCHAEFER 2006.
[1863] POLCARO ET AL. 2011.
[1864] OSANNA 2019b.
[1865] SASSATELLI - GOVI 2010, 36.
[1866] SASSATELLI - GOVI 2010, 36.

confirm this hypothesis, as *auguracula* tend to reflect cardinal directions, even though deviations have been found to occur[1867]. In summary, the Doric Temple can be interpreted as an *Arx*, with the *auguraculum* standing outside but in a visual and ritual relationship with the urban space[1868]. The line of the *spectio* in this case would be in the direction of the summer solstice sunset[1869]. The first tower on the ritual circuit appears to have been the Triangular Forum[1870], suggesting again the primacy of this area for the urban plan. If *lustratio* ceremonies or the *sulcus primigenius* ritual act were performed, it is plausible that the starting point was the Triangular forum and the Herculaneum gate at the end of *Via Consolare* the end point, again where the solstitial direction pointed and the augural direction of the *spectio*. This involves a whole-wall circuit in an anti-clockwise direction and ending where the sun set at summer solstice[1871]. The precise anti-clockwise marking of the twelve towers may indicate, for Poccetti, the religious connection of the urban design with the *templum*'s orientation, simulating Rome's *lustratio* ceremony[1872]. The probable timing of the foundation in Rome was probably sunrise, at least to favour benign portents when taking the *auspicia* [1873]. In the case of Pompei, however and as theoretically proposed, it would be sunset from the Doric Temple and sunrise from the urban plateau.

Among the critical issues in this investigation are the chronological definition of the urban orientation and its phases. It seems that the urban solstitial alignment of Pompei can be dated back to at least a restructuring of the city in the late Hellenistic age at the end of the 4th and the beginning of the 3rd cent. BC. Although, it is possible that there was just a continuation, at that time, of what was already in place from the archaic period and already evident in the configuration of the urban sacred spaces[1874]. The localisation of religious practice in the Temple of Apollo and the Doric Temple must have perpetuated the collective memory of sacredness in these spaces in the minds of the populace. Moreover, there seems to have been a recognition of a relationship between the temporal and the sacred, in that the exact *dies* when the Doric Temple aligned with the sun, the day of the summer solstice, determined the orientation of the Hellenistic urban layout, as a whole. It is not possible to state whether the city retained the same orientation from the Archaic to the Hellenistic period, but it is evident that the sacred spaces preserved the collective temporal memory of foundation through the recurrent seasonality of the sky.

[1867] TORELLI 2005; D'ALESSIO 2013; SASSATELLI - GOVI 2010.
[1868] COARELLI 1983a, 100–101.
[1869] MOSER 2014b, 131.
[1870] COARELLI 2000, 103.
[1871] POCCETTI 2020, 155.
[1872] POCCETTI 2020, 155.
[1873] Ennio, *Annals*, I, 83-100; Cicerone, Div, I, 108.
[1874] OSANNA 2016, 73.

XII. NUCERIA

Introduction

The site is at an important junction in a valley that connects the south part of Campania (Pontecagnano, Fratte) and the south of the Italian peninsula with the Sarno Valley (Pompei, Stabiae) and the Campanian plain[1875]. The foundation of Nuceria can be dated back to between the 7th and 6th cent. BC[1876]. The ethnic character of the community is varied, including the Sarrastres, Etruscans and Greeks, as can be inferred from the rich funerary goods and inscriptions that have been found in these three languages. Its name is of Oscan origin and means ‘the new stronghold’. In the Sarno Valley around the 6th cent. BC, the Etruscan alphabet was the prevailing one[1877]. Inscriptions in the Nuceria alphabet appear from 575 BC, synchronic with Etruscan inscriptions in the Sorrentine Peninsula as a whole[1878].

Around 450 BC, the Samnites took over the settlement and the site acquired the name of Nuceria Alfaterna, from the homonymous Samnite tribe the *Alfaternum*. The city’s importance during this period is indicated by the splendour of the funerary goods up until the Roman age and by when it was named *Urbula*, the small Rome. During the Oscan phase, the urban area was formalised in a rectangular shape with a huge surrounding wall of 1200 m by 1000 m[1879], that is still visible in places. The organization of the streets is orthogonal in nature. Karl Julius Beloch formulated the hypothesis of a Nucerian league, in the tradition of Polybius[1880]. However, Felice Senatore has dismissed that idea due to a lack of evidence to support it[1881]. Independently of the hypothesis of there having been such a league, the importance of the town in the area is still notable, in how it extended its jurisdiction beyond the town itself[1882].

Urban Orientation in Phases

The extent of the urban area is around 120 hectares, comparable to Capua and double that of Pompei[1883]. The lack of material evidence that could facilitate a confident modelling of the urban structure of Nuceria has been recently discussed by Fabrizio Ruffo[1884]. In addition to the fragmentary and minimal nature of such indicators of the past, their chronology mainly relates to the restructuring of the city after the Second Punic War. However, Johannowsky studied the residue left from the destruction wreaked on Nuceria in 216 BC by Hannibal[1885]. The iso-orientation between previous and

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[1875] ESPOSITO 1994, 112.
[1876] RUFFO 2017, 57.
[1877] CERCHIAI 2011, 59.
[1878] CERCHIAI 2010a, 248.
[1879] SOMMELLA 1991, 170.
[1880] Polyb. 3.91.4.
[1881] SENATORE 2001, 201–210.
[1882] CERCHIAI 2011, 58.
[1883] JOHANNOWSKY 1994, 103.
[1884] RUFFO 2017, 58.
[1885] JOHANNOWSKY 1994, 103.

later structures, near the theatre and to the north-west of Santa Maria Maggiore, may suggest pushing back the date of the urban design to an earlier phase[1886]. Specifically, the disposition and chronology of the necropolises to the south, outside the city wall and aligning with the road, would suggest the orientation dates back to the 6th cent BC.

The urban morphology has been traced along three main streets: two *decumani*, the inferior and the superior, and the *cardo*. The *decumanus inferior*, as named by Matteo and Alfonso Fresa, was brought to light and made visible in Via Petrosino at San Clemente after excavation work in 1979–1984 by A. Pecoraro (figs. 88-89). According to Ruffo, the continuation of this axis can be found to the east in Via Sant'Ornato and to the west in a segment of Via Milano[1887]. According to the Fresa brothers, the superior *decumanus* corresponds with Via Campania as traces of it were recovered from underneath the Schiavo family's house at Pareti, and it can be recognised in the continuation of a wall near to the Palazzo Fresa[1888]. Subsequently, the superior *decumanus* was identified as being in line with the modern main road SS18. The *cardo* appears to correspond with Via San Pietro. Marisa De' Spagnolis added a further east-west axis north of the inferior *decumanus*, which would have run tangentially to the amphitheatre[1889]. In Pizzone, a further extra-urban road was discovered, in the context of a Roman necropolis, as a continuation in what is now the SS18 road[1890]. The resulting two-fold division of space traced by the *decumanus inferior* and the *decumanus superior* was further integrated with several other axes. In particular, Ruffo identified eleven east-west axes and seven north-south ones within a modular arrangement that made use of the double *actus*, typical of a Roman town between the 3rd and the 1st cent. BC[1891]. In relation to the Samnite period, Ruffo considered the existence of the three above mentioned streets[1892]. For Sommella, an inter-axis of 42 m between the east-west streets and 150 m could be perceived, thus suggesting a *per stringas* layout[1893]. In modern times, the river was channelled parallel to the streets, therefore it might have been a constraint even in the ancient times[1894]. Moreoever, the urban morphology of Nuceria may be seen as the materialisation of the development of some extra-urban viability axes. Beloch described the fortunate position of the settlement as a useful junction between the Campanian plain and southern Italy's Magna Graecia through the Sarno Valley[1895]. The *decumanus inferior* exits from the urban area deviating towards the north-east and, on the west, towards Pompei[1896]. The *decumanus superior* leads toward the area of Salerno and towards Stabiae in the west.

[1886] JOHANNOWSKY 1994, 103; See V. Panebianco, in *Apollo II-III,* 1973-74, 190ss.
[1887] RUFFO F. 2016, 60.
[1888] FRESA - FRESA 1974, 65.
[1889] DE' SPAGNOLIS CONTICELLO 1990.
[1890] DE' SPAGNOLIS 2006.
[1891] RUFFO 2017, 65–66.
[1892] RUFFO 2017, 67.
[1893] SOMMELLA 1991, 170–178.
[1894] LUONGO - MAGNETTA 1994, 26.
[1895] BELOCH 1989, 280.
[1896] DE' SPAGNOLIS CONTICELLO 1994; SORICELLI 2002.

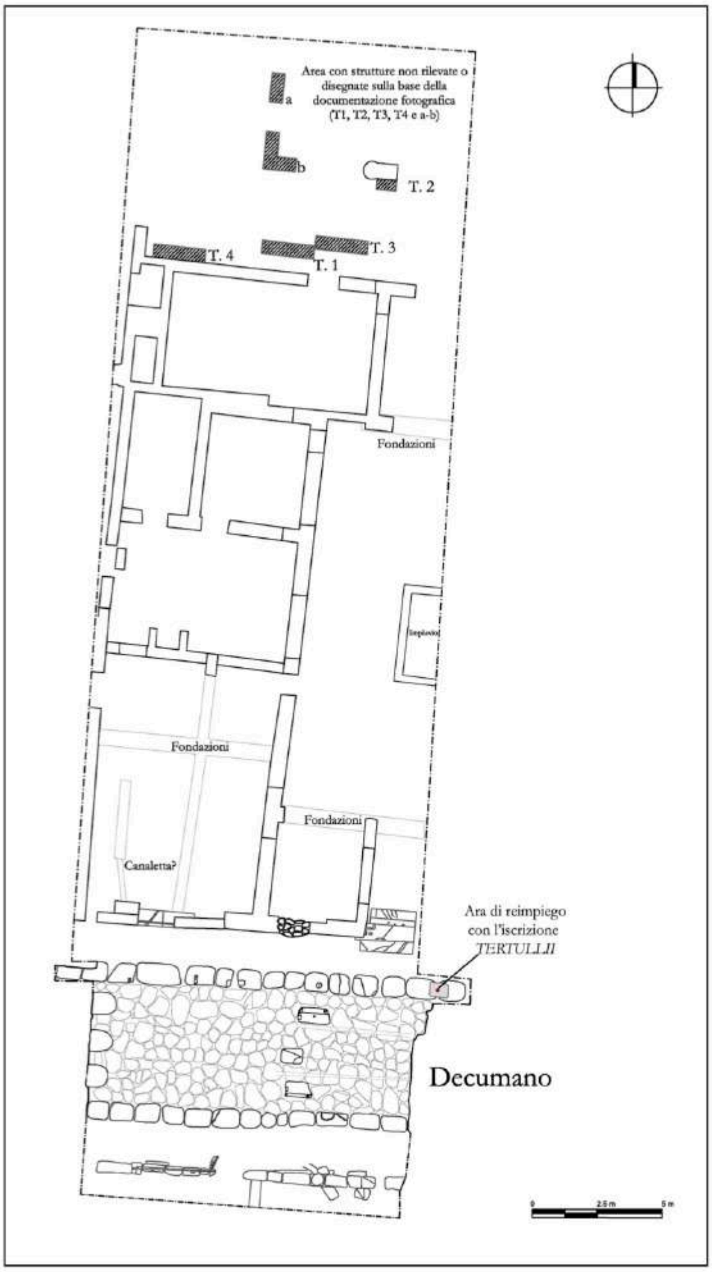

Figure 88. The decumanus inferior at Fasolino property, Nocera Superiore. General planimetry of the excavation. After PERDUTO - COROLLA - SANTANGELO 2019, 119[1897].

[1897] PERDUTO - COROLLA - SANTANGELO 2019, 119.

Figure 89. View of the *decumanus inferior* looking towards east. Photo by the author (September 2022).

Table 22

Phase	Data	Reference System	Data Source	Azimuth
2nd cent. BC	5° E	Cartographic	RUFFO 2017, p. 59	5° 95°

Skyscape Analysis of the Urban grid

A possible astronomical orientation displayed by the urban morphology was considered by Werner Johannowsky[1898]. To the north, the orientation of the urban grid 5°az. does not point towards Mt. Torrenone (359°az., 5.6°alt.) but towards the left slope of Mt. La Foresta (fig. 90). The peak of Mt. La Foresta stands at 7° az., 5.7° alt., and it does not have any feature to suggest it was the target of the urban grid. In the south, the urban area is surrounded by Monte Lattari, creating quite a high-profile horizon. To the west, there is a clear view of the flat plateau. The east-west axis of Nuceria is directed towards the rising sun at the equinoxes; this correspondence seems worth mentioning as it is possibly intentional (fig. 91). The 'equinox' here corresponds to the day counted midway between

[1898] JOHANNOWSKY 1994, 103.

the solstices, as typical of Classical and Roman thought[1899]. The date of the urban planning of Nuceria is only corroborated at a later stage some time after its foundation, although an Etruscan-Italic foundation ritual would fit with an astronomical orientation of the town. The deviation of 5° from the cardinal directions might be indicative of a knowledge of the equinox typical for the time.

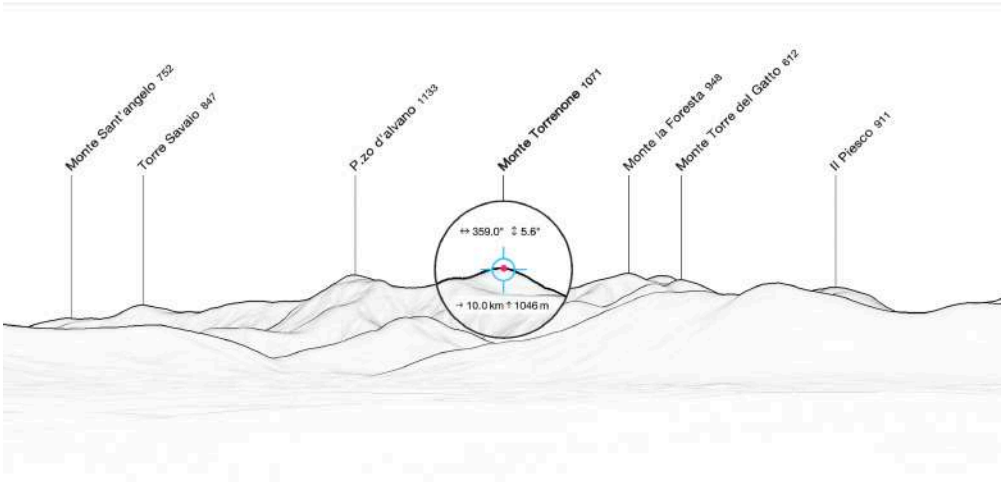

Figure 90. Looking towards the north from Nuceria cardo (5°az), but not exactly in the direction of Mt. Torrenone (359°az). Elaborated by the author with PeakFinder webservice.

Figure 91. Landscape and skyscape visibility from Nuceria in line with the urban axes. Elaborated by the author with Horizon© ANDREW SMITH 2022. See Plate XII.

Table 23

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
	E	600 BC	40.74	95	6.1	+0.21	Mt. Piesco Grande (5.7 km far)	Equinox (ancient definition) sun rising
	W	600 BC	40.74	275	0	+3.72	Towards Pompei	Spica setting (δ = +3.7°)
	N	600 BC	40.74	5	5.4	+54.38	Mt. La Foresta (8.8 km far)	
	S	600 BC	40.74	185	17.5	-31.57	Mt. Sant'Angelo di Cava (3.3 km far)	

[1899] See the discussion on the several definitions of 'equinox' in section 2.1.3, Chapter Two.

XIII. STABIAE

Introduction

An ancient settlement arose here near the modern town of Castellammare di Stabia (SA), on the plateau called Varano. The promontory is on the northern slope of the Lattari Mountains, and the ancient geomorphology would have given the impression that it was overhanging the sea[1900]. The site was key for the road network between Pompei and the Sorrentine Peninsula, also acting as a connection point between Nuceria and Surrentum. The urban settlement was integrated with Roman villas of *otium* such as Villa San Marco, which is datable to the Late Republican and Imperial period. Excavation activities that occurred in the middle of the 18th cent. were reopened by Libero d'Orsi in the 1980s. In this more recent time, the excavated site extended over an area of around 4.5 hectares. Libero d'Orsi excavated the pre-79 AD occupation in a residential area, particularly focusing on villas included within the urban grid.

The Archaic Town

Evidence of human activity in this place extends back to the Neolithic Age. The first stable settlement developed in the second half of the 7th cent. BC, as can be inferred from a study of the Madonna delle Grazie necropolis[1901], where the aristocratic grave goods seem indicative of Etruscan influence and habits. The Etruscan presence in the territory is witnessed by a great quantity of inscriptions that continue to be evident up until the end of the 5th cent. BC.

The Oscan Town

The 'Samnitisation' of the area is assessed to have occurred from the second half of the 4th cent. BC in the context of a generally increasing population, as is common in the whole of Campania in this period[1902]. Samnite control of the city continued until the first decade of the 1st cent. AD, when the city was besieged by Silla during the Social War. Then bereft of its political autonomy, the city was subjected to significant levels of demolishment after its territory was annexed by Nuceria, that had been loyal to Rome during the military operations. An extra-urban sanctuary at Privati on the slope of Mt. Faito was found to have existed from the end of the 4th cent. BC, though traces of an earlier use of the site have also been uncovered[1903]. Most of the votive materials are from the end of the 4th–3rd cent. BC and are related to the role of the female in fecundity [1904]. Minerva and Hercules antefixes were recovered and recognised to be of the same mould as those which decorated the Pompeian Doric Temple in its Hellenistic phase [1905].

[1900] OSANNA - RESCIGNO 2021, 215.
[1901] MINIERO 1987; SODO 2009.
[1902] OSANNA - RESCIGNO 2021, 216.
[1903] MINIERO 1987, 179.
[1904] MINIERO 1987, 181.
[1905] MINIERO 1987, 184.

Urban Orientation in Phases

The size of pre-Roman Stabiae is difficult to determine but probably extended over an area of around 45000 m^2, where the settlement was laid out to work in harmony with the original orographic contours, being probably within the two valleys created by the fluvial courses. Two orthogonal axes are present in the urban morphology (fig. 92). The Oscan foot was recognised by Andreas Oettle as the unit of measurement used in the layout[1906]. However, after a road was recovered that was 5.20 m wide and made of beaten-earth and tuff flakes, Fabrizio Ruffo preferred to trace the urban grid back to the later Roman period and the post-Sillan destruction[1907].

Table 24

Phase	Data	Reference System	Data Source	Azimuth
/	N 10° W	Cartographic	WEBER	80°
/	N 10°–12°W	Cartographic	RUFFO 2009, 96	78°–80°
/	78° ± 2°	Geographic	LiDAR DMS 1m	78° ± 2°

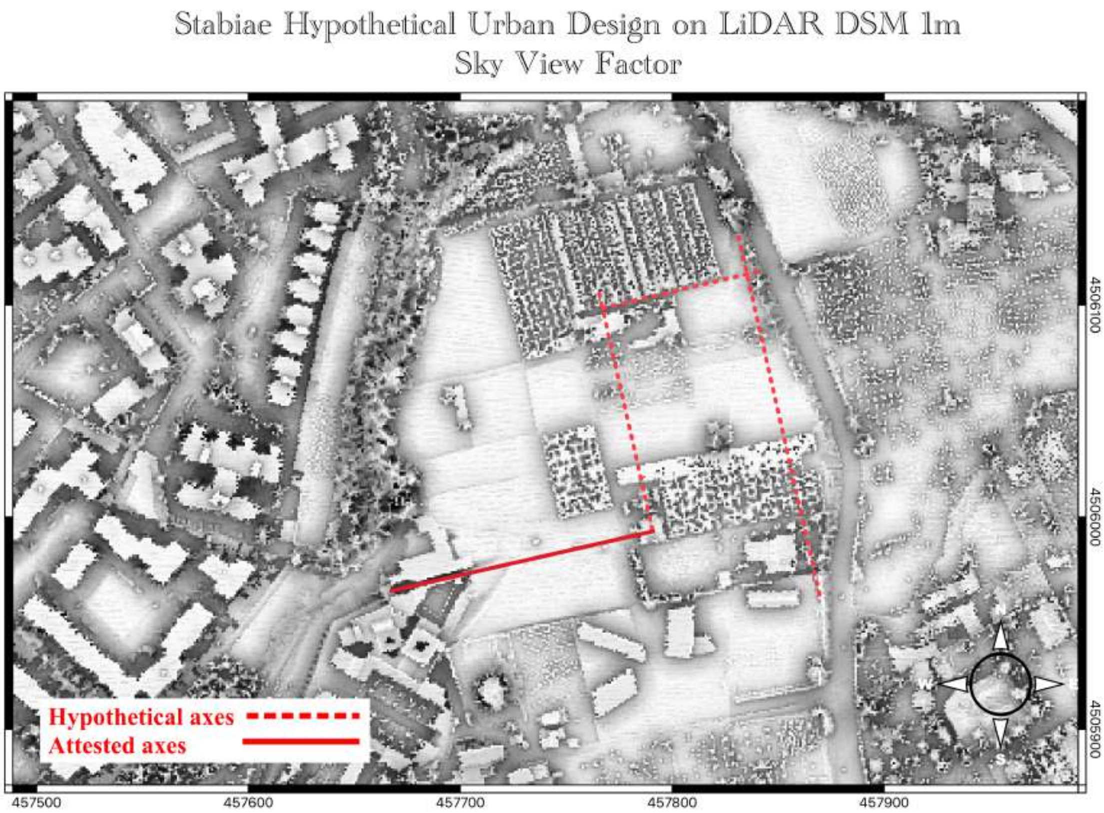

Figure 92. Urban form of Surrentum after RUFFO 2009 on LiDAR DSM 1 m resolution with Sky View Factor Relief Visualisation. Elaborated by the author.

[1906] OETTEL 1996, 164–165.
[1907] RUFFO 2009, 97.

Skyscape Analysis of the Urban Grid

On the east side of the town, the urban axes point towards an azimuth of 78°. At that point on the horizon, the sun would have risen 60 days before and after summer solstice (in around 300 BC). Furthermore, the heliacal rising of the Pleiades in early summer would have been seen along the same orientation (figs. 93-94). However, this astronomical orientation with the rising position of the Pleiades is more accurate for an earlier time, fitting best with that of the foundation of the settlement in the Orientalising period. The same astronomical orientation is present at Capua. On the south side, the urban axis points with good accuracy towards the nearby Mt. Pendulo, which might have been used as reference point in the landscape for planning the urban design (fig. 93). To the north, Mt. Somma-Vesuvius is almost targeted whereas, to the west, the direction of the town's axes sight the sea.

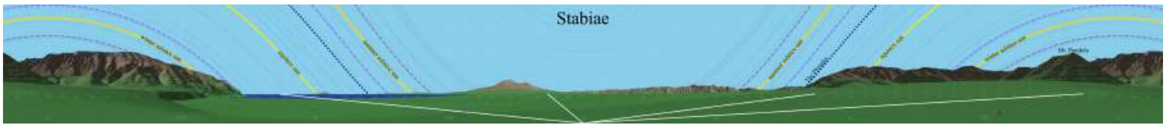

Figure 93. Landscape and skyscape visibility from Stabiae in line with the urban axes. North is in the centre. Elaborated by the author with Horizon© ANDREW SMITH 2022. See Place XIII.

Table 25

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
Debris road integrated within San Marco villa	E	300 BC	40.71	78	4	+11.70	Mt. Faiostello	sun rising 60 days before/after summer solstice (Pleiades δ=14.4° in 300 BC; δ=12.2° in 700 BC)
	W	300 BC	40.71	258	-0.2	-9.02	Sea	
	N	300 BC	40.71	348	1.6	+49.42	Volcanic complex Mt. Somma-Vesuvius	
	S	300 BC	40.71	168	12.2	-35.94	Mt. Pendolo (2 km far)	

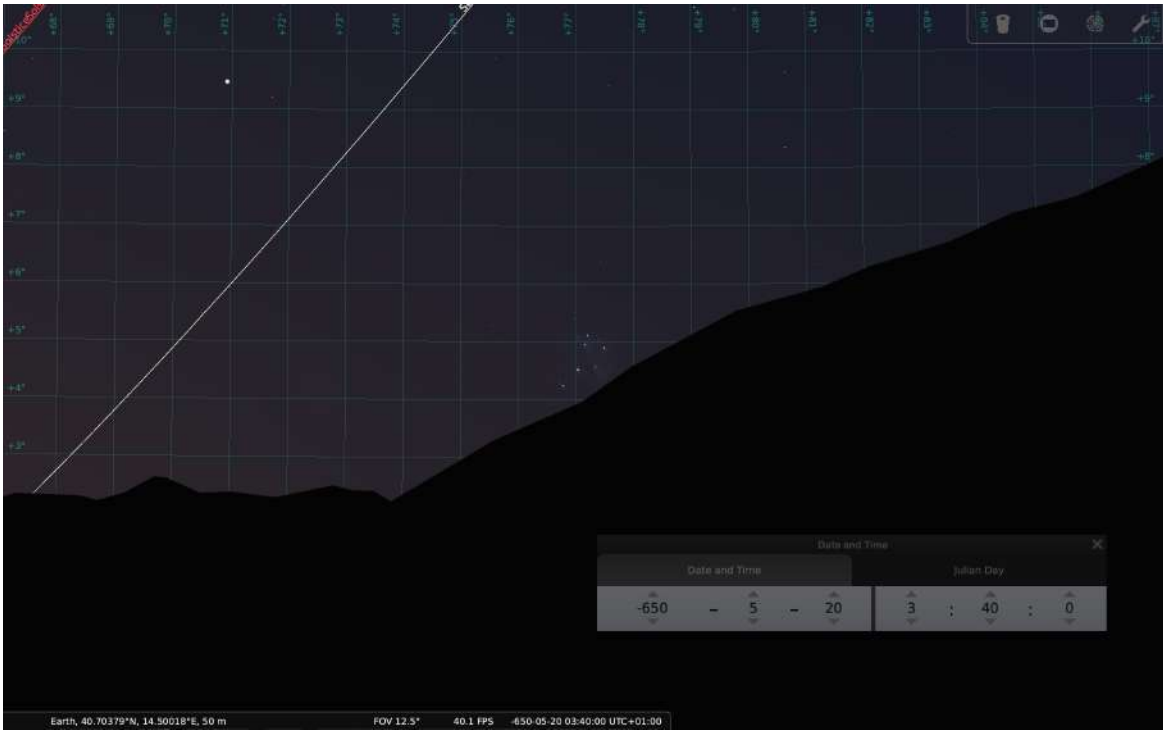

Figure 94. The Pleiades constellation rising in the Orientalising period in line with Stabiae axes. Elaborated by the author after Stellarium V.22.2 and PeakFinder local landscape.

XIV. SURRENTUM

Introduction

The ancient site of Surrentum is below that of modern Sorrento, at the end of the Sorrentine peninsula. The plateau is constrained by the geomorphology of the area and the vicinity to the sea. Surrentum was the main centre of the peninsula[1908]. The mythical foundation of Surrentum is credited to Liparo, son of Ausone. According to Breglia Pulci Doria, the toponymy of Surrentum indicates a connection with the Sirens cult, also present in the peninsula at the Punta Campanella sanctuary[1909]. The major cults of the peninsula were indeed dedicated to the sirens, as well as to Athena. The destruction and abandonment of the ancient site happened during the 79AD eruption.

The Proto-Urban Phase

The first archaeological evidence of occupation of the area of Surrentum are two vase fragments datable to just before the second half of the 8th cent. BC[1910]. During the course of the 7th cent. BC, the community identified itself with a warrior elite, as can be inferred from the connotations conveyed by recovered burial goods. The Sarrastan tribes occupied the Sorrentine peninsula, in its woodlands and fields, exerting control over nearby valleys and communication networks[1911]. The burial customs of the *symposion*, the importation of ceramics, the Etruscan inscriptions along with those in the local Nucerian language, indicate an open panorama of exchanges with other groups in the wider Mediterranean context[1912]. Several necropolis areas are confirmed as having been erected between the end of the 7th cent. BC and the end of the 6th cent. BC, such as at Sottomonte, Sant'Agnello, Piano, and at the Deserto di Sant'Agata dei due Golfi[1913].

The Archaic Town

From the 6th cent BC, the life of the urban area appears to have been more stable, given the delimitation and disposition of the tombs around the living zone and the recovery of an antefix of Kyme production suggesting the presence of monumental buildings[1914]. At Cancellieri, part of an Archaic structure (6th –5th cent. BC) was uncovered at its foundation level; this building was not oriented in the same way as the surrounding structures[1915]. From the planimetry of the excavation, it is possible to quantify a divergence between the building and the surrounding structures of around a few degrees[1916]. The heterogeneity of the community in Surrentum in the Archaic period is proved by the inscriptions found there; these show italic traditions, not Etruscan but ones more dependent on

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[1908] BUDETTA 1999, 9.
[1909] BREGLIA PULCI DORIA 2016.
[1910] CLAUDE ALBORE LIVADIE 2010, 168.
[1911] CLAUDE ALBORE LIVADIE 2010, 168.
[1912] CLAUDE ALBORE LIVADIE 2010, 169–171.
[1913] RESCIGNO 2010a, 177.
[1914] RESCIGNO 2010a, 180; OSANNA - RESCIGNO 2021, 218.
[1915] DE CARO 1995, 701.
[1916] BUDETTA 1996, 2; 1999, 52.

Sabine and Umbrian roots[1917]. The contact with Greek culture and the acculturation models that developed is confirmed by the use of Greek names. In this context, the Etruscans played a synoecismatic role, prevailing in the coastal hubs with cabotage navigation[1918].

From the middle of the 6th cent. BC, there is archaeological evidence of an extra-urban sanctuary at Punta della Campanella[1919]. The grand aspect of the temple is confirmed by recovered leonine masks, typical of Poseidonia and in the Achaean style, similar to the decorative details found at the Doric Temple in Pompei[1920]. The temple sanctuary was renovated between the end of the 5th and the 4th cent. BC which, according to Rescigno, indicates the political impact of Neapolis on the gulf as a whole[1921]. Unfortunately, there is no topographical evidence of structures at this sanctuary. The localisation of the temple at the extreme point of the peninsula was confirmed by the recovery of a cave inscription (2nd cent. BC) mentioning three *meddices Minervii* undertaking restructuration works on their way to the sanctuary[1922].

The Oscan Town

A reorganisation of the urban layout took place in the 4th–3rd cent. BC. Among the earliest structures showing this new urban orientation are those that can be observed at the excavation at Porta Parsano, a city gate where a *cardo* transited in alignment with the gate's wall; this excavation has confirmed the chronology of the revised urban layout[1923]. Moreover, a meeting point between a *cardo* and a *decumanus* with structures datable to the Samnite period was found beneath the Cappella Donnorso [1924]. Habitative structures from the Samnite period were also recovered at Via della Pietà[1925]. Also relevant to this phase is the wall circuit in tuff stone and *opera quadrata,* encircling the town and creating an enclosed area of 24 hectares[1926].

Urban Orientation in Phases

The urban morphology of modern-day Sorrento is mostly a continuation of the ancient layout of Hellenistic Surrentum, as was first suggested by Karl Julius Beloch[1927]. Paolino Mingazzini and Fridericus Pfister identified 8 *decumani* and 8 *cardi*[1928]. When considering the excavation at Cancellieri, the orientation of the Archaic town seems different from that of the later Hellenistic layout[1929]. Via San Cesareo was identified as one of the major *decumani,* corresponding in alignment

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1917 Budetta 1999, 46.
1918 Budetta 1999, 46–47.
1919 Rescigno 2010a, 181.
1920 Rescigno 2010a, 185.
1921 Rescigno 2010a, 187.
1922 Budetta 1999, 43–45.
1923 De Caro 1995, 702; Budetta 1999, 50–51.
1924 Rescigno 2010a, 189.
1925 Budetta 1996, 132–134; Russo 1999, 204.
1926 Rescigno 2010a, 190.
1927 Rescigno 2010a, 177; Budetta 1999, 49.
1928 Mingazzini - Pfister 1946, 31.
1929 De Caro 1995, 702.

with the main pre-Roman east-west axis including that of Via San Paolo[1930]. Indeed, systematic research of the urban layout by Tommasina Budetta, ongoing since 1993, has confirmed the antiquity of via S. Maria della Pietà as the superior *decumanus*, and via S. Nicola-via Santa Maria delle Grazie as the inferior *decumanus*[1931]. The *cardo* would appear to be via Tasso in this context[1932]. Additionally, a beaten-earth road was found running north-south at Corso Italia 35, which would indicate another *cardo* of the town[1933] as well as at via Padre Reginaldo Giuliani[1934].The resulting urban layout is composed of three parallel strips, with two main *decumani,* a superior and an inferior one, and another three minor *decumani* (figs. 95–96)[1935]. According to Budetta, this layout can be reckoned to have been in place between the 4th and 1st cent. BC[1936]. However, according to Mario Russo, the disposition of the necropolises may suggest an antecedent organised occupation[1937]. In total, the design comprehends six rows of *insulae* with dimensions of 60 m in width by 75–85 m in length. In the Augustan epoch, many streets were demolished to make way for the construction of luxurious villas, prior to the partial destruction caused by the 79AD eruption.

Table 26

Phase	Data	Reference System	Data Source	Azimuth
6th –5th cent. BC	/	Cartographic (Planimetry)	BUDETTA 1996, fig. 2	/
4th –3rd cent. BC	75°	Cartographic	RESCIGNO-SENATORE 2009, 433-435.	75°

[1930] RUSSO 1999, 197.
[1931] DE CARO 1995, 700; BUDETTA 1999, 49.
[1932] RUSSO 1999, 198.
[1933] DE CARO 1995, 700–701.
[1934] RUSSO 1999, 197.
[1935] RESCIGNO 2010a, 190.
[1936] BUDETTA 1999, 49.
[1937] RUSSO 1999, 204.

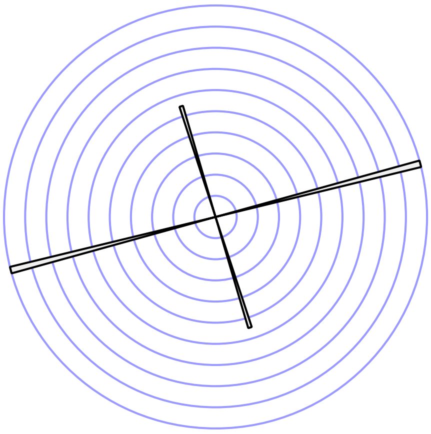

Figure 95. Surrentum Polar Diagram. Elaborated by the author with Line Direction Histogram plug-in in QGIS on vectors drawn on LiDAR DSM 1m resolution.

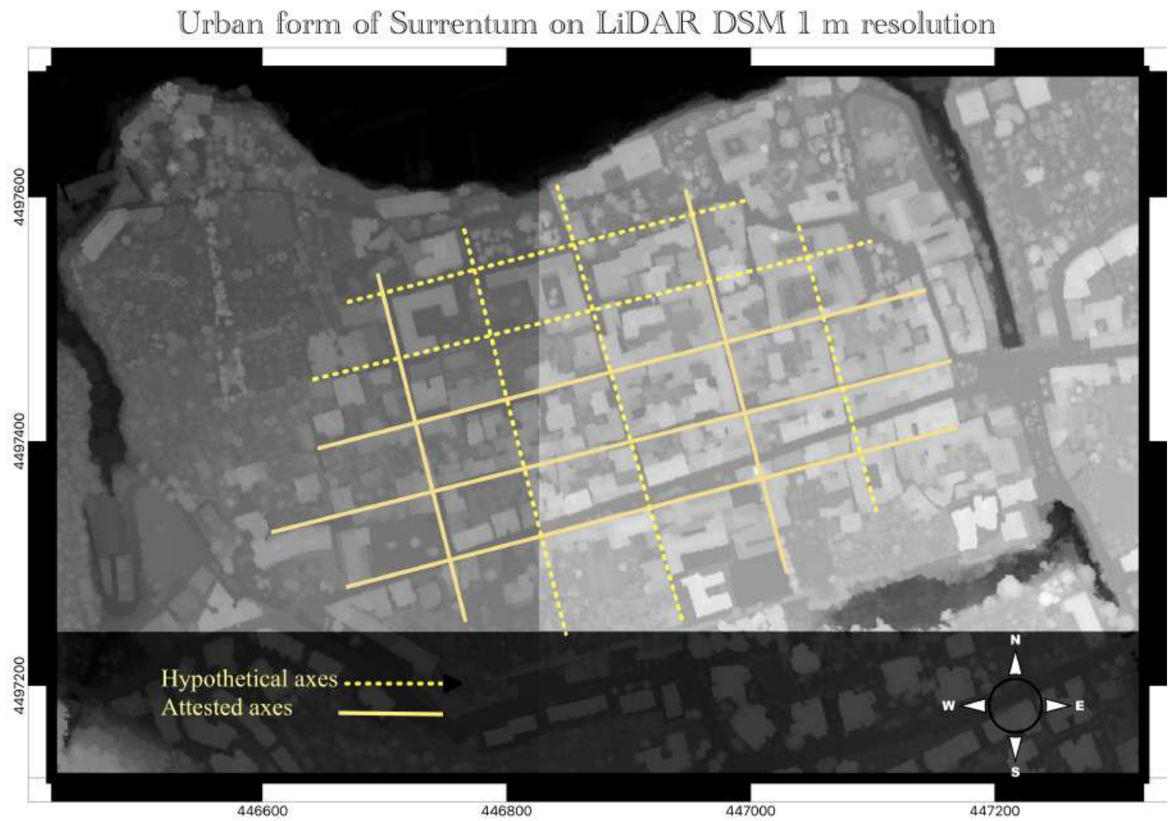

Figure 96. Reconstructed urban form of Surrentum on LiDAR DSM 1m resolution after RUSSO 1999. Elaborated by the author with QGIS.

Skyscape Analysis of the Urban Grid

In the east, the urban axis of Surrentum points towards the Lattari Mountains between Mt. Crocione and Mt. San Michele (fig. 97). Rising above these mountains, the sun would have been seen in the Taurus constellation around 50 days before the summer solstice. A couple of weeks later, the Pleiades asterism would have been seen in that same direction in its heliacal rising before dawn; this means that the constellation started to be visible after a period of around 40 days from the previous spring equinox, during which time the constellation was hidden from view. To the west, the urban axes point towards a hill 1 km away, with the sun setting on that line around 14 days from the equinoxes. To the north, there is an open view of the gulf and the sea whereas, to the south, distant views are blocked by the nearby hills of the Sorrentine Peninsula. The only plausible astronomical event in line with the urban axes is to the east, with the rising of the Pleiades constellation in the north-east around May in conjunction with the rising of the sun. This urban orientation is very similar to that of Capua, Stabiae, Abella, and Suessula.

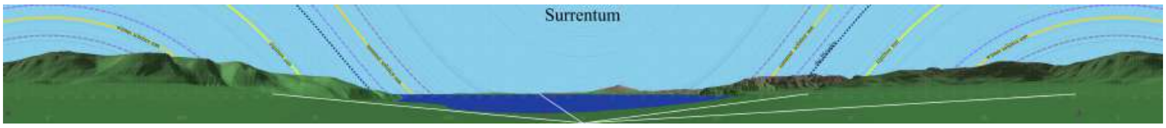

Figure 97. Landscape and skyscape visibility from Surrentum in line with the urban axes. North is in the centre. Elaborated by the author with Horizon© ANDREW SMITH 2022. See Plate XIV.

Table 27

Archaeological structure	Direction	Chronology	Latitude	Azimuth	Horizon Height	Declination δ	Landscape	Skyscape
	E	300 BC	40.63	75.5	6.3	+15.09	Lattari Mountains between Mt. Crocione and Mt. San Michele (11 km far)	sun rising 50 days before/after summer solstice
	W	300 BC	40.63	255.5	7.1	-6.21	(1 km far)	March new moon
***Cardo* behind Porta Parsano Nuovo**	N	300 BC	40.63	345.5	0.4	+47.68	Rocca Chiarano (137 km far)	
	S	300 BC	40.63	165.5	9.5	-38.12	(1.7 km far)	

CHAPTER FIVE. DATA ANALYSIS

1. RESULTS

The following discussion is based on a statistical analysis, also included here, of the sample of case-study orientations that have been described in Chapter Four. As Schaefer and Polcaro stated, the first and most important reliability test in any archaeoastronomical research is a statistical test[1938]. Even though statistics do not have *per se* an epistemic value, it is a fundamental step that can then be complemented by other evidence[1939]. Only the eastern direction of the regular urban grids is assessed in this analysis, within a sky arc of 90° centred in an easterly direction. This corresponds to a range from 45° to 135° azimuth. The reasons behind this choice are the need for relative simplicity in the data analysis, as well as the primal significance of the east-west axis, at least in the context of Etruscan and Roman urban foundation rituals. This analytical approach assumes an orthogonal morphology in the urban designs, even though this is not completely applicable in all case studies, such as in Etruscan Capua. In effect, complementary and similar types of analysis performed using other relevant directions, such as those directed towards the north, do not affect the resultant outcomes. The histogram (fig. 98) is a Gaussian statistic based on the urban orientation of the fourteen case studies outlined. Each case study is referred to with a Roman number corresponding to the order of the Chapter Four studies and the related plate numbers at the end of this thesis. On the x-axis is shown the azimuth value of each east-pointing town axis. Also, the position of the sun at winter and summer are shown as vertical lines for reference. On the right, a diachronic analysis is attempted. The data analysis has thus been broken down into diachronic groups to indicate the possible choices in urban design for the different phases of urbanisation in ancient Campania. The dating attributed to each town is given according to a hypothesised foundation chronology. Admittedly, the chronology of the urban layout, archaeologically confirmed, often does not go back as far as the foundation chronology. Indeed, uncertain chronology is acknowledged for a few sites, such as Herculaneum. Despite this uncertainty, the general preference here has been to work from the probable foundation chronology in order to achieve a better methodological coherence[1940]. It is worth noting, though, that the phase between the 5th–4th cent. BC lacks data due to the simple fact of the absence of new town foundations in that period. As a general observation, there is noticeable trend that urban orientations tend to concentrate on the north-east sector of the sky, being generally clustered in that direction over the passage of centuries. On the left (fig. 98), the histogram shows all fourteen case studies together. A trend can thus be noted of above 3σ. The same results are visualised in polar plots which represent the whole horizon (figs. 99-100). Again, only the eastern urban axes are considered within the data graphs. It must be pointed out that, in the previously mentioned plots, the altitude of the skyline is not included, but only the azimuth or the angular value from north. Therefore, the variability in the data clustering might be due to differences in horizon height on the local skyline. For this reason, a further step is attempted (fig. 101). There, the histogram shows the astronomical declination value of

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[1938] SCHAEFER 2006; POLCARO 2016.
[1939] RODRÌGUEZ-ANTÒN 2017, 20.
[1940] RESCIGNO - SENATORE 2009, 426.

all Campanian towns. This analysis is essential due to the inclusion of the horizon altitude value and the latitude of each site. Again, an important data peak can be noted, though requiring further interpretation in relation to historical and archaeological considerations.

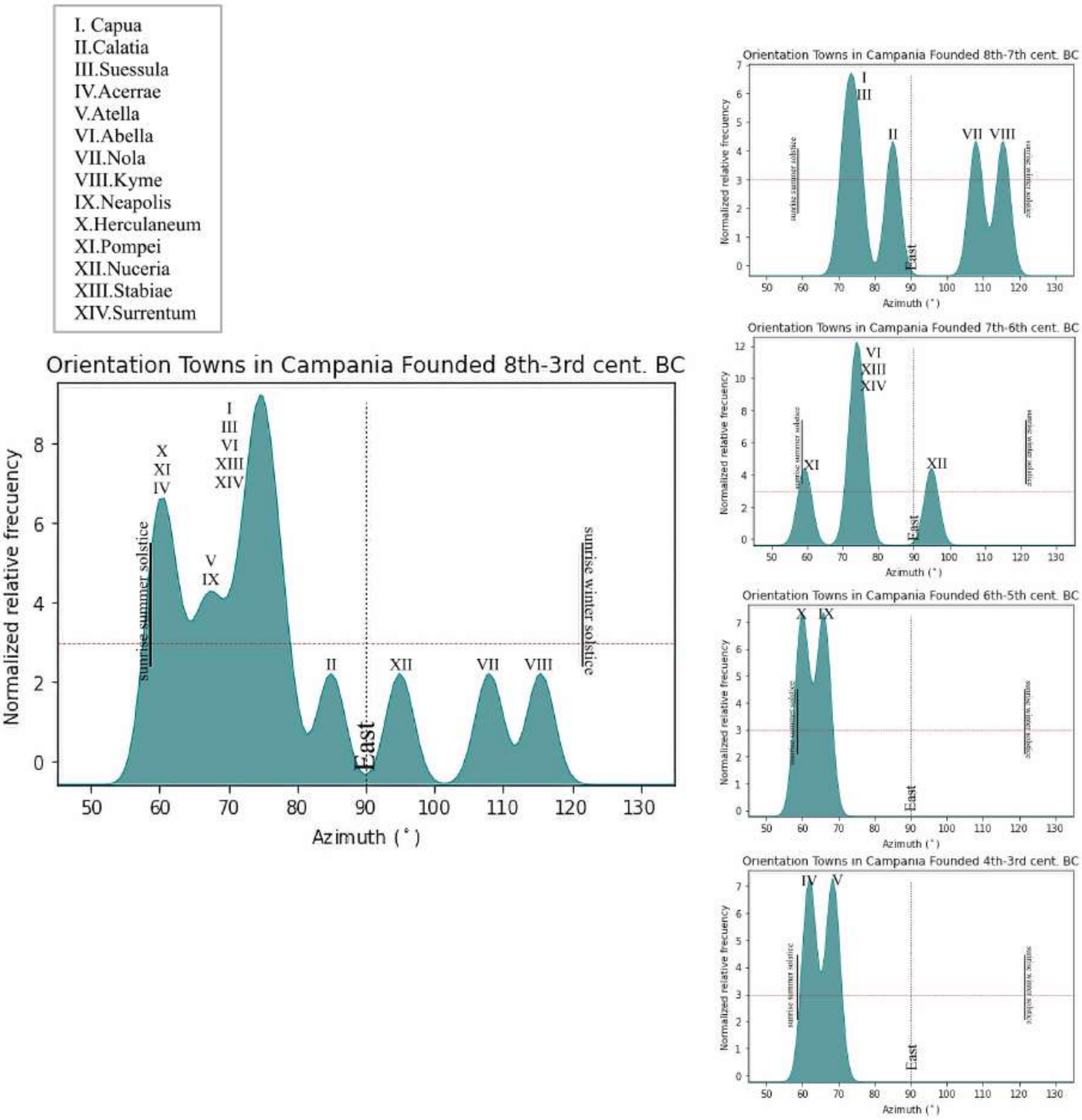

Figure 98. Gaussian statistics based on the orientation of cities in Campania from the 8th to the 3rd cent. BC on the left; on the right, the same data sample analysed according to diachronic phases of town foundations. Elaborated by the author with Python script (Spider v.5) written by A. César González-García and Andrea Rodríguez-Antón.

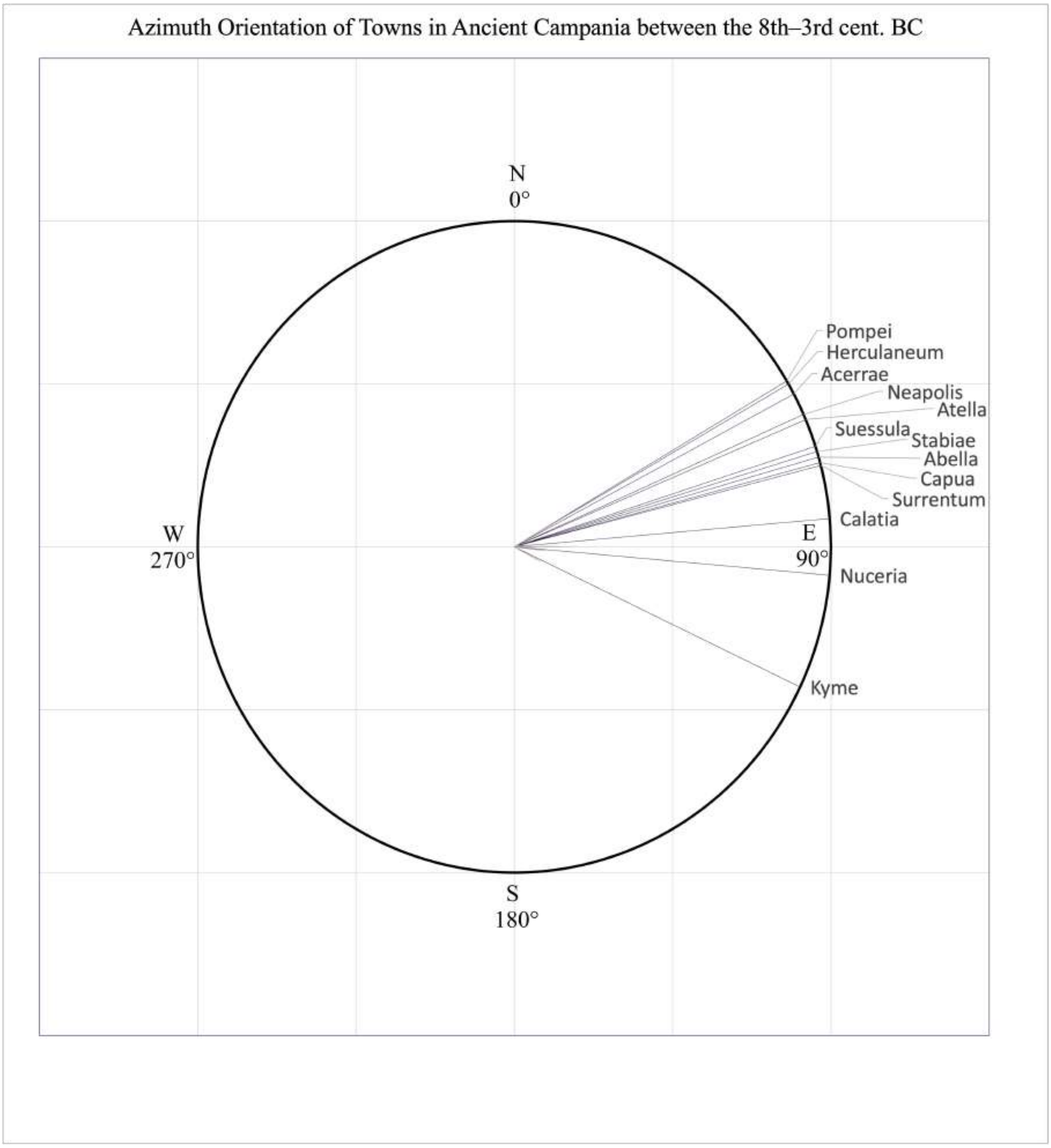

Figure 99. Polar plot on the orientations of cities in Campania from the 8th to the 3rd cent. BC. North in on the top. Elaborated by the author with Excel.

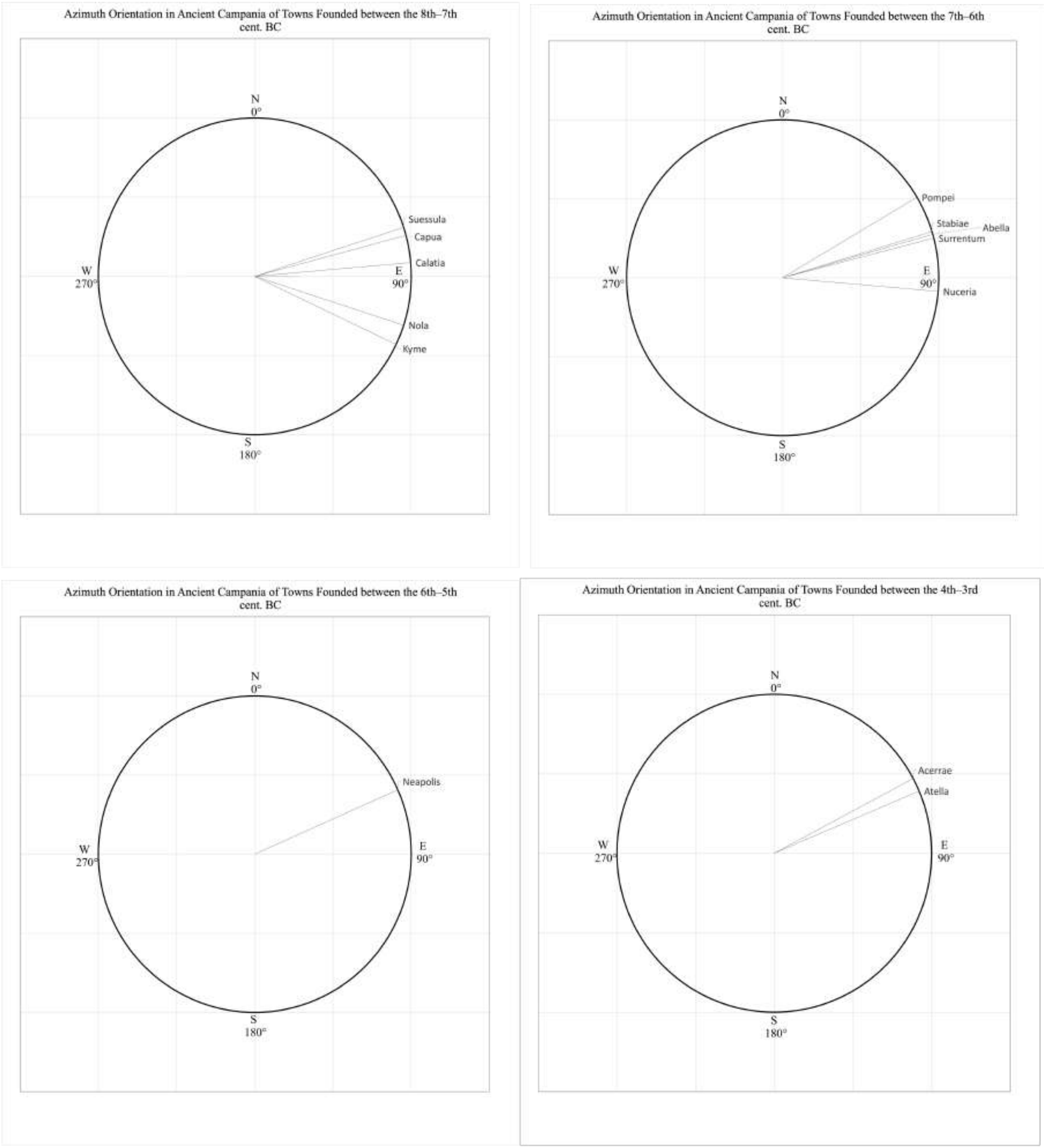

Figure 100. Data analysis orientation divided into diachronic groups to emphasise choice of urban design for the different phases of urbanisation of Campania. Elaborated by the author with Excel.

2. DISCUSSION

8th to 7th BC Foundations

In the 8th–7th cent. BC phase, a distribution tendency is already present around the azimuth 70°–80°, with Capua's and Suessula's orientations, in a trend which will be incremented with successive foundations, as later discussed (figs. 98, 100). The distribution in this early phase, in the 8th–7th cent. BC, shows some anomalous orientations with respect to the general trend. These are Kyme, the only settlement with an urban east-west axis towards south-west/north-east, together with the orientation of Nola which precise layout is difficult to determine anyway. The urban grid for these towns is rotated around 10°–20° clockwise in relation to due north. Adding to the complexity, numerous orientation changes have been attested in the Kyme urban area across the diachronic phases of the town's existence. The main factors that may have prevailed in finally deciding Kyme's orientation could have been water drainage issues and the need for reclamation of what was a marshy environment due to aquifers below ground under the urban plateau[1941].

7th to 6th BC Foundations

By the end of the 7th cent. BC and the beginning of the 6th cent. BC, the foundations of many urban settlements, fostered by a tendency towards synoecism, are in evidence in southern Campania and the Sarno Valley, particularly in Nuceria and Pompei[1942]. This can be seen to have occurred within the wider context of Tyrrhenian maritime emporia such as in Poseidonia, Marcina (Fratte), Gravisca, Ostia, and Massalia[1943]. Calatia can possibly also be included in this list, even though the earliest evidence of an urban grid there can only be dated back to the 4th cent. BC. A direct astronomical, solstitial or cardinal, determination of Etruscan urban design can be recognised in Pompei and Nuceria, in contrast to previous statements on the topic declaring a want of any astronomically derived orientations in these locations[1944]. This perceived method of orientation appears to have been similarly applied in the design of Marzabotto, and possibly at Norba, and appears to have been later adopted by the Romans in the 4th–3rd cent. BC in Calatia and in the whole centuriation around Capua in the 1st cent. BC. This method rested in the direct observation of the sun, towards the eastern sector of the sky arc, at dawn. The slight divergences in the orientation of the grid are due to the different days of the year when the observation was performed. However, the coincidences between the grids and the key solar positions appear indicative of an intentional process in the design of the urban grids in relation to the solstices and equinoxes. In Nuceria, archaeological evidence of a pre-Roman phase is minimal. However, an almost cardinal orientation seems highly credible given that the city's

1941 D'ACUNTO 2020, 40.
1942 CERCHIAI 1995, 99–104; D'AGOSTINO 2011, 77.
1943 RUFFO 2017, 57.
1944 JOHANNOWSKY 1994, 103.

foundation in the Archaic period has an Etruscan component in the foundation ritual[1945]. Italic and Etruscan foundation design may have been related to the actual autoptic observation of the sun to find the direction of 'east'. But, since the sun does not rise every day of the year at the same point on the horizon, these urban morphologies may well have adopted for their orientations the consistent points on the horizon where the sun rises at the equinoxes, as understood in antiquity, or the solstices. This is the very practice recorded later by the Roman agrimensores within the tradition of the *Etrusca Disciplina.* This Italic foundation practice was probably given sacred and ritual significance, as evidenced in Pompei where the peculiar orientation of the Doric Temple at the Triangular Forum pointed very accurately at the summer solstice sunset. This orientation reflects a trend of the Oscan-Samnite, as emphasised for temples after the 4th–3rd cent BC by Pagano and Ruggieri[1946].

This data-analysis summary does not fully explain the urban sector of Siepone in Etruscan Capua, the orientation of which relates neither to the equinoxes nor to the solstices. When the theories of the Etruscan *limitatio* are considered, different times of the year could have been used as providers of stable reference points. Even though this is a small and peripherical sector of the huge town of Capua, its peculiar orientation remains a matter of conjecture and uncertain explanation. Nevertheless, it is worth noting that Capua, Suessula, Abella, Stabiae, and Surrentum all show a very similar orientation of between 72° to 78° azimuth. To this list, some Archaic ditches in Acerrae territory may be added. Statistical analysis was thus applied to declination values, instead of azimuth values, to fully discern a possible astronomical relevance in relation to this cluster of orientations[1947]. In fact, declination by its nature inherently takes account of values of azimuth, latitude, and skyline altitude, within a single data value. The results of the declination plot in the statistical sampling indicated a peak around δ=+18° (fig. 101). This data may be interpreted as the local position of the rising sun around May. It is possible that this event might have been used as a record of a turning point in the seasonal cycle. This moment in the year also corresponds to the heliacal rising of the Pleiades, as already discussed in the 'Interpretation'. In general, the north-east of the sky was the favourable one in terms of the *summa felicitas*. The settlements which show this orientation trend are characterised by a strongly Etruscan-Italic aspect. It is plausible that this orientation model was exported from Capua to other settlements. Also, questions still remain as to whether a unitarian political act took place at Capua during the Archaic period, even though the remains of the neighbourhood of Siepone suggest this, within a sacred topography from the Temple of Diana Tifatina to the Fondo Patturelli sanctuary. If this picture is indeed realistic, a sacred *templum* for the town's foundation might be thus inferred. In the historical context of Campania for the period after the middle of the 7th cent. BC, a hegemonial role for Capua and for the Etruscan aristocracy in the urbanisation of the region seems highly likely[1948]. In the context of the extensive diffusion of its material culture, Capua seems to have become the local agent for commercial and general-exchange dynamics[1949].

[1945] Johannowsky 1994, 103; See V. Panebianco, in *Apollo II-III,* 1973-74, 190ss.
[1946] Pagano - Ruggieri 2011.
[1947] For definition of declination see the section on the 'Celestial Sphere' in the 'Methodology' part, Chapter One.
[1948] Cerchiai 1995, 99–104; d'Agostino 2011, 77.
[1949] d'Agostino 2011, 77.

Thus, it is plausible to assume that this orientation model might have been exported from Capua and spread out across the Campanian plain all the way to the Etruscan groups of the Sorrentine peninsula. An astronomical motivation for this specific orientation might be suggested, although other explanatory models should not be excluded.

6th to 5th BC Foundations

During the 6th–5th cent. phase, Neapolis was founded. The orientation of Neapolis appears not very dissimilar from the previously described orientation trend. Without excluding the possibility of an influence from the model based on the position of the sun at the Pleiades heliacal rising, an innovative urban design may be perceived in Neapolis's foundation. This was a Greek system of urban foundation based on geometry and, maybe on Pythagorean triads. The study of the planning of Neapolis has been telling for many scholars in elucidating urban design practices of the time. According to Fausto Longo and Teresa Tauro, the urban plan of Neapolis is based on the geometric principles of the golden section and the squaring of the circle[1950]. In the view of Alfonso Mele, this design practice can be perceived as part of a Pythagorean tradition present in Tyrrhenian Campania between the 6th and the 5th cent. BC. This planning procedure may have begun from the meridian, that is the cardinal line, exactly north-south. To find the meridian line, a gnomon might have been used according to a common practice based on observing the shadow of the sun, which could have been performed on any days of the year at any two symmetrical moments before and after midday[1951]. The meridian line might have been the original axis used in the design of Neapolis; this hypothesis differs from Tauro and Longo's suggestion that the original line of foundation was achieved through sighting from the San Martino hill towards the *plateia Furcillensis*. The sun might again have played a fundamental role, even though in a subtler and more tacit way[1952]. With the hypotenuse on the meridian line, a right-angle triangle of 5:12:13 might have been modelled; or, in alternative, the construction of an octagon might have been followed with the division of the circle into 16 sections with the use of knotted cords [1953]. As an outcome of these geometric construction, the orientation of 66° azimuth would have resulted. Questions remain if and how a similar design was adopted for the shaping or restructuring of *Regio VI* in Pompei, which shows the same orientation as Neapolis's, at least in terms of the north-south axis. If this iso-orientation is noncoincidental, this may call into question the chronology of this sector of the town of Pompei, which might be dating to the 5th cent. BC. Pompei was already founded between the 7th–6th cent. BC, probably by following an Etruscan foundation ritual at summer solstice. Possibly, the implantation of the 5:12:13 module had to be integrated with the pre-existing urban morphology with the axes of Via delle Terme and Via della Fortuna, whose junctions with Via di Mercurio result in no orthogonal angles. The similarities

[1950] LONGO - TAURO 2017, 25.
[1951] See 'Planning with the Sky' section, Chapter Two.
[1952] LONGO - TAURO 2017, 26.
[1953] HAMBERG 1965, 116.

between Pompei and Neapolis is apparent in the similar orientation of the Pompeian Temple of Apollo and the Neapolitan Temple of Dioscuri, both fully integrated within their respective urban matrices[1954].

4th to 3rd BC Foundations

According to Johannowsky, although the date for the urban arrangement of Herculaneum is not known, the comparison with the 5th–4th cent. BC Atella's grid can suggest a Greek urbanism: «at the settlement of Atella, with a layout very similar to Herculaneum's one, there is no astronomical orientation typical of the Campanian towns which date back to the Etruscan hegemony, but an orientation similar to Greek towns relatively recent, such as Neapolis, where the στενοποί are orthogonal to the coastline»[1955]. Commenting on this passage, Sosio Capasso added that such Etruscan orientation systems are evident at Capua and Calatia[1956]. However, Herculaneum's orientation is very similar to Pompei's and, therefore, a close relationship in the design of the two towns looks deliberate. Herculaneum was only partially inserted into the diachronic record due to the lack of information on its date of foundation. In the 4th–3rd cent. BC, the Neapolitan system might also have been adopted for the foundation of Atella. The orientation might have been the result of using the Pythagorean triangle 5:12:13 on the meridian line or other geometrical methods. Even though Atella's history is closely related to that of the Acerrae's territory since they share a similar agrarian organisation, their urban orientations differed. Indeed, Acerrae's orientation tends towards its aligning with the position of the sun at summer solstice, similarly to that in Pompei and Herculaneum. However, a clear understanding of Atella's configuration is lacking, so that even the possible shape of the urban plan is conjectural. Nevertheless, it seems appropriate to subscribe to the view of Johannowsky and Bencivenga Trillmich, who asserted that the urban design of Atella tends towards Greek models, especially those of Neapolis[1957]. This orientation method may become better understood in the future within the context of the diffusion of Pythagoreanism in ancient Campania[1958]. Finally, it may be worth mentioning that the same orientation used in the foundation of Neapolis was employed in Alexandria in Egypt, founded by Alexander the Great, and it is possible that a similar triad of 5:12:13 might have been used in its planning.

[1954] See section IX on 'Neapolis', Chapter Four.
[1955] «l'abitato, a pianta molto simile, di Atella, come ad Ercolano, non abbiamo l'orientamento astronomico tipico delle città campane che risalgono al periodo dell'egemonia etrusca ma un orientamento analogo a impianti greci relativamente recenti, come quello di Neapolis, dove gli στενοποί sono normali alla costa» in JOHANNOWSKY 1982, 149; n.18.
[1956] CAPASSO 1997, 38.
[1957] BENCIVENGA TRILLMICH 1984.
[1958] MELE 2007b, 260–298.

3. INTERPRETATION

A declination distribution for the Campanian towns is presented here to facilitate the data interpretation (fig. 101). The histogram shows the astronomical declination value of all Campanian towns; the main declinations of the sun across the year are also marked for reference. The results of the declination plot in the statistical sampling indicated a significant peak around $\delta=+18°$ (fig. 101). This data may be interpreted as the local position of the rising sun around May. It is possible that this event might have been used as a record of a turning point in the seasonal cycle. This moment in the year also corresponds to the heliacal rising of the Pleiades. The importance of this seasonality marked by the appearance of the Pleaides was highlighted in the ancient Greek world for its relevance to agricultural and navigational activities[1959]. The discourse can be summarised in Hesiod's dictum «[w]hen the Pleiades, daughters of Atlas, are rising [in early May], begin your harvest»[1960].

In the context of Campania, it is worth recalling Athenaeus' cosmological ascription to Nestor's goblet, according to Asclepiades of Myrlea's (2nd–1st cent. BC) comment to Homer, that Nestor's cup was displayed, in Athenaeus' time, at Capua and was dedicated to Artemis[1961]. The analogy between the cup and the cosmos is attributable to the golden studs on the silver goblet resembling the starry night[1962]. According to this tradition, Homer saw the six Pleiades golden stars as engraved in Nestor's cup[1963]. In addition, the beverage used within the cup was sacred barley-groats and grated goat-cheese sprinkled over wine[1964]. The sacrality of the harvest was thus emphasised by the presence of the starry Pleiades, in the context of the *symposion*. The Pleiades were thought to bring ambrosia to Zeus, possibly given their importance for crop timing[1965]. Ambrosia, the immortality nectar, was also thrown on Herakles' pyre during his apotheosis[1966]. After the middle of the 4th cent. BC, a new Temple (A) was built in the area of the forum at Cumae, with a decorative roof system with a series of antefixes representing winged female figures: the astral group of the Hyades or Pleiades have been recognised in these figures[1967]. This provides further evidence of the importance of this asterism during the Campanian phase of Cumae.

Moreover, when looking at the Etruscan local calendar of the Tabula Capuana, the centrality of the *Leθam* is recurrent in festivities in March, April, May, and June and is comparable with the sphere of influence of the Roman god Fortuna[1968]. In this period of the year, as now, the sun would have lengthened its presence in the heavens, adding hours of light to the day. According to Mauro Cristofani, the ritual activities in March are part of a preparatory cult for a greater sacrifice in honour

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1959 See section 3 on 'Festivals and Calendars', Chapter Three.
1960 Hes. *Op.* 383, trans. H. EVELYN-WHITE 1914.
1961 Ath. *Depn*. XI, 489b-c.
1962 Ath. *Depn*. XI, 489c-e.
1963 Ath. *Depn*. XI, 491e-492f.
1964 Hom. *Il.* XI.626-641.
1965 Hom. *Od.* XII.62-63; Ath. *Depn*. XI, 490b; on the cycle of ambrosia see DUMÉZIL 1924.
1966 DUMÉZIL 1924, 93.
1967 BRIDJDER - LULOF 1989; KRAUSKOPF 1992; RESCIGNO 2006; AVERNA 2020, 65-69.
1968 CRISTOFANI 1995, 67.

of *Leθams*[1969]. In April, the celebrations happened at the sanctuary of Uni, which may have been situated at Hamae, in San Leucio, or Fondo Patturelli[1970]. In general, *Leθams* assumed the character of a generatrix goddess, both agrarian and human, sphere of power, occurring at the beginning of the year. It is unclear whether the urban space should be read as an astronomical reflection of such a calendric system[1971]. In a 4th cent. *Iuvila* inscription is mentioned a celebration during the full moon before summer solstice, which also corresponds to the full moon around the heliacal rising of the Pleiades. However, the importance of spring is again emphasised. Moreover, Vitruvius pointed out that, at the time of the rising of the Pleiades, the sun enters in Gemini, increasing the length of the days[1972]. By extension, this may have caused this time of the year to be seen as a good season for starting an urbanisation design and monumentalising projects, given the approach of the warmest season.

The region of Campania was an agrarian organised territory since, at least, the Archaic period[1973]. Stefano De Caro emphasised the production cereal based extensive logic in the plain as a long-term phenomenon[1974]. For Luca Cerchiai the increasing exploitation of the land was a direct effect of the growing population, and therefore, of the urbanisation[1975]: a world of cities, but directly connected with the surrounding countryside. This process is observed in other areas of the Italian peninsula, Latium, Etruria, the Po Valley, and Magna Graecia[1976]. The synoecism and centralisation of villages inevitably brought to the incrementation of primary needs, satisfied by a major control over countryside[1977]. Thus, the organisation of the land, trough ditches, swamp reclamation, channels and its trade network is directly connected with the urban layout[1978]. Somehow comparable to the great Eastern civilisations, the production and distribution of cereals was centralised[1979]. This became evident from the Neapolitan alliance with Athens, and later with Rome, both centred on the supply of wheat. Indeed, from the mid-5th cent. BC, Campanian coin production adopted the wheat spike as its only numismatic symbol. The polyadic siren Parthenope in Neapolis was said to have been covered by wheat sheafs in her honour, as confirmed in later literature[1980]. In this context, it is not difficult to see how the observation of the sky could provide a framework for the cyclical production, both on a practical and religious level. Thus, the present study of town orientations has brought further awareness on the countryside, as an integrated and major part of the urban life.

[1969] Cristofani 1995, 90, 117.
[1970] Cristofani 1995, 106–108.
[1971] Cristofani 1995, 120.
[1972] Vitr. *De arch.* 9.3.1.
[1973] De Caro 2002, 135–136; Cerchiai 2019, 12.
[1974] De Caro 2002, 136.
[1975] Cerchiai 2019, 12.
[1976] Cerchiai 2019, 12.
[1977] Cerchiai 2019, 12.
[1978] Cerchiai 2019, 12.
[1979] De Caro 2002, 136.
[1980] Mele 2014, 159; Dionys. Per. 357-359; Prisc. *Perieg*. 351-353.

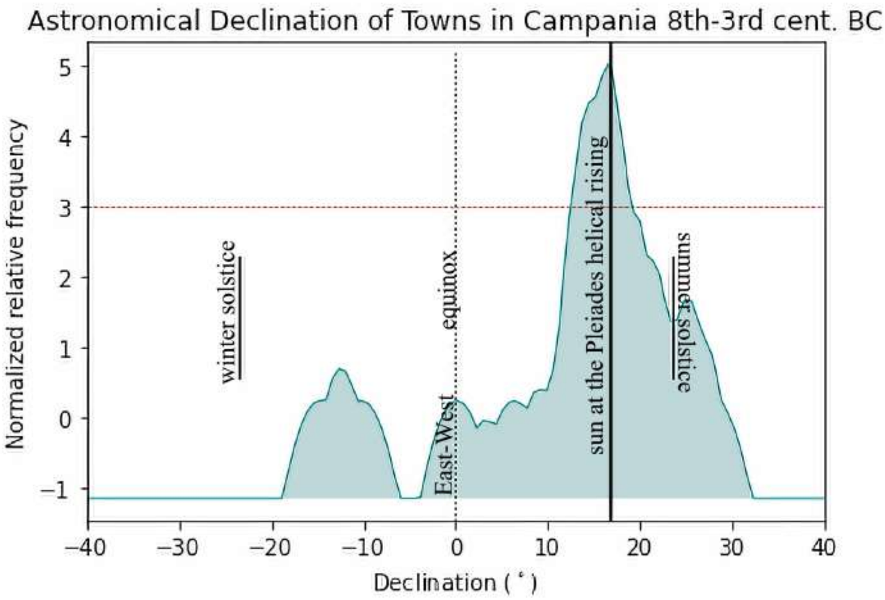


Figure 101. Left. The peak of the statistics based on the declination of towns in Campania from the 8th to the 3rd cent. BC points at the position of the sun at the time of the heliacal rising of the Pleiades. Elaborated by the author with Python script (Spider v.5) written by A. César González-García and Andrea Rodríguez-Antón. Right. Cumae's Temple A antefix, interpreted by RESCIGNO 2006 as the Pleaides asterism, after KRAUSKOPF 1992, tav. 78.5.

Starting with a theoretical review of the role of the sky in urban planning, this research has then focused on exploring the scope and evidence for astronomical orientations of towns and temples in the region of ancient Campania. In the first theoretical part, Chapter One starts with a rationale and a methodological discussion of the role of the discipline of skyscape archaeology/archaeoastronomy in debates on spatial and temporal divisions of the ancient cosmos. There follows a methodological section on cartography extended out to reference systems in the celestial sphere, which represent a fundamental tool of comprehension for a full understanding of the practical part. A historical context for the urbanisation of ancient Campania is also introduced at this point. In summary, the chapter concludes that each direction is potentially archaeoastronomical, not only the cardinal ones: towns and temples can all be analysed under this approach. In this research, this was a way to test a pattern already highlighted for the Campanian towns by Carlo Rescigno and Felice Senatore[1981]. It is true that the celestial vault has a close-knit relationship with the sacred. Nevertheless, the sky was also the only functional and practical 'instrument' with which to orient oneself in space and time in Greek, Etruscan, and Roman antiquity, as seen in Chapter Two.

From sighting poles to cords and rods, spanning to boundary stones to set limits, literary and archaeological evidence are brought together to summarise every practical aspect of survey and land division which can be related to the movement of the sky. After the instruments used have been discussed, the methods employed for orientation with celestial motions are explained: finding the north within ancient stellar nights or through the sun shadow cast by a gnomon. Solstices were also fundamental positions on the horizon so that, since Archaic Greece, these divided into sectors the mapping of the *oikoumene*, the inhabited earth. Furthermore, a number of examples of foundation rituals and of the theoretical knowledge involved in urban planning have been highlighted from among Greeks, Etruscans and Romans. This section combines a short outline of the Greek *polis*; the role of the *Etrusca disciplina* in the setting of the *templum*; an integrated discussion of the solstitial direction of the *auguraculum* at Cosa; ideas about the Roman *cardo* and *decumanus*, with the latter to be understood as the primary line related to the sun's course; Rome's foundation ritual and the colonial *natalis urbis* as a reflection of the three-way partition of the cosmos, with the tracing of the *sulcus* in an anti-clockwise direction, reminiscent of the anti-clockwise rotation of the heavens when looking towards the north. The chapter ends by summarising the factors which can determine an urban orientation. The slope of the terrain is the main *secundum naturae* constraint, even though this has not been fully analysed in the practical section, as geo-morphological data of the paleo-surface of the ancient plains, plateaux, and mountains would need an extensive specialised study in itself. Instead, the focus here is on the *secundum caelum* factors, which can be divided into two types: functional motivation related to achieving a balance of solar irradiation across the year as a whole, as urged by modern urbanists such as Gaetano Vinaccia for the solstitial direction, and, through the lens of foundation ritual, the *decumanus* is set in line with the rising sun. The latter, then, enables

[1981] RESCIGNO - SENATORE 2009.

speculation about the precise day of the foundation of a town and its periodic anniversary celebrations. This chapter ends with a brief discussion of wind directions.

In Chapter Three, the focus is on the sky and the sacred, starting with astral religion in terms of: the relationship between celestial light and faith (*fides*); the worship of celestial bodies in Greece, such as the sun with the debated equivalence between Apollo and Helios; the gradual anthropomorphising of the sun in Etruria with *Usil* and *Thesan*, with the latter interpreted as potentially a moon goddess; the role of Sol in Latium in relationship with the mythical ancestors according to Mario Torelli's interpretation, later further discussed in the context of temple and altar orientations at *Castrum Inui* in Ardea. Evidence is drawn from Artemis *Mounichia* at Pireo for the moon and its cult, when at full moon the sky is *amphiphôs*, or lit by both sides. The Etruscan moon goddess *Tiur*, or the lunar attribute of *Catha* in connection with *Śuri*, is also briefly discussed within current scholars' debates on the topic. A significant portion of the text here is devoted to temple orientations, with a preliminary comment on the academics' approach to such studies particularly referring to ancient literary sources. Agreement on which direction should be measured is problematic: here, a 'statue-facing direction' and a 'prayer-facing direction' have both been proposed in order to distinguish between the temple entrance and the opposite temple back directions. Although temples in Greece did not always face east, they tended to do so in Magna Graecia and Sicily. Doric temples in the Archaic period used to be darker and more eastern facing than Classical Ionic style ones. Doors and windows can provide further information on the amount of natural light entering the cella. On the basis of such discussions, it is reasonable to suggest that epiphanies of sunlight did happen after intentional architectural planning that took into account the sun's course. Having said that, topographical targets may have also been relevant in relation to planning decisions, as well as stellar reference points for nocturnal rites. In the Etruscan world, temples opened towards the south, receiving natural light on their front façade, even though without the cella being illuminated. The correlation between the sixteen directions of deities and temple orientations was also considered in all its complexity with reference to the current state of debate on the topic. Among recent achievements, the archaeoastronomical alignment at Pyrgi Temple B with Venus is confirmed by the dedication to Astarte and the iso-orientation of other Phoenician temples, which would point to a wintery seasonality for this cultic acme. In the Oscan–Samnite world, temple orientation is very neatly targeted towards the south-east sector of the horizon. Thus, winter solstice sunrise might have been a relevant moment in the temporal articulation of this community. Alternatively, it is possible that this orientation might be related to the full moon at summer solstice as can be read in the lines of an *iuvila* stele found at the Capuan Fondo Patturelli sanctuary or as indicated by orientation analysis of the Doric Temple at Pompei. In Latium, the topographical reference point might have been Diana Nemorensis at the Lake of Nemi, also in connection with the main solar and lunar setting and rising points. Festivals and calendars are discussed in the last section of Chapter Three. The movements of the stars for navigation, agriculture, and ritual activities are described, in the context of both literary and archaeological evidence. A fragment of a Euboeanising LG I krater from Pithekoussai, representing the constellation of Boötes, can be telling for this topic. The intercalation for the luni-solar calendar in Greece is discussed, with the Olympic games being set accordingly. In the case of Etruria, the Tabula Capuana prescribed rituals occurring at specific times of the year; these probably began in March in line with the Oscan and Roman Archaic calendar. In such time-reckoning systems, the month was divided to match with the phases of the moon, with the Ides at full moon. The most important time for observing the sky was at the *kalendae*, dedicated to Juno, looking towards the west after the setting of the sun: the first sight of the new waxing moon would have marked the beginning of a new month, from when the dates of all other festivities were calculated. In Campania, these twilight observations may have happened at the sanctuary of Diana Tifatina, where the open view towards the west would have allowed a calendric synchronisation with the astral harmony.

Chapter Four is an in-depth analysis, case by case, of towns and temples in Campania. The original insights generated by this thesis should be apparent, starting with Capua. There, the Archaic, regular but not exactly orthogonal, neighbourhood of the Siepone seems interconnected with the topography of the sacred, and according to a unitary plan. The temple of Diana Tifatina and the Fondo Patturelli sanctuary share the same orientation of az. 75°/255°. Using skyscape analysis, on the first day of the year of the Archaic calendar, this orientation system would point to the setting sun with the new crescent moon in the south-west and, in the north-east, towards the constellation of the Pleiades rising at early summer above Mt. Virgo. This specific orientation can be perceived also in other Campanian towns, such as at Suessula and Abella on the internal part of the plain and towards the Sorrentine peninsula at Stabiae and Sorrentum. It is possible this orientation model was exported from Capua, or specifically from Diana Tifatina sanctuary as institution regulating the calendar, to other settlements. Further research is needed in order to comprehend more fully this orientation system, as the skyscape factor might not be the only one of relevance here. The peak of the declination distribution points at the position of the sun at the time of the heliacal rising of the Pleiades, in early summer (May/June). This data can be interpreted according to the Pleiades religious and practical role in the context of the agricultural and navigational activities. Particularly, due to the cereal connotations of Parthenope at Neapolis, a possible connection between the Sirens and the Pleiades can be discerned in the future, also in the context of music and the harmony of the spheres based on the Pythagorean tradition: for example, the seven cords of the lyre were thought to correspond to the seven stars of the Pleiades. Further research in this area of study may consider how ancient toponyms can be significant in this cultic context: Mt. Virgo and the Partenio Mountains suggest a reference to the stadium of virgins and to the nymph Parthenope and, hence, the Pleiades. At Kyme, antefixes with astral motifs decorating Temple A have been interpreted as representations of the Pleiades carrying ambrosia[1982], even though the topography of the sanctuary does allow only an uncertain measurement of the orientation of the temple in relation to these stars. However, it is possible that the setting of the constellation behind the acropolis was used to establish the timing of spring festivities

[1982] RESCIGNO 2006.

around the equinox and the winter season and the end of the navigational period. At Kyme, the Major Temple on the higher terrace of the acropolis had a precise cardinal orientation, whereas the temple on the inferior terrace seems to point towards Mt. Tifata and Capua. Questions about this latter choice may be understood to have been part of intense conversations between new arrivals and the established Etruscan Capuan aristocracy within the topic of political fidelity: the attribute of the Italic Jupiter is *fides*, the sacral guarantee of treaties, which has a celestial connotation with the daily light from the sky, which is approached thanks to temple locations on high tops. On the top of Mt. Tifata, a Hellenistic temple was built facing towards Via Campana and the Kyme acropolis although, at the time, the Cumaean temple entrance was rotated towards the lateral side. In alternative a cult relative to Artemis/Diana could be read in orientation choice of the Inferior Terrace temple towards Mt. Tifata, and thus, Diana Tifatina temple. The urban orientation of Kyme was modified several times as is evident in the lower city and the Forum area, and should probably be understood as swamp-reclamation modifications, though always oriented towards the south-east sector of the horizon. The only town with a possibly similar orientation is Nola, but the evidence is so fragmentary and scant that it is highly speculative at to what the pre-Roman orientation system might have been. The archaeological situation is similar for Nuceria, although both towns were vital and extended centres as suggested by the evidence from the necropolis and the literary passages by antiquarians. The urban layout of Nuceria is clear, being regular, orthogonal, and cardinal in the Roman period, but it is difficult to ascribe the same layout to the previous phases in the life of the settlement. Not dissimilar is the situation in Calatia, with its almost cardinal layout from the end of the 4th and the beginning of the 3rd cent. BC, and the arrival of the Appian Way as a *terminus ante quem* for the urban orientation. Acerrae and Atella, although integrated within a single agrarian system, display two different urban orientations, the former quite near the solstitial position of the sun, comparable to Pompei and Herculaneum, the latter showing similarities with Neapolis's urbanism. Indeed, the specific town design employed in Neapolis introduced an innovative and ground-breaking form of urbanism in ancient Campania starting from the end of the 6th cent. BC and the beginning of the 5th. The geometrical rationality of Neapolis has been the object of centuries of studies into the notion of the ideal town. In accord with Gustaf Hamberg, it is worth emphasising the significance of the meridian line as the possible origin of the system utilised as a whole, and that the orientation is the result of constructing an octagon or applying Pythagorean triads in the form of 5:12:13. A similar modular system might have been applied at Pompei in *Regio VI*. Via di Mercurio in Pompei is oriented in the same way as the south-north *stenopoi* in Neapolis, at around 154°. As a result, the temple of Apollo in Pompei and the temple of Dioscuri in Neapolis share the same orientation. However, in Pompei the situation is much more complex, due to the probable imposition of different urban designs during different phases in the life of the town and to the complex geomorphology of its plateau. A foundation ritual related to the solstices is intimated by the Doric temple's peculiar rotation and the orientation of Via delle Terme towards the summer solstice sunrise. Summer solstice full moon was also visible in front of the temple when the sun was setting behind it. This astronomical event may be related to the celebration of the solar year and to the apotheosis of the sun, while also corresponding to the town's foundation. The presence of Minerva and Herakles at the sanctuary fits in with this mythical narrative. The nearby Herculaneum might have been influenced by the approach adopted in Pompei's urban design, even though there is no evidence of the layout in Herculaneum from before the 4th cent. BC. As with the east-west axes of Pompei, Herculaneum is iso-oriented at circa 60°, with a summer solstice sunrise that would have been risen from behind the pre-79AD shape of Mt. Somma-Vesuvius; when looking towards the sea, the winter solstice sunset would have entered the town parallel with the line of the streets.

In conclusion, the state of the art within the discipline of archaeoastronomy is very much in its initial phases and offers considerable scope for further studies on many topics within this field. Greek urbanism has not been studied at all within an archaeoastronomical approach. Etruscan and Roman town planning can also be the object of further case-by-case analyses within a general focus on how the rituals of foundations were applied, as prompted by the ancient skies. Solstitial lines need to be compared with architectural directions to enable any possible hypotheses in this area of interest. Cities are complex entities with their political stratifications and with the need for practical plans adapted to fit with the local terrain; across Campania, the archaeological evidence of how the pre-Roman resolution of the conflicting drives and needs was achieved is clearly indicated by the very varied solutions that were developed. Nevertheless, by adopting a skyscape perspective, it has been possible to identify the key and fundamental lines of the urban designs, both the indirect ones when using the gnomon to determine the meridian and the direct observation of the sun or stars feeding into spatial (and related) design decisions. The moon and main constellations were surely observed in ancient Campania to set the calendar, as well as the timing of agricultural and navigational activities, which this thesis has attempted to elucidate in terms of how this might have happened. Temples certainly offer more scope for study in these terms. Their sacredness is assured, whereas the sky is inherently the source of a transcendental reality. Light itself can endow with divinity. Dawn and dusk are transitional moments between different realities. Skyscape archaeology applied to temples may give interesting results and new perspectives across a range of contexts. Moreover, the application of 3D virtual anastylosis can valorise astronomical alignments with a full dome reconstruction of ancient skies and the casting of natural shadows, as enabled by software packages such as Stellarium.

Returning to the rationale behind this thesis and the unity between space and time as read through the lens of this discipline, it is possible to conclude that the seasonality of ritual activities is still mostly unknown. The act of celebration was surely connected to astral movements as there was no other medium within which to frame time. The spatiality of temples is thus very telling in this sense, even though the archaeoastronomical evidence should always be read in conjunction with other types of source information. The solstices were fundamental transitional moments in the solar year that could be integrated within a whole urban design, such as in Pompei and in Marzabotto. The moon beated the times of the months with its phases: in Campania, its observation probably fell within the jurisdiction of the Temple of Diana Tifatina. The cult was strictly inter-related to that of Diana

Nemorensis in Latium: the thirteen altars at Lavinium show a similar orientation of the temple of Diana Tifatina. In the night sky, the Pleiades were objects of observation and of cult in ancient Campania, due to their synchronisation with agricultural and navigational activities. The harvest of the first crop was dictated by the heliacal rising of the constellation in early summer. It may be not a coincidence that on an Oscan *Iuvila* inscription, the full moon before summer solstice celebration was mentioned. Most Etruscan-Italic towns in ancient Campania seem oriented towards the rising sun in early summer, even though other factors should not be excluded. The cult of the Pleiades would fit well into the ritual background of the sirens in the Gulf and Parthenope, in the context of *parthenoi* rites of passages, nocturnal torch races, navigation, cereal production and exchange, spring-early summer festivities, immortality and ambrosia, but the in-depth study of this topic will be left for further investigation. The Campania region was an organised agricultural territory, which economy was based on the exploitation of land and commercial exchange of cereals. From the study of town's orientations has opened towards a different scenario: the countryside and the agrarian landscape were direct outcome of the urbanisation process of Campania, where the observation of the sky regulated life, space, and time of those communities.

BIBLIOGRAPHY

ADLER *et al.* 1892 = F. Adler - R. Borrmann - W. Dörpfeld - F. Graeber - P. Graef, *Olympia II: Die Baudenkmäler von Olympia*, Berlin 1892.

ADORNATO 2003 = G. Adornato, "L'Area Sacra di S. Omobono: per una revision della documentazione archeologica", in *Mélanges l'École Fr. Rome* 115, 2, 2003: 809–835.

AGAFONKIN 2018 = V. Agafonkin, "Visualizing street orientations on an interactive map", in 2018, available at https://mourner.github.io/road-orientation-map.

AKKERMAN 2016 = A. Akkerman, *Phenomenology of the Winter-City: Myth in the Rise and Decline of Built Environments*, New York 2016.

ALEXANDRATOS 2009 = L. Alexandratos, "Gli agrimensori romani e l'astronomia", in *Maia* 61, 1, 2009: 285–305.

ALLEGRO - SANTANIELLO - BEDINI 2008 = N. Allegro - E. Santaniello - E. Bedini, *L'abitato della prima fase di Capua: prime testimonianze*, 2008.

ALLEGRO - SVANERA 1996 = N. Allegro - S. Svanera, "Proprietà Merola. Campagne di scavo 1996-1997", in *Boll. di Archeol.* 37–38, 1996: 83–87.

AMATO - GUASTAFERRO - LUPIO 2002 = L. Amato - C. Guastaferro - A. Lupio, "Prospezioni geo-archeologiche nell'area delle fortificazioni di Cuma", in B. d'Agostino - A. D'Andrea (ed. by), *CUMA: Nuove forme di intervento per lo studio del sito antico. Atti della Giornata di Studio – Napoli 12 Febbraio 2001*, Napoli 2002.

ANTONELLO *et al.* 2015 = E. Antonello - F.V. Polcaro - A.M. Tunzi Sisto - M. Lo Zupone, "Astronomical Orientations in Sanctuaries of Daunia", in F. Pimenta - N. Ribeiro - F. Silva - N. Campion - A. Joaquinito - L. Tirapicos (ed. by), *Stars and Stones: Voyages in Archaeoastronomy and Cultural Astronomy. Proceeding of the SEAC 2011 meeting in Evora, Portugal*, Oxford 2015: 236–239.

ARATA 2010 = F.P. Arata, "Osservazioni sulla topografia sacra dell'Arx capitolina", in *Mélanges l'École française Rome - Antiq.* 122–1, 2010: 117–146.

ARENELLA 2001 = A. Arenella, *Indagine topografica nel territorio dell'antica Calatia: settore sud-orientale*, Seconda Università degli Studi di Napoli, 2001.

ARTHUR 1986 = P. Arthur, "Problems of the Urbanisation of Pompeii: Excavations 1980-1981", in *Antiq. J.* 66, 1, 1986: 29–44.

ASHERI 1966 = D. Asheri, *Distribuzioni di terre nell'antica Grecia: memoria*, 1966.

ASSMANN 2011 = J. Assmann, *Cultural Memory and Early Civilization: Writing, Remembrance, and Political Imagination*, Cambridge 2011.

ATKINSON 1912 = W. Atkinson, *The Orientation of Buildings Or Planning for Sunlight*, New York 1912.

AVAGLIANO 2018 = A. Avagliano, *Le origini di Pompei: la città tra il VI e il V secolo a.C.*, Leuven 2018.

AVENI - ROMANO 1994 = A. Aveni - G. Romano, "Orientation and Etruscan ritual", in *Antiquity* 68, 260, 1994: 545–563.

AVENI - ROMANO 2000 = A. Aveni - G. Romano, "Temple Orientations in Magna Graecia and Sicily", in *J. Hist. Astron.* 31, 25, 2000: S51–S57.

AVERNA 2020 = A. Averna, *Cuma campana. Il Tempio A del foro e le sue terrecotte architettoniche*, Università degli Studi della Campania Luigi Vanvitelli, 2020.

BAGNASCO GIANNI 2008 = G. Bagnasco Gianni, "Rappresentazioni dello spazio "sacro" nella documentazione epigrafica etrusca di epoca orientalizzante", in X. Dupré Raventós - S. Ribichini - S. Verger (ed. by), *Saturnia Tellus. Definizioni dello spazio consacrato in ambiente etrusco, italico, fenicio-punico, iberico e celtico. Atti del Convegno Internazionale svoltosi a Roma dal 10 al 12 novembre 2004*, Roma 2008: 267–281.

BAGNASCO GIANNI 2018 = G. Bagnasco Gianni, "Tarquinia, principi e forme della città. Una proposta di lettura", in G. Bagnasco Gianni (ed. by), *Mura Tarquiniesi: Riflessioni in margine alla città*, Milano 2018: 17–66.

BAGNASCO GIANNI 2019 = G. Bagnasco Gianni, "Notes on Etruscan cosmology: the case of the

Tumulus of the Crosses at Cerveteri", in G. Magli - A. Gonzàlez-García - J. Belmonte Aviles - E. Antonello (ed. by), *Archaeoastronomy in the Roman World*, 2019: 17–34.
BAGNASCO GIANNI - GOBBI - SCOCCIMARRO 2015 = G. Bagnasco Gianni - A. Gobbi - N. Scoccimarro, "Segni eloquenti in necropoli e abitato", in M.L. Haack (ed. by), *L'écriture et l'espace de la mort. Épigraphie et nécropoles à l'époque pré-romaine. Rencontres internationales (Roma, 5-7 mars 2009)*, Roma 2015: 277–279.
BALISTA - SAINATI - SALERNO 2002 = C. Balista - C. Sainati - R. Salerno, "La nuova scoperta. Il santuario oreintale a Meggiaro. Lo scavo, le strutture, i depositi", in A. Ruta Serafini (ed. by), *Este preromana: una città e i suoi santuari*, Dosson (TV) 2002: 127–141.
BALL - DOBBINS 2013 = L.F. Ball - J.J. Dobbins, "Pompeii Forum Project: Current Thinking on the Pompeii Forum", in *Am. J. Archaeol.* 117, 3, 2013: 461–92.
BALLABRIGA 2010 = A. Ballabriga, *Le Soleil et le Tartare: L'Image mythique du monde en Grèce archaïque*, Paris 2010.
BARBOLINI 2014 = F. Barbolini, *Teoria e pratica dell'architettura solare: Morfologia, rendimento, strategia progettuale*, Alma Mater Studiorum Univerità di Bologna, 2014.
BARDET 1945 = G. Bardet, "Le facteur soleil en urbanisme", in *Tech. Archit. Le Soleil* 3, 7–8, 1945: 202–206.
BARNES 2014 = J.T. Barnes, "Asteras Eipein: An Archaic View of the Constellations from Halai", in *Hesperia J. Am. Sch. Class. Stud. Athens* 83, 2, 2014: 257–276.
BARONIO 2017 = P. Baronio, "I caratteri dell'urbanistica etrusca ad assi ortogonali in area Padana: nuove considerazioni sull'impianto di Kainua-Marzabotto alla luce delle recenti indagini metrologiche", in *Ocnus* 25, 2017: 113–142.
BARONIO 2019 = P. Baronio, "Between heaven and earth. Town planning and urban image in the Etruscan cities of the Late Archaic period", in P. Carlotti - L. Ieva - M. Ficarelli (ed. by), *Reading Built Spaces. Cities in the making and future urban form. 4th ISUFitaly International Seminar on Urban Form (Bari, 26-28 September 2018)*, Roma 2019: 431–443.
BATINO 2016 = S. Batino, "Appunti per la Pompei dei Margini", in *Archeol. Class.* 67, 2016: 183–214.
BECKER 2013 = H.W. Becker, "Political systems and law", in J.M. Turfa (ed. by), *The Etruscan World*, Abingdon 2013: 351–372.
BELL 1997 = C. Bell, *Ritual: Perspectives and Dimensions*, Oxford 1997.
BELMONTE 2015 = J.A. Belmonte, "Orientation of Egyptian Temples: An Overview", in C.L.N. Ruggles (ed. by), *Handbook of Archaeoastronomy and Ethnoastronomy*, New York 2015: 1501–1518.
BELMONTE 2021 = J.A. Belmonte, "What Equinox?", in E. Boutsikas - S.C. McCluskey - J. Steele (ed. by), *Advancing Cultural Astronomy: Studies In Honour of Clive Ruggles*, Cham 2021: 11–33.
BELMONTE - MOLINERO POLO - MIRANDA 2009 = J.A. Belmonte - M.A. Molinero Polo - N. Miranda, "Unveiling Seshat: new insights into the stretching of the cord ceremony", in J.A. Belmonte - M. Shaltout (ed. by), *In search of cosmic order, selected essays on Egyptian archaeoastronomy*, Cairo 2009: 197–212.
BELOCH 1989 = J. Beloch, *Campania: storia e topografia della Napoli antica e dei suoi dintorni*, Napoli 1989.
BELOCH 1890 = K.J. Beloch, *Campanien : Geschichte und Topographie des antiken Neapel und seiner Umgebung*, Breslau 1890.
BENCIVENGA TRILLMICH 1984 = C. Bencivenga Trillmich, "Risultati delle più recenti indagini archeologiche nell'area dell'antica Atella", in *RendAccNap* 69, 1984: 1–24.
BENDLIN 2002 = A. Bendlin, "Mundus Cereris: Eine kultische Instituion zwischen Mythos und realität", in C. Auffarth - J. Rüpke (ed. by), *πιτομή τῆς οἰκουμένης': Studien zur römischen Religion in Antike*, Stuttgart 2002: 37–73.
BILIĆ 2006 = T. Bilić, "Some Northern Constellations used for Navigation", in *Vjesn. Arheol. muzeja u Zagreb.* XXXIX, 1, 2006: 15–58.

BILIĆ 2012 = T. Bilić, "Apollo, Helios, and the Solstices in the Athenian, Delphian, and Delian Calendars", in *Numen* 59, 2012: 509–532.
BILIĆ 2016 = T. Bilić, "The Island of the Sun: Spatial Aspect of Solstices in Early Greek Thought", in *Greek, Rom. Byzantine Stud.* 56, 2016: 195–224.
BILIĆ 2021 = T. Bilić, "Calendric Aspects of Myths and Cults Involving Apollo's Visit to Hyperborea", in *Class. J.* 116, 3, 2021: 257–283.
BILLE - SØRENSEN 2007 = M. Bille - T.F. Sørensen, "An Anthropology of Luminosity: The Agency of Light", in *J. Mater. Cult.* 12, 3, 2007: 263–284.
BIZZARRI 1962 = M. Bizzarri, "La necropoli di Crocifisso del Tufo in Orvieto", in *Stud. Etruschi* XXX, 1962: 1–156.
BOEING 2019 = G. Boeing, "Urban spatial order: street network orientation, configuration, and entropy", in *Appl. Netw. Sci.* 4, 67, 2019: 1–19.
BONGHI JOVINO 2010 = M. Bonghi Jovino, "Gli aspetti controversi della storia di Capua preromana. Ricerche attuali e problemi aperti", in *Orizz. Rass. di Archeol.* 11, 2010: 129–132.
BONGHI JOVINO 2011A = M. Bonghi Jovino, "Una piccola scultura nel grande processo di trasformazione da Capua etrusca a Capua Sannitica", in *ACME. Ann. della Fac. di Lett. e Filos. dell'Università degli Stud. di Milano* LXIV, II, 2011: 21–33.
BONGHI JOVINO 2011B = M. Bonghi Jovino, "Ripensando Pompei arcaica", in D.F. Maras (ed. by), *Corollari: scritti di antichità etrusche e italiche in omaggio all'opera di Giovanni Colonna*, Pisa 2011: 4–13.
BOSCHI - GIORGI - SILANI 2017 = F. Boschi - E. Giorgi - M. Silani, "Reconstructing the ancient urban landscape in a long-lived city: the Asculum project - combining research, territorial planning and preventative archaeology", in *Archeol. e Calc.* 28, 2, 2017: 301–309.
BOUBEKRI 2008 = M. Boubekri, *Daylightinig, Architecture and Health: Building Design Stategies*, Oxford 2008.
BOUTSIKAS 2007 = E. Boutsikas, *Astronomy and Ancient Greek Cult An application of archaeoastronomy to Greek religious architecture, cosmologies and landscapes*, University of Leicester, 2007.
BOUTSIKAS 2020 = E. Boutsikas, *The Cosmos in Ancient Greek Religious Experience: Sacred Space, Memory, and Cognition*, Cambridge 2020.
BOUTSIKAS 2021 = E. Boutsikas, "An Investigation of the Role of Architectural Orders in Greek Temple Orientation", in E. Boutsikas - S.C. McCluskey - J. Steele (ed. by), *Advancing Cultural Astronomy: Studies In Honour of Clive Ruggles*, 2021: 189–210.
BOUTSIKAS - HANNAH 2011 = E. Boutsikas - R. Hannah, "Ritual and the cosmos: astronomy and myth in the Athenian Acropolis", in C.L.N. Ruggles (ed. by), *"Oxford IX" International Symposium on Archaeoastronomy. Proceedings IAU Symposium*, 2011: 342–348.
BOUTSIKAS - HANNAH 2012 = E. Boutsikas - R. Hannah, ""Aitia", Astronomy and the Timing of the Arrhephoria", in *Annu. Br. Sch. Athens* 107, 2012: 233–245, 387–388.
BOUTSIKAS - RUGGLES 2011 = E. Boutsikas - C. Ruggles, "Temples, Stars, and Ritual Landscapes: The Potential for Archaeoastronomy in Ancient Greece", in *Am. J. Archaeol.* 115, 1, 2011: 55–68.
BOWEN - GOLDSTEIN 1988 = A.C. Bowen - B.R. Goldstein, "Meton of Athens and Astronomy in the Late Fifth Century b.c.", in E. Leichty - M. de J. Ellis - P. Gerardi (ed. by), *A Scientific Humanist: Studies in Memory of Abraham Sachs*, Philadelphia 1988: 39–81.
BOYANCÉ 1966 = P. Boyancé, "L'Apollon solaire", in *Mélanges d'archéologie, d'épigraphie et d'histoire offerts à Jérôme Carcopino*, Paris 1966: 149–170.
BRADY 2015 = B. Brady, "Star phases: the naked-eye astronomy of the Old Kingdom Pyramid Texts", in F. Silva - N. Campion (ed. by), *Skyscapes: The Role and Importance of the Sky in Archaeology*, Oxford 2015: 76–86.
BRAGANTINI *et al.* 2010 = I. Bragantini - G.C. Manasse - D. Giampaola - S. Febbraro - B. Roncella, "Lo scavo di Piazza Nicola Amore a Napoli: le fasi edilizie e decorative del complesso monumentale", in I. Bragantini (ed. by), *Atti del 10° congresso internazionale dell'AIPMA*

(Association internationale pour la peinture murale antique): Napoli 17-21 settembre 2007, Napoli 2010: 607–621.
BREGLIA PULCI DORIA 1987 = L. Breglia Pulci Doria, “Le Sirene. Il canto, la morte, la polis”, in *Aion* 9, 1987: 91–93.
BREGLIA PULCI DORIA 1990 = L. Breglia Pulci Doria, “Le Sirene, il confine, l’aldilà”, in *Mélanges Pierre Lévêque. Tome 4: Religion*, Besançon 1990: 63–78.
BREGLIA PULCI DORIA 2016 = L. Breglia Pulci Doria, “Le sirene: un’identità sorrentina?”, in C. Pepe - C. Rescigno - F. Senatore (ed. by), *Sirene: Atti del VI ciclo di conferenze “Piano di Sorrento. Una storia di terra e di mare”. Sezione Sirene 2013*, Roma 2016: 1–14.
BRELICH 2015 = A. Brelich, *Introduzione allo studio dei calendari festivi*, Roma 2015.
BRIDJDER - LULOF 1989 = H.A.G. Bridjder - P.S. Lulof, “Thesan, de etruskische godin van het morgenrood”, in *Ver. van Vrienden Allard Pierson Museum Amsterdam. Meded.* 45, 1989: 12–17.
BROCATO 2000 = P. Brocato, “Cosa quadrata”, in A. Carandini - R. Capelli (ed. by), *Roma: Romolo, Remo e la fondazione della città. Catalogo della mostra*, Milano 2000: 271.
BROWN 1980 = F.E. Brown, *Cosa, the Making of a Roman Town*, 1980.
BROWN - RICHARDSON - RICHARDSON 1960 = F.E. Brown - E. Richardson - L.J. Richardson, *Cosa II: The Temples of the Arx*, Roma 1960.
BUDETTA 1996 = T. Budetta, “Indagini sull’impianto urbano”, in *Boll. di Archeol.* 39–40, 1996: 125–134.
BUDETTA 1999 = T. Budetta, *Il Museo Archeologico Territoriale della Penisola Sorrentina “Georges Vallet”*, Salerno 1999.
BURKERT 1975 = W. Burkert, “Apellai und Apollon”, in *Rhein. Mus. Philol.* 118, 1/2, 1975: 1–21.
BURKERT 1985 = W. Burkert, *Greek Religion. Archaic and Classical*, Cambridge MA 1985.
BURKERT 1988 = W. Burkert, “The Meaning and Function of the Temple in Classical Greece”, in M. V. Fox (ed. by), *Temple in Society*, Eisenbrauns 1988: 27–47.
BUSHNELL 1864 = H. Bushnell, “City Plans”, in *Work and Play*, New York 1864: 308–336.
BUTTI - PERLIN 1980 = K. Butti - J. Perlin, “Solar Architecture in Ancient Greece”, in *A Golden Thread: 2500 Years of Solar Architecture and Technology*, New York 1980.
CALCAGNO 2002 = I. Calcagno, .
CALIÒ 2014 = L.M. Caliò, “Misurare la polis. Legge, spazio e tempo nella città di Pericle”, in *Thiasos, Monogr.* 5, 2014: 157–180.
CALIÒ 2020 = L.M. Caliò, *Polis: Ippodamo e la filosofia della città*, Roma 2020.
CAMARDO - COURT 2013 = D. Camardo - S. Court, “Herculaneum”, in *Encycl. af Anc. Hist.*, : 3150–3155.
CAMARDO - ROSSI 2005 = D. Camardo - A. Rossi, “Suessula: Trasformazione e fine di una città”, in G. Vitolo (ed. by), *Le città campane tra tardo antico e alto medioevo, Società Napoletana di Storia Patria in Castelnuovo, Napoli 21-22 aprile 2004*, Salerno 2005: 167–192.
CAMODECA 2012 = G. Camodeca, “La documentazione epigrafica e i templi dell’acropoli di Cuma romana”, in C. Rescigno (ed. by), *Cuma, il tempio di Giove e la terrazza superiore dell’acropoli. Contributi e documenti*, Venosa 2012: 67–84.
CAMPBELL 2000 = B. Campbell, *The writings of the roman land surveyors. Introduction, Text, Translation and commentary*, London 2000.
CAMPION 2015 = N. Campion, “Skyscapes: Locating Archaeoastronomy within Academia”, in F. Silva - N. Campion (ed. by), *Skyscapes: The Role and Importance of of the Sky in Archaeology*, Oxford 2015: 8–19.
CAMPOREALE 2017 = G. Camporeale, “Sulla Genesi della Città nell’Italia Preromana. Economia, Sociologia, Urbanistica: Il caso dell’insediamento dell’Accesa”, in *Archeol. e Calc.* 28, 2, 2017: 69–85.
CANTILENA 2009 = R. Cantilena, “La moneta a Cuma tra storia e mito”, in *Atti del XLVIII Convegno di Studi sulla Magna Grecia (Taranto, 27 settembre-1 ottobre 2008)*, Taranto 2009: 197–227.
CAPASSO 1997 = S. Capasso, *Gli Osci nella Campania antica*, 1997.

Caputo *et al.* 1996 = P. Caputo - R. Morichi - R. Paone - P. Rispoli, *CUMA e il suo parco archeologico*, Roma 1996.
Carafa 2008 = P. Carafa, *Culti e santuari della Campania antica*, Roma 2008.
Carafa 2011 = P. Carafa, "Minervae et Marti et Herculi aedes doricae fient (Vitr. 1.2.5). The Monumental History of the Sanctuary in the Triangular Forum", in S.J.R. Ellis (ed. by), *The Making of Pompeii. Studies in the History and Urban Development of an Ancient Town*, Portsmouth 2011: 89–110.
De Caro 1985 = S. De Caro, "Nuove Indagini Sulle Fortificazioni Di Pompei", in *AION* 7, 1985: 75–114.
De Caro 1992 = S. De Caro, "Lo Sviluppo Urbanistico di Pompei", in *Atti e Memorie della Società Magna Grecia*, Ro 1992: 67–90.
De Caro 1994 = S. De Caro, "L'attività della Soprintendenza Archeologica di Napoli e Caserta nel 1993", in *Magna Grecia, Etruschi e Fenici, Atti del trenatreesimo Convegno di Studi sulla Magna Grecia (Taranto, 8-13 ottobre 1993)*, Taranto 1994: 647–670.
De Caro 1995 = S. De Caro, "Attività della Soprintendenza Archeologica di Napoli e Caserta nel 1994", in *Corinto e l'Occidente. Atti del Trentaqauttresimo convegno di Stud. sulla Magna Grecia (Taranto, 7-11 ottobre 1994)* 1995: 672–703.
De Caro 1997 = S. De Caro, "La Campania", in *Mito e Stor. Magna Grecia. Atti del XXXVI Convegno di Stud. sulla Magna Greci (Taranto 4-7 ottobre 1996)* 1997.
De Caro 1999 = S. De Caro, "L'attività della soprintendenza di Napoli e Caserta nel 1997. Le Rassegne Archeologiche. La Campania", in *Confini e Frontiera nella Grecità d'Occidente. Atti dei XXXVII convegno di studi sulla Magna Grecia, Taranto, 3-6 ottobre 1997*, Taranto 1999: 793–843.
De Caro 2002 = S. De Caro, "Introduzione alle relazioni sugli scavi in atto", in G. Franciosi (ed. by), *Ager Campanus. Atti del convegno internazionale "La storia dell'Ager Campanus, I Problemi della limitatio de sua lettura attuale", Real Sitio di S. Leucio, 8-9 giugno 2001*, Napoli 2002: 135–136.
De Caro 2009 = S. De Caro, "La città sannitica. Urbanistica e architettura", in F. Zevi (ed. by), *Pompei*, Napoli 2009: 55–112.
De Caro 2012 = S. De Caro, *La terra nera degli antichi campani: guida archeologica della provincia di caserta*, Napoli 2012.
Carratelli 1965 = G.P. Carratelli, "Le stelle di Pyrgi", in *Parola Passato* 103, 1965: 303–305.
Castagnoli 1956a = F. Castagnoli, "La centuriazione di Cosa", in *Mem. Am. Acad. Rome* 24, 1956, 1956: 147–165.
Castagnoli 1956b = F. Castagnoli, *Ippodamo di Mileto e l'urbanistica a pianta ortogonale*, Roma 1956.
Castagnoli 1993 = F. Castagnoli, "Topografia e urbanistica di Roma nel IV secolo A.C.", in F. Castagnoli (ed. by), *Topografica Antica: Un metodo di studio*, Roma 1993: 215–237.
Cataldi 2004a = G. Cataldi, "Forma quadrata Italiae. La pianificazione territoriale dell'Italia romana", in *Atti e Mem. dell'Accademia Petrarc. di Lett. Arti e Sci.* LXV, 2003, 2004: 102–104.
Cataldi 2004b = G. Cataldi, "Forma quadrata italie. La pianificazione territoriale dell'Italia Romana", in *La pianificazione romana nella Valdinievole*, Pieve a Nievole 2004: 7–37.
Catucci - Jannelli - Sanesi Mastrocinque 2002 = M. Catucci - L. Jannelli - L. Sanesi Mastrocinque, *Il deposito votivo dell'acropoli di Cuma*, Roma 2002.
Cavalieri Manasse - Giampaola - Roncella 2017 = G. Cavalieri Manasse - D. Giampaola - B. Roncella, "Nuove riflessioni sul complesso monumentale di Piazza Nicola Amore a Napoli", in C. Capaldi - C. Gasparri (ed. by), *Complessi mo- numentali e arredo scultoreo nella Regio I Latium et Campania: nuove scoperte e proposte di lettura in contesto. Atti del Convegno internazionale, Napoli, 5 e 6 dicembre 2013*, Napoli 2017: 203–221.
De Cazanove 2005 = O. De Cazanove, "Mont et citadelle, temple et templum. Quelques réflexions sur l'usage religieux des hauterus dans l'Italie républicaine", in *Arch. für Relig.* 7, 1, 2005: 62–82.
Cerchiai 1995 = L. Cerchiai, *I Campani*, Milano 1995.
Cerchiai 2002 = L. Cerchiai, "Sybaris and Thurii", in L. Cerchiai - L. Jannelli - F. Longo (ed. by),

The Greek cities of Magna Graecia and Sicily, Los Angeles 2002.
CERCHIAI 2008 = L. Cerchiai, “La Campania: I fenomeni di colonizzazione”, in G.M. Della Fina (ed. by), *La colonizzazione etrusca in Italia. Atti del XV Convegno Internazionale di Studi sulla Storia e l’Archeologia dell’Etruria*, Roma 2008: 401–421.
CERCHIAI 2010A = L. Cerchiai, “Sui Pelasgi della Valle del Sarno”, in F. Senatore - M. Russo (ed. by), *Sorrento e la Penisola Sorrentina tra Italici, Etruschi e Greci nel contesto della Campania antica. Atti della giornata di studio in omaggio a Paola Zancani Montuoro (Sorrento, 19 maggio 2007)*, Roma 2010: 247–253.
CERCHIAI 2010B = L. Cerchiai, *Gli antichi popoli della Campania. Archeologia e storia*, 2010.
CERCHIAI 2011 = L. Cerchiai, “Ripartendo da Beloch: brevi considerazioni sul popolamento di Nuceria e della Valle del Sarno”, in F. Senatore (ed. by), *Karl Julius Beloch. Da Sorrento nell’antichità alla Campania. Atti del convegno storiografico in memoria di Claudio Ferone*, 2011: 223–228.
CERCHIAI 2019 = L. Cerchiai, “Urbanizzazione nelle città campane tra Etruschi, Greci e Sanniti”, in M. Maiuro - M. Balbo (ed. by), *Popolazione, risorse e urbanizzazione nella Campania Antica. Dall’età preromana alla tarda antichità*, Bari 2019: 11–20.
CERCHIAI 2020 = L. Cerchiai, “I sistemi di regimazione delle acque nella Campania arcaica”, in E. Bianchi - M. D’Acunto (ed. by), *Opere di regimentazione delle acque in età arcaica. Roma, Magna Grecia e Grecia, Etruria e mondo italico, Roma*, Roma 2020: 327–337.
CERCHIAI - SALVADORI 2012 = L. Cerchiai - Y. Salvadori, “La tomba 39 di via San Massimo a Nola. Breve spunto per la cronologia e l’inizio dell’insediamento proto-urbano”, in C. Chiaramonte Treré - G. Bagnasco Gianni - F. Chiesa (ed. by), *Interpretando l’antico. Scritti di archeologia offerti a Maria Bonghi Jovino*, 2012: 435–455.
CESARANO 2004 = M. Cesarano, “Nola: segni di differenziazione sociale in alcuni corredi di età orientalizzante da un centro della mesogaia campana”, in *La formazione della città in Etruria. Atti del I corso di perfezionamento (anno accademico 2002-2003)*, Roma 2004: 23–40.
CESARANO 2011 = M. Cesarano, “Nola “polis degli Ausoni” in Ecateo di Mileto alla luce della documentazione dalle necropoli”, in *Incidenza dell’Antico* 9, 2011: 143–168.
CESARANO 2018 = M. Cesarano, “Nola. La “città nuova” della mesogaia”, in M. Osanna - S. Verger (ed. by), *Pompei e gli Etruschi*, Milano 2018: 173–177.
CESARANO 2020 = M. Cesarano, “Nola: suggestioni culturali dal ginnasio di Atene”, in *Incidenza dell’antico. Dialoghi di Stor. greca* 18, 2020: 145–202.
CESARANO 2021 = M. Cesarano, “...et vicina Vesevo ora iugo. Nuovi dati per lo studio dell’ager Nolanus”, in A. Coralini (ed. by), *Extra moenia. Abitare il territorio della regione vesuviana*, Roma 2021: 69–88.
CHAMPEAUX 1892 = J. Champeaux, *Fortuna. Recherches sur le culte de la Fortune à Rome et dans le monde romain des origines à la mort de César. Fortuna dans la religion archaïque.*, Rome 1892.
CHERICI 2006 = A. Cherici, “Per una scienza etrusca”, in *Sci. Technol. Cult. Herit.* 15, 2006: 9–28.
CHERICI 2013 = A. Cherici, “The science of the Etruscans”, in J.M. Turfa (ed. by), *The Etruscan World*, London/New York 2013: 683–694.
CHIARAMONTE TRERÉ 1986 = C. Chiaramonte Treré (ed. by), *Nuovi contributi sulle fortificazioni pompeiane*, Milano 1986.
CHIERICI 2007 = G. Chierici, “I pozzi sepolcrali di Sanpolo d’Enza”, in P. Magnani (ed. by), *Tutti gli scritti di archeologia*, Reggio Emilia 2007: 143–159.
CHOUQUER *et al.* 1987 = G. Chouquer - M. Clavel-Lévéque - F. Favory - J.-P. Vallat, *Structures agrarie en Italie, Centro-Meridionale. Cadastres et paysages ruraux*, Roma 1987.
CINQUANTAQUATTRO 2000 = T. Cinquantaquattro, “Abella, un insediamento della mesogaia campana. Note di topografia”, in *Aion* 7, 2000: 61–85.
CINQUANTAQUATTRO 2013 = T. Cinquantaquattro, “Abella (Avella)”, in T. Cinquantaquattro - G. Pescatori (ed. by), *REGIO 1: Avella, Atripalda, Salerno*, Roma 2013: 7–26.
CINQUE - IROLLO 2008 = A. Cinque - G. Irollo, “La paleogeografia dell’antica Herculaneum e le

fluttuazioni, di origine bradisismica, della sua linea di costa", in P.G. Guzzo - M.P. Guidobaldi (ed. by), *Nuove ricerche archeologiche nell'area vesuviana (scavi 2003-2006). Atti del Convegno Internazionale, Roma 1-3 febbraio 2007*, Roma 2008: 425–438.
CIONI - SANTACROCE - SBRANA 1999 = R. Cioni - R. Santacroce - A. Sbrana, "Pyroclastic deposits as a guide for reconstructing the multi-stage evolution of the Somma-Vesuvius Caldera", in *Bull. Volcanol.* 60, 1999: 207–222.
CLAUDE ALBORE LIVADIE 2010 = Claude Albore Livadie, "La Campania media e la Penisola sorrentino-amalfitana dall'età del Rame all'età del Ferro; alcune situazioni a confronto", in F. Senatore - M. Russo (ed. by), *Sorrento e la Penisola Sorrentinatra Italici, Etruschi e Greci nel contesto della Campania antica. Atti della giornata di studio in omaggio a Paola Zancani Montuoro (Sorrento, 19 maggio 2007)*, Roma 2010: 149–175.
CLAVEL-LEVÊQUE - LEVÊQUE 1984 = M. Clavel-Levêque - P. Levêque, *Villes et structures urbaines dans l'Occident romain. Seconde édition*, Paris 1984.
COARELLI 1983A = F. Coarelli, .
COARELLI 1983B = F. Coarelli, *Il Foro Romano*, Roma 1983.
COARELLI 1995A = F. Coarelli, "Venus Iovia, Venus Libitina? Il santuario di Fondo Patturelli a Capua", in *L'incidenza dell'antico, Studi in memoria di E. Lepore. Atti del Convegno internazionale : Anacapri, 24-28 marzo 1991*, Napoli 1995: 371–387.
COARELLI 1995B = F. Coarelli, "Venus Iovia, Venus Libitina? Il santuario di Fondo Patturelli a Capua", in *L'incidenza dell'antico, Studi in memoria di E. Lepore. Atti del Convegno internazionale : Anacapri, 24-28 marzo 1991*, Napoli 1995.
COARELLI 2000 = F. Coarelli, "Pompei: il foro, le elezioni, le circoscrizioni elettorali", in *Ann. di Archeol. e Stor. Antica* 7, 2000: 87–111.
COARELLI 2001 = F. Coarelli, "Il Foro Triangolare:decorazione e funzione", in P.G. Guzzo (ed. by), *Pompei: Scienza e Società. 250° anniversario degli Scavi di Pompei, Convegno Internazionale, Napoli, 25-27 novembre 1998*, Milano 2001: 97–107.
COARELLI 2005 = F. Coarelli, "I percorsi cerimoniali a Roma in età regia", in E. Greco (ed. by), *Teseo e Romolo: le origini di Atene e Roma a confronto (Atti del convegno internazionale di studi Scuola archeologica italiana di Atene, Atene 30 giugno-1 luglio 2003)*, Athens 2005: 29–42.
COLE 2004 = S.G. Cole, *Landscapes, Gender, and Ritual Space: The Ancient Greek Experience*, Berkeley 2004.
COLONNA 1985 = G. Colonna, "Santuari d'Etruria", in G. Colonna (ed. by), *Santuari d'Etruria*, Milano 1985.
COLONNA 1988 = G. Colonna, "Il lessico istituzionale etrusco e la formazione della città, specialmente in Emilia Romagna", in *La formazione della città preromana in Emilia Romagna, Atti del convegno di studi (Bologna - Marzabotto 7-8 dicembre 1985)*, Bologna 1988: 15–36.
COLONNA 1991 = G. Colonna, "Le civiltà anelleniche", in G. Pugliese Carratelli (ed. by), *Storia e Civiltà della Campania. L'evo antico*, Napoli 1991: 25–67.
COLONNA 2000 = G. Colonna, "l santuario di Pyrgi dalle origini mitostoriche agli altorilievi frontonali dei Sette e di Leucotea", in *Sci. dell'Antichità* 10, 2000: 251–336.
COLONNA 2006 = G. Colonna, "Sacred Architecture and the Religion of the Etruscans", in N. de Grummond - E. Simon (ed. by), *The Religion of the Etruscans*, Austin 2006: 132–168.
COLONNA 2012 = G. Colonna, "Il pantheon degli Etruschi – "i più religiosi degli uomini" – alla luce delle scoperte di Pyrgi", in *Lectio brevis anno accademico 2011-2012, MemAccLinc*, Roma 2012: 557–595.
COLONNA 2022 = G. Colonna, "Gli Etruschi nel Tirreno Meridionale: tra Mitistoria, Storia e Archeologia", in *Etruscan Stud.* 9, 2022: 191–206.
COOPER 1968 = F.A. Cooper, "The Temple of Apollo at Bassae: New Observations on Its Plan and Orientation", in *Am. J. Archaeol.* 72, 2, 1968: 103–111.
COPPOLA 2010 = D. Coppola, *ANEMOI. Morfologia dei venti nell'immaginario della Grecia arcaica*, Napoli 2010.

DELLA CORTE 1922 = M. Della Corte, “Groma”, in *Monum. Antichi* 28, 1922: 5–100.
COULTON 1975 = J.J. Coulton, “Towards Understanding Greek Temple Design: General Consideration”, in *Annu. Br. Sch. Athens* 70, 1975: 55–99.
COULTON 2002 = J.J. Coulton, “The Dioptra of Hero of Alexandria”, in J. Tuplin - T.E. Rihll - L. Wolpert (ed. by), *Science and Mathematics in Ancient Greek Culture*, Oxford 2002: 150–164.
CRAWFORD *et al.* 2011 = M. Crawford - W.M. Broadhead - J.P.T. Clackson - F. Santangelo - S. Thompson - M. Watmough - E. Bissa - G. Bodard (ed. by), *Imagines Italicae: A Corpus of Italic Inscriptions*, London 2011.
CRISCUOLO - PACCIARELLI 2009 = P. Criscuolo - M. Pacciarelli, “La facies cumana della prima età del Ferro nell’ambito dei processi di sviluppo medio-tirrenico”, in *Cuma. Atti del quarantottesimo convegno di studi sulla Magna Grecia (Taranto, 27 settembre-1 ottobre 2008)*, Taranto 2009: 325–351.
CRISTOFANI 1995 = M. Cristofani, *Tabula capuana. Un calendario festivo di età arcaica*, Firenze 1995.
CRISTOFANI 1998 = M. Cristofani, “Luoghi di culto dell’Ager Campanus”, in S.A. Muscettola - G. Greco (ed. by), *I culti della Campania Antica. Atti del Convegno Internazionale di Studi in ricordo di Nazarena Valenza Mele, Napoli 15-17 Maggio 1995.*, Roma 1998: 169–173.
CRISTOFANI 2009 = M. Cristofani, “La Fase ‘Etrusca’ di Pompei”, in F. Zevi (ed. by), *Pompei*, Napoli 2009: 17–54.
CRISTOFARO N.D. = I. Cristofaro, “The Equisolar Axis in Urban Morphology: Pompeii, the Solstices and Sunlight Irradiation”, in *Proceedings VIII AACCP2021 (Architecture, Archaeology and Contemporary City Planning) symposium. Cities in Evolution: Diachronic Transformations of Urban and Rural Settlements*, Istanbul n.d.
CRISTOFARO 2021 = I. Cristofaro, “In the light of the Milky Way: An Interpretative Key for Crux-Centaurus Alignments across Prehistoric Europe”, in A.C. González-García - R.M. Frank - L.D. Sims - M.A. Rappengluck - G. Zotti - J.A. Belmonte - I. Sprajc (ed. by), *Beyond Paradigms in Cultural Astronomy. Proceedings of the 27th SEAC conference held together with the EAA*, Oxford 2021.
CRISTOFARO 2022 = I. Cristofaro, “Il Tempio Dorico a Pompei: orientamento e illuminazione solare”, in M. Cipriani - E. Greco - A. Pontrandolfo (ed. by), *Dialoghi sull’Archeologia della Magna Grecia e del Mediterraneo. Atti del VI Convegno Internazionale di Studi, Paestum, 1-3 ottobre 2021*, Paestum 2022: 291–300.
CRISTOFARO - SILANI 2021 = I. Cristofaro - M. Silani, “Approaching Skyscape Archaeology: A Note on Method and Fieldwork for the Case Study of Pompeii”, in *Groma. Doc. Archaeol.* 5, 2020, 2021: 1–22.
CRISTOFARO - SILANI - ZOTTI N.D. = I. Cristofaro - M. Silani - G. Zotti, “From Urban Orientations to 3D Visualisation: Solar Irradiation in Pompeii within Ancient Virtual Skies”, in *J. Comput. Appl. Archaeol.* n.d.
D’ACUNTO 2020 = M. D’Acunto, “I sitestemi di regimentazione delle acque a Cuma in epoca arcaica: dalla pianificazione urbana all’intervento di Aristodemo”, in V. Caminneci - M.C. Parello - M.S. Rizzo (ed. by), *Le forme dell’acqua Approvvigionamento, raccolta e smaltimento nella città antica Atti delle Giornate Gregoriane XII Edizione (Agrigento 1-2 dicembre 2018)*, Bologna 2020: 39–49.
D’AGOSTINO 1985 = B. d’Agostino, “La formazione dei centri urbani”, in M. Cristofani (ed. by), *Civiltà degli Etruschi*, Milano 1985: 43–47.
D’AGOSTINO 2001 = B. d’Agostino, “Le terrecotte architettoniche arcaiche”, in Jozef Arthur de Waele (ed. by), *Il tempio dorico del Foro Triangolare di Pompei*, Roma 2001: 133–196.
D’AGOSTINO 2006 = B. d’Agostino, “The First Greeks in Italy”, in G.R. Tsetskhladze (ed. by), *Greek Colonisation. An Account of Greek Colonies and Other Settlements Overseas*, Leiden 2006: 201–238.
D’AGOSTINO 2011 = B. d’Agostino, “Gli Etruschi e gli altri nella Campania Settentrionale”, in *Gli Etruschi e la Campania Settentrionale, Atti del XXVI convegno di Studi Etruschi ed Italici, Caserta - S. M. Capua Vetere - Capua - Teano, 11-15 novembre 2007*, Pisa 2011: 69–91.

d'Agostino 2014 = B. d'Agostino, "Il popolamento campano della I età del ferro. Il villanoviano campano", in C. Rescigno - F. Sirano (ed. by), *Immaginando città. Racconti di fondazioni mitiche, forma e funzioni delle città campane, catalogo della mostra (S. Maria Capua Vetere e Paestum)*, Salerno 2014: 44–48.
d'Agostino - Cerchiai 1999 = B. d'Agostino - L. Cerchiai, "Il mare, la morte, l'amore", in *Gli Etruschi, i Greci e l'immagine*, Roma 1999.
d'Agostino - Cerchiai 2004 = B. d'Agostino - L. Cerchiai, "I Greci nell'Etruria Campana", in G.M. Della Fina (ed. by), *I Greci in Etruria. Atti dell'XI Convegno Internazionale di Studi sulla Storia e l'Archeologia dell'Etruria. Annali della Fondazione per il Museo Claudio Faina*, Roma 2004: 271–289.
D'Alessio 2009 = M.T. D'Alessio, *I culti a Pompei. Divinità, luoghi e frequentatori (VI secolo a.C - 79 d.C.)*, Roma 2009.
D'Alessio 2013 = M.T. D'Alessio, "Riti e miti di forndazione nell'Italia antica. Riflessione sui luoghi di Roma", in G. Bartoloni - L.M. Michetti (ed. by), *Mura di legno, mura di terra, mura di pietra: fortificazioni nel Mediterraneo antico, Atti del Convegno Internazionale, Sapienza, Università di Roma, 7-9 maggio 2012*, Roma 2013: 316–331.
D'Ambrosio - De Caro 1989 = A. D'Ambrosio - S. De Caro, "Un contributo all'architettura e all'urbanistica di Pompei in età ellenistica. I saggi nella casa VII, 4, 62", in *Aion Arch. St.Ant.* 11, 1989: 173–215.
D'Henry 1973 = G. D'Henry, "Il territorio a nord del Sele", in *Economia e società nella Magna Grecia. Atti del XII Convegno di Studi sulla Magna Grecia (Taranto, 8-14 ottobre 1972)*, Napoli 1973: 287–296.
D'Onofrio 2002 = A. D'Onofrio, "Primi dati sull'urbanistica di Cuma: l'area tra il Foro e le fortificazioni settentrionali", in B. D'Agostino - A. D'Andrea (ed. by), *CUMA: Nuove forme di intervento per lo studio del sito antico. Atti della Giornata di Studio – Napoli 12 Febbraio 2001*, Napoli 2002: 131–152.
Dallas 2018 = T.G. Dallas, "Are the Moons of Ninnion a Representation of Earthshine?", in *Mediterr. Archaeol. Archaeom.* 18, 4, 2018: 19–23.
Davidson 2007 = J. Davidson, "Time and Greek religion", in D. Ogden (ed. by), *A Companion to Greek Religion*, Oxford 2007: 204–218.
de' Spagnolis Conticello 1990 = M. de' Spagnolis Conticello, "Nocera Superiore (Salerno)", in *Boll. d'Archeologia* 1–2, 1990: 239–247.
de' Spagnolis Conticello 1994 = M. de' Spagnolis Conticello, *Il pons sarni di Scafati e la via Nuceria-Pompeios*, Roma 1994.
De' Spagnolis 2006 = M. De' Spagnolis, "La necropoli ellenistico-romana di Pizzone (Nocera Superiore)", in T. Fortunato (ed. by), *Nuceria: scritti storici in memoria di Raffaele Pucci*, Postiglione 2006: 67–70.
Desantis - Malnati 2009 = P. Desantis - L. Malnati, "Il complesso sacro della "terza stipe": analisi dei documenti e ipotesi ricostruttive dell'area sacra nord-orientale di Marzabotto (con Appendice di Francesca Sighinolfi)", in G. Cresci - M. Marrone - M. Tirelli (ed. by), *Altnoi. Il santuario altinate. Strutture del sacro a confronto e i luoghi di culto lungo la via Annia (Atti del Convegno: Venezia, 4-6 dicembre 2006)*, Roma 2009: 293–324.
Detienne 2002 = M. Detienne, *Apollo con il coltello in mano. Un approccio sperimentale al politeismo greco*, Milano 2002.
Deuschle 2018 = U. Deuschle, *Create a panorama*, 2018.
Dicks 1966 = D.R. Dicks, "Solstices, Equinoxes, & the Presocratics", in *J. Hell. Stud.* 86, 1966: 26–40.
Dicks 1970 = D.R. Dicks, *Early Greek Astronomy to Aristotle*, Ithaca, NY 1970.
Dilke 1971 = O.A.W. Dilke, *The Roman Land Surveyors. Introduction to the Agrimensores*, 1971.
Dilke 1985 = O.A.W. Dilke, *Greek and Roman Maps*, Ithaca 1985.
Dinsmoor 1934 = W.B. Dinsmoor, "The Date of the Older Parthenon", in *Am. J. Archaeol.* 38, 3,

1934: 408–448.
DINSMOOR 1939 = W.B. Dinsmoor, “Archaeology and Astronomy”, in *Proc. Am. Philos. Soc.* 80, 1, 1939: 95–173.
DINSMOOR 1975 = W.B. Dinsmoor, *The Architecture of Ancient Greece*, New York 1975.
DOBROWOLSKI 1991 = W. Dobrowolski, “Il mito di Prometeo: Il limite tra il cielo e la terra nell’arte etrusca”, in *Archeologia Classica. Miscellanea Etrusca e italica in onore di Massimo Pallottino*, Roma 1991: 1213–1230.
DOYLE 2019 = B. Doyle, *horiZONE online service*, 2019.
DROMAIN 2016A = M. Dromain, *La fenêtre et l’éclairage dans l’architecture grecque antique : monuments publics et religieux de la Grèce égéenne*, Université Bordeaux Montaigne, 2016, available at http://www.theses.fr/2016BOR30047.
DROMAIN 2016B = M. Dromain, “Sacrée lumière et divine architecture: lumière et éclairage naturels des lieux de culte grecs antiques”, in C. Beaufort - M. Lebrère (ed. by), *Les Ambivalences de la lumière, Actes du troisième colloque transdisciplinaire intitulé «Confins et voisinages. Les arts dans la topologie des champs du savoir », 9-11 octobre 2014, Université de Pau et des Pays de l’Adour, Pau*, Pau 2016.
DUMÉZIL 1924 = G. Dumézil, *Le festin d’immortalité: étude de mythologie comparée indo-européenne*, Paris 1924.
DUMÉZIL 1996 = G. Dumézil, *Archaic Roman Religion, with an appendix on the religion of the Etruscans*, Baltimore 1996.
ECKSTEIN 1979 = A.A.E. Eckstein, “The Foundation Day of Roman Coloniae”, in *Calif. Stud. Class. Antiq.* 12, 1979: 85–97.
EDLUND-BERRY 1987 = I. Edlund-Berry, *The Gods and the Place: Location and Function of Sanctuaries in the Countryside of Etruria and Magna Graecia (700-400 B.C.)*, 1987.
ELIA 1964 = O. Elia, “Lo stamnos dionisiaco di Nocera”, in *Apollo Boll. dei Musei Prov. del Salenitano* 3, 4, 1964.
ESCACENA CARRASCO 2009 = J.L. Escacena Carrasco, “La Égersis de Melqart: Hipótesis sobre una teología solar cananea”, in *Complutum* 20, 2, 2009: 95–120.
ESCHEBACH 1970 = H. Eschebach, *Die Stadtebauliche Entwicklung des Antiken Pompeij*, Heidelberg 1970.
ESCHEBACH - ESCHEBACH 1995 = H. Eschebach - L. Eschebach, *Pompeji. Vom 7. Jahrhundert v. Chr. bis 79 n. Chr.*, Köln 1995.
ESPOSITO 1994 = E. Esposito, “La valle del Sarno: uso del territorio e viabilità”, in A. Pecoraro (ed. by), *Nuceria Alfaterna e il suo territorio. Dalla fondazione ai Longobardi*, Nocera Inferiore 1994: 111–120.
ESTEBAN - PELLÍN 2016 = C. Esteban - D.I. Pellín, “Temples of Astarte across the Mediterranean”, in *Mediterr. Archaeol. Archaeom.* 16, 4, 2016: 161–166.
FACCHETTI 2000 = G.M. Facchetti, *Frammenti di diritto privato etrusco*, Firenze 2000.
FARNELL 2010 = L.R. Farnell, *The Cults of the Greek States*, Oxford 2010.
DI FAZIO 2012A = M. Di Fazio, “Tempo del sacerdote, tempo del cittadino. Sacro e memoria culturale presso gli Etruschi”, in V. Nizzo - L. La Rocca (ed. by), *Antropologia e Archeologia a confronto.: rappresentazione e pratiche del sacro. Atti del 2° congresso internazionale di studi (Roma, Museo Nazionale Preistorico Etnografico “Luigi Pigorini”, 20-21 maggio 2011)*, Roma 2012: 147–166.
DI FAZIO 2012B = M. Di Fazio, “I luoghi di culto di Feronia. Ubicazioni e funzioni”, in G.M. Della Fina (ed. by), *Il fanum Voltumnae e I santuari comunItarI dell’ItalIa antIca. Atti del XIX convegno Internazionale di studi sulla storia e l’archeologia dell’Etruria*, Roma 2012: 379–408.
DI FAZIO 2016 = M. Di Fazio, “Tavola rotonda”, in M. Aberson - M.C. Biella - M. Di Fazio - P. Sánchez - M. Wullschleger (ed. by), *L’Italia centrale e la creazione di una koiné culturale? I percorsi della “romanizzazione”, E pluribus unum? Italy from the pre-Roman fragmentation to the Augustan Unity, vol. 2 (eds.)*, Bern 2016: 413–416.
DI FAZIO 2017 = M. Di Fazio, “Politeismi ristretti e maternità “politiche”: uno sguardo sull’Italia

preromana", in P.G. F. - P. G. - S. M. (ed. by), *Maternità e politeismi*, Bologna 2017: 419–429.
Di Fazio 2018 = M. Di Fazio, "Religions of Ancient Italy", in *The Peoples of Ancient Italy*, Boston/Berlin 2018: 149–172.
Di Fazio 2020a = M. Di Fazio, "Writing Time and Space in Ancient Etruria", in R.D. Whitehouse (ed. by), *Etruscan Literacy in its Social Context*, London 2020: 135–144.
Di Fazio 2020b = M. Di Fazio, "La dea: il suo profilo, il suo culto", in M.G. Benedettini - A.M. Moretti Sgubini (ed. by), *Un grande santuario interetnico: Lucus Feroniae. Scavi 2000-2010*, Pisa 2020: 213–224.
Fecondo 2015 = P. Fecondo, *Il terriotorio tra Calatia e Suessula*, Seconda Università degli Studi di Napoli-Università degli Studi Suor Orsola Benincasa, 2015.
Fentress 1996 = E. Fentress, "Saturnia: Figures in a Centuriated Landscape", in A. Chastagnol - S. Démougin - C. Lepelley (ed. by), *Splendidissima civitas: études d'histoire romaine en hommage â François Jacques*, Paris 1996: 196–211.
Fentress - Perkins 2016 = E. Fentress - P. Perkins, "Cosa and the ager Cosanus", in A.E. Cooley (ed. by), *A companion to Roman Italy*, Oxford 2016: 378–400.
Feraboli 1986 = S. Feraboli, "Eracle, le "Trachinie" e il Calendario", in *Quad. Urbinati di Cult. Class.* 23, 2, 1986: 125–135.
Ferranti 2011 = J. de Ferranti, *ViewFinder Panoramas*, 2011.
Ferranti 2015 = J. de Ferranti, *Virtual Earth Products*, 2015.
Ferrari 2008 = G. Ferrari, *Alcman and the Cosmos of Sparta*, Chicago 2008.
Ferro - Magli 2012 = L. Ferro - G. Magli, "The astronomical orientation of the urban plan of Alexandria", in *Oxford J. Archaeol.* 31, 4, 2012: 381–389.
Ferro - Magli - Osanna 2020 = L. Ferro - G. Magli - M. Osanna, "Gromatic Images from New Discoveries in Pompeii", in *Nexus Netw. J.* 22, 3, 2020: 717–733.
Filippi 1983 = M.R. Filippi, "Le procedure: le operazioni preliminari", in E. Gabba (ed. by), *Misurare la terra: centuriazione e coloni nel mondo romano.*, Modena 1983: 124–127.
Filippucci 2012 = M. Filippucci, *Dalla forma urbana all'immagine della città Geometria e gurazione all'origine dello spazio costruito*, "Sapienza" Università di Roma, 2012.
Fogliazza 2020 = S. Fogliazza, "Il dio nel pozzo. Nuove considerazioni sui culti nel "pozzo del centro" a Servirola", in M. Cremaschi - R. Macellari - G.A. Rossi (ed. by), *Attualità di don Gaetano Chierici. Archeologo, museologo e maestro di impegno civile (Reggio Emilia 19 - 21 settembre 2019) Atti del Convegno di Studi*, Roma 2020: 123–131.
Fowler - Turner 1983 = D.H. Fowler - E.G. Turner, "Hibeh papyrus i 27: An early example of Greek arithmetical notation", in *Hist. Math.* 10, 1983: 344–359.
Franchi De Bellis 1981 = A. Franchi De Bellis, *Le Iovile capuane*, Firenze 1981.
Franciosi 2009 = V. Franciosi, "Pompei: Lo sviluppo urbanistico", in R.T. Macfarlane - G.F. De Simone (ed. by), *Studies on Vesuvius' North Slope and Bay of Naples*, 2009: 77–86.
De Francisis 1956 = A. De Francisis, "Templum Dianae Tifatinae", in *Arch. Stor. di Terra di Lav.* 1, 1, 1956: 301–352.
De Francisis 1975 = A. De Francisis, "Il Criptoportico dell'antica Capua e gli scavi nella zona adiacente", in *RANap* L, 1975: 39–54.
Franzoni 2002 = C. Franzoni, "Il cielo e il tempo", in S. Settis - C. Franzoni (ed. by), *I Greci. Storia, Cultura, Arte, Società. Atlante*, Torino 2002: 141–162.
Fresa 1965 = A. Fresa, "I santuari solari d'Ischia, Delo e Tebe", in *Atti dell'Accademia Pontaniana, Nuova Ser.* 14, 1965.
Fresa - Fresa 1974 = M. Fresa - A. Fresa, *Nuceria Alfaterna in Campania*, Napoli 1974.
Frickenhaus 1912 = A. Frickenhaus, *Lenäenvasen*, Berlin 1912.
Fulminante 2014 = F. Fulminante, *The Urbanisation of Rome and Latium Vetus: From the Bronze Age to the Archaic Era*, New York 2014.
Fustel de Coulanges 1972 = N.-D. Fustel de Coulanges, *La città antica*, Firenze 1972.
Gainsford 2012 = P. Gainsford, "'Odyssey' 20.356-57 and the Eclipse of 1178 B.C.E.: A Response

to Baikouzis and Magnasco”, in *Trans. Am. Philol. Assoc.* 142, 1, 2012: 1–22.
LE GALL 1975 = J. Le Gall, “Les Romains et l’orientation solaire”, in *Mélanges l’école Fr. Rome* 87, 1, 1975: 287–320.
GARCÍA QUINTELA 2022 = M. V. García Quintela, “Meton of Athens: An Astronomer in the Democratic Landscape of the Polis”, in *Gerión. Rev. Hist. Antig.* 40, 2, 2022: 553–573.
GASPARRI 1999 = C. Gasparri, “Nuove indagini nel Foro di Cuma”, in S. Quilici Gigli (ed. by), *La forma della città e del territorio, Atti dell’incontro di studio (S. Maria Capua Vetere, 27-28 novembre 1998)*, Roma 1999: 131–137.
GEERTMAN 2001 = H. Geertman, “Lo studio della città antica. Vecchi e nuovi approcci”, in P.G. Guzzo (ed. by), *Pompei. Scienza e società. Convegno internazionale per il 250° anniversario degli scavi di Pompei (Napoli, 25-27 novembre 1998)*, Milano 2001: 131–135.
GEERTMAN 2007 = H. Geertman, “The Urban Development of the Pre-Roman City”, in J.J. Dobbins - P.W. Foss (ed. by), *The World of Pompeii*, London/New York 2007: 82–97.
VON GERKAN 1940 = A. Von Gerkan, *Der Stadplan von Pompeji*, Berlin 1940.
GIAMPAOLA 1994 = D. Giampaola, “I monumenti”, in F. Zevi (ed. by), *Neapolis*, Napoli 1994.
GIAMPAOLA 1996 = D. Giampaola, “Indagini archeologiche nel centro storico di Napoli”, in *Boll. di Archeol.* 39–40, 1996: 84–93.
GIAMPAOLA 1997 = D. Giampaola, “Acerra. La città antica e il suo teatro”, in A. Montano - C. Robotti (ed. by), *Il Castello Baronale di Acerra. Storia Architettura Ambiente*, Acerra 1997: 171–189.
GIAMPAOLA 2002 = D. Giampaola, “Un territorio per due città: Suessula e Acerra”, in G. Franciosi (ed. by), *Ager Campanus. La storia dell’ager Campanus. I problemi della limitatio e sua lettura attuale*, Napoli 2002: 165–169.
GIAMPAOLA 2009 = D. Giampaola, “Archeologia e città: la riconstruzione della linea di costa”, in *TeMA - Trimest. del Lab. Territ. Mobilità e Ambient.* 2, 3, 2009: 37–46.
GIAMPAOLA *et al.* 2005 = D. Giampaola - V. Carsena - G. Boetto - F. Crema - C. Florio - D. Panza - B. Pizzo - C. Capretti - G. Galotta - G. Giachi - N. Macchioni - M.P. Nugari - M. Bartolini, “La scoperta del porto di “Neapolis” : dalla ricostruzione topografica allo scavo e al recupero dei relitti”, in *Archaeol. maritima Mediterr. Int. J. Underw. Archaeol.* 2, 2005: 47–91.
GIAMPAOLA - D’AGOSTINO 2005 = D. Giampaola - B. D’Agostino, “Osservazioni storiche e archeologiche sulla fondazione di Neapolis”, in W. V. Harris - E. Lo Cascio (ed. by), *Noctes Campanae: Studi di storia antica ed archeologia dell’Italia preromana e romana in memoria di W. Frederiksen*, Napoli 2005: 49–80.
GIAMPAOLA - RONGA - SICA 1997 = D. Giampaola - G. Ronga - M. Sica, “Appunti per la storia del paesaggio agrario di Acerra”, in *Atlante Temat. di Topogr. Antica II suppl.* 1997: 225–238.
GIAMPAOLA - ROSSI 2011 = D. Giampaola - A. Rossi, “Suessula: i nuovi rinvenimenti”, in *Gli Etruschi e la Campania settentrionale, Atti del XXVI Convegno di studi etruschi ed italici, Caserta, Santa Maria Capua Vetere, Capua, Teano, 11-15 novembre 2007*, Pisa 2011: 533–540.
GIANGIULIO 1985 = M. Giangiulio, “Appunti di storia dei culti”, in *ACSMG* XXV, 1985: 101–154.
GIANGIULIO 2012 = M. Giangiulio, “Le origini coloniali tra memoria e tradizione”, in *Alle origini della Magna Grecia: mobilità, migrazioni, fondazioni. Atti del Cinquantesimo convegno di Studi sulla Magna Grecia (Taranto, 1-4 ottobre 2010)*, Taranto 2012: 389–396.
GIGLIO 2016 = M. Giglio, “Considerazioni sull’impianto urbanistico di Pompei”, in *Vesuviana* 8, 2016: 11–48.
GIOVAGNORIO - CHIRI 2016 = I. Giovagnorio - M.G. Chiri, “The Environmental Dimension of Urban Design: A Point of View”, in M. Ergen (ed. by), *Sustainable Urbanization*, London 2016: 37–60.
GIOVAGNORIO *et al.* 2017 = I. Giovagnorio - D. Usai - A. Palmas - M.G. Chiri, “The environmental elements of foundations in Roman cities: A theory of the architect Gaetano Vinaccia”, in *Sustain. Cities Soc.* 32, 2017: 42–55.
GLINSTER 2020 = F. Glinster, “Getting to know Diana”, in E. Bispham - D. Miano (ed. by), *Gods and Goddesses in Ancient Italy*, Abingdon 2020: 47–62.
LE GOFF 1982 = J. Le Goff, “Sacro/profano”, in *Encicl. Einaudi*, : 552–564.

GONZÁLEZ-GARCÍA - BELMONTE 2014 = A.C. González-García - J.A. Belmonte, "Sacred Architecture Orientation across the Mediterranenan: A Comparative Statistical Analysis", in *Mediterr. Archaeol. Archaeom.* 14, 2, 2014: 95–113.
GONZÁLEZ-GARCÍA *et al.* 2022 = A.C. González-García - M. V. García Quintela - A. Rodríguez-Antón - D. Espinosa-Espinosa, "The Winter Solstice as a Roman Cultural Fingerprint from the Mythical Origins of Rome to Augustus", in *Environ. Archaeol.* 2022.
GONZÁLEZ-GARCÍA - MAGLI 2015 = A.C. González-García - G. Magli, "Roman City Planning and Spatial Organization", in C. Ruggles (ed. by), *Handbook of Archaeoastronomy and Ethnoastronomy*, New York 2015: 1643–1650.
GONZÁLEZ-GARCÍA - RODRÍGUEZ-ANTÓN - BELMONTE 2014 = A.C. González-García - A. Rodríguez-Antón - J.A. Belmonte, "The Orientation of Roman Towns in Hispania: Preliminary Results", in *Mediterr. Archaeol. Archaeom.* 14, 3, 2014: 107–119.
GOTTARELLI 2003 = A. Gottarelli, "Auguraculum, sedes inaugurationis e limitation rituale della città fondata. Elementi di analogia tra la froma urbana della città etrusca di Marzabotto ed il templum augurale di Bantia", in *Ocnus* 11, 2003: 135–149.
GOTTARELLI 2005 = A. Gottarelli, "Templum solare e città fondata. La connessione astronomica della forma urbana della città etrusca di Marzabotto", in *Culti forma urbana*, 2005: 101–138.
GOTTARELLI 2013 = A. Gottarelli, *Contemplation. Templum solare e culti di fondazione (1998-2013). Sulla regola aritmogeometrica del rito di fondazione della città etrusco-italica tra il VI e IV secolo a.C.*, Bologna 2013.
GRAF 1996 = F. Graf, "Gli dei greci e i loro santuari", in S. Settis (ed. by), *I Greci. Storia, Cultura, Arte, Società. Una storia greca. Formazione (fino al VI secolo a.C.)*, Torino 1996: 343–380.
GRAHAM 1964 = A.J. Graham, "*Colony and mother city in ancient Greece*", in Manchester 1964.
GRAHAM 1972 = J.W. Graham, "Notes on houses and housing-districts at Abdera and Himera", in *Am. J. Archaeol.* 76, 3, 1972: 295–301.
DEL GRANDE 1959 = C. Del Grande (ed. by), "Antichità greche", in *Encicl. Class. Stor. e Antich.*, vol. 3.
GRECO 1994 = E. Greco, "L'urbanistica Neapolitana: continuità dell'antico", in F. Zevi (ed. by), *Neapolis*, Napoli 1994: 35–53.
GRECO 1995 = E. Greco, "Sulle Città coloniali dell'Occidente greco antico", in *Les grecs et l'Occident : actes du Colloque de la Villa Kérylos (1991)*, Roma 1995: 83–94.
GRECO 1996 = E. Greco, "Edifici Quadrati", in L. Breglia Pulci Doria (ed. by), *L'incidenza dell'antico, Studi in memoria di E. Lepore. Atti del Convegno internazionale: Anacapri, 24-28 marzo 1991*, Napoli 1996.
GRECO 1997 = E. Greco, "Definizione dello spazio urbano: architettura e spazio pubblico", in S. Settis (ed. by), *I Greci. Storia cultura arte società, vol. II t. 2: Una storia greca. Definizione (VI-IV secolo a. C)*, Torino 1997: 619–652.
GRECO 1999 = E. Greco, "Introduzione", in E. Greco (ed. by), *La città greca antica: Istituzioni, società e forme urbane*, Roma 1999: VII–XV.
GRECO 2005 = E. Greco, "Ritorno a Neapolis greca", in E. Lo Sardo (ed. by), *Eureka ! Il genio degli antichi*, Napoli 2005: 112–115.
GRECO 2018 = E. Greco, *Ippodamo di Mileto: immaginario sociale e pianificazione urbana nella Grecia classica*, Paestum 2018.
GRECO 2011 = G. Greco, "La definizione degli spazi pubblici a Cuma tra Greci e Sanniti", in *ACME. Ann. della Fac. di Lett. e Filos. dell'Università degli Stud. di Milano* LXIV, II, 2011: 35–53.
DE GRUMMOND 2006A = N.T. de Grummond, *An Archive of Images of Etruscan Mythology*, 2006.
DE GRUMMOND 2006B = N.T. de Grummond, *Etruscan myth, sacred history, and legend*, Philadelphia, PA 2006.
DE GRUMMOND 2008 = N.T. de Grummond, "Moon over Pyrgi: Catha, an Etruscan Lunar Goddess?", in *Am. J. Archaeol.* 112, 3, 2008: 419–428.
DE GRUMMOND 2013 = N.T. de Grummond, "Haruspicy and augury: sources and procedures", in *The*

Etruscan World, London/New York 2013: 539–556.
GUARDUCCI 1967 = M. Guarducci, *Epigrafia Greca. Caratteri e storia della disciplina. La scrittura greca dalle origini all'età imperiale*, Roma 1967.
GUARINO 2011 = A. Guarino, "Croce, crux interpretum. Alcune note sulla croce celeste Etrusca, sull'orientamento di templi Etrusco-Italici e sul "fegato di Piacenza"", in *Munuscula. Omaggio degli Allievi Napoletani a Mauro Cristofani*, Pozzuoli 2011: 183–235.
GUIDI 1982 = A. Guidi, "Sulle prime fasi dell'urbanizzazione del Lazio protostorico", in *Opus* I, 2, 1982: 279–289.
GUIDOBALDI - PESANDO 2018 = M.P. Guidobaldi - F. Pesando, *Pompei Oplontis Ercolano Stabiae*, Bari 2018.
GUZZO 2011 = P.G. Guzzo, "Del Vesuvio e delle sue presunte raffigurazioni", in C. Gasparri - G. Greco - R. Pierobon Benoit (ed. by), *Dall'immagine alla storia. Studi per ricordare Stefania Adamo Muscettola*, Napoli 2011: 495–503.
GUZZO 2016 = P.G. Guzzo, *Le città di Magna Grecia e di Sicilia dal VI al I secolo*, Roma 2016.
HAHN 2001 = R. Hahn, *Anaximander and the Architects*, Albany, NY 2001.
HALBHERR 1890 = F. Halbherr, "Iscrizioni Cretesi", in *Mus. Ital. di Antich. Class.* 3, 1890: 559– 748.
HAMBERG 1965 = P.G. Hamberg, "Vitruvius, Fra Giocondo and the City Plane of Naples", in *ActArch* XXXVI, 1965: 105–126.
HANNAH 2005 = R. Hannah, *Greek and Roman Calendars: Constructions of Time in the Classical World*, London 2005.
HANNAH 2009 = R. Hannah, *Time in Antiquity*, London 2009.
HANNAH 2013 = R. Hannah, "Greek Temple Orientation: The Case of the Older Parthenon in Athens", in *Nexus Netw. J.* 15, 3, 2013: 423–443.
HANNAH - MAGLI - ORLANDO 2016 = R. Hannah - G. Magli - A. Orlando, "The Role of Urban Topography in the Orientation of Greek Temples: the Cases of Akragas and Selinunte", in *Mediterr. Archaeol. Archaeom.* 16, 4, 2016: 213–217.
HARZALLAH *et al.* 2005 = A. Harzallah - D. Siret - E. Monin - J. Bouyer, "Controverses autour de l'axe héliothermique : l'apport de la simulation physique à l'analyse des théories urbaines", in *Repenser les limites : l'architecture à travers l'espace, le temps et les disciplines, 31 août - 4 septembre 2005*, Paris 2005.
HAVERFIELD 1913 = F. Haverfield, *Ancient Town-Planning*, Oxford 1913.
HEATH 2004 = T. Heath, *Aristarchus of Samos: The Ancient Copernicus*, New York 2004.
HEIDEL 1976 = W.A. Heidel, *The Frame of the Ancient Greek Maps*, New York 1976.
HENNEMEYER 2011 = A. Hennemeyer, "Zur Lichtwirkung am Zeustempel von Olympia", in P.I. Schneider - U. Wulf-Rheidt (ed. by), *Licht-Konzepte in der vormodernen Architektur. Internationales Kolloquium in Berlin vom 26. Februar – 1. März 2009 veranstaltet vom Architekturreferat des DAI*, Berlin 2011: 101–110.
HENNEMEYER 2015 = A. Hennemeyer, "The Temple Architecture and its Modifications during the 5th Century BCE", in A. Patay-Horváth (ed. by), *New Approaches to the Temple of Zeus at Olympia: Proceedings of the First Olympia-Seminar (Budapest, Hungary, May 8-10, 2014)*, Newcastle upon Tyne 2015: 16–38.
HERBERT 1984 = S.C. Herbert, "The Orientation of Greek Temples", in *Palest. Explor. Q.* 116, 1984: 31–34.
HEURGON 1970 = J. Heurgon, *Recherches sur L'Histoire, la Religion et la Civilisation de Capoue Préromaine des Origines à la Deuxième Guerre Punique*, Paris 1970.
HOEPFNER - SCHWANDNER 1994 = W. Hoepfner - E.-L. Schwandner, *Haus und Stadt im klassischen Griechenland. Wohnen in der Klassischen Polis I*, München 1994.
HOLAPPA - VIITANEN 2011 = M. Holappa - E.-M. Viitanen, "Topographic conditions in the urban plan of Pompeii: the urban landscape in 3D", in S.J.R. Ellis (ed. by), *The Making of Pompei: Studies in the history and urban development of an ancient town*, Portsmouth 2011: 169–189.
INCERTI 1999 = M. Incerti, "The urban fabric of Bologna: orientation problems", in *Transformations*

of Urban Form: From Interpretations to Methodologies in Practice. The Sixth International Seminar on Urban Form, from interpretations to methodologies in practice. Atti del Convegno Internazionale sulla Città (ISUF 99), Firenze 1999: 3–12.
INCERTI 2010 = M. Incerti, "Astronomia e astrologia nel disegno della forma urbana: il caso di Ferrara e Bologna", in *Bruniana Camp. Ric. Filos. e Mater. Stor.* XVI, 2, 2010: 639–646.
ISAGER - SKYDSGAARD 1992 = S. Isager - J.E. Skydsgaard, *Ancient Greek Agriculture: An Introduction*, London/New York 1992.
ISLER 1989 = M. Isler, "An Ancient Method of Finding and Extending Direction", in *J. Am. Res. Cent. Egypt* 26, 1989: 191–206.
JACOBY 1954 = F. Jacoby, *Die Fragmente der griechischen Historiker (FGrHist) IIIb*, Leiden 1954.
JEFFREYS 1998 = D. Jeffreys, "The topography of Heliopolis and Memphis: Some cognitive aspects", in *Stationen:Beitrage zur Kulturgeschichte Ägyptens, Rainer Stadelmann gewidmet*, Mainz 1998: 63–71.
JIMÉNEZ SAN CRISTÓBAL 2007 = I.A. Jiménez San Cristóbal, "Un iniziato sotto un tumulo a Cuma?", in *Z. Papyrologie Epigraphik* 161, 2007: 105–114.
JOHANNOWSKY 1982 = W. Johannowsky, "Problemi urbanistici di Ercolano", in *Cronache ercolanesi* 12, 1982.
JOHANNOWSKY 1989 = W. Johannowsky, *Capua antica*, Napoli 1989.
JOHANNOWSKY 1994 = W. Johannowsky, "L'urbanizzazione nella valle del Sarno", in A. Pecoraro (ed. by), *Nuceria Alfaterna e il suo territorio. Dalla fondazione ai Longobardi*, Nocera Inferiore 1994: 103–109.
JOHNSTON 2021 = P.A. Johnston, "Catullus, Horace and Diana Tifatina's Sacred Choir", in G. Casadio - P.A. Johnston (ed. by), *Artemis and Diana in Ancient Greece and Italy: At the Crossroads between the Civic and the Wild*, Cambridge 2021: 276–286.
KADISH 2014 = S. Kadish, *On and Off the Street grid: Relative Distributions of Road Orientations*, 2014.
KAHN 1970 = C.H. Kahn, "On Early Greek Astronomy", in *JHS* 90, 1970: 99–116.
KELLEY - MILONE 2011 = D.H. Kelley - E.F. Milone, *Exploring ancient skies. An encyclopedic survey of archeoastronomy*, New York 2011.
KIESLING 2018 = J.B. Kiesling, "*Gods over the Horizon: Terrestrial Orientations in Greek Temples*", in 2018.
KIRK - RAVEN 1957 = G.S. Kirk - J.E. Raven, *The Presocratic Philosophers: A Critical History with a Selection of Texts*, Cambridge 1957.
KIRK - RAVEN 1983 = G.S. Kirk - J.E. Raven, *The Presocratic Philosophers: A Critical History with a Selection of Texts*, Cambridge 1983.
KOKALJ - HESSE 2017 = Ž. Kokalj - R. Hesse, *Airborne laser scanning raster data visualization: A Guide to Good Practice*, Ljubljana 2017.
KOKALJ - SOMRAK 2019 = Ž. Kokalj - M. Somrak, "Why Not a Single Image? Combining Visualizations to Facilitate Fieldwork and On-Screen Mapping", in *Remote Sens.* 11, 7, 2019: 747.
KONARIS 2010 = M. Konaris, "The Greek Gods in Late Nineteenth- and Early Twentieth- Century German and British Scholarship", in B. Jan - A. Erskine (ed. by), *The Gods of Ancient Greece. Identities and Transformations*, Edinburgh 2010: 483–503.
KOSOWSKY 2014 = M. Kosowsky, "HeyWhatsThat", in *https://www.heywhatsthat.com*, 2014.
KOUROUNIOTES - THOMPSON 1932 = K. Kourouniotes - H.A. Thompson, "The Pnyx in Athens", in *Hesperia* 1, 1932: 90–217.
KRAUSKOPF 1991 = I. Krauskopf, "Ex Oriente Sol, Zu den orientalischen Wurzeln der etruskischen Sonnenikonographie", in *Archeol. Class. Misc. Etrusca e Ital. onore di Massimo Pallottino* 43, 1991: 1261–1263.
KRAUSKOPF 1992 = I. Krauskopf, "Himmlische Wasserträgerinnen", in *Kotinos. Festschrift für Erika Simon*, Mainz 1992: 350–355.
LAFORGIA 1988 = E. Laforgia, "La presenza della Soprintendenza Archeologica ad Avella", in

Didattica e territorio. Corso di formazione per docenti in servizio, Nola 1988: 99–106.
LAFORGIA - DE FILIPPIS 2002 = E. Laforgia - A. De Filippis, “Centuriazione a Gricignano d’Aversa”, in G. Franciosi (ed. by), *Ager Campanus. La storia dell’ager Campanus. I problemi della limitatio e sua lettura attuale. Atti del Convegno internazionale (Real sito di S. Leucio, 8-9 giugno 2001)*, Napoli 2002: 137–146.
LALONDE - LANGDON - WALBANK 1991 = G. V. Lalonde - M.K. Langdon - M.B. Walbank, *Inscriptions: Horoi, Poletai Records, Leases of Public Lands*, Princeton 1991.
LEPORE 1976 = E. Lepore, “Timeo in Strabone V, 4, 3, C 242-243 e le origini campane”, in *L’Italie préromaine et la Rome républicaine. Mélanges offerts à Jacques Heurgon*, Roma 1976: 573–585.
LÉVÊQUE - VIDAL-NAQUET 1964 = P. Lévêque - P. Vidal-Naquet, *Clisthène L’Athénien. Essai sur la représentation de l’espace et du temps dans la pensée politique grecque de la fin du VIe siècle à la mort de Platon*, Paris 1964.
LEWIS 2001 = M.J.T. Lewis, *Surveying instruments of Greece and Rome*, Cambridge 2001.
LINDERSKI 1983 = J. Linderski, “Natalis Patavii”, in *Z. Papyrologie Epigraphik* 50, 1983: 227–232.
LIPPOLIS - LIVADIOTTI - ROCCO 2007 = E. Lippolis - M. Livadiotti - G. Rocco, *Architettura greca: storia e monumenti del mondo della polis dalle origini al V secolo*, Milano 2007.
LOMBARDI SATRIANI 1984 = L.M. Lombardi Satriani, “La casa dell’uomo. Sacrificio, fondazione, memoria”, in F. Faeta (ed. by), *L’architettura popolare in Italia. Calabria*, Roma-Bari 1984: 177–194.
LOMBARDO 1999 = M. Lombardo, “La polis: società e istituzioni”, in E. Greco (ed. by), *La città greca antica: Istituzioni, società e forme urbane*, Roma 1999: 5–36.
LONGO 2014 = F. Longo, “Fondazioni di città nel mondo greco in età arcaica”, in C. Rescigno - F. Sirano (ed. by), *Immaginando città. Racconti di fondazioni mitiche, forma e funzioni delle città campane, catalogo della mostra (S. Maria Capua Vetere e Paestum)*, Salerno 2014: 230–233.
LONGO - TAURO 2016 = F. Longo - T. Tauro, “Costruire la città: riflessioni sull’impianto urbano di Neapolis”, in *DROMOI. Studi sul mondo antico offerti a Emanuele Greco dagli allievi della Scuola Archeologica Italiana di Atene*, Paestum 2016: 189–212.
LONGO - TAURO 2017 = F. Longo - T. Tauro, *Alle origini dell’urbanistica di Napoli*, Paestum 2017.
LUCIANO 1988 = P. Luciano, “Avella tra mito e storia: dalla fondazione di Abella al periodo romano”, in *Didattica e territorio. Corso di formazione per docenti in servizio*, Nola 1988: 87–98.
LUISI 2001 = R. Luisi, *Indagine topografica nei territori dell’antica Calatia: settore sud-occidentale*, Seconda Università degli Studi di Napoli, 2001.
LULOF 2000 = P.S. Lulof, “Archaic terracotta acroteria representing Athena and Heracles: manifestations of power in central Italy”, in *J. Rom. Archaeol.* 13, 2000: 207–219.
LUONGO - MAGNETTA 1994 = G. Luongo - M. Magnetta, “Nocera: caratteristiche fisiche del territorio”, in A. Pecoraro (ed. by), *Nuceria Alfaterna e il suo territorio. Dalla fondazione ai Longobardi*, Nocera Inferiore 1994: 25–35.
LYONS 1927 = H. Lyons, “Ancient surveying instruments”, in *Geogr. J.* 69, 1927: 132–41.
MAGGIANI 1998 = A. Maggiani, *Vasi attici figurati con dediche a divinità etrusche*, Roma 1998.
MAGGIANI 2005 = A. Maggiani, “Divination. La divinazione in Etruria”, in *Thes. Cultus Rituum Antiq.*, vol. III, : 52–78.
MAGINI 2003 = L. Magini, “Astronomia e calendario nell’antica Roma”, in *Riv. Ital. di Archeoastronomia* I, 2003: 107–119.
MAGINI 2015 = L. Magini, *Stars, Myths and Rituals in Etruscan Rome*, New York 2015.
DE MAGISTRIS 2007 = E. De Magistris, *Paestum e Roma Quadrata*, 2007.
MAGLI 2008A = G. Magli, “On The Origin Of The Roman Idea Of Town: Geometrical And Astronomical References”, in *Archeol. Balt.* 10, 2008: 149–154.
MAGLI 2008B = G. Magli, “On the orientation of Roman towns in Italy”, in *Oxford J. Archaeol.* 27, 1, 2008: 63–71.
MAIURI 1929 = A. Maiuri, *Studi e ricerche sulle fortificazioni di Pompei*, Roma 1929.
MAIURI 1939 = A. Maiuri, “Scavo della ‘Grande Palestra’ nel quartiere dell’Anfiteatro (a. 1935-

1939)", in *Not. degli scavi di Antich.* 1939: 165–238.
Maiuri 1973 = A. Maiuri, *Alla ricerca di Pompei preromana*, Napoli 1973.
Malville 2008 = J.M. Malville, "The Astronomical Gnomon: A Series of Interactive Experiments in Archaeoastronomy", in J.C. Holbrook - J.O. Urama - R.T. Medupe (ed. by), *African Cultural Astronomy – Current Archaeoastronomy and Ethnoastronomy Research in Africa*, Dordrecht 2008: 39–51.
Mandolesi 1999 = A. Mandolesi, *La "prima" Tarquinia: l'insediamento protostorico sulla Civita e nel territorio circostante*, Firenze 1999.
Mansuelli 1972 = G.A. Mansuelli, "Marzabotto, dix années de fouilles et de recherches", in *MEFRA* 84, 1972: 110–144.
Maras 2013 = D.F. Maras, "Numbers and Reckoning: A Whole Civilization Founded upon Divisions", in J. Macintosh Turfa (ed. by), *The Etruscan World*, Abingdon 2013: 478–491.
Marcattili 2017 = F. Marcattili, "Inversione della norma ed integrazione sociale: per un'interpretazione dei templi a cella trasversale", in *Rend. della Pointificia Accad. Rom. di Archeol.* LXXXIX, 2017: 705–744.
Marconi 1996 = C. Marconi, "La città visibili e i suoi monumenti", in S. Settis (ed. by), *I Greci. Storia, Cultura, Arte, Società. Una storia greca. Formazione (fino al VI secolo a.C.)*, Torino 1996: 755-.
Marconi - Pumo 2017 = C. Marconi - R. Pumo, "Selinunte, Sicily", in *IFA Archaeol. J.* 2017: 5.
Mardaljevic 2005 = J. Mardaljevic, "Quantification of Urban Solar Access", in M. Jenks - N. Dempsey (ed. by), *Future Forms and Design For Sustainable Cities*, Oxford 2005: 371–391.
Marmocchi 1837 = F.C. Marmocchi, *Corso di Geografia Universale sviluppato in cento lezioni e diviso in tre grandi parti*, Firenze 1837.
Martin-Mcauliffe - Papadopoulos 2012 = S.L. Martin-Mcauliffe - J.K. Papadopoulos, "Framing Victory: Salamis, the Athenian Acropolis, and the Agora", in *J. Soc. Archit. Hist.* 71, 3, 2012: 332–361.
Martin 1879 = T.-H. Martin, "Comment Homère s'orientait. Explications fort simples substituées à des fables trop savantes", in *Mémoires l'Institut Natl. Fr.* 29, 2, 1879: 1–28.
De Martino 2017 = M. De Martino, "L'identità greca di Neapolis", in C. Brélaz (ed. by), *L'héritage grec des colonies romaines d'Orient. Interactions culturelles dans les provinces hellénophones de l'empire romain. Actes du colloque de Strasbourg (8-9 novembre 2013)*, Strasbourg 2017: 355–370.
Mastrocinque 1993 = A. Mastrocinque, "Eracle "Iperboreo" in Etruria", in A. Mastrocinque (ed. by), *Ercole in Occidente*, Trento 1993: 49–62.
Mastrocinque 2021 = A. Mastrocinque, "The Triform Goddess Diana and her Patronage of Political Meetings in her Groves", in G. Casadio - P.A. Johnston (ed. by), *Artemis and Diana in Ancient Greece and Italy: At the Crossroads between the Civic and the Wild*, Cambridge 2021: 209–238.
Van Der Meer 2011 = B. Van Der Meer, *Etrusco Ritu. Case Studies in Etruscan Ritual Behaviour*, Louvain 2011.
Melandri 2011 = G. Melandri, *L'età del ferro a Capua. Aspetti distintivi del contesto culturale e suo inquadramento nelle dinamiche di sviluppo dell'Italia protostorica*, Oxford 2011.
Melandri 2012 = G. Melandri, "La ricomposizione dello sviluppo insediativo protostorico di Capua attraverso il rapporto dialettico con le aree funerarie", in C. Chiaramonte Treré - G. Bagnasco Gianni - F. Chiesa (ed. by), *Interpretando l'antico. Scritti di archeologia offerti a Maria Bonghi Jovino*, Milano 2012: 483–509.
Mele 1985a = A. Mele, "La città greca", in E. Pozzi (ed. by), *Napoli antica. Catalogo della Mostra. Napoli 1985-1986*, Napoli 1985: 103–108.
Mele 1985b = A. Mele, "Il Dibattito", in *ACSMG* XXV, 1985: 157–158.
Mele 1991 = A. Mele, "Le popolazioni italiche", in *Storia del Mezzogiorno. Il Mezzogiorno antico*, Napoli 1991.
Mele 2007a = A. Mele, "Atene e la Magna Grecia", in E. Greco - M. Lombardo (ed. by), *Atene e l'Occidente. I grandi temi: le premesse, i protagonisti, le forme della comunicazione e*

dell'interazione, i modi dell'intervento ateniese in Occidente. Atti del Convegno Internazionale, Atene, 25- 27 maggio 2006, Athens 2007: 239–268.
MELE 2007B = A. Mele, *Magna Grecia: colonie achee e pitagorismo*, Napoli 2007.
MELE 2014 = A. Mele, *I Greci in Campania*, Roma 2014.
MENICHELLI 2009 = S. Menichelli, "Etruscan Altars from the 7th- 4th centuries B.C.E.: Typology, Function, Cult", in *Etruscan Stud.* 12, 2009: 99–129.
MEREU 2021 = E. Mereu, "Uno scavo presso il decumano massimo di Calatia", in P. Di Lorenzo (ed. by), *Archeologia svelata. Leggere e raccontare il territorio della Campania antica*, Caserta 2021: 46–48.
MERTENS 2006 = D. Mertens, *Città e monumenti dei Greci d'Occidente: dalla colonizzazione alla crisi di fine V secolo a.C.*, Roma 2006.
MHEALLAIGH 2020 = K. ní Mheallaigh, *The Moon in the Greek and Roman Imagination: Myth, Literature, Science and Philosophy*, Cambridge 2020.
MICCO 2016 = V. Micco, "Il dio Inuus, proposte etimologiche ed interpretative", in A. Ancillotti - A. Calderini - R. Massarelli (ed. by), *Forme e strutture della religione nell'Italia mediana antica - Forms and structures of religion in ancient Central Italy: III Convegno internazionale dell'Istituto di ricerche e documentazione sugli antichi Umbri, 21-25 settembre 2011, Perugia - Gubbio*, Roma 2016: 555–559.
MICHETTI 2019 = L.M. Michetti, "Caere e Pyrgi. La città arcaica nelle sue forme sociali e politiche e la nascita degli empori", in L. Bentini - M. Marchesi - L. Minarini - G. Sassatelli (ed. by), *Etruschi. Viaggio nelle terre dei Rasna, Catalogo della mostra (Bologna 2019-2020)*, Verona 2019: 161–165.
MIKALSON 1975 = J.D. Mikalson, *The Sacred and Civil Calendar of the Athenian Year*, Princeton 1975.
MIKALSON 2010 = J.D. Mikalson, *Ancient Greek religion*, Chichester 2010.
MILES 2016A = M.M. Miles, "Birds around the Temple: constructing a sacred environement", in J. McInerney - I. Sluiter (ed. by), *Valuing Landscape in Classical Antiquity. Natural Environment and Cultural Imagination*, Leiden 2016: 151–195.
MILES 2016B = M.M. Miles, "The Interiors of Greek Temples", in M.M. Miles (ed. by), *A Companion to Greek Architecture*, 2016: 206–222.
MINGAZZINI - PFISTER 1946 = P. Mingazzini - F. Pfister, *Forma Italiae. Regio 1.: Latium et Campania. Surrentum*, Firenze 1946.
MINIERO 1987 = P. Miniero, "Indagini, rinvenimenti e ricerche nell'ager Stabianus", in *Riv. di Stud. pompeiani* 1, 1987: 177–190.
MINOJA 2006 = M. Minoja, ""Ciotola di forma insolita": una nuova forma ceramica nella fase iniziale del santuario di Fondo Patturelli a Capua", in A. Cardarelli - M. Pacciarelli - A. Vanzetti (ed. by), *Studi di protostoria in onore di Renato Peroni*, Borgo San Lorenzo 2006: 650–656.
MINOJA 2011 = M. Minoja, "Tra Curti e Capua: riflessioni sul limite orientale della Città", in L. Falcone (ed. by), *Curti tra storia e archeologia*, Caserta 2011: 13–22.
MIRANDA DE MARTINO 2016 = E. Miranda De Martino, "Augusto e i Sebasta. L'identità greca nell'impero", in *Maia* 68, 2, 2016: 389–398.
MIRANDA - BELMONTE - MOLINERO 2008 = N. Miranda - J.A. Belmonte - M.A. Molinero, "Uncovering Seshat: New Insights into the Stretching of the Cord Ceremony", in *Archaeol. Balt.* 10, 2008: 57–61.
MOLINA MORENO 2013 = F. Molina Moreno, *Winged Mythical Singers of Cosmic Music*, Universidad Complutense de Madrid, 2013, available at https://eprints.ucm.es/id/eprint/23744/.
MOMIGLIANO 1989 = A. Momigliano, "Le origini della repubblica romana", in *Roma Arcaica*, Firenze 1989: 131–163.
MOMMSEN 1863 = T. Mommsen, *Corpus inscriptionum Latinarum*, Berlin 1863.
MONACO 2002 = L. Monaco, "Centuriazione e gestione delle acque. Considerazioni in tema di aspetti agrari nell'ager campanus", in G. Franciosi (ed. by), *La romanizzazione della Campania antica*, Napoli 2002: 87–123.

Monaco 1998 = M. Monaco, “Italie - Dossier IV “L’ager Campanus””, in *Atlas historique des cadastres d’Europe*, Luxembourg 1998.
Monaco 2003 = M. Monaco, *La reconstitution d’un paysage antique: l’ager Campanus. Application des méthodologies des systèmes d’information géographiques*, Université de Franche-Comté, Università degli studi di Napoli Federico II, 2003.
Monaco 2004 = M. Monaco, “Métrologie en Campanie et techinques d’approche”, in M. Clavel-Lévêque - G. Tirologos (ed. by), *De la terre au ciel: paysages et cadastres antiques*, 2004: 49–73.
Monaco - Clavel-Lévêque 2004 = M. Monaco - M. Clavel-Lévêque, “Analyse spatiale, archéologie des paysages et centuriation, application des méthodes SIG : 2 - La modélisation d’un paysage centurié : le Sud Biterrois ; 3 - La reconstitution d’un paysage antique : l’ager Campanus”, in *Dialogues d’histoire ancienne* 30, 1, 2004: 186–200.
Montavon 2010 = M. Montavon, *Optimisation of Urban Form by Evaluation of the Solar Potential*, Ecole Polytechnique Federale, Lausanne, France, 2010.
Monti 1999 = P. Monti, “Homeric Tradition in the Mediterranean Navigation of the Pithekoussans”, in *Talanta* XXX–XXXI, 1999.
Moro 2005 = E. Moro, *La santa e la sirena. Sul mito di fondazione di Napoli*, Ischia Ponte 2005.
Moro 2019 = E. Moro, *Sirene: la seduzione dall’antichità ad oggi*, Bologna 2019.
Morris 1987 = I. Morris, *Burial and Ancient Society: The Rise of the Greek City-State*, Cambridge 1987.
Moscati 2010 = P. Moscati, “Archeoastronomia: metodi e strumenti”, in E. Antonello (ed. by), *Il cielo e l’uomo: problemi e metodi di astronomia culturale Atti del VII Convegno Nazionale della Società Italiana di Archeoastronomia Roma, Museo Nazionale Romano, Terme di Diocleziano 28 - 29 settembre 2007*, Milano 2010.
Moser 2014a = C. Moser, “Linear Reflections: Ritual Memory and Material Repetition at the Thirteen Altars at Lavinium”, in C. Moser - C. Feldman (ed. by), *Locating the Sacred: Theoretical Approaches to the Emplacement of Religion*, 2014.
Moser 2014b = C. Moser, *Material Witnesses: The Altars of Republican Rome and Latium and the Memory of Sacrifice*, Brown University, 2014.
Muscettola 1985 = S.A. Muscettola, “Il tempio dei Dioscuri”, in E. Pozzi (ed. by), *Napoli antica. Catalogo della Mostra. Napoli 1985-1986*, Napoli 1985: 196–208.
Mylonopoulos 2011 = I. Mylonopoulos, “Divine images ‘behind bars’. The semantics of barriers in Greek temples”, in J. Wallensten - M. Haysom (ed. by), *Current approaches to religion in ancient Greece. Papers presented at a symposium at the Swedish Institute at Athens, 17–19 April 2008*, Stockholm 2011: 269–291.
Naddaf 2005 = G. Naddaf, *The Greek Concept of Nature*, Albany 2005.
Di Nallo 2014 = M. Di Nallo, “«Von zweiseitiger zur zusätzlichen Belichtung»: L’illuminazione naturale nella moderna architettura scolastica svizzera”, in S. Berselli - M. Brunner - D. Mondini (ed. by), *«Le jeu savant» Luce e oscurità nell’architettura del XX secolo*, Mendrisio 2014: 165–173.
Nappo 1997 = S. Nappo, “The Urban Transformation at Pompeii in the Late Third and Early Second Centuries B.C.”, in R. Laurence - A. Wallace-Hadrill (ed. by), *Domestic Space in the Roman World: Pompeii and Beyond*, Portsmouth 1997: 91–121.
Nissen 1869 = H. Nissen, *Das Templum: Antiquarische Untersuchungennel*, Berlin 1869.
Nissen 1906 = H. Nissen, *Orientationen: Studien zur Geschichte der Religion*, Berlin 1906.
Nizzo 2016 = V. Nizzo, “*L’idea della “città” alle radici della “Storia”. Sociologia del confronto fra mondo indigeno peninsulare e mondo egeo all’alba della «colonizzazione»: metodi, problemi e prospettive*”, in S. Sanchirico - F. Pignataro (ed. by), Roma 2016: 85–155.
Nuzzolo - Krejčí 2017 = M. Nuzzolo - J. Krejčí, “Heliopolis And The Solar Cult In The Third Millennium Bc”, in *Ägypten Und Levante / Egypt Levant* 27, 2017: 357–380.
Oettel 1996 = A. Oettel, *Fundkontexte roemischer Vesuvvillen im Gebiet um Pompeji*, Mainz 1996.
Olgyay 2015 = V. Olgyay, *Design with Climate: Bioclimatic Approach to Architectural Regionalism*, Princeton 2015.

ORFILA PONS - CHÁVEZ ÁLVAREZ - SÁNCHEZ LÓPEZ 2014 = M. Orfila Pons - E. Chávez Álvarez - E.H. Sánchez López, *La orientación de las estructuras ortogonales de nueva planta en época romana. De la varatio y sus variaciones*, Granada 2014.
ORFILA PONS - CHÁVEZ ÁLVAREZ - SÁNCHEZ LÓPEZ 2017 = M. Orfila Pons - E. Chávez Álvarez - E.H. Sánchez López, "Urbanizar En Época Romana: Ritualidad Y Practicidad. Propuesta De Un Procedimiento Homologado De Ejecución", in *SPAL - Rev. Prehist. y Arqueol.* 26, 2017: 113–134.
OSANNA 2014 = M. Osanna, "Nell'età della globalizzazione: Pompei in età augustea", in M.T. Cinquantaquattro (ed. by), *Augusto e la Campania*, Milano 2014: 54–59.
OSANNA 2015 = M. Osanna, "Sanctuaries and Cults in pre-Roman Pompeii", in *Greek Colonisation. New Data, Current Approaches Proceedings of the Scientific Meeting held in Thessaloniki (6 February 2015)*, 2015: 73–91.
OSANNA 2016 = M. Osanna, "Nuove Ricerche nei Santuari Pompeiani", in E. Lippolis - M. Osanna (ed. by), *I Pompeiani e i loro dei. Culti, rituali e funzioni sociali a Pompei. Atti della giornata di studi, Roma, 15 febbraio 2016*, Roma 2016: 71–88.
OSANNA 2019A = M. Osanna, "Gli Etruschi e l'urbanizzazione della Campania antica: il caso di Pompei", in L. Bentini - M. Marchesi - L. Minarini - G. Sassatelli (ed. by), *Etruschi. Viaggio nelle terre dei Rasna, Catalogo della mostra, Bologna, 7 dicembre 2019-24 maggio 2020*, Milano 2019: 225–228.
OSANNA 2019B = M. Osanna, *Pompei. Il tempo ritrovato: Le nuove scoperte*, Milano 2019.
OSANNA - MAGLI - FERRO 2019 = M. Osanna - G. Magli - L. Ferro, "Gromatics' illustrations from newly discovered pavements in pompeii", in *arXiv* 2019.
OSANNA - RESCIGNO 2018 = M. Osanna - C. Rescigno, "La fase "etrusca" di Pompei", in M. Osanna - S. Verger (ed. by), *Pompei e gli Etruschi*, Milano 2018: 178–197.
OSANNA - RESCIGNO 2021 = M. Osanna - C. Rescigno, "Pompei, Sorrento e la battaglia di Cuma", in *Rend. Mor. Acc. Lincei* 32, s. 9, 2021: 199–266.
OSANNA - RESCIGNO - SILANI 2022 = M. Osanna - C. Rescigno - M. Silani, "Considerazioni sulla forma urbana di Pompei arcaica", in R. Brancato - L.M. Caliò - M. Figuera - G.M. Gerogiannis - E. Pappalardo - S. Todaro (ed. by), *Schemata. La città oltre la forma*, Roma 2022: 387–413.
OSANNA - VERGER 2017 = M. Osanna - S. Verger, "La valle del Sarno, Pompei e gli Etruschi", in M. Osanna - S. Verger (ed. by), *Pompei e gli Etruschi*, Milano 2017: 13–22.
OSBORNE 2007A = R. Osborne, "Did democracy transform Athenian space?", in *Building Communities: House, Settlement and Society in the Aegean and Beyond*, 2007: 195–199.
OSBORNE 2007B = R. Osborne, "Did democracy transform Athenian space?", in *Br. Sch. Athens Stud.* 15, 2007: 195–199.
PACCIARELLI 2001 = M. Pacciarelli, *Dal villaggio alla città. La svola protourbana del 1000 a.C. nell'Italia tirrenica*, Firenze 2001.
PACCIARELLI 2014 = M. Pacciarelli, "Considerazioni sull'avvio del processo di urbanizzazione in Italia e sulle origini di Capua", in C. Rescigno - F. Sirano (ed. by), *Immaginando città. Racconti di fondazioni mitiche, forma e funzioni delle città campane, catalogo della mostra (S. Maria Capua Vetere e Paestum)*, Salerno 2014: 49–53.
PAGANO 1983 = M. Pagano, "Un nuovo termine della centuriazione dell'Ager Campanus", in *Misurare la terra: centuriazione e coloni nel mondo romano. Catalogo della Mostra, Modena, 11 dicembre 1983-12 febbraio 1984*, Modena 1983: 231–234.
PAGANO 1990 = M. Pagano, "Ercolano. Saggi all'interno dell'area urbana", in *BA* 3, 1990: 125–128.
PAGANO - RUGGIERI 2011 = M. Pagano - F. Ruggieri, "Ricerche preliminari di archeoastronomia sui templi dell'area sannitico-molisana", in E. Antonello (ed. by), *Astronomia Culturale in Italia. Lavori presentati a Convegni Nazionali della Società Italiana di Archeoastronomia*, 2011: 99–104.
PAGANO - TOMEO 2021 = M. Pagano - A. Tomeo, *Capua la seconda Roma. Nuovi studi e ricerche*, Napoli 2021.
PAIRAULT 1969 = F.-H. Pairault, "Diana Nemorensis: déesse Latine, déesse Héllenissée", in *MEFRA* 81, 2, 1969: 425–471.

PALET MARTÍNEZ - FIZ FERNÁNDEZ - ORENGO 2011 = J.M. Palet Martínez - J.I. Fiz Fernández - H.A. Orengo, “Integración de Metodologías GIS para el estudio del territorio en época romana: aplicación a las centuriaciones del ager Tarraconensis.”, in *Anejos de AEspA* 2011: 627–645.
PALLONETTI 2018 = M. Pallonetti, “Una cuspide di lancia in ferro dal »Tempio Superiore« dell’acropoli di Cuma”, in R.G. i Fabregat - F. Longo (ed. by), *Armi votive in Magna Grecia. Atti del convegno Salerno-Paestum 23-25 novembre 2017*, Mainz 2018: 307–313.
PALLOTTINO 1956 = M. Pallottino, “Deorum sedes”, in *Studi in Onore di Aristide Calderini e Roberto Paribeni*, Milano 1956: 223–234.
PALLOTTINO 1971 = M. Pallottino, “La città etrusco-italica come premessa alla città romana: varietà di sostrati formativi e tendenze di sviluppo unitario”, in *Atti Convegno internazionale sulla città antica in Italia. Milano-Varenna-Brescia, 27 settembre-2 ottobre 1970*, Milano 1971: 11–22.
PANNEKOEK 1961 = A. Pannekoek, *A History of Astronomy*, London 1961.
PANTAZIS - LAMBROU 2018 = G. Pantazis - E. Lambrou, “Knowingly orientation of Ancient Greek Temples”, in *Ann. Archaeol.* 1, 2, 2018: 21–28.
PANTAZIS *et al.* 2009 = G. Pantazis - E. Lambrou - K. Nikolitsas - M. Papathanassiou - A. Iliodromitis, “The Orientation of Delos’ Monuments”, in *Mediterr. Archaeol. Archaeom.* 9, 1, 2009: 55–68.
PAPPALARDO - CIARDIELLO 2005 = U. Pappalardo - R. Ciardiello, *Guida Geoarcheologica della Costa Campana ad uso dei naviganti*, Napoli 2005.
PARISI 2020 = V. Parisi, “Colonie in festa. Qualche riflessione sugli aspetti archeologici delle feste nelle città della Magna Grecia”, in *Thiasos* 9, 1, 2020: 279–295.
PARISINOU 2000 = E. Parisinou, *The light of the gods : the role of light in archaic and classical Greek cult*, London 2000.
PARKER 2011 = R. Parker, *On Greek Religion*, Ithaca 2011.
PARTIDA 2020 = E. Partida, “Admission of Sunlight and Ventilation in Ancient Greek Architectural Design: The Evidence from Delphi”, in *Τέχνης εμπειρία. Νέα Αρχαιολογικά Ευρήματα και Πορίσματα*, Athens 2020: 177–189.
PENROSE 1893 = F.C. Penrose, “On the Orientation of Greek Temples”, in *Proc. R. Soc. London* 53, 1893: 379–384.
PERDUTO - COROLLA - SANTANGELO 2019 = P. Perduto - A. Corolla - G. Santangelo, “Salerno, Rota e Nocera alla metà del VI secolo”, in C. Ebanista - M. Rotili (ed. by), *Prima e dopo Alboino sulle tracce dei Longobardi. Atti del Convegno internazionale di studi Cimitile-Nola-Santa Maria Capua Vetere, 14-15 giugno 2018*, San Vitaliano (NA) 2019: 107–126.
PERNIGOTTI 2018 = A.P. Pernigotti, “Moto diurno e moto annuo: Riflessioni sul sistema cosmico degli Etruschi”, in *Stud. Etruschi* LXXXI, 2018: 183–199.
PERNIGOTTI 2019 = A.P. Pernigotti, “A Contribution to the Study of the Orientation of Etruscan Temples”, in G. Magli - A.C. Gonzalez-García - E. Antonello - J.A. Belmonte (ed. by), *Archaeoastronomy in the Roman World*, New York, NY 2019: 3–15.
PERNIGOTTI 2021A = A.P. Pernigotti, “Luci e ombre: Orientamento e illuminazione naturale nei templi etruschi”, in L. Donati - P. Bruschetti - V. Mascelli (ed. by), *Luci dalla tenebre dai lumi degli Etruschi ai bagliori di Pompei*, Cortona 2021: 115–120.
PERNIGOTTI 2021B = A.P. Pernigotti, “Etruscan Temples and the Sun: An Analysis on the Orientation of Etruscan Sacred Buildings”, in A.C. González-García - R.M. Frank - L.D. Sims - M.A. Rappengluck - G. Zotti - J.A. Belmonte - I. Sprajc (ed. by), *Beyond Paradigms in Cultural Astronomy. Proceedings of the 27th SEAC conference held together with the EAA*, Oxford 2021: 125–132.
PERONI 1988 = R. Peroni, “Comunità e insediamento in Italia fra Età del bronzo e prima Età del ferro”, in *Storia di Roma I. Roma in l’Italia*, Torino 1988: 7–37.
PERONI 1989 = R. Peroni, “Il senso della protostoria in Italia”, in *Protostoria dell’Italia continentale : la penisola italiana nelle età del bronzo e del ferro*, Roma 1989: 7–24.
PERSICHINI 2004 = S. Persichini, “Tracce di divisioni agrarie preromane nel territorio di Acerra”, in *La formazione della città in Etruria. Atti del I corso di perfezionamento (anno accademico 2002-2003)*, Roma 2004: 45–65.

PETACCO - RESCIGNO 2005 = L. Petacco - C. Rescigno, “Calatia: città e territorio tra crisi e trasformazione”, in G. Vitolo (ed. by), *Le città campane tra tarda antichità e alto Medioevo*, 2005: 131–166.
PETACCO - RESCIGNO 2007 = L. Petacco - C. Rescigno, “I saggi sul Capitolium e il settore occidentale della piazza forense”, in C. Gasparri - G. Greco (ed. by), *Cuma. Il foro. Scavi dell'Università di Napoli Federico II, 2000-2001.*, Pozzuoli 2007: 77–117.
DE PETRA 1869 = G. de Petra, “Recensione del Das Templum”, in *G. degli Scavi di Pompei (nuova Ser.* Maggio-Giugno, 1869.
PIMENTA - TIRAPICOS - SMITH 2009 = F. Pimenta - L. Tirapicos - A. Smith, “A Bayesian Approach to the Orientations of Central Alentejo Megalithic Enclosures”, in *Archaeoastron. J. Astron. Cult.* XXII, 2009: 1–20.
PIZZIRANI 2005 = C. Pizzirani, “Da Odisseo Alle Nereidi. Riflessioni sull'iconografia Etrusca del mare attraverso i secoli”, in *Ocnus* 13, 2005: 251–270.
POCCETTI 2016A = P. Poccetti, “The Italic words for ‘moon/month’ and ‘sun’ : New evidence from the Sabellian languages”, in B.S.S. Hansen - B.N. Whitehead - T. Olander - B.A. Olsen (ed. by), *Etymology and the European Lexicon. Proceedings of the 14th Fachtagung der Indogermanischen Gesellschaft (Copenhagen 17–22 September 2012)*, Wiesbaden 2016: 353–363.
POCCETTI 2016B = P. Poccetti, “Note sulla nuova iscrizione osca da Cuma. Il nuovo teonimo nel contesto dei culti della città in fasedi romanizzazione”, in A. Ancillotti - A. Calderini - R. Massarelli (ed. by), *Forme e strutture della religione nell'Italia mediana antica - Forms and structures of religion in ancient Central Italy: III Convegno internazionale dell'Istituto di ricerche e documentazione sugli antichi Umbri, 21-25 settembre 2011, Perugia - Gubbio*, Roma 2016: 573–592.
POCCETTI 2020 = P. Poccetti, “Le iscrizioni osche dette “eítuns” di Pompei”, in M. Torelli (ed. by), *Pompei 79 d.C. :Una storia romana (Roma, Colosseo 6.11.2020 - 31.1.2021)*, Milano 2020: 152–157.
POCCETTI - SAMPAOLO 2014 = P. Poccetti - V. Sampaolo, “Capua. Ancora novità dal santuario del Fondo Patturelli”, in C. Rescigno - F. Sirano (ed. by), *Immaginando Città: Racconti di fondazioni mitiche, forma e funzioni delle citta campane. Santa Maria Capua Vetere-Paestum*, 2014: 144–148.
POLCARO 2016 = F.V. Polcaro, “The Credibility of Archaeoastronomy: Suggestion From Pharmacology?”, in *Mediterr. Archaeol. Archaeom.* 16, 4, 2016: 1–5.
POLCARO *et al.* 2011 = F.V. Polcaro - M. Mucciarelli - S. Pizzimenti - A. Polcaro, “Il megalite di Cannalicchio di Castelgrande (PZ) ed i suoi analoghi nell'antica Lucania”, in L. Lozito - F. Pastore (ed. by), *Atti del Convegno Cielo e Cultura Materiale: Recenti Scoperte in Archeaoastronomia (Pestum 20 novembre 2010)*, Salerno 2011: 19–36.
DE POLIGNAC 1995 = F. de Polignac, *Cults, Territory, and the Origins of the Greek City-State*, Chicago 1995.
DE POLIGNAC 2005 = F. de Polignac, “Forms and Processes: Some Thoughts on the Meaning of Urbanization in Early Archaic Greece”, in R. Osborne - B. Cunliffe (ed. by), *Mediterranean Urbanization 800-600 BC*, Oxford 2005: 45–69.
PRAYON 1991 = F. Prayon, ““Deorum sedes”: Sull'orientamento dei templi Etrusco-Italici”, in *Archeol. Class.* 43, May, 1991: 1285–1295.
PROSDOCIMI 1989 = A. Prosdocimi, “Le religioni degli Italici”, in G. Pugliese Carratelli (ed. by), *Italia omnium terrarum parens. La civiltà degli Enotri, Choni, Ausoni, Sanniti, Lucani, Bretti, Sicani, Siculi, Elimi*, Milano 1989: 475–545.
PROSDOCIMI 2009 = A.L. Prosdocimi, “Decumanus ‘ab oriente ad occasum’ e cardo ‘ex transverso currens’”, in *Etruria e Italia preromana. Studi in onore di Giovannangelo Camporeale*, Pisa-Roma 2009: 717–747.
PROSDOCIMI - MARINETTI 2012 = A.L. Prosdocimi - A. Marinetti, “Una groma da Padova: tra veneticità finale e prima romanizzazione”, in *Agri Centuriati* 9, 2012: 9–20.
PTOLEMAIOS 2017 = Ptolemaios, *Φάσεις ἀπλανων ἀστέρων καὶ συναγωγὴ ἐπισημασιων. Apparizioni*

delle stelle inerranti e raccolta di indicazioni sui mutamenti del tempo, Savona 2017.
Quilici Gigli 2002 = S. Quilici Gigli, "Sulle vie che ricalcano gli assi centuriali", in G. Franciosi (ed. by), *Ager Campanus. Atti del convegno internazionale "La storia dell'Ager Campanus, I Problemi della limitatio de sua lettura attuale", Real Sitio di S. Leucio, 8-9 giugno 2001*, 2002: 95–114.
Quilici Gigli - Rescigno 1996 = S. Quilici Gigli - C. Rescigno, "Scavo nell'area urbana dell'antica Calatia", in *Boll. di Archeol.* 37–38, 1996: 94–102.
Quilici Gigli - Rescigno 2000 = S. Quilici Gigli - C. Rescigno, *Scavo nell'area urbana dell'antica Calatia*, 2000.
Rafanelli 2021 = S. Rafanelli, "Le divinità astrali. Aspetti iconografici", in L. Donati - P. Bruschetti - V. Mascelli (ed. by), *Luci dalla tenebre dai lumi degli Etruschi ai bagliori di Pompei*, Cortona 2021: 65–75.
Rampazzo 2011 = C. Rampazzo, *Alle origini della "limitatio" : tracce di suddivisioni agrarie in Etruria*, Università Ca'Foscari di Venezia, 2011.
Ranieri 2010 = M. Ranieri, "Le diagonali e gli orientamenti archeoastronomici", in E. Antonello (ed. by), *Atti del X Convegno SIA, Società Italiana di Archeoastronomia, Trinitapoli, Parco Archeologico degli Ipogei (BAT), 22-23 Ottobre 2010*, Napoli 2010: 213–226.
La Regina 1999 = A. La Regina, "Istituzioni agrarie italiche", in E. Petrocelli (ed. by), *La civiltà della transumanza. Storia, cultura e valorizzazione dei tratturi e del mondo pastorale in Abruzzo, Molise, Puglia, Campania e Basilicata*, Isernia 1999: 3–18.
Regis 2011 = C. Regis, "Capua: l'abitato arcaico del Siepone. Gli scavi 2005 nel settore sud-est: planimetria generale degli edifici e primo esame delle caratteristiche delle murature e delle coperture", in O. Paoletti - M.C. Bettini (ed. by), *Gli Etruschi e La Campania settentrionale: atti del XXVI Convegno di studi etruschi ed italici, Caserta, Santa Maria Capua Vetere, Capua, Teano, 11–15 novembre 2007*, Pisa 2011: 229–235.
Reijs 2015 = V. Reijs, *Comparing Programs that Calculate the Skyline Profile*, 2015.
Renfrew 1975 = C. Renfrew, "Trade as Action at a Distance: Questions of Integration and Communication", in J.A. Sabloff - C.C. Lamberg-Karlovsky (ed. by), *Ancient Civilisation and Trade*, Albuquerque 1975: 3–59.
Renfrew 1986 = C. Renfrew, "Interazione fra comunità paritarie e formazione dello stato", in *Dialoghi di Archeol.* 4, 1, 1986: 27–33.
Renna 1992 = E. Renna, *Vesuvius Mons: Aspetti del Vesuvio nel mondo antico tra filologia archeologia vulcanologia*, Napoli 1992.
Rescigno 1998 = C. Rescigno, *Tetti Campani*, Roma 1998.
Rescigno 2002 = C. Rescigno, "Ricerche sull'urbanistica dei centri campani: Calatia", in *Orizz. Rass. di Archeol.* III, 2002: 99–104.
Rescigno 2006 = C. Rescigno, "Ambrosia per gli dei: note iconografiche a margine della cosiddetta Iade della Raccolta Cumana", in *AEIMNHSTOS Miscellanea di studi per Mauro Cristofani*, 2006: 506–514.
Rescigno 2010a = C. Rescigno, "Note sulla forma urbana di Surrentum", in F. Senatore - M. Russo (ed. by), *Sorrento e la penisola sorrentina tra Italici, Etruschi e Greci nel contesto della Campania antica, Atti del Convegno di Studi, Sorrento, 19 maggio 2007*, Roma 2010: 176–199.
Rescigno 2010b = C. Rescigno, "Cuma preromana nel Museo di Baia: temi e materali", in *Mélanges l'École française Rome - Antiq.* 122, 2, 2010: 345–376.
Rescigno 2012 = C. Rescigno, "Il tempio di Giove sulla rocca cumana. Motivazioni di una ricerca", in *Cuma, il tempio di Giove e la terrazza superiore dell'acropoli. Contributi e documenti*, Venosa 2012: 13–34.
Rescigno 2016 = C. Rescigno, "Il santuario di Apollo tra vecchie acquisizioni e nuove prospettive di ricerca", in E. Lippolis - M. Osanna - A. Lepone (ed. by), *I Pompeiani e i loro dei. Culti, rituali e funzioni sociali a Pompei. Atti della giornata di studi, Roma, 15 febbraio 2016*, 2016: 37–69.
Rescigno 2017 = C. Rescigno, "Lo spazio del sacro e la città: Cuma e Capua", in E. Govi (ed. by),

La città etrusca e il sacro Santuari e istituzioni politiche Atti del Convegno Bologna 21-23 gennaio 2016, Bologna 2017: 205–222.
RESCIGNO - PARISI 2022 = C. Rescigno - V. Parisi, "Apollo sull'acropoli. Il tempio superiore di Cuma tra architettura e contesti rituali", in *La colomba di Apollo. La fondazione di Cuma e il ruolo del culto apollineo nella colonizzazione euboica d'Occidente*, Pozzuoli 2022: 35–59.
RESCIGNO - SENATORE 2009 = C. Rescigno - F. Senatore, "Le città della piana campana tra IV e III sec. a.C.: dati storici e topografici", in M. Osanna (ed. by), *Verso la città: Forme insediative in Lucania e nel mondo italico fra IV e III sec. a.C.. Atti del Convegno, Venosa 2009*, Potenza 2009: 415–462.
RESCIGNO - SIRLETO 2011 = C. Rescigno - R. Sirleto, "Cuma, terrazza superiore dell'acropoli. Scavi al tempio di Giove", in *J. Fasti Online* 2011.
REY - BARDE - PIDOUX 1928 = A.A. Rey - C. Barde - J. Pidoux, *La science des plans de villes: ses applications a la construction, a l'extension, a l'hygiène et a la beauté des villes, orientation solaire des habitations*, Paris 1928.
RIBICHINI 1975 = S. Ribichini, "Melqart nell'iscrizione di Pyrgi?", in *AA. VV. Saggi Fenici*, 1975: 41–47.
RICHARD 1976 = J.-C. Richard, "Le culte de « Sol » et les « Aurelii »: à propos de Paul. Fest. p. 22 L.", in *L'Italie préromaine et la Rome républicaine. Mélanges offerts à Jacques Heurgon*, Roma 1976: 915–925.
RICHARDSON 1978 = L. Richardson, "Honos et Virtus and the Sacra Via", in *AJA* 82, 1978: 240–246.
RODRÌGUEZ-ANTÒN 2017 = A. Rodrìguez-Antòn, *Cosmovisión y urbanismo en la roma antigua: orientación de ciudades y campamentos romanos*, Universidad de La Laguna, 2017.
RODRÍGUEZ-ANTÓN *et al.* 2019 = A. Rodríguez-Antón - M. Orfila Pons - A.C. González-García - J. Belmonte Aviles, "The Uaratio and Its Possible Use in Roman Urban Planning to Obtain Astronomical Orientations", in G. Magli - A.C. González-García - J. Belmonte Aviles - E. Antonello (ed. by), *Archaeoastronomy in the Roman World*, New York 2019: 103–122.
ROLANDI *et al.* 2008 = G. Rolandi - A. Paone - M. De Lascio - G. Stefani, "The 79 AD eruption of Somma: the relationship between the date of the eruption and the southeast tephra dispersion", in *J. Volcanol. Geotherm. Res.* 169, 1, 2008: 87–98.
ROLLER 2015 = D.W. Roller, *Ancient Geography. The Discovery of the World in Classical Greece and Rome*, London 2015.
ROSADA 1991 = G. Rosada, "Divisione agraria, orientamento e suolo", in M. Fano Santi (ed. by), *Archeologia e astronomia: colloquio internazionale, Venezia 3-6 maggio 1989*, Roma 1991: 88–95.
ROSADA 2010 = G. Rosada, "Arte (Mestiere?) dell'Agrimensor", in *Histria Antiq.* 19, 2010: 125–152.
ROSE 1931 = H.J. Rose, "Mundus", in *Stud. e Mater. di Stor. delle Relig.* 7, 1931: 114–127.
ROSSI 2011 = A. Rossi, "Ritornando su K. J. Beloch: riflessioni sull'antica Suessula e sul suo territorio", in F. Senatore (ed. by), *Karl Julius Beloch: da Sorrento nell'antichità alla Campania. Atti del convegno storiografico in memoria di Claudio Ferone. Piano di Sorrento, 28 marzo 2009.*, Roma 2011: 303–331.
ROSSI 2019A = A. Rossi, "Suessula e il suo paesaggio: persistenza e discontinuità attraverso le indagini di aerotopografia archeologica", in *Secondo Convegno Internazionale di Archeologia Aerea. Dagli Aerostati ai Droni: le immagini aeree in archeologia, Roma, Academia Belgica 3-5-febbraio 2016*, 2019: 140–145.
ROSSI 2019B = A. Rossi, "Frontiere, Confini e territori nella Campania antica: alcuni indicatori archeologici e ambientali", in M. Cipriani - E. Greco - A. Pontrandolfo - M. Scafuro (ed. by), *Terzo Convegno Internazionale Dialoghi sull'Archeologia della Magna Grecia e del Mediterraneo "Identità/Senso di appartenenza. Modelli interpretativi a confronto" (Paestum 16-18 novembre 2018)*, Paestum 2019: 445–454.
ROSSI 2019C = A. Rossi, "La romanizzazione della piana campana: insediamenti urbani e spazio agrario", in *Diverging Trajectories: Approaches to Italian Urbanism in the Era of the Roman*

Conquest, Royal Netherlands Institute in Rome, 26-27 June 2019, 2019.
ROSSI 2003 = C. Rossi, *Architecture and Mathematics in Ancient Egypt*, Cambridge 2003.
ROWLAND - HOWE 1999 = I.D. Rowland - T.N. Howe, *Vitruvius: Ten Books on Architecture*, Cambridge 1999.
RUFFO 2009 = F. Ruffo, "Stabiae: Villa San Marco e l'impianto urbano alla luce delle recenti indagine archeologiche (2008). Osservazioni preliminari", in *Riv. di Stud. Pompeiani* 20, 2009, 2009: 87–102.
RUFFO 2010 = F. Ruffo, *La Campania antica: appunti storia e topografia. Dal Massico-Roccamonfina al Somma-Vesuvio.*, Napoli 2010.
RUFFO 2011 = F. Ruffo, "Neapolis: linee di lettura della città antica", in Pasquale Rossi (ed. by), *Imago_Urbis Antico e contemporaneo nel centro storico di Napoli*, Napoli 2011: 117–129.
RUFFO 2012 = F. Ruffo, "Pompei, Nola, Nuceria: assetti agrari tra la tarda età repubblicana e la prima età imperiale. Documentazione archeologica e questioni di metodo", in *Ann. Archeol. Stud. e Ric. sul campo* 2011–2012, 2012: 53–126.
RUFFO F. 2016 = Ruffo F., "La piana del Sarno (ager Nucerinus, ager Pompeianus, ager Stabianus): fonti archeologiche e (ri)letture cartografiche per lo studio delle centuriazioni e della viabilita in eta romana", in *Agri Centuriati* 12, 2015, 2016: 9–40.
RUFFO 2017 = F. Ruffo, "Osservazioni e ipotesi sulla forma urbana di Nuceria Alfaterna", in *Riv. di Stud. Pompeiani* XXVIII, 2017: 57–74.
RUGGIERI - CANDURRO 2014 = F. Ruggieri - L. Candurro, "I Templi e le Stelle", in V.F. Polcaro (ed. by), *Atti del XII Convegno SIA, Società Italiana di Archeoastronomia, Albano Laziale (RM), 5-6 Ottobre 2012*, Napoli 2014: 363–378.
RUGGIERI - PAGANO 2010 = F. Ruggieri - M. Pagano, "Il tempio e le stelle. Analisi dell'orientamento di templi e santuari delle popolazioni parlanti la lingua osca", in M. Incerti (ed. by), *MENSURA CAELI: Territorio, città, architetture, strumenti. Atti dell'VIII Convegno Nazionale della Società Italiana di Archeoastronomia (SIA)*, Ferrara 2010: 229–239.
RUGGLES 2015A = C. Ruggles, "Basic Concepts of Positional Astronomy", in C.L.N. Ruggles (ed. by), *Handbook of Archaeoastronomy and Ethnoastronomy*, New York 2015: 459–472.
RUGGLES 2015B = C. Ruggles, "Long-Term Changes in the Appearance of the Sky", in C. Ruggles (ed. by), *Handbook of Archaeoastronomy and Ethnoastronomy*, New York 2015: 473–482.
RUGGLES 1997 = C.L.N. Ruggles, "Whose equinox?", in *Archaeoastron. J. Astron. Cult.* 28, 1997: S45–S51.
RÜPKE 2011 = J. Rüpke, *The Roman Calendar from Numa to Constantine: Time, History, and the Fasti*, Chichester 2011.
RUSSO 1999 = M. Russo, "Sorrento. Edifici pubblici, case private e tabernae tra età ellenistica e tardo antica lungo due assi viari", in F. Senatore (ed. by), *Pompei il Vesuvio e la penisola sorrentina. Atti del secondo ciclo di conferenze di geologia, storia e archeologia, Pompei, Istituto "B. Longo", ottobre 1997 - febbraio 1998*, Roma 1999: 145–231.
RUTTER 2001 = N.K. Rutter (ed. by), *Historia numorum: Italy*, London 2001.
RYKWERT 1988 = J. Rykwert, *The Idea of a Town: The Anthropology of Urban Form in Rome, Italy and the Ancient World*, Cambridge MA 1988.
SABBATUCCI 1988 = D. Sabbatucci, *La religione di Roma antica: dal calendario festivo all'ordine cosmico*, Milano 1988.
SACCOCCIO 2020 = F. Saccoccio, "Crop Field Management and Social Structure at Gricignano d'Aversa (Campanian Plain, Southern Italy) in the Early Bronze Age", in *Environ. Archaeol.* 2020.
SACCOCCIO - MARZOCCHELLA - VANZETTI 2013 = F. Saccoccio - A. Marzocchella - A. Vanzetti, "The field system of Gricignano d'Aversa (Southern Italy) and the agrarian impact in the Piana Campana, ca. 3900 cal BP", in *Quat. Int.* 303, 2013: 82–92.
SAHLINS 2011 = M. Sahlins, "Twin-Born with Greatness: The Dual Kingship of Sparta", in *HAU J. Ethnogr. Theory* 1, 1, 2011: 63–101.
SALMON 1969 = E.T. Salmon, *Roman Colonization under the Republic*, London 1969.
SALT 2009 = A. Salt, "The Astronomical Orientation of Ancient Greek Temples", in *PLoS One* 4, 11,

2009.
SAMPAOLO 1996 = V. Sampaolo, “Osservazioni sul sistema viario a nord di Capua”, in *Boll. di Archeol.* XXXIX–XL, 1996: 1–6.
SAMPAOLO 1999 = V. Sampaolo, “Organizzazione dello spazio urbano e di quello extraurbano a Capua”, in S. Quilici Gigli - L. Quilici (ed. by), *La forma della città e del territorio: Esperienza metodologiche e risultati a confronto. Atti dell’Incontro si studio-S. Maria Capua Vetere 27-28 novembre 1998. Atlante tematico di Topografia Antica, V*, Roma 1999: 139–146.
SAMPAOLO 2005 = V. Sampaolo, “L’attività archeologica a Napoli e Caserta nel 2004”, in *Tramonto della Magna Grecia. Atti del qurantaquattresimo convegno di studi sulla Magna Grecia (Taranto, 24-28 settembre 2004)*, Taranto 2005: 663–705.
SAMPAOLO 2008 = V. Sampaolo, “La perimetrazione di Capua e l’abitato arcaico”, in O. Paoletti - M.C. Bettini (ed. by), *La Citta Murata In Etruria. Atti Del XXV Convegno Di Studi Etruschi ed Italici, Chianciano Terme, Sarteano, Chiusi, 30 Marzo - 3 Aprile 2005*, Pisa 2008: 471–483.
SAMPAOLO 2010 = V. Sampaolo, “I nuovi scavi del fondo Patturelli. Elementi per una definizione topografica”, in *Atti del XVII Congresso internazionale di Archeologia Classica*, Roma 2010: 3–10.
SAMPAOLO 2011 = V. Sampaolo, “I nuovi scavi del fondo Patturelli: Elementi per una definizione topografica”, in *ACME. Ann. della Fac. di Lett. e Filos. dell’Università degli Stud. di Milano* 64, 2, 2011: 7–19.
DE SANCTIS 2012 = G. De Sanctis, “«Urbigonia». Sulle tracce di Romolo e del suo aratro”, in *I Quad. del Ramo d’Oro* 2012: 105-135.
SANNIBALE 2019 = M. Sannibale, “Il crescente lunare con dedica a Tiur già collezione Borgia”, in *Rend. della Pontif. Accad. Rom. di Archeol.* 91, 2018–2019, 2019: 169–207.
SASSATELLI - GOVI 2010 = G. Sassatelli - E. Govi, “Cults and foundation rites in the Etruscan city of Marzabotto”, in L.B. Van Der Meer (ed. by), *Material aspects of Etruscan religion. Proceedings of the international colloquium (Leiden 2008)*, Leuven 2010: 27–37.
SASSATELLI - GOVI 2013 = G. Sassatelli - E. Govi, “Etruria on the Po and the Adriatic”, in J.M. Turfa (ed. by), *The Etruscan World*, 2013: 281–300.
SASSU 2018 = R. Sassu, “La dimensione umana dello spazio divino. Riflessioni sulle motivazioni e sulle modalità di frequentazione del santuario greco”, in *Mediterr. Antico* XXI, 1–2, 2018: 417–454.
SAUNDERS 1976 = T.J. Saunders, “Notes on Plato as a city planner”, in *Bull. Inst. Class. Stud.* 23, 1976: 23–26.
SCAFETTA - MAZZARELLA 2019 = N. Scafetta - A. Mazzarella, “The city of the sun and Parthenope: classical astronomy and the planning of Neapolis, Magna Graecia”, in *J. Hist. Geogr.* 65, 2019: 29–47.
SCARCI 2021 = A. Scarci, “Iron and Bronze Weapons from the Sanctuary at Monte Casale (Prov. Syracuse/I) as »ex voto par transformation, ex voto par destination«”, in G. Bardelli - R. Graells (ed. by), *Ancient Weapons. New Research Perspectives on Weapons and Warfare Proceedings of the International Conference – Mainz, September 20th - 21st 2019*, Mainz 2021: 13–30.
SCATOZZA HÖRICHT 2001 = L.A. Scatozza Höricht, *Materiali votivi e luoghi di culto nel territorio di Avella*, Napoli 2001.
SCHAEFER 2001 = B.E. Schaefer, “New methods and techniques for historical astronomy and archaeoastronomy”, in *Archaeoastron. J. Astron. Cult.* 15, 2001: 121–136.
SCHAEFER 2006 = B.E. Schaefer, “Case Study of Three of the Most Famous Claimed Archaeoastronomical Alignments in North America”, in T.W. Bostwick - B. Bates (ed. by), *Viewing the sky through past and present cultures: selected papers from the Oxford VII International conference on archeoastronomy*, Phoenix 2006: 27–56.
SCHERILLO 1982 = A. Scherillo, “Il Vesuvio prima e dopo Plinio”, in *La regione sotterratadal Vesuvio*, Napoli 1982: 945–955.
SCLAVI *et al.* 2016 = S. Sclavi - M. Monaco - F. Carnevale - M. Ranieri - S. Gaudenzi - F.V. Polcaro - C. Scatigno, “The Orientation Of The Mithraea in Ostia Antica”, in *Mediterr. Archaeol. Archaeom.* 16, 4, 2016: 257–266.

SCULLY 1993 = V. Scully, *Architecture: The Natural and the Manmade*, 1993.
SCULLY 2013 = V. Scully, *The Earth, the Temple, and the Gods: Greek Sacred Architecture*, San Antonio, Texas 2013.
SENATORE 2001 = F. Senatore, "La lega nucerina", in F. Senatore (ed. by), *Pompei tra Sorrento e Sarno. Atti del terzo e quarto ciclo di conferenze di geologia, storia e archeologia (Pompei, gennaio 1999 - maggio 2000)*, Pompei 2001: 185–265.
SHALTOUT - BELMONTE 2005 = M. Shaltout - J.A. Belmonte, "On the Orientation of Ancient Egyptian Temples: (1) Upper Egypt and Lower Nubia", in *J. Hist. Astron.* 36, 3, 2005: 273–298.
SHALTOUT - BELMONTE - FEKR 2005 = M. Shaltout - J.A. Belmonte - M. Fekr, "On the Orientation of Ancient Egyptian Temples: (3) Key Points at Lower Egypt and Siwa Oasis, Part II", in *J. Hist. Astron.* 38, 4, 2005: 413–42.
SHELTON 1981 = J. Shelton, "Mathematical problems on a papyrus from the Gent collection", in *Zeitschrift für Papyrol. und Epigr.* 42, 1981: 91–94.
SHEPPERSON 2017 = M. Shepperson, *Sunlight and Shade in the First Cities: A Sensory Archaeology of Early Iraq*, Gottingen 2017.
SHIPLEY 2005 = G.J. Shipley, "Little boxes on the hillside: Greek town planning, Hippodamos, and polis ideology", in M.H. Hansen (ed. by), *The Imaginary Polis. Symposium, January 7–10 2004*, Copenhagen 2005: 335–403.
SILVA 2015 = F. Silva, "The Role and Importance of the Sky in Archaeology: An Introduction", in F. Silva - N. Campion (ed. by), *Skyscapes: The Role and Importance of of the Sky in Archaeology*, Oxford 2015: 1–7.
SILVA 2020 = F. Silva, "A probabilistic framework and significance test for the analysis of structural orientations in skyscape archaeology", in *J. Archaeol. Sci.* 118, 2020: 1–13.
SILVI 2009 = C. Silvi, "The Italian National Solar Energy History Project", in *Proceedings of ISES Solar World Congress 2007: Solar Energy and Human Settlement*, 2009: 3065–3068.
SIMON ERIKA 1983 = Simon Erika, *Festivals of Attica: an archaeological commentary*, Madison 1983.
DE SIMONE - RUFFO 2017 = A. De Simone - F. Ruffo, "Ercolano e il mare. Breve nota su una lunga stagione di studi, ipotesi, ricerche", in L. Cicala - B. Ferrara (ed. by), *«Kithon Lydios». Studi di storia e archeologia con Giovanna Greco*, 2017: 811–826.
DE SIMONE 2011 = G.F. De Simone, "Con Dioniso fra i vigneti del vaporifero Vesuvio", in *Cronache ercolanesi* 41, 2011: 287–308.
DE SIMONE 2014 = G.F. De Simone, "On the shape of Vesuvius before AD 79 (and why it should matter to modern archaeologists)", in *Riv. di Stud. Pompeiani* 25, 2014: 201–205.
DE SIMONE 2016 = G.F. De Simone, "The Agricultural Economy of Pompeii: Surplus and Dependence", in M. Flohr - A. Wilson (ed. by), *The Economy of Pompeii*, Oxford 2016: 23–51.
SIRANO 2014A = F. Sirano, "Capua. Il comporsi della città dall'età arcaica a quella classica", in C. Rescigno - F. Sirano (ed. by), *Immaginando Città: Racconti di fondazioni mitiche, forma e funzioni delle citta campane. Santa Maria Capua Vetere-Paestum*, Napoli 2014: 112–116.
SIRANO 2014B = F. Sirano, "II processo di formazione di Capua", in C. Rescigno - F. Sirano (ed. by), *Immaginando Città: Racconti di fondazioni mitiche, forma e funzioni delle citta campane. Santa Maria Capua Vetere-Paestum*, Salerno 2014: 93–98.
SIRANO 2018 = F. Sirano, "Gli dei di Capua e il sistema del sacro: testimonianze di età romana", in *Parola Passato* 73, 2, 2018: 301–316.
SISANI 2001 = S. Sisani, *Tuta Ikuvina. Sviluppo e ideologia della forma urbana a Gubbio*, Roma 2001.
SMITH 2020 = A. Smith, *Horizon 0.13c GIS tool*, 2020.
SODO 2009 = A.M. Sodo, "Il rinvenimento di due sepolture arcaiche in località Calcarella (Castellammare di Stabia)", in *Riv. di Stud. pompeiani* 20, 2009: 77–85.
SOLDATI 2023 = F. Soldati, *PeakFinder*, 2023.
SOMMELLA 1988 = P. Sommella, *Italia antica: l'urbanistica romana*, Roma 1988.

SOMMELLA 1991 = P. Sommella, "Città e territorio nella Campania romana", in G. Pugliese Carratelli (ed. by), *Storia e civiltà della Campania. L'evo antico*, Napoli 1991: 151–191.
SORICELLI 2019 = G. Soricelli, "L'agro vesuviano dopo l'eruzione del 79 d.C.", in M. Maiuro - M. Balbo (ed. by), *Popolazione, risorse e urbanizzazione nella Campania Antica. Dall'età preromana alla tarda antichità*, Bari 2019: 155–178.
SORICELLI 2002 = G.L. Soricelli, "Divisioni agrarie romane e occupazione del territorio nella piana nocerino-sarnese", in G. Franciosi (ed. by), *Ager Campanus. La storia dell'ager Campanus. I problemi della limitatio e sua lettura attuale. Atti del Convegno internazionale (Real sito di S. Leucio, 8-9 giugno 2001)*, Napoli 2002.
SPARAVIGNA 2016A = A.C. Sparavigna, "*Roman towns oriented to sunrise and sunset on solstices*", in 2016: 1–6.
SPARAVIGNA 2016B = A.C. Sparavigna, "The Town Planning of Pompeii and Herculaneum Having Streets Aligned Along Sunrise on Summer Solstice", in *SSRN Electron. J.* 2016: 1–7.
SPARAVIGNA 2020A = A.C. Sparavigna, "Brindisi e il suo giorno natale, tra cronologia ed astronomia", in *HAL open Sci.* hal-032423, 2020.
SPARAVIGNA 2020B = A.C. Sparavigna, "Invito alla lettura dell'articolo intitolato "Il giorno di fondazione delle colonie romane" di Arthur Eckstein", in *Zenodo* 2020.
SPARAVIGNA 2020C = A.C. Sparavigna, "What the Latin literature truly tells us about the orientation of camps, towns and centuriation", in *Zenodo* 2020.
SPAWFORTH 2006 = A. Spawforth, *The Complete Greek Temples*, London 2006.
ŠPRAJC 2015 = I. Šprajc, "Alignments upon Venus (and Other Planets) - Identification and Analysis", in C.L.N. Ruggles (ed. by), *Handbook of Archaeoastronomy and Ethnoastronomy*, New York 2015: 507–516.
STACCIOLI 1968 = R.A. Staccioli, "Urbanistica etrusca", in *Archeol. Class.* 20, 1968: 141–150.
STEWART *et al.* 2019 = A. Stewart - E. Driscoll - S. Estrin - N.J. Gleason - E. Lawrence - R. Levitan - S. Lloyd-Knauf - K. Turbeville, "Classical Sculpture from the Athenian Agora, Part 2: The Friezes of the Temple of Ares (Temple of Athena Pallenis)", in *Hesperia J. Am. Sch. Class. Stud. Athens* 88, 4, 2019: 625–705.
STILLWELL 1954 = R. Stillwell, "The Siting of Classical Greek Temples", in *J. Soc. Archit. Hist.* 13, 1954: 3–8.
SUDANO 2022 = F. Sudano, "Sistemi idraulici di raccolta e smaltimento delle acque a Terina", in *Atti del V Convegno Internazionale di Studi Dialoghi sull'Archeologia della Magna Grecia e del Mediterraneo, Paestum 19-21 novembre 2020*, Paestum 2022: 213–225.
TAYLOR 2002 = R. Taylor, "Temples and Terracottas at Cosa", in *Am. J. Archaeol.* 106, 2002: 59–83.
THOMSON 2013 = J.O. Thomson, *History of Ancient Geography*, Cambridge 2013.
THULIN 1909 = C.O. Thulin, *Die etruskische Disciplin. 3: Die Ritualbücher*, Göteborg 1909.
VAN TILBURG 2015 = C. Van Tilburg, *Streets and Streams: Health Conditions and City Planning in the Graeco-Roman World*, Leiden 2015.
TIRELLI 1981 = M. Tirelli, "La rappresentazione del sole nell'arte etrusca", in *Stud. Etruschi* XLIX, 1981: 41–50.
TOCCO 1976 = G. Tocco, "Saggi di scavo nella città e nella necropoli di Cumae", in Arte Tipografica Napoli (ed. by), *La Magna Grecia nell'età Romana. Atti del XV Convegno di Studi sulla Magna Grecia, Taranto, 5-10 ottobre 1975*, Taranto/Napoli 1976: 485–496.
TOMEO *et al.* 2021 = A. Tomeo - A. Cristillo - D. Ilaria - R. Sirleto, "Santa Maria Capua Vetere (Ce): il mausoleo di Via Galatina (proprietà Orsi Immobiliare)", in *Atti del LX Convegno di Studi sulla Magna Grecia, Taranto, 2021*, 2021.
TORELLI 1966 = M. Torelli, "Un templum augurale d'età repubblicana a Bantia", in *Atti della Accad. Naz. dei Lincei. Rend. Cl. di Sci. morali, Stor. e Filol.* 21, 1966: 293–315.
TORELLI 1993 = M. Torelli, "Gli aroma e il sale. Afrodite ed Eracle nell'emporia arcaica dell'Italia", in A. Mastrocinque (ed. by), *Ercole in Occidente*, Trento 1993: 91–117.

Torelli 2005 = M. Torelli, “Templum”, in *Thes. Cultus Rituum Antiq. (ThesCRA). Cult Places. Represent. Cult Places. IV*, : 341–347.
Torelli 2011 = M. Torelli, “Inuus, Indiges, Sol. Castrum Inui: il santuario al Fosso dell’Incastro (Ardea) e le sue divinità”, in *Ostraka Riv. di Antich.* XX, 1/2, 2011: 191–234.
Torelli 2013 = M. Torelli, “Il tempio, la festa, il passato. Immagine e storia degli edifici templari greci”, in *Engramma* 110, 2013: 37–52.
Torelli 2016 = M. Torelli, “Il sole, gli antenati, gli approdi: un sistema cultuale sulle coste del Tirreno”, in A. Ancillotti - A. Calderini - R. Massarelli (ed. by), *Forme e strutture della religione nell’Italia mediana antica - Forms and structures of religion in ancient Central Italy: III Convegno internazionale dell’Istituto di ricerche e documentazione sugli antichi Umbri, 21-25 settembre 2011, Perugia - Gubbio*, Roma 2016: 637–648.
Tozzi 1974 = P. Tozzi, *Saggi di topografia storica*, Firenze 1974.
Traversetti - F. Bartoli - Caneva 2018 = L. Traversetti - F. Bartoli - G. Caneva, “Wind-driven rain as a bioclimatic factor affecting the biological colonization at the archaeological site of Pompeii, Italy”, in *Int. Biodeterior. Biodegrad.* 134, 2018: 31–38.
Turfa 2012 = J.M. Turfa, *Divining the Etruscan World: The Brontoscopic Calendar and Religious Practice*, Cambridge 2012.
Tveite 2015 = H. Tveite, *The QGIS Line Direction Histogram Plugin*, 2015.
Vallese 2014 = G. Vallese, “le stelle i viaggi: un ciclo astronomico nel portale centrale della Basilica di San marco a Venezia (prima parte)”, in A. di B.A. di Venezia (ed. by), *Insegnare l’arte? Pedagogia e didattica dell’arte come filosofia dell’esperienza creativa*, Venezia 2014: 235–276.
Vinaccia 1926 = G. Vinaccia, “Saggio di Metrologia Etrusca”, in *Atti della R. Accad. dei Lincei. Rend.* 2, 11–12, 1926: 532–542.
Vinaccia 1939a = G. Vinaccia, *Il corso del sole in urbanistica ed edilizia*, Milano 1939.
Vinaccia 1939b = G. Vinaccia, *Il Problema dell’Orientamento nell’Urbanistica dell’Antica Roma*, Roma 1939.
Viscardi 2010 = G.P. Viscardi, “Artemide Munichia: aspetti e funzioni mitico-rituali della dea del Pireo”, in *Dialogues d’histoire ancienne* 36, 2, 2010: 31–60.
Viscardi 2015a = G.P. Viscardi, “L’astuzia mimetica della ragione rituale:analisi della dimensione sonora nella prassi iniziaticaalla luce della performance theory”, in Igor Baglioni (ed. by), *Ascoltare gli Dèi / Divos Audire: Costruzione e percezione della dimensione sonora nelle religioni del Mediterraneo antico. L’ Antichità classica e cristiana*, Roma 2015: 93–116.
Viscardi 2015b = G.P. Viscardi, *Munichia: la dea, il mare, la polis. Configurazioni di uno spazio artemideo*, Roma 2015.
Vitale 2000 = F. Vitale, *Astronomia ed esoterismo nell’antica Pompei e ricerche archeoastronomiche a Paestum, Cuma, Velia, Metaponto, Crotone, Locri e Vibo Valentia*, Padova 2000.
Vlastos 2005 = J.O.G. Vlastos, *Plato’s Universe*, Las Vegas 2005.
Vogel - Märker 2010 = S. Vogel - M. Märker, “Reconstructing the Roman Topography and Environmental Features of the Sarno River Plain (Italy) before the AD 79 Eruption of Somma–Vesuvius”, in *Geomorphology* 115, 2010: 67–77.
Vogel - Michael - Seiler 2011 = S. Vogel - M. Michael - F. Seiler, “Revised modeling of the post-AD 79 volcanic deposits of Somma-Vesuvius to reconstruct the pre-AD 79 topography of the Sarno River plain (Italy)”, in *Geol. Carpathica* 62, 1, 2011: 5–16.
De Waele *et al.* 2001 = J.A. De Waele - B. d’Agostino - P.S. Lulof - L.A. Scatozza Horicht (ed. by), *Il tempio dorico del foro triangolare di Pompei*, Roma 2001.
Wagner 2019 = N. Wagner, “Dall’artigianato arcaico alle produzioni ellenistiche. Le terrecotte architettoniche ellenistiche di Capua”, in C. Rescigno - P. Lulof - I. Manzini (ed. by), *Deliciae Fictiles V. Networks and Workshops: Architectural Terracottas and Decorative Roof System in Italy and beyond (Naples, March 15th-18th, 2018)*, Oxford 2019: 293–301.
Wallace-Hadrill 2012 = A. Wallace-Hadrill, *Herculaneum*, Darmstadt-Mainz 2012.

WARD-PERKINS 1974 = J.B. Ward-Perkins, *Cities of ancient Greece and Italy: Planning in classical antiquity*, Toronto/New York 1974.
WEISS 2016 = M. Weiss, "Cosmogonia italica", in A. Ancillotti - A. Calderini - R. Massarelli (ed. by), *Forme e strutture della religione nell'Italia mediana antica - Forms and structures of religion in ancient Central Italy: III Convegno internazionale dell'Istituto di ricerche e documentazione sugli antichi Umbri, 21-25 settembre 2011, Perugia - Gubbio*, Roma 2016: 661–667.
WILLIAMSON 1993 = C. Williamson, "Light in Dark Places: Changes in the application of natural night in sacred Greek Architecture", in *Pharos. J. Netherl. Inst. Athens* I, 1993: 3–33.
WOOLLEY 1925 = C.L. Woolley, "The excavations at Ur, 1924–1925", in *Antiq. J.* 5, 1925: 347–402.
ZANELLA 2019 = S. Zanella, "Pompei. Sulle tracce di fondazioni e rifondazioni urbane", in *Riv. di Stud. Pompeiani* 30, 2019, 2019: 7–19.
ZANKER 2013 = P. Zanker, *La Città Romana*, Roma 2013.
ZAVARONI 2006 = A. Zavaroni, "Le iuvilas di Capua, Anna Perenna e gli Argei Romani", in *Dialogues d'histoire ancienne* 32, 2, 2006: 45–58.
ZEVI 1982 = F. Zevi, "Urbanistica di Pompei", in *La regione sotterrata dal Vesuvio. Studi e prospettive, Atti del convegno internazionale (11-15 novembre 1979)*, Napoli 1982: 353–365.
ZEVI 2004 = F. Zevi, "L'attività archeologica a Napoli e Caserta nel 2004", in *Alessandro il Molosso e i "condottieri" in Magna Grecia. Atti dei quarantatreesimo convegno di studi sulla Magna Grecia (Taranto-Cosenza 26-30 settembre 2003)*, Taranto 2004: 853–923.
ZEVI *et al.* 2008 = F. Zevi - F. Demma - E. Nuzzo - C. Rescigno - C. Valeri (ed. by), *Museo Archeologico dei Campi Flegrei. Catalogo generale. Cuma*, Napoli 2008.
ZEVIANI 2022 = C. Zeviani, "Confini e frontiere nell'Etruria nordorientale Uno studio sulle identità di lignaggio e di comunità attraverso i cippi di confine", in A.-L. Baylé - M. Jaillet (ed. by), *Dépasser la limite. Actes de la Deuxième rencontre des jeunes chercheurs sur l'Italie préromaine*, 2022: 43–51.
ZOTTI 2013 = G. Zotti, *Make Stellarium Panoramas from Google Earth*, 2013.
ZOTTI 2019 = G. Zotti, "Visualising skyscapes: GIS-based 3-D modelling and astronomical simulation", in L. Henty - D. Brown (ed. by), *Visualising Skyscapes: Material Forms of Cultural Engagement with the Heavens*, Abingdon 2019: 35–54.
ZOTTI *et al.* 2019 = G. Zotti - B. Frischer - F. Schaukowitsch - M. Wimmer - W. Neubauer, "Virtual Archaeoastronomy: Stellarium for Research and Outreach", in G. Magli (ed. by), *Archaeoastronomy in the Roman World*, Cham 2019: 187–205.
ZOTTI *et al.* 2021 = G. Zotti - S.M. Hoffmann - A. Wolf - F. Chéreau - G. Chéreau, "The Simulated Sky: Stellarium for Cultural Astronomy Research", in *J. Skyscape Archaeol.* 6, 2, 2021: 221–258.
ZOTTI - SCHAUKOWITSCH - WIMMER 2018 = G. Zotti - F. Schaukowitsch - M. Wimmer, "Beyond 3D Models: Simulation of Phased Models in Stellarium", in *Mediterr. Archaeol. Archaeom.* 18, 4, 2018: 17–24.
ZOTTI - WOLF 2020 = G. Zotti - A. Wolf, *Stellarium 0.20.3 User Guide [online]*, 2020.

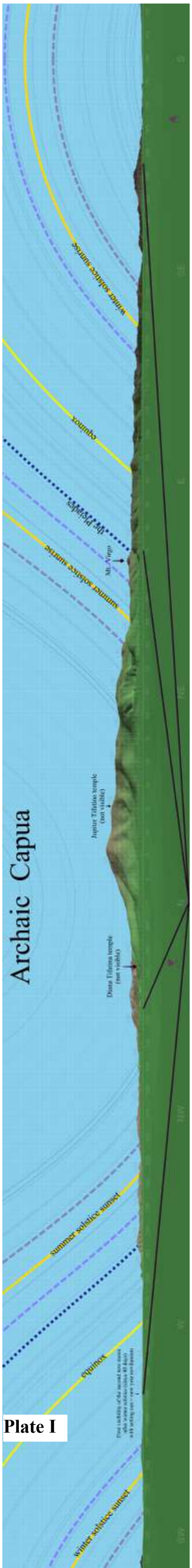
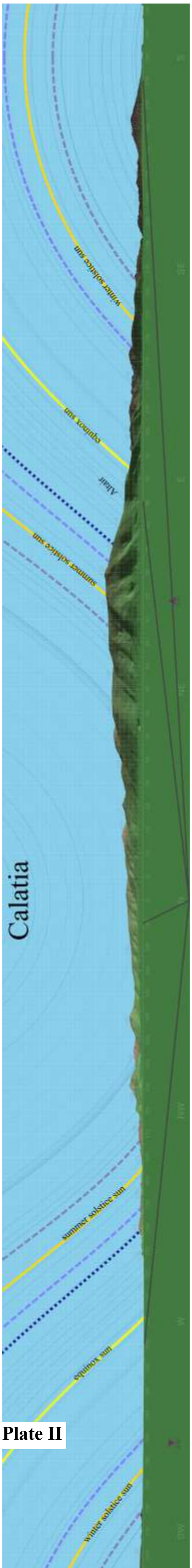


Plate I



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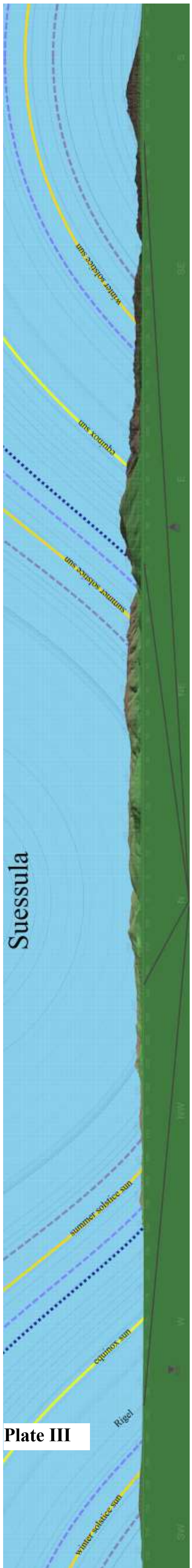

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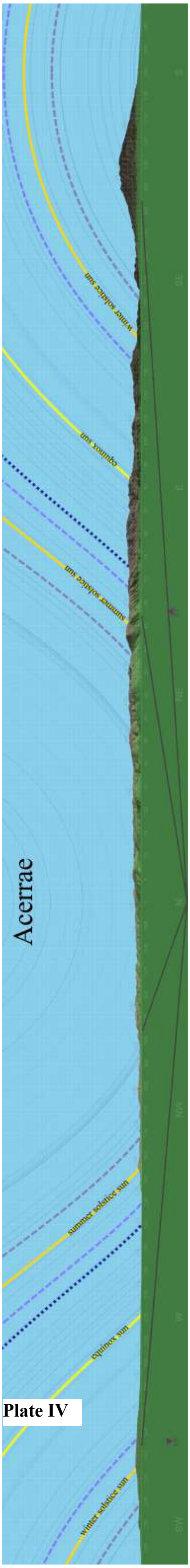

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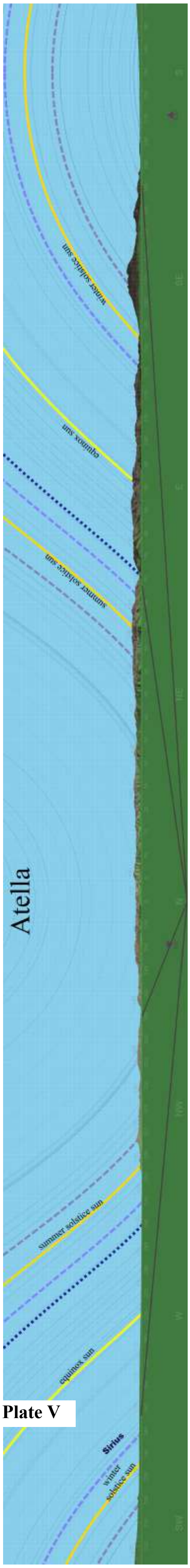

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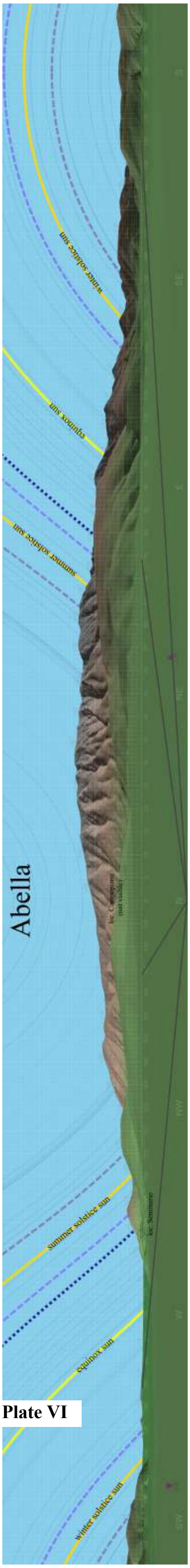
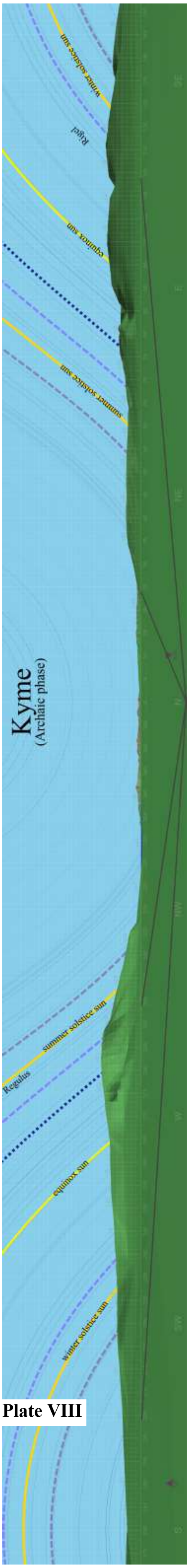


Plate VI

Plate VII



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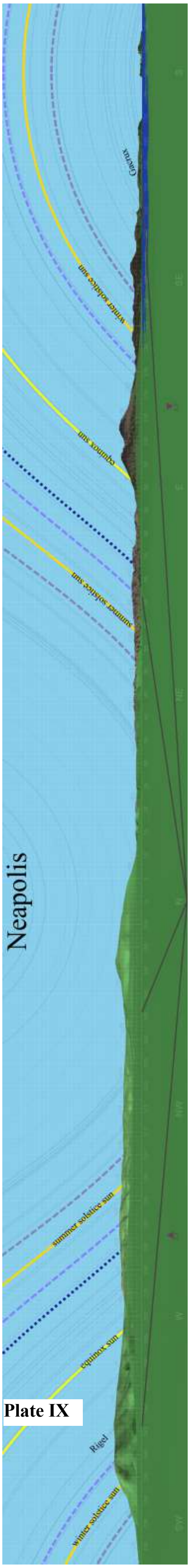


Plate IX

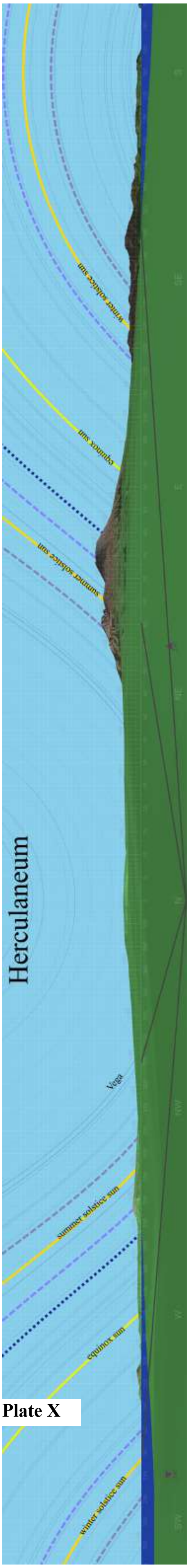


Plate X

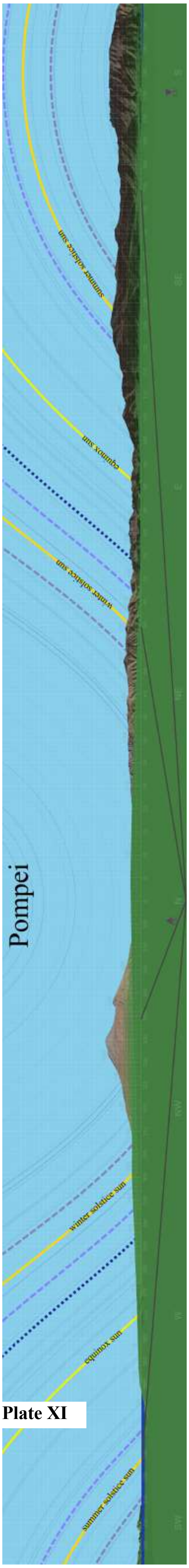
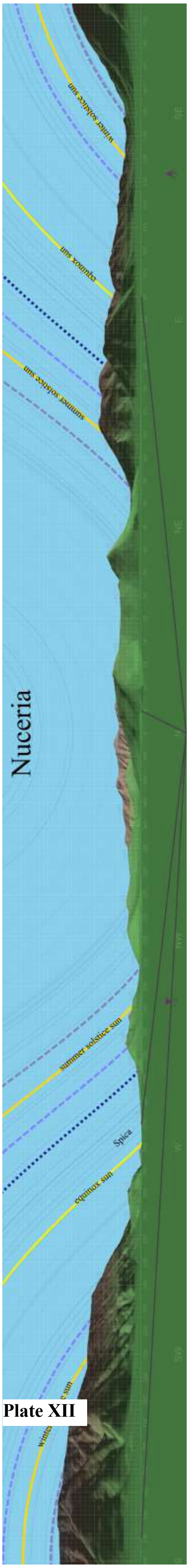


Plate XI



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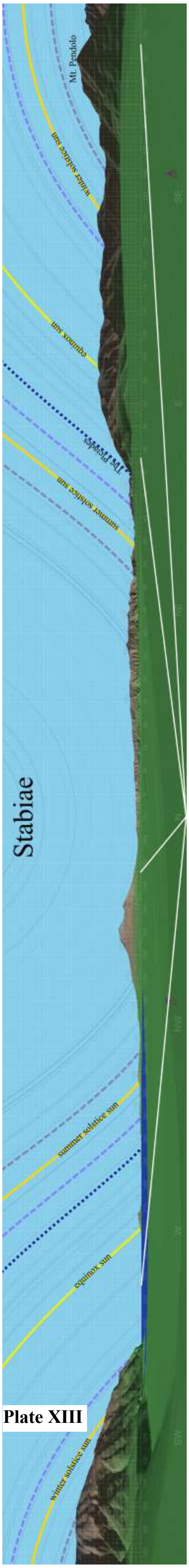

Plate XIII

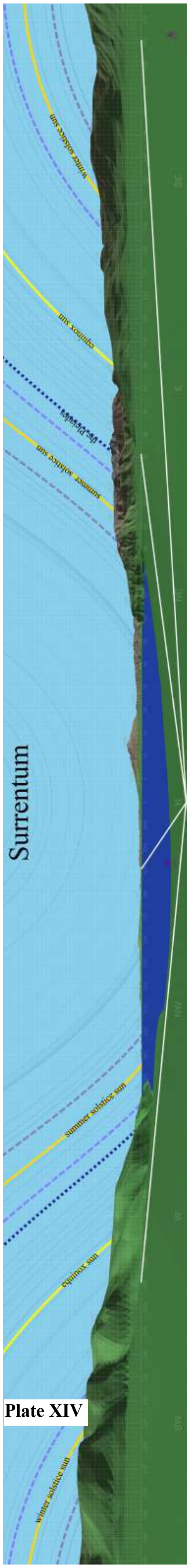

Plate XIV

RELAZIONE FINALE DOTTORATO TRIENNIO 2019-2022

ILARIA CRISTOFARO
CICLO XXXV
MAT. D141000025

TITOLO DELLA TESI DOTTORALE

Traces of Foundations within Ancient Skies:
Archaeoastronomical Orientations of Towns and Temples in Campania between the 8th and 3rd cent. BC

LAVORO DI RICERCA

In parallelo alle attività di ricerca bibliografica, le attività di ricerca pratica sul campo si sono svolte nei seguenti **sopralluoghi**[1]:

- Rilievo topografico con Stazione Totale, e fotografico presso Pompei, 21 giugno 2020.
- Rilievo fotografico full-dome, GPS, laser scanner, presso Tempio di Diana Tifatina, 18 e 24 giugno 2021.
- Rilievo fotografico full-dome, GPS, presso Tempio di Giove Tifatino, 18 giugno 2021.
- Rilievo fotografico full-dome, GPS, presso Acerrae, 19 giugno 2021.
- Rilievo fotografico full-dome, GPS, laser scanner, presso Tempio Dorico e Via delle Terme a Pompei, 20–21 giugno 2021.
- Produzione di documentazione fotografica nell'ambito del solstizio d'inverno (Pompei, Herculaneum, Cuma), 13 – 23 dicembre 2021.
- Rilievo fotografico presso Tempio di Diana Tifatina, 3–4 marzo 2022.
- Rilievo fotogrammetrico da terra presso Tempio Dorico a Pompei, marzo 2022.
- Rilevo fotogrammetrico da drone UAV presso terrazza inferiore all'acropoli di Cuma, 24 giugno 2022.
- Produzione di documentazione fotografica Atella e Nuceria, 20 – 23 settembre 2022.

ATTIVITÀ DI FORMAZIONE INTERNA

Le attività di formazione si sono incentrate sulle principali **aree tematiche di ricerca del Dipartimento**, incluso il perfezionamento linguistico nella **lingua inglese** e il **perfezionamento informatico**. Tra le tante attività di formazione interne di ricordano le seguenti:

- I convegni e seminari organizzati dalla Scuola Dottorale in Scienze Umane e Sociali.
- Presentazione dei libri segnalati dal collegio docenti del dottorato.
- Convegni *Horizon Europe* 2021-2027.
- Convegno "Sconfinamenti di genere. Donne coraggiose che vivono nei testi e nelle immagini" (Prof.sse Pepe e Porciani).
- Corsi con la Fondazione Emblema sull'inserimento nel mondo lavorativo (prof. Nadia Barella).
- Seminari in occasione delle Giornate Mondiali della Lingua Latina e Greca.
- Laboratori disciplinari a.a. 2019/2020 (referente prof. Sodano).
- Corso di inglese "English for Academic Purposes" (prof. Marta Cariello), a.a. 2019/2020.
- Corso di informatica "Network Structures in Social Systems" (prof. Cordasco) a.a. 2019/2020.
- Corso di formazione specifica per la Sicurezza nei cantieri archeologici a.a. 2019/2020 .
- Convegno Internazionale "La colomba di Apollo"(Prof. Rescigno, Dott.ssa Parisi).
- Seminari organizzati dal Prof. Scarano sulla storia contemporanea.
- Seminari organizzati dal Prof. Sielo e dalla Prof.ssa Porciani sulla geocritica.
- Seminari all'interno del Progetto IDP-Illuminated Dante Project 2.0.
- Ciclo di lezioni, convegni e seminari STEC, "Documentare, Costruire e Trasmettere la memoria" (referente prof. Rescigno), a.a. 2020/2021.
- Convegno "Percorsi interdisciplinari della ricerca storico-religiosa sul mondo antico: temi, concetti e prospettive" (referente prof.ssa Santi).
- Master Class in lingua inglese con l'Istituto per il Servizio internazionale di Turismo e di lingue straniere dell'Università Statale di Pyatigorsk – PSU - (Russia).
- Corso di informatica STEC, Archeologia virtuale: frammenti, tecnologie, valorizzazione (prof. Gabellone).

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[1]Limitatamente all'emergenza COVID-19.

ATTIVITÀ DI FORMAZIONE ESTERNA

- Corso di specializzazione post-laurea "**Tecnologías digitales de documentación geométrica y representación del Patrimonio (TDDG)**", VIII edizione, (LiDAR aereo, Laser Scanner Terrestre, Fotogrammetria digitale, Ottimizzazione 3D, anastilosi digitale), 5 moduli/250 ore/6 mesi, 30 novembre 2021 – 5 giugno 2022, Corso on-line presso Centro de Supercomputación de Galicia (CESGA), organizzato da INCIPIT Istituto di Scienza del Patrimonio del CSIC Consiglio di Ricerca Nazionale Spagnolo (https://cursotddg.com), con certificazione allegata.

- Borsa di studio per coprire la quota d'iscrizione a **V Summer School ARES "Archeologia Aerea e telerilevamento di prossimità con sistemi aeromobili a pilotaggio remoto"**, 17 ottobre – 22 ottobre 2022, presso Laboratorio di "Topografia antica e Fotogrammetria" e Laboratorio di Aerotopografia Archeologica e Remote Sensing (LARES) Dipartimento di Beni Culturali, Via Dalmazio Birago, 64, Università del Salento, con certificazione allegata. Referente Direttore del corso il prof. Giuseppe Ceraudo.

SOGGIORNO DI RICERCA ALL'ESTERO

Per il periodo 10 marzo–17 giugno 2022 la sottoscritta si è recata con il **progetto Erasmus+ Traineeship** presso l'istituto di ricerca **INCIPIT Istituto di Scienza del Patrimonio** del CSIC (Consiglio di Ricerca Nazionale Spagnolo) a **Santiago de Compostela**, Spagna (Edificio Fontán, bloque 4, Monte Gaiás, s/n, 15707 Santiago de Compostela, A Coruña, Spain) (referente esterno: Prof. A. Cesar Gonzalez-Garcia). L' attività di ricerca si è approfondita con lo **studio statistico per questioni di archeoastronomia**. In questo contesto si sono presentati i risultati preliminari del dottorato "Built by Sunlight: Foundation Ritual, Urbanism, and Seasons in Pompeii", **seminario di ricerca** a INCIPIT, Edificio Fontán, Monte Gaiás, Santiago De Compostela, Spagna (https://www.incipit.csic.es/en/events/search/pompei), 31 maggio 2022.

ATTIVITÀ DI DIVULGAZIONE

- Giornate del patrimonio 2020, Tempio di Apollo, Pompei, 26 – 27 settembre 2020.
- Solstizio d'Estate a Pompei, "Sogno Di Una Notte Di Inizio Estate", 21 giugno 2021
- Visita guidata a Pompei e Cuma con Prof. Wu Hung (University of Chicago) e colleghi, 27 giugno e 4 luglio 2022.

SUMMER SCHOOLS E ALTRE ATTIVITÀ

- **Campagna di scavo** presso l'acropoli di Cuma per i mesi di luglio 2021 e 2022, in particolare supportando l'attività di rilevamento topografico.
- Supporto al **rilevamento geo-archeologico** a Stabiae, con BOVIAR (Milano), luglio 2022.

PRESENTAZIONE DEL LAVORO DI DOTTORATO A CONVEGNI NAZIONALI E INTERNAZIONALI

- Convegno EAA-European Association of Archaeologists (Virtual), presentazione on-line, 26-30 agosto 2020.
- "Cities In Evolution. Diachronic Transformations Of Urban And Rural Settlements", VIII AACCP (Architecture, Archaeology and Contemporary City Planning) symposium, Dynamic Research on Urban Morphology-DRUM laboratory, Özyeğin University, Istanbul, Turkey, presentazione on-line, 26 aprile–2 maggio 2021.
- Computer Applications & Quantitative Methods in Archaeology CAA 2021 virtual conference, "Digital Crossroads", Limassol (Cyprus), presentazione on-line, 14–18 giugno 2021 (con Michele Silani e Georg Zotti).
- 18th Sophia Centre Conference 2021, "Stories from the Sky", University of Wales Trinity Saint David, Lampeter (Wales, United Kingdom), presentazione on-line, 19 giugno 2021.
- 28th Annual Meeting of the European Society for Astronomy in Culture (SEAC), "Cultural Astronomy and Ancient Skywatching", Stara Zagora (Bulgaria), presentazione on-line, 6–10 Settembre 2021.
- VI convegno Dialoghi della Magna Grecia "Architettura, Urbanistica e Società nelle colonie greche", Paestum, presentazione *in situ*, 1–3 ottobre 2021.

- 10° Convegno Internazionale di Archeoastronomia in Sardegna "La Misura del Tempo", Sala Conferenze Fondazione Sardegna, Sassari, presentazione *in situ*, 3 dicembre 2021, su invito.
- 11° Convegno Internazionale di Archeoastronomia in Sardegna, "La Misura del Tempo", Sala Conferenze Fondazione Sardegna, Sassari, presentazione on-line, 25 novembre 2022, su invito.

PUBBLICAZIONI NEL TRIENNIO 2019-2022

- CRISTOFARO I., SILANI M., ZOTTI G. (in stampa). "From Urban Orientations to 3D Visualisation: Solar Irradiation in Pompeii within Ancient Virtual Skies". *Journal of Computer Applications in Archaeology*, ISSN: 2514-8362
- CRISTOFARO I. (in stampa). "The Equisolar Axis in Urban Morphology: Pompeii, the Solstices and Sunlight Irradiation". In: Alessandro Camiz, Zeynep Ceylanlı, Zeren Önsel Atala, Özge Özkuvancı (eds.). *Cities in Evolution: Diachronic Transformations of Urban and Rural Settlements. VIII AACCP (Architecture, Archaeology and Contemporary City Planning) symposium, Özyeğin University in Istanbul, Turkey, April 26th-May 2nd*. Istanbul: DRUM Press.
- CRISTOFARO I. (in stampa). "Il Tempio Dorico a Pompei: Orientamento e Illuminazione Solare". In (a cura di): Emanuele Greco, *Dialoghi sull'Archeologia della Magna Grecia e del Mediterraneo, Atti del VI Convegno Interazione di Studi (Paestum, 1–3 ottobre 2021)*. Paestum: Pandemos.
- CRISTOFARO I. (in stampa). "Rituals of Sunlight: Orientation and Natural Illumination at Triangular Forum Doric Temple in Pompeii". In Nicholas Campion (eds.), *Proceedings of the 18th Sophia Centre Conference 2021, "Stories from the Sky", University of Wales Trinity Saint David, Lampeter, 19th June 2021*, Ceredigion: Sophia Centre Press, Lampeter.
- CRISTOFARO I. (in stampa). "A Review of Dragos Gheorghiu (ed.), Art in the Archaeological Imagination", *Journal of Skyscape Archaeology*, ISSN: 2055-348X
- CRISTOFARO I. (2022). "Review of Efrosyni Boutsikas, The Cosmos in Ancient Greek Religious Experience: Sacred Space, Memory, and Cognition". *Journal of Skyscape Archaeology*, vol. 8, p. 140-144, ISSN: 2055-348X, doi: https://doi.org/10.1558/jsa.23779
- CRISTOFARO I (2021). "The Equisolar Axis in Urban Morphology: Pompeii, the Solstices and Sunlight Irradiation". In Alessandro Camiz, Zeynep Ceylanlı, Zeren Önsel Atala, Özge Özkuvancı (eds.) *Book of Abstracts: Cities in Evolution: Diachronic Transformations of Urban and Rural Settlements. VIII AACCP (Architecture, Archaeology and Contemporary City Planning) symposium, Özyeğin University in Istanbul, Turkey, April 26th-May 2nd, 2021*, vol. 1, p. 47-48, Istanbul: DRUM Press, ISBN: 978-1-716-22187-3
- CRISTOFARO I. (2021). "In the light of the Milky Way: An Interpretative Key for Crux-Centaurus Alignments across Prehistoric Europe". In A. César González-García, Roslyn Frank, Lionel D. Sims, Michael A. Rappenglück, Georg Zotti, Juan A. Belmonte, Ivan Šprajc (eds.), *Beyond Paradigms in Cultural Astronomy. Proceedings of the 27th SEAC conference held together with the EAA Bern, (4 - 8 September 2019)*. BAR INTERNATIONAL SERIES, vol. 3033, p. 115-122, BAR Publishing, ISSN: 0143-3067
- CRISTOFARO I., SILANI M. (2020). "Approaching Skyscape Archaeology: A Note on Method and Fieldwork for the case study of Pompeii".*GROMA*, vol. 5, ISSN: 2531-6672, doi: 10.12977/groma
- CRISTOFARO I. (2020). "When the Sun Meets Okeanos: The Glitter Path as an Eschatological Route, from the Late Bronze Age to Archaic Greece". *Journal of Skyscape Archaeology*, vol. 6, p. 30-52, ISSN: 2055-348X
- CRISTOFARO I. (2020). "Harmony and a Phenomenology of Liquid Skies". In Nicholas Campion (ed.), *The Harmony Debates: Exploring a Practical Philosophy for a Sustainable Future*, with a foreword by HRH The Prince of Wales, 269-287, Ceredigion: Sophia Centre Press, ISBN: 978-1-907767-22-7

Santa Maria Capua Vetere, 29 novembre 2022

La sottoscritta, dott.ssa Ilaria Cristofaro

Ilaria Cristofaro