

Creating collective identities
through astronomy?

A study of Greek temples in Sicily

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Abstract

This is a study of the alignments of Greek temples in Sicily and the implications for the study of identity and ethnicity in the Greek world of the first millennium BC. The thesis presents data from 41 temples and applies a new method of statistical analysis and presentation in order to draw conclusions as to whether or not there are any meaningful patterns of alignment related to astronomical practices. I test several hypotheses, first by determining if there is a correlation between temple alignment and sunrise, and then analysing sub-samples by location, genealogy, period of construction, type (celestial or chthonic) and gender of deity the temple is dedicated to, as well as four specific deities. Additionally I examine them in their historical and cultural contexts for evidence of hybridisation with the native inhabitants of Sicily. I find that the temples in Sicily exhibit a closer correlation with solar alignments than temples in Greece do, but that the alignments of individual temples are selected for reasons associated with local historical and topographical contexts. The study as a whole is conducted within a post-positive framework, which intentionally tackles one of the problems of interdisciplinary studies, that they can lack a coherent means of integrating data.

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1. Introduction

A common problem in reconstructing the past is that traces that remain never fully correspond to the reality of what happened. History is selective, and the texts that survive do so because of patronage, bias or chance. Archaeological remains may not be so carefully selected but even so the fragments of a pot which come out of the ground are still not the same as the whole pots which may have been used or treasured by peoples past. Organic remains may have disappeared entirely. Therefore an artefact which has survived unchanged and in situ for over two thousand years may seem useful.

This could be a description of the night sky. While it was obviously not hand-crafted, the act of interpretation makes this sight of social importance. Its distance from the Earth and its lack of decay mean that the state of the sky in the past can be known and reconstructed (Ruggles & Saunders, 1993). While interpretations of the sky differed in the past, the challenge - to explain or control the sky - remains the same for all societies. The distance of the sky from the Earth means that these interpretations really only have a use for social control if the explanations are shared by a society as a whole. Therefore it could be said that the sky is the ultimate Rorschach test for a society. This study is an exploration of that idea. I intend to show that the use of astronomy in the past can be used as evidence of a created identity by examining the Greek temples of Sicily.

Sicily in the first millennium BC is fertile ground for such a study as the notion of social identity and ethnicity on the island, along with southern Italy, is currently a dynamic topic of study. I believe that discussion can be divided into disagreement in two different areas. The first is the conflict between the orthodox and post-colonial interpretations of Greek settlement. Section two briefly offers an overview of how the

Greek presence in Sicily has been studied, from art appreciation to the construction of a history of colonisation. Section Three examines the more recent archaeological rejoinders to such studies. It also introduces what I believe is the central problem to the study of much of the ancient past, the problem of reconciling diverse and possibly incommensurable methods of studying the behaviour and beliefs of past peoples.

My belief is that it is more helpful to focus upon the problem rather than the disciplinary boundaries, and so I show why an archaeoastronomical approach may provide data and interpretation which can bridge the gap between archaeological and historical approaches. I am keenly aware that archaeoastronomical methodology is not widely known, so I introduce this in Section Four. Having introduced yet another method into the same field I then propose how to combine them in a clear way, following recent post-positivist approaches (Section Five).

Sections Six to Fifteen comprise the bulk of the thesis. Section Six is the data chapter from which I draw the various analyses. I would be unhappy with purely descriptive analysis of these results. Any individual result could be due to purely random factors, and so in section Seven I describe what I believe is a novel method for analysing the probability that groups of alignments occur due to chance. I believe the innovation is due to a different focus in my use of statistical tools. Rather than aim for power in teasing our signal from noise, I have chosen to aim for intelligibility.

This is the guiding principle for the thesis. If interdisciplinary work is to open a meaningful dialogue between scholars in different disciplines then it has to be understandable by single-subject specialists in those disciplines. In my case if I wish to change the opinions of ancient historians on the nature of identity, then my

statistical analysis must be presented in such a way that they can actively assess with it. I believe my method of presentation means that a classicist or archaeologist does not have to know what a binomial distribution is to be able to argue whether or not my results are robust. Similarly I have on occasions 're-invented the wheel' when discussing the social aspects of religion. This is because astronomers and archaeoastronomers may be far better statisticians than myself, but that expertise means little if I do not make clear where I am drawing my assumptions from. It is my belief that without scrutiny from all relevant disciplines a study cannot be said to be truly interdisciplinary.

Section Fifteen might initially appear to be a brief historical counterpoint to the statistical analysis. In fact the statistical method is historically based, but simply cannot be applied to small samples. This section is a discussion of those small samples where there is strong historical and archaeological evidence to suggest the use of intentional astronomical practices. The analysis is ended with Section Sixteen which draws the various strands together.

Sections Seventeen and Eighteen bring the thesis back to the wider social context of the study. While the temples are interesting in themselves, I believe that the results and analysis in this thesis can also contribute to the discussions about the nature of Greek identity in the archaic and classical world.

The thesis concludes with Section Nineteen which reiterates what I believe are my key findings and sets out where I believe there are further opportunities to develop this work. There are, I believe, a great many possibilities opened up by it. It not only addresses a question about the nature of identity in Greek Sicily, it also provides a model for interdisciplinary work between archaeology and classics. Further the

statistical methods developed here will have the potential to be used in a variety of contexts across the world, not only in archaeoastronomy but in any field where statistical data can be analysed with reference to a binomial distribution. Most usefully, I believe this method emphasises the importance of social practices, where data are generated in a social context.

2. The Context of Greek Colonisation

John Romer's history of archaeology takes an unusual view of the origins of archaeology. Romer (2000, p. 14) dates it to 1736 when King Charles of the Two Sicilies bought land, including a 'statue mine' over what was the Roman city of Herculaneum. Initially treating it as a mine for retrieving Classical treasures, King Charles eventually founded the *Accademia Ercolanese* to publish the findings and place them in the context of what was then known about the Classical past. Romer's point of origin for archaeology is not shared by all historians of archaeology, but it does contain two important features for understanding the archaeology of Greek Sicily. One is that archaeology was seen as the cataloguing of artefacts within their Classical context. The second is that this was the original tradition from which other forms of archaeology have departed. It would be unfair to categorise later work as the same form of antiquarianism, but at the same time it is necessary to see this tradition of archaeology as being a way of understanding Ancient History, rather than a study in its own right, formed some of the basic assumptions of the first Classical archaeologists and these assumptions to some extent still shape Classical archaeology today.

Early work on the archaeological remains of the archaeological sites of Sicily could be described as descriptive, or cataloguing. In modern terms this sounds dismissive, but in fact this was a necessary step. The publication of *Die griechischen Tempel in Unteritalien und Sicilien* by the architects Koldewey and Puchstein (1899) was one of the first descriptions of the Sicilian temples to be published. Penrose's surveys (1892, 1899, 1901) were slightly more sophisticated. He was pursuing a research question following Lockyear's work on the Egyptian pyramids and Stonehenge, in trying to correlate the alignments of the Greek temples to significant dates via solar or celestial alignments. Apart from this much of the early work such as that of Orsi (1899, 1903,

1906, 1910, 1919, 1966), Gabrici (1927, 1929, 1956) and Marconi (1929a, 1929b, 1931) was extensive and reports of the architecture and artefacts recovered from excavations published in great detail in journals such as *Monumenti Antichi* and *Notizie degli Scavi di Antichità*. These excavations continue to be the foundation for claims made about the date and attribution of many temples today.

The approach to the Greek material in Sicily was radically altered by Dunbabin (1948) with his work *The Western Greeks*. This book marks a watershed in the study of Greek Italy because it reflected the changes in approach to archaeological materials which were under way in the 1930s and 1940s. It also brought the concept of the 'Western Greeks' into the forefront of the scholarly consciousness. Ironically, by reducing the material from part of some vague and amorphous Greek ideal to a local and bounded subset of the Greek world, Dunbabin opened the archaeological material to a wider context. Now the artefacts were not simply Greek, but also occupied a place on the fringe of a wider world, and in opposition to the local native population. De Angelis (1998) would later hold his work to be an example of a bad model of colonisation, but by raising the question of Greek and native interaction Dunbabin had opened up the means for his own work to be challenged.

Archaeological work at this time also took a more localised perspective. De Miro (1962) asked questions about the hellenisation of the Agrigentine territory and Orlandini (1963) questioned to what extent the earliest levels of pottery at Gela could be traced back to a Lindian foundation. Detail was not lost from archaeological reports, but now the emphasis was on how the pottery compared with other local assemblages rather than how it represented a Greek ideal.

The apogee of this kind of study is in Boardman's book *The Greeks Overseas* which was first published in 1964 and in its fourth edition, published in 1999. It remains the primary textbook for the discussion of Greek colonisation. In many ways it is an

evolution of Dunbabin's position. Boardman took the view that the history of Thucydides could be read as an accurate account of the foundations of the settlements. The result was a narrative of Greek cities in the homeland intentionally setting out to found new cities in Italy and Sicily, usually with an accuracy of dating down to a year. Hence it is common to read statements like "Six years after the foundation of Naxos, the Chaclidians there set out to found another colony, at Leontini, with reinforcements from home" (Boardman, 1999, p. 169).

Boardman integrated archaeological evidence where it supported the historical record and so early Euboean pottery is seen as evidence of a foundation by Euboeans for cities such as Naxos or Zancle, whilst Corinthian pottery is associated with the Corinthian foundation of Syracuse. Boardman is aware that archaeological evidence can be ambiguous, and so where it does not agree with the historical record, such as at the foundation of Megara Hyblaea, which from archaeological finds may pre-date Syracuse, he rejects it. Instead he prefers to follow Thucydides (Boardman, 1999, pp. 175-176).

Elsewhere archaeology adds relatively little to Boardman's view of the west, beyond providing useful illustrations where it supports the historical evidence. As a result the relationships with the native peoples are considered to be rather simplistic; according to Boardman (1999, pp. 189-192) akin to the relationship between master and slave. This is of little consequence as Boardman is more interested in the Greeks than the natives, and argues that the natives were hellenised by the mid-fifth century and so not really a matter of concern. This dismissive attitude inspired one of his most notorious phrases: "In the west the Greeks had nothing to learn, much to teach" (Boardman, 1999, p. 190). This attitude makes most sense if one accepts Boardman is following the Classical sources, such as Thucydides, which are interested in the

Sicilian colonies their interactions with the rest of Greece rather than with their native Sicilian neighbours.

However, Boardman's work is not merely Dunbabin's work rewritten. Boardman sees a more active role for the Sicilians in the realm of art. He considers temple architecture to lag behind the styles of the homeland, but also accepts that in roofing the Sicilians adopted a style and refined it. Nevertheless there is a hangover of the centre-periphery model of the Greeks bringing civilisation to the west, and he dismisses some later objections to this model as "latterday agonizing of colonizing" (Boardman, 1999, p. 276). Boardman's model of colonisation is one of the Greeks as a movement enlightening the world.

More recent work in Sicily has approached the archaeological material from the opposite direction. Work such as Shepherd's (1995) analysis of Greek burials in Sicily, or De Angelis' (1994) explanation for the foundation of Selinous, have examined the local archaeological record and then searched to see what the historical record can say about their findings. This work has been increasingly framed within the perspective of what Hodos (2006, pp. 11-18) has identified as postcolonialism. Postcolonial approaches attempt to reconcile the traditional approaches to colonisation with an active role for the inhabitants of the land being colonised.

The current state of the study of Greek colonisation is therefore slightly confused. Most recent work is locally focused. Acculturation is seen as a local dialogue between peoples located in a specific place and a specific time (Malkin, 2004). The results are studies which no longer see the colonisation of places like Sicily as interactions between two discrete cultures, but instead as melting pots where new hybrid identities are formed (e.g. Antonaccio 2003, 2005). This poses a difficulty to

anyone who then sees cities with Greek pottery and Greek architecture appearing in histories of Greece for the part they took in Greek politics. By the time of the fifth-century Modern historians are talking about Hellenised sites, and there is no comparable discussion of the Sikelisation of Greece. How can these two perspectives be reconciled?

Possible reasons for disagreement over the nature of colonisation and acculturation in archaic Sicily are two. First of all, one side or the other could simply be wrong. Another possibility is that they simply are not talking about the same thing when they refer to colonisation.

The possibility of one side being wrong has been raised. This has been done most explicitly in De Angelis's 1998 article in *Antiquity*. In this article he tackles Dunbabin's work, which set the agenda for post-war discussion of the western colonies. De Angelis proposes that Dunbabin's work was a defence of empire, and reflective of the time he lived in. This period marked the end of the British Empire with India gaining its independence in 1947 and the colonies of Africa gaining their freedom over the next decades. De Angelis contends that Dunbabin's view of the Greeks in Sicily was coloured by his opinion of the British and their role in the colonies. As a defender of imperialism Dunbabin, according to De Angelis, sought to justify and magnify the role of the Greeks in Sicily at the expense of the natives.

I find the paper curiously inconsistent. In concentrating upon Dunbabin's view of the western Greeks De Angelis misses his (unfinished) work *The Greeks and their Eastern Neighbours*, which takes a different view of the barbarian cultures at the other end of the Mediterranean (Dunbabin, 1957). Hodos (2006, pp. 10-11) notes that here Dunbabin acknowledges that the Greeks took more than they gave to the cultures of

the near east, but unlike in the west now argues this is a good thing and shows Greek superiority. Clearly Dunbabin's work is influenced by the times he worked in, but this is mundane historical fact. Dunbabin clearly believed the evidence of acculturation was different in the east and the west. No doubt he had a complicated relationship with modern colonisation, due to his position as an Australian in Oxford. In light of this, the dismissal of earlier work simply as 'Imperialist' seems rather one-dimensional.

Furthermore, De Angelis' article is interesting for what it leaves unsaid, which is that there are still active scholars whose work may be termed, if one wishes, 'imperialist'. There is no corresponding critique of recent postcolonial work as being similarly politically biased. This is inconsistent. Boardman has complained that:

Most recently a strange measure of political correctness has crept in, thrusting the desired modern stands on to antiquity and making assumptions about the prejudices of recent generations of scholars, replacing them with new prejudices which are poorly established on any basic academic principle, To be Greco-centric is no longer a matter of being prejudiced by the quality of evidence and historical observation, but simply a matter of being wrong.

Boardman (1999:286)

As it happens I believe the work below will show that Boardman is wrong about the quality of evidence, but equally I believe he is right to question why no similar political critiques of postcolonial works are published by the same people. Hodos (2006, p. 12) has argued that such a critique is not necessary, that postcolonial works acknowledge the input of colonisers and so are politically self-critiquing. This is true in some cases, but it is not necessarily a view shared by all recent scholars of the postcolonial strand.

For example, such a critique is unlikely to come from De Angelis. In his 1998 article De Angelis cites Davies (1996, p. 2). Davies argues that fifty years need to pass before political influences on scholarship are distant enough to assess. This is simply not the case. The rise of post-processualism and its rejection of systemic explanations in favour of a concentration upon the individual came from the same country and in the same decade that Margaret Thatcher famously stated: "There is no such thing as society." The connection between post-processualism and Thatcherism has also been noted by Fleming (2004, p. 144). It would be simplistic to say that one caused the other, but both could be reflections of a changing mood which placed more emphasis upon the individual.

There is no reason to assume we have entered a more politically enlightened age. Therefore current work and perspectives should be open to question and challenge just as preceding viewpoints are. This is not a matter of political balance. It is simply in the nature of academic work to analyse and criticise what has been written before, and it is not for any scholar to define certain areas as being off limits. I suspect, from reading his other work, that De Angelis would agree.

My second possible reason for disagreement was that scholars are not talking about the same thing when they refer to colonisation. The field is interdisciplinary, using evidence from ancient texts as well as mute archaeological materials. It will be helpful if we examine colonisation in order to think about what exactly colonisation is.

3. What Colonises?

When we refer to the colonisation of archaic Sicily, what exactly do we mean? What is it that colonises and what is it that we observe? When we talk about Greek colonisation are we talking about a movement of people or materials? If we approach the colonisation of Sicily from the position of Classical Archaeology then two lines of evidence immediately present themselves, Classics and Archaeology. Because Classical Archaeology is so often practised as a distinct sub-field of Classics there is not always the cross-fertilisation of ideas from other fields of archaeology that there could be. This has been commented on by Snodgrass (2002) and De Angelis (2006), though recent work, particularly by Antonaccio (2003, 2004, 2005) and Hodos (1999, 2006), is addressing this problem. What follows is a closer examination of what we look for in the historical record as signifying colonisation, and then a brief survey of how archaeologists outside Classics may look for signs of colonisation. I shall then give my own critical analysis. This is necessary, as I will show that the questions we ask will eliminate some answers and promote others.

3.1 Historical Colonisation

Defining colonisation through the historical texts is surprisingly difficult. This should not be the case. For example, Thucydides (VI.3) produces names and dates for a string of colonies in eastern Sicily. Elsewhere we have sources such as Herodotus (V.42-48) on the foundation of Herakleia Minoa, Strabo (who gives a description in VI.2) and Diodorus Siculus (who describes conflict with the natives in book XII, chapter 8 of his Library). Elsewhere I shall argue that the problem with the historical record is not that it is lacking, but in fact that it is so dominant it would almost be possible to argue there is too much of it (see section 5 on Post-Positivism). While there is plenty of historical evidence for colonisation, the immediate issue is the same for almost any historical inquiry. The historical record is written by, for and

largely about the male Greek elite. As an example of the surprising paucity of information I shall refer to Thucydides, who tells the tale of Megara Hyblaea and Selinous (modern Selinunte).

About the same time Lamis arrived in Sicily with a colony from Megara, and after founding a place called Trotilus beyond the river Pantacyas, and afterwards leaving it and for a short while joining the Chalcidians at Leontini, was driven out by them and founded Thapsus. After his death his companions were driven out of Thapsus, and founded a place called the Hyblaeon Megara; Hyblon, a Sicel king, having given up the place and inviting them thither. Here they lived two hundred and forty-five years; after which they were expelled from the city and the country by the Syracusan tyrant Gelo. Before their expulsion, however, a hundred years after they had settled there, they sent out Pamillus and founded Selinus; he having come from their mother country Megara to join them in its foundation.

Thucydides (VI.4.1-2) translation by Richard Crawley

This is one of the longer descriptions of a foundation. It names an oikist, or founder, and it gives a date at least in relation to its destruction which would have been known in the fifth-century BC. It gives a genealogical connection from the city to a metropolis. What it does not give is any details of who the colonists were. We do not have any information as to the size of the colonisation party. More crucially we have no demographic information. Were these men settling a colony or were these groups of kin settling in a new location? We cannot even be sure from the text if a city was founded: the word Thucydides uses is *chôra* or land. This could be a conglomeration of farmsteads. Megara itself is thought to have synoecised in the eighth-century (Legon 2004:463 citing Plut. *Quaest. Graec.* 17).

More information on the settlement of colonies is forthcoming in Herodotus' tale (IV.150-158) of the foundation of Cyrene in Libya. The details as Herodotus presents them are uncertain, as he gives the both the Theran and Cyrenecan versions of the tale, but in both versions (Herod. IV.153, 156) the Therans provide the colonists with

two pentekonters.. Cawkwell (1992, p. 290) calculates from Morrison and Williams' (1948) research that a pentekonter carried fifty oarsmen and two officers. He adds extra for the possibility of transport and concludes that the colonisation party must have been two hundred at most. He also finds, from the tale told by Herodotus (IV.153) of how the settlers were chosen by lot from families with two brothers, that the settlers were predominantly male.

We cannot be certain that we can take the sources above literally, but they do lead to some conclusions about what the notion of colonisation means from a later historical perspective. It involves the physical movement of people to a new territory. Specifically it would seem the identity of the new settlement as 'Greek' is also founded upon the ethnicity of the males in the city. Thus to make a statement that a colony is a Greek settlement is to make a gendered statement. It would seem likely then that the initial foundations of the colonies were not *poleis* in the sense of the city-states of the homeland. These were small communities. Indeed in the Greek homeland in this period it is questionable if the term polis is entirely applicable. During the eighth and seventh centuries BC the concept of the polis seems to have been forming and Donlan (2005, p. 23) sees this continuing into the sixth-century. The process of synoecism, the gathering together of settlements into unified social groups suggests there must have been some element of local identity, but this too was probably in the process of formation rather than a finished product (Hansen, 2006, p. 51).

Thucydides' brief comment on the foundation of Selinous also gives us further information. Historically the transfer of population probably did not happen in discrete events. Megara Hyblaea would still seem to be receiving settlers from Megara even as it prepares to found its own colony. However, such fragments of information tell us nothing about the scale of transfer of bodies or the gender of the

later settlers. Megara could have been offloading surplus males, or there may have been ties of intermarriage between elites in Megara Hyblaea and the home city in an attempt to emphasise the ethnic ties.

3.2 Archaeological Colonisation

In the past the archaeological perspective upon colonisation could have been said to be similar. In the lands beyond the limits of the Roman Empire, archaeology initially fed a desire to create a past in the style of the classical world for peoples who had no texts (Díaz-Andreu, 2007, pp. 317-367). This led to a nationalist and essentialist form of archaeology where material artefacts were seen as correlating with physical peoples (Trigger, 2006, pp. 211-313). This simple connection has been discarded as more sophisticated models of trade and exchange have been developed. It is clear that ideas can travel, as the classical Roman temple perfectly illustrates. Its form it is clearly derived from the classical Greek temple which developed in earlier centuries, yet it is clear from the historical record that the inhabitants of Rome in the first century AD believed they had conquered Greece and not vice versa.

The change in attitude may be summed up in Antonaccio's (2004, p. 60) statement that 'pots are for people' rather than 'pots are people'. If this is the case, then the presence of some Greek material culture at archaeological sites can no longer be conclusive proof of a physical Greek presence. At Morgantina, for example, Attic amphorae appear from the late seventh-century BC (Hodos, 2006, p. 130). However, not all Greek forms of pottery were imported. The use of assemblages associated with wine-drinking as an expression of status by the natives need not imply that the activities were Hellenised. Instead the use and consumption of exotic goods could be a display of status (Whitehouse & Wilkins, 1989, p. 114; Hodos, 2000, p. 47). It is necessary to look at wider pottery assemblages.

The Greek sites are clearly distinct from the native settlements, both in quantity and diversity of pottery. Yet the pottery does not show a strong connection between a mother-city and its colony. At Megara Hyblaea, for example, Boardman (1999, p. 176) notes that the earliest pottery is Corinthian while East Greek wares appear around 650 BC (after Villard, 1964-5, p. 603). What is lacking any is evidence of a strong Megarian influence in the early pottery amongst the thousands upon thousands of vessels (Vallet & Villard, 1964). Orlandini (1963) has found evidence of Proto-corinthian wares dating to the end of the eighth-century in what, around the early seventh-century, would become the Rhodian and Cretan colony of Gela. Clearly forms of pottery and personal goods are not irrelevant to the ethnicity of the city, but equally it is not possible to draw much beyond the broadest conclusions about identity from the recovered assemblages. Their value is primarily as economic data.

Another form of archaeological remains which can be examined is the domestic architecture. The extensive excavations by Vallet *et al* (1976) have made Megara Hyblaea one of the major sites for the study of Greek houses (Broise, Gras, & Tréziny, 1982). Hodos (2006, pp. 99-113) contrasts the rectilinear houses of Megara Hyblaea, Naxos and Syracuse with the more circular forms of the native buildings. This is clearly a real difference. More questionable is the existence of early town planning. Hodos (2006, p. 101) refers to eighth-century silos at the Punic settlement of Motya (Famà, 2002) as showing a similar sense of urban planning to the Greek colonies. In the case of Megara Hyblaea, Boyd and Jameson (1981, p. 329) identify two urban grids. De Angelis (2004, pp. 17-20) identifies a grid, which he dates to the earliest time of the colony on the grounds that no prior buildings exist in the streets or Agora.

These conclusions are plausible, but the evidence can be interpreted in other ways. I am not certain the analogy with Motya is entirely sound. There are certainly similarities as the settlements both have rectilinear houses. Yet Motya was undoubtedly derived from Carthaginian settlement (Whitaker 1921, Isserlin & Taylor 1974) while the Greek cities would have drawn upon Greek traditions of planning, such as they were. While these traditions included rectilinear houses they may not have fully included orthogonal planning. Castagnoli (1971, p. 57) argues that urban blocks should be of a uniform size, and argues that this is a fifth-century innovation associated with Hippodamian planning. However he is willing to trace back a prototype of grid planning to the end of the sixth-century (Castagnoli, 1971, pp. 10-12) due to excavations of such layouts at Olbia (Owens, 1991, p. 36) and Selinous (Gabrici, 1929, p. 61). Rectilinear houses tessellate, and so building a series of houses together may cause a rough grid to crystallise rather than fill out a conceptually planned space. In the case of the agora of Megara Hyblaea it is true that it had not been built upon, but had the citizens not decided to build two temples (see sections 6.19, 6.20) in the south of it in the seventh-century it would have been larger. Here I would follow Rykwert (1988, pp. 76-78) in cautioning that the planning in the earliest phases of the colony may be apparent rather than intentional. Vink (1997, p. 135) likewise would be sceptical of an early urban plan. She places the grid pattern of Zagora in Euboea to the late eighth-century and considers it to be at least half a century ahead of orthogonal urban planning in southern Italy and Sicily. Shipley (Shipley, 2005) takes a more sophisticated view of planning. He initially looks for parallel streets where some houses may share the alignment of the street, such as at Naxos and Megara Hyblaea. This may be a case of a grid forming as extra streets are added to the city. This does not necessarily distinguish between intentional and emergent design. However it does give credibility to the statement that Kasmenai was intentionally planned (Shipley, 2005, p. 339) as it is reasonable to believe that this seventh-century settlement was designed to emulate the layout of earlier settlements. This leaves the problem that while the cities of Sicily certainly became

regularly planned, projecting later grids onto the past may be anachronistic in some cases.

Despite her comments on the native house forms, Hodos (2006, p. 105) complicates matters by showing that mere house shape is not enough to identify ethnicity by finding evidence of a pre-Hellenic rectilinear tradition at Leontini. Leighton (2000, pp. 36-38) finds evidence of continuity of Iron Age practices in the interiors of the houses such as the form of hearths, the use of pithoi set into the ground as storage vessels, and the form of loomweights.

Against this is Hodos' (1999) earlier work in trade and exchange regarding fibulae in Sicily and southern Italy. While the pottery in Greek colonies is overwhelmingly Greek, the metalwork (found mainly in the form of fibulae) is largely native (Hodos, 1999, pp. 61-63). Common Sikel fibulae are found in Greek contexts in Sicily (Dunbabin 1948, p 265; Frasca 1981). Hodos (1999, p. 74) dismisses this as evidence of intermarriage on three grounds. One is that the range of fibulae, and in the quantity are vastly greater in native contexts than in Greek contexts. Instead she argues that selective use of fibulae by the Greeks is the metalwork correlate of the selective use of Greek pots by the natives. This would therefore be evidence of exchange rather than trade. Finally the fibulae themselves have straight pins, which are not found in native contexts. This last point is derived from Graham (1984, p. 301), who argues that the burials from which the fibulae were recovered show Greek women in Greek dress.

The historical evidence from later periods, however, does show that intermarriage was likely. Hall (2004, pp. 40-41) cites not only a dispute over intermarriage between Selinous and Segesta recorded by Thucydides (VI.2.2), but also hybrid

names from seventh-century pottery sherds found in Etruria. This, he argues is evidence of intermarriage. Slightly later in date he also cites sixth-century pottery sherds from Montagna di Marzo in Sicily which bear Greek names written in Sicel form (Manni, 1978). Hall (2004, p. 40) notes that women are only mentioned as colonisers when the circumstances of colonisation are unusual, as in the evacuation of Phocaea (Herod. I.164.3) and Polybius (XII.5.8) description of the origin of matrilineal succession at Locri Epizephyrioi. History and Archaeology would appear revealing two different pasts.

3.3 Cross purposes?

The comparison of archaeological and historical evidence above reveals two very different perspectives. The historical data are individualised. They deal with named people at fixed times with known origins and motivations. They reveal information about some specific individuals and also about identities at large group scales. The archaeological evidence, in contrast, is aggregate population data. It cannot say anything about a specific person, but it does reveal interplay between people. It is heterogeneous and ambiguous. It tells us about interactions between peoples, but not necessarily about those peoples themselves. Bluntly, most archaeological evidence cannot answer the questions that chronologically focused historians ask. This is what creates the notion that archaeology can fill out the gaps in history (Boardman 1999:161).

I believe that this is a false assumption by historians. What we have in Geometric Sicily, when the colonies are being founded, is not a gap in the historical record. It is an absence. Because of this I find the claim by Boardman (1999, p. 161) that an archaeologist 'may sometimes claim priority; remembering, of course, how much his chronology still depends on the ancient historians' dates' peculiar. No historian

would assume that any single source was reliable if he had two sources for the same event. It is therefore not logical to follow a single source for a prehistoric event purely because it exists. The historical record for the earliest period of Sicilian settlement is still a prehistoric matter, therefore historical evidence can only speak about Greek identity in the historical period.

Where the two disciplines can meaningfully engage is in the study of human processes. These occur at multiple levels or scales (Wilson, 2002, pp. 91-92) each of which may be distinctly different in appearance. Thus, while I disagree with Boardman's (1999, p. 190) interpretation of a master and slave relationship between the Greeks and the Sikels, I can sympathize when he complains that the objections are political rather than evidence-based. The postcolonial work is sound, rigorous, thorough but at a different scale than that of Boardman. By the fifth-century BC the material culture of Sicily is hellenised. Mainland Greece, in contrast, is not noticeably Sikelised. Any postcolonial explanation wishing to defend the agency and independence of the native Sikel settlers will have to account for the fact that when the Romans invaded southern Italy and Sicily they were seen as invading Greek territory.

3.4 Archaeological evidence of Macro-Identities

To provide another perspective on the nature of Greek colonisation, I propose to introduce new archaeological evidence at a scale suitable for interacting with the traditional historical accounts. At the same time I shall attempt to use the same data as a middle ground between the historical data and the current work being produced by the more archaeologically focused researchers in the field to produce a hybrid narrative of Greek colonisation. I believe the way to do this is to bring a cognitive approach to the material. If this is to be at the large social scale necessary to interact

with the historical record, I will need material which reveals what a city collectively thinks. This can be accessed through religion.

The concept of a religious *group* thinking is probably nonsensical to someone who takes a socially atomic view of religion where belief is a matter for the individual. Barnouw (1961, p. 1006) defines an atomistic society as one where smaller social units can easily break away and exist apart from their larger society. I contend that in many ways the more recent archaeological work on Sicily has been atomistic in nature, and that this is valid for the questions asked but may not work when society is viewed at a larger scale. We talk of individuals working as units in competition for social prestige amongst other individuals. Collective results can be explained as the sum of individual decisions. In contrast, there are barriers to a socially atomic religion in the modern world, and these barriers were stronger in the context of the ancient world.

For example, while we could conceive of individuals in the world choosing to use pottery of one type rather than another, or organise their household in one manner or another, this freedom of choice is not possible with religion. Certainly an individual could reject a local religion, but you cannot have a religion of one. For a practice to be a religion rather than a superstition it requires social activity between people. In the ancient world this distinction takes on a stronger nature as the polis is, amongst other things, a religious community. This extended not just to men but also, at least in later periods, women and slaves. Hansen (1997, p. 15) notes the importance of the Thesmophoria as an example of a feminine-led religious practice common to Greek cities. This degree of integration was not merely desirable, but necessary.

Boyer's (2002) somewhat optimistically titled book *Religion Explained* provides a multi-rooted source for religion which proves to be a useful model for ancient religion. Rather than view religion as a monolithic entity, he acknowledges the wide

variety of functions it serves and of the ways in which it is practiced (Morgan, 2003, pp. 107-163). Amongst other things, religious belief explain origins, it explains how the mechanics of the world work, and it justifies the way things are. All of these things could be explained by myths or legends. What religion provides is a meta-narrative that binds these factors together and creates something which is mutually reinforcing. If a religion explains how the natural world works, then it is in a position to define how the social world should be organised too. Similarly, social relations with no causal effect on agricultural matters become vitally important to farming through the agency of the gods. This explains the need, rather than the desire, to incorporate all sections of society, even slaves and resident foreigners, into religious practice.

The resulting model is what Wilson (2002, pp. 1-4) has called an 'organismic' model of religion in which the practioners each play their part within a collective body. From this perspective the opinion of the collective becomes a viable object of study even if, as is likely, no individual member has a complete picture of what this collective opinion might be. For the purposes of this study precisely identifying or defining what the collective opinion of a Greek city might be is both futile and irrelevant. It is futile because there simply are not the data available. It is irrelevant because the whole picture is not needed, but identifiable traces which can be said to belong to the collective. This is another reason why religion is a suitable topic for study as it does leave collective traces in the form of temples.

A temple is not a product of everyone. Individual hands shaped blocks and placed them together whilst others were engaged in other activities. Nonetheless, while it was not a product of everyone it was a product for everyone. Religion in the ancient Greek world was a religion of practice (Mikalson, 2005, pp. 23,182). It was a matter of things done as well as believed and therefore needed a space to be practised in. The

religious practice would be an expression of the collective belief, and the temple, sanctuary or cult site in which it was practised would have to be compatible with this. In the case of an open-air sanctuary or a sacred spring or other natural feature given religious significance, then compatibility is the only feature we could assess. Temples in contrast are constructed and so must be an expression of the collective belief of how a religion should work.

Even here some elements may be the product of an individual, such as the ornamentation and style of the building. These would be features about which the collective held no opinion. Nonetheless, where there was a collective belief then we should expect to find that. If a temple did not reflect these beliefs then it would not be suitable for ritual. This would diminish the reputation of any benefactor, and leave open the opportunity for a rival donor to put things right. Therefore it is not a surprise that the altar of a Greek temple is not found within a temple but almost uniformly to the front of it (Yavis, 1949, p. 56). This is because a temple is not a necessity for a sanctuary, while an altar is. Given that temple-less sanctuaries must have open-air altars it follows that Greek religious practice must also have sacrifice occurring outdoors. A temple with an altar inside, emphasising the power of the individual who funded the temple, could not work because the sacrifice inside would be in the wrong place, and thus invalid in the eyes of the community.

As well as being a place a temple is, of itself, an artefact. As seen above the presence of an artefact by itself tells us little of how it was used. In the case of a temple this particular problem is magnified as there will be comparatively few temples at any site in comparison to other artefacts. Therefore we not only need to observe a temple, but also to understand how it was used. One possible factor may be alluded to by Vitruvius. Writing centuries after the Greek colonisation of Sicily, he explicitly

connects the orientation of temples to beliefs of what is proper. He proposes that Roman beliefs are best served by temples that face the western quarter of the sky:

This will enable those who approach the altar with offerings or sacrifices to face the direction of the sunrise in facing the statue in the temple, and thus those who are undertaking vows look toward the quarter from which the sun comes forth out of the east to look upon them as they pray and sacrifice.

Vitruvius IV.5.1 Translation by M.H. Morgan.

There is no direct correlation between Vitruvius's own vision and Greek cosmology. Roman cosmology was influenced by many other cultures as well as Greek. It does, however, indicate that a connection between cosmology and architectural orientation on the part of the Greeks is plausible, and that orientation data should indicate the presence or lack of an architecturally embedded cosmology. A connection has been proposed sporadically before by Penrose (1892,1899,1901) and Dinsmoor (1939) who have argued that temple alignments face sunrise at the time of their foundation dates. Scully (1979) merely suggests there may be specific orientations connected with certain dates as part of a wider scheme of connecting the temple with the land and the sky. If a survey of temples were to show that temple orientations were indistinguishable from a random pattern, this would cast doubt on the proposed solar alignments.

A temple is not only an artefact, but also a way of structuring space. Its location will define where rituals take place and where any procession will end. Its orientation may also orchestrate the movement of peoples in permitting some actions but not others. In doing this it provides a bridge between the viewpoints of the individual-centred and collective-centred approaches to identity. Its location and orientation will be reflective of the way people collectively think as part of a ritual at the time of its construction. It will then take on a more active role in shaping behaviour as individuals work within the space that the collective has defined. In this way we can

see a space where individuals engage and possibly work in opposition against the collective mind while at the same time we can also see the collective mind as something other than the sum of its parts. Malafouris (2008, p. 1995) has raised this issue as a dichotomy between the 'objective-participant' conception of the person and the 'subjective-individualist' conception of the person, following Gill's (1998) work on the notion of self in Homer.

This view rests on the controversial position in philosophy of 'the extended mind' (Clark & Chalmers, 1998; Clark, 2008) which postulates that the mind is subject to what they term 'active externalism'. The environment, which includes constructions, can perform an active role in cognitive processes. The usual examples given are the use of tools for memory such as notebooks; Clark and Chalmers argue that this is a process, and that the system performing the task should not be an issue. This is not wholly accepted by philosophers. O'Brien (1998, p. 82) argues that external memory only gains meaning when engaged by perception. External tools are unresponsive to other environmental factors and thus are not cognitive. Nonetheless he does not rule out physical forms as memory stores. Wilson (2005) offers a suitable interpretation for archaeologists. What is in the artefact is not cognition but a limited form of agency which Wilson (2005, p. 235) defines as "...something that can control what lies within its physical boundaries, and that has autonomy from what lies beyond those boundaries." This would match Starr's (1986, p. 30) observation that bonds in Greek religion are 'almost unconscious'.

Therefore it would seem that a study of temples and their orientations will potentially allow a different type of evidence to apply to the study of Greek colonisation. Conceptually it appears to be of a scale sufficient to cross-reference with historical data, by being significant at the group level. Just as the historical data refers to poleis as entities, the temples are expressions of collective activity as a polis

(Snodgrass, 1993, p. 30). At the same time, being archaeological data, the temples can also be examined within an archaeological perspective by analysing their place and role within the landscape. The temples therefore potentially sit at the interface between historical and archaeological approaches. The method I propose to examine the orientations of these temples is an archaeoastronomical survey.

4. Archaeoastronomy, a brief introduction

Michael Hoskin has an anecdote which he believes shows the value of archaeoastronomy in his book *Tombs, Temples and their Orientations*. It concerns the identity of the builders of some megalithic tombs in Spain.

[M]ycenaean colonizers were imagined to have settled at Los Millares in Almería, and to have followed the customs they had known back home when building tholoi in their new colony.

Had one of these archaeologists practised archaeotopography, their successors would have been spared embarrassment when radiocarbon dating revealed the Almerian tombs were in fact a millennium and a half older than those of Mycenae - for an analysis of the orientations shows that the Mycenaean tombs face downhill, while 60 out of the 66 tholoi at Los Millares face easterly, between 62° and 117°: not only had the supposed colonisers forgotten how to build in enduring blocks of stone, but they had apparently changed their religion into the bargain.

(Hoskin, 2001, p. 14)

As a counter-example which might explain why none of the archaeologists was an archaeoastronomer or archaeotopographer is the description of archaeoastronomy by Clive Ruggles, a professor of the subject, as: “[A] field with academic work of high quality at one end but uncontrolled speculation bordering on lunacy at the other.” (Carlson, 1999)

Precisely defining what archaeoastronomy *is* is a pastime for a person with plenty of time to spare. Bostwick (2006, p. 3) has stated that it is a branch of anthropology in the American tradition, the study of human behaviour in the past and present. Bahn (1996, p. 49) has described it as a specialised field of cognitive archaeology. The art historian Richard Poss (2005, p. 97) has described it as a form of art history, which makes sense in the context of rock art he studies. For the purpose of this study a precise definition is irrelevant, Sinclair’s (2006, p. 13) definition that

archaeoastronomy is the study of how people interacted with the sky is sufficient. The diversity of definitions above serves to show that archaeoastronomical techniques are flexible enough to be incorporated into the present investigation. It also strongly suggests that critiques of archaeoastronomy should be attended to if the fieldwork is to steer clear of some avoidable errors.

The first was mentioned by Hoskin in the quote above. He prefers to use the term archaeotopography rather than archaeoastronomy for his work (Hoskin, 2001, p. 13). The problem for Hoskin is that the term 'archaeoastronomy' suggests that the significance of any results have already been prejudged as being astronomically important. By looking for explicitly astronomical targets it is possible to miss meaningful topographical orientations, such as those of mosques.

The response to this is two-fold. The first is that in general the terminology will be avoided. 'Archaeotopography', like the term 'Cultural Astronomy' proposed by Ruggles and Saunders (1993) or other neologisms like 'Cosmovisión', may be sensible, but they are not commonly recognised terms and if they commonly have to be explained in terms of 'archaeoastronomy' then they are to some extent failures. The criticism which Hoskin's term addresses is, however, extremely pertinent. It could be ignored, as my hypothesis is that there *is* astronomical significance in the temples of Sicily and so this is an explicitly archaeoastronomical survey. Still, his significant point, that the existence of that astronomical significance has not been proven, means that any survey must first show from the results that there is something to explain. However, this can be achieved in an astronomical survey if it is accepted that there may be a negative result. An astronomical survey need not insist upon an astronomical explanation for orientations, whether in whole or even in part, for a selection of buildings.

Another criticism of archaeoastronomical methodology that remains unsettled is the question of what role ahistorical and socially abstract statistics can play in the evaluation of well-attested historical evidence. This position, if approached from the opposite side would be: To what extent scholars are allowed to cherry-pick historical observations to interpret artefacts without a demonstration that such astronomical features could be expected by chance? This was a common battleground in 1980s with the opposing camps divided into 'Green' and 'Brown' archaeoastronomers, the names taken from the colour of the book cover which was held as typifying their approach (Aveni, 1986). Iwaniszewski (2001) attempted to lay the groundwork for a more unified approach to alignment studies. He has since retreated from this position dismissing his earlier efforts as 'naïve' (Iwaniszewski, 2003, p. 7). Papers published in the proceedings of the most recent 'Oxford' volume, the quadrennial conference of the major scholarly society for archaeoastronomy suggests that the divisions between the methods were not fully resolved, and that methodology remains a contentious issue.

Green Archaeoastronomy is named after the cover of the book *Archaeoastronomy in the Old World* (Heggie, 1982). It is primarily statistically led. The method consists of gathering data on alignments in such quantities that any preference for a specific range of targets will emerge as statistically significant from the data set. The advantage of this method is that it uses the physical remains and does not require access to extensive data about the social context. In samples where information about the society which built the monuments is sparse, such as the prehistoric communities of the British Isles, this technique may still be employed. Rather like for rock art (Taçon & Chppendale, 1998) a formal analysis may reveal information which was not explicitly recognised in an ancient society. However, the independence from social factors which is also the basis for many criticisms of its use. Keith Kintigh (1992) argues that the truth or otherwise of many archaeoastronomical claims is irrelevant

simply because archaeologists do not ask questions where this matters. The absence of cultural information is also a drawback if you wish to say much about the cultural problems which interest archaeologists.

Brown Archaeoastronomy, in contrast, is a more historically centred approach. It takes its name from the cover of *Archaeoastronomy in the New World* (Aveni, 1982), which indicates where it was developed. The records of the Spanish chroniclers provide a much richer source of information for prehistoric societies than in Europe and so astronomical meanings can be read in sites where they would otherwise be lost owing to the absence of textual evidence. For example the Dresden Codex makes clear the Mayan interest in Venus, which can then be used when examining buildings dedicated to Quetzalcoatl or Xolotl (Kelley & Milone, 2004, pp. 367-8). However, this reliance on historical data can be problematic. A recent analysis of the Caracol at Chichen Itza by Schaefer (2006b) showed that the proposed astronomical alignments were probably not meaningful. Additionally he questions whether purely historical approaches can have the capacity and methods to meaningfully integrate the astronomical data they purport to explain (Schaefer, 2006a).

The two methods each have their uses and flaws. Clearly there has to be a historical element in the study. The issue of Greek colonisation and how it occurred is a social question. Even if a study could tackle colonisation and ignore the social aspects of the process, such an approach would not be desirable as the audience for such a thesis would be interested in the human aspect of acculturation. Archaeologists and historians examine artefacts or texts to answer questions about people. At the same time I believe a historically driven approach risks duplicating the perspective of historians by framing all data within an inherently historical framework. Effectively the approach would have the assumption that the historical record is accurate incorporated within it. Further, what exactly can be historically interpreted? The

reason there is so much disagreement about the nature of colonisation in Sicily is that so little is historically known, and what information exists is from sources written centuries after the events they describe. I propose to employ a hybrid methodology.

The data set will be historically and culturally bounded. I shall examine only temples as these form a coherent set of buildings with a presumably similar use throughout the first millennium BC. The precise nature of Greek religion may change during this period, but I can still expect the temples to be intimately connected with religious practice. The historical bounds will be between the purported first colonisation of Sicily by the Greeks and the fall of Syracuse to the Romans in 212 BC. This spans the Archaic, Classical and Hellenistic periods, but it also marks the period of time in the cities where the inhabitants appear to have thought of themselves as 'Greek' rather than 'Roman' and so will provide a coherent cultural group. The study will be limited to Sicily, ignoring the many Greek colonies in southern Italy. This is for reasons of time and funding to conduct such a study as well as of space. The island of Sicily can be expected to constitute a coherent social unit. It is far from clear that southern Italy can be assumed to be culturally homogeneous with Sicily and the greater area of the territory even raises the question of how homogeneous southern Italian natives can be said to be.

4.1 Fieldwork Method

The temples were measured to determine the azimuth of their alignment from the *cella* through the front of the temple. The orientation was measured in degrees clockwise from true north at 0°. The visible horizon altitude was also measured, to enable the calculation of what declination they faced. The declination is important as this is the measure of latitude on the celestial sphere, and so indicates which rising (or setting) stars or sunrise (or sunset) a temple could face.

The alignment was taken along the axis of symmetry through the *cella*, the inner chamber towards the *naos*, and through to the entrance to the temple. The axis of symmetry had to be measured indirectly. This may seem odd. The purpose of measuring this axis was to see in which direction the line of sight from the *cella* through the *naos* faces. This would suggest that standing in the *cella* and looking out would be the way to do it. I did not do this, partly for reasons of access, but also for the sake of producing replicable results. My notion of where the axis of symmetry is may be somewhat different from where others might feel it lies. A single measurement through the centre would also leave the measurements susceptible to random errors. Instead I worked from the principle that an axis of symmetry is defined from the structure of a temple.

In an ideal world a Greek temple would be perfectly rectangular. The long sides of the temple would be parallel to the axis of symmetry and the short sides would be perpendicular to the axis. In reality these relationships may differ slightly if the temple is slightly out of shape, but the multiple measurements help reduce any errors arising from this. The method provides up to eight different possible measurements. The orientation of each wall making up the four sides of the temple can be measured in both directions. The difference in viewpoints means that there is less likely to be a systematic error (caused by, to pick an example, a displaced brick in one of the walls which distracts the eye from the true line of the wall) than if one wall had been measured on several successive occasions. It also moves the compass around the site, making any magnetic anomalies more obvious. The measurements were read to the nearest degree using a compass-clinometer and corrected for magnetic declination using NOAA's website.¹ The use of eight measurements for the azimuth reduces the error, and so measurement to within a degree would seem

¹ Available at <http://www.ngdc.noaa.gov/geomagmodels/Declination.jsp>

justified. The height of the horizon in contrast could not be measured the same way as not all directions faced the same horizon as the *cella* to *naos* line. The altitudes were measured where possible with three measurements, one of the horizon as seen looking along the two longest walls and once through the centre of the temple.

Three problems were foreseen with this method and built into the survey design.

The first is that not all temples had four surviving walls visible. Application of the method shows that even if this is the case and only one wall survives then there is a procedure for taking a measurement. At the lowest level of accuracy two directions can be measured which still makes the one degree accuracy plausible.



A surviving wall of Temple B at Naxos. Photo author.

The second problem was the presence of metal railings which naturally will have a major impact on the accuracy of any compass measurement. The planned solution was to measure the temples from at least 10 metres back from any railings, if possible. The presence of many ramps, rails and bridges at Megara Hyblaea meant this was not always possible. In these instances measurements were taken of other features of the site where there was confidence in the result, and then used to calibrate the published archaeological plans to confirm the orientation of the temples. The clinometer measurements were unaffected by magnetic anomalies.



Metal railings at Megara Hyblaea. Photo author.

The third problem was that the local horizon might be obscured and in several places this was indeed the case. Where this was so, the measurements were made for a flat horizon and noted in the results section. The importance of this is questionable. In antiquity many of these buildings would have faced urban skylines. It is simply not known whether such temples, if they were aligned intentionally, were aligned to the natural horizon or to the local urban horizon. The same could even be said for temples where the natural horizon is visible in modern times. These sites have

ceased to be sacred, but by being preserved as heritage sites they are no longer culturally *in situ*. The urban nature of the sites remained an unresolved problem, (see section 8.12).



The lush vegetation at Akragas by the Olympieion. Photo author.

Two other common problems were encountered which were not anticipated. At some sites preservation exceeded expectations. At temple E in Selinous it is possible to enter the temple and view the horizon from inside, and this was done. In contrast the temple of Concord at Akragas was also in such good condition that even if it had not been under renovation it is unlikely that the horizon would have been visible, from behind the temple, as the internal walls were in place. At sites where no line of sight through the centre was visible then, where possible, I stood with my back to the front of the temple and measured the horizon in front of me. Where there was no dramatic change in the height of the horizon this was sufficient to give me a measurement.

The other difficulty was that some sites were simply inaccessible or unmeasurable. In these cases proxies were used. For example, the alignment of the temple of Aphrodite at Akrai is based on two measurements of the alignment of the theatre. Similar proxies were found in buildings or roads for other temples. These alignments were then used to calibrate the north indicator, if there was one, of the published archaeological plans. This calibration technique was extended to temples which had not been visible or identifiable at sites visited. This relies on the assumption that the individual drawing the plan was either accurate or consistently inaccurate in orientation.

The azimuths by themselves gave a reasonable approximation of the directions in which the temples faced. Declination data have also been included. The reason for this is that declination measurements are essential if we are to reconstruct the ancient sky that the temple faced. However, the fact that most of these sites are in urban locations does raise questions about the accuracy of any reconstruction as discussed below, (see section 8.12).

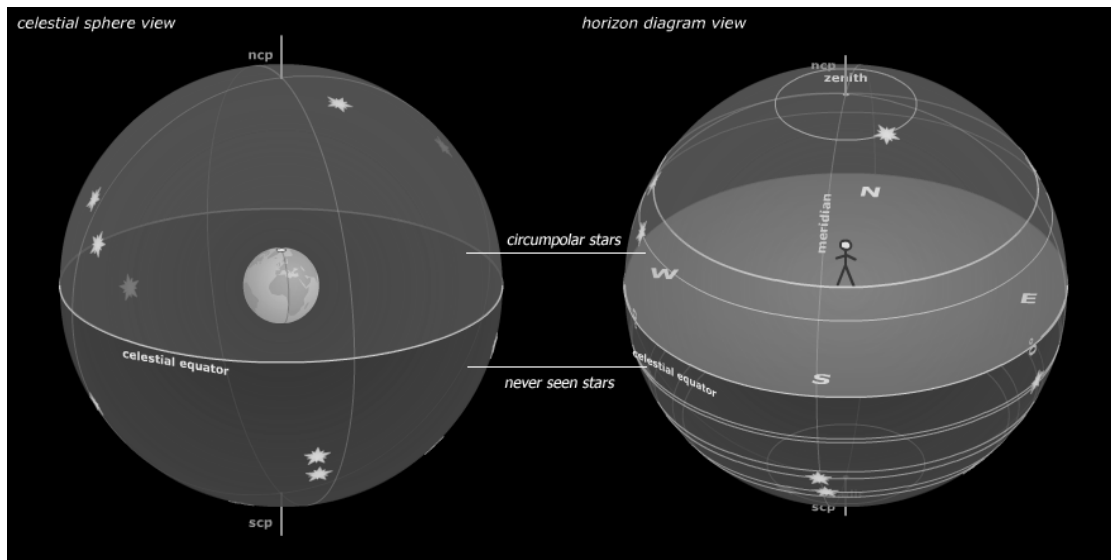
4.2 The importance of Declination

The calculation of the declination of a point on the horizon is a crucial step in correlating a terrestrial alignment with a celestial target. Declination is the measure of celestial latitude and a fixed reference point for all stars on the scale of a human lifetime. Stars occupy specific places on the celestial sphere and so can be thought of as marking certain declinations. However, over longer periods their position changes in known and predictable ways. This means that a known date is required if we are to determine what stars sat at what declinations on a specific date. Parallel lines of

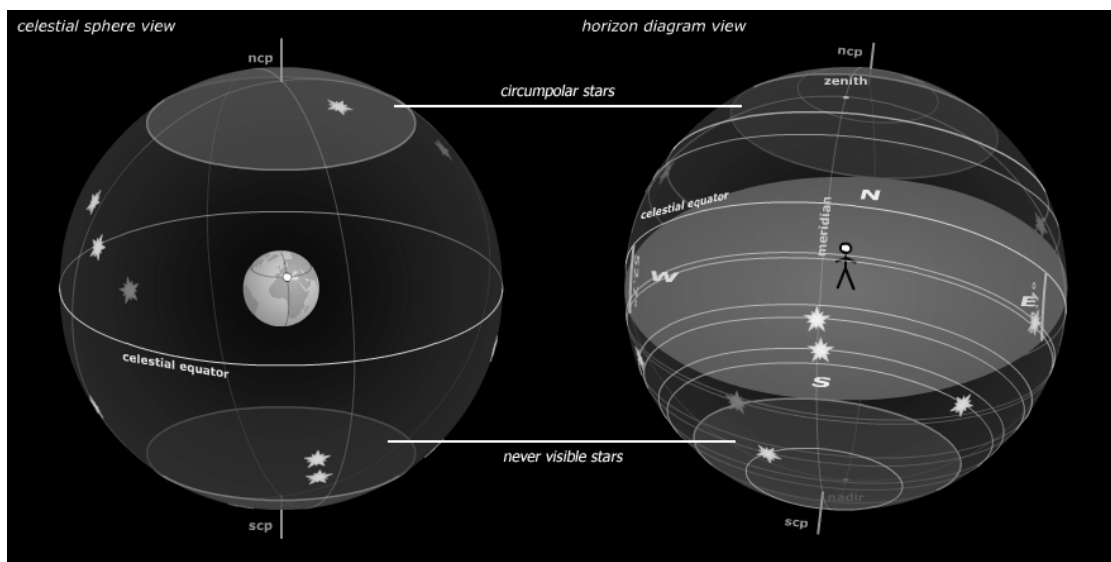
declination or celestial latitude can be thought of as crossing the horizon at an angle. The exact angle varies with the latitude of the observer.

If you were to stand at the North Pole and stare at the sky for a long period of time during the night, you would see Polaris revolve in a tight circle around the north celestial pole directly overhead. Looking towards the horizon you would see stars trace paths parallel to a flat horizon. If, in contrast, you were to stand at the equator the north celestial pole, about which the stars revolve, would sit on the Northern horizon, exactly due north. The stars due east would appear to rise vertically in front of you and, if you were facing east, pass directly over your head and then fall vertically from the sky. For all other points between the pole and the equator, the stars would rise and fall at an angle dependent on their latitude.

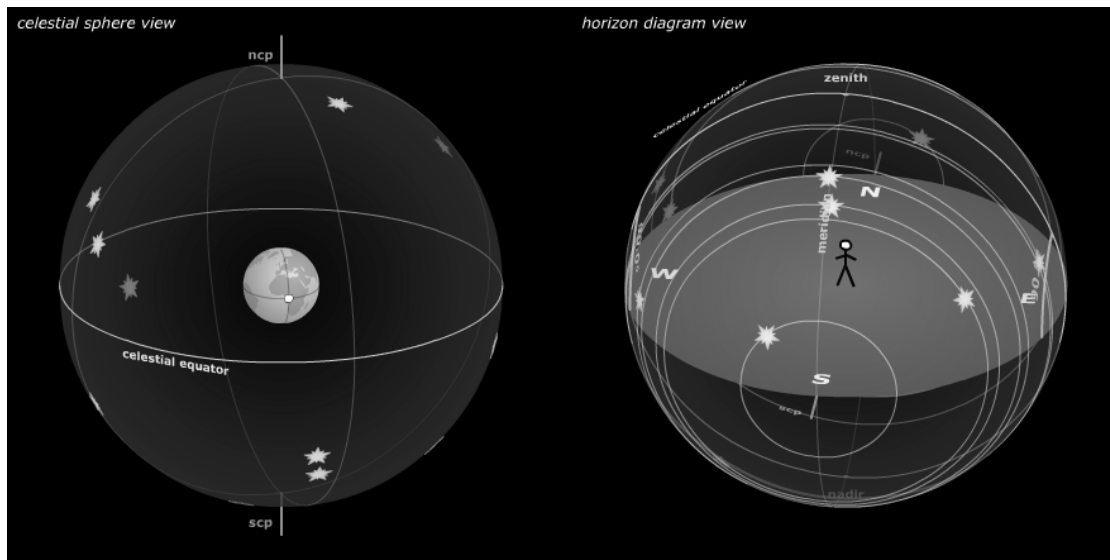
Another factor which changes with latitude is the visible range of declinations. In the northern hemisphere, the further south you are the more of the southern sky becomes visible. At the North Pole, the north celestial pole is directly overhead and the celestial equator runs around the flat horizon. If you were to move just one degree of latitude to the south then the view would be slightly different. The celestial equator would emerge from the eastern horizon and pass round to the south, but due south it would be one degree above the horizon. Between this point and the horizon, stars of the southern celestial hemisphere would be seen. The declination of the stars on the southern horizon would be -1° . By the time you travel as far south as Sicily around 37° N, the celestial equator is 53° high in the sky, meaning that stars down to a declination of -53° can be seen. This means that the visible sky depends upon the position of the observer. Information about latitude as well as azimuth is necessary in order to be able to calculate what astronomical events a temple might face. The latitudes of sites were taken using a hand-held GPS and later corroborated using Google Earth.



Visible stars at the North Pole. Diagram created with the Rotating Sky Explorer by Dr. Kevin Lee and NAAP Labs. «http://astro.unl.edu/naap/motion2/animations/ce_hc.html»



Visible stars at the latitude of Sicily. Diagram created with the Rotating Sky Explorer by Dr. Kevin Lee and NAAP Labs. «http://astro.unl.edu/naap/motion2/animations/ce_hc.html»



Visible stars at the Equator. Diagram created with the Rotating Sky Explorer by Dr. Kevin Lee and NAAP Labs. «http://astro.unl.edu/naap/motion2/animations/ce_hc.html»

A third factor to consider is the horizon altitude. As mentioned above, unless you are at the equator, rising bodies will not just rise vertically in the sky, they will also be moving across at an angle. The higher up they move, the further across they travel. If a high horizon, such as a mountain obscures the visibility of a body then when it emerges it will have travelled in azimuth from where it would have appeared if the horizon were flat. Therefore measurements of azimuth data without altitude data cannot be used for precise astronomical investigations. (but see section 8.12.2 upon Urban Astronomy for questions on precision in Greek astronomy)

The formula used to calculate the declinations was:

$$\text{declination} = \arcsin \left[\sin (\text{lat} * \pi / 180) * \sin (\text{alt} * \pi / 180) + \cos (\text{lat} * \pi / 180) * \cos (\text{alt} * \pi / 180) * \cos (\text{az} * \pi / 180) \right] * 180 / \pi$$

The frequent, if confusing, use of $(\pi / 180)$ is due to the measurements being made in degrees rather than radians. The result is a figure in positive degrees for alignments north of the celestial equator and negative degrees for alignments south of the celestial equator.

Measurements were cross-checked with other records of temple alignments, most notably Aveni and Romano's (2000) work. Additionally the release of Google Earth, a freely accessible geographical browsing program,² provided the possibility of re-examining sites, especially if there were already measurements of other local sites to calibrate for local magnetic anomalies.

In addition to the alignment data I also include, where available, information on the dating and attribution of the temples. I believe that this is unprecedented in comparison with similar studies of the region. I am aware that Aveni and Romano record dates and divinities associated with temples. However this is only in the form of tabulation, which means that if you disagree with their date of sixth-century BC for the temple of Zeus at Akragas then you are simply left with a choice of whether or not to accept it. In contrast I give more evidence as to why I discount attributions for Temples D and F at Akragas, rather than attribute them to Juno Lacinia and Concord.

I should make clear that I do not find Aveni and Romano's alignment data to be inaccurate, but I do question their use of cultural data. An example would be the case of their correlation between the alignments of four temples to Apollo at -4° . They argue that this is a correlation with the month of Pyanopsion when beans were offered to Apollo. I believe including data such as the pre-existing street grid with which the temples are aligned permits the reader to make an evaluation of a less spectacular claim that these temples were aligned to adhere to the local topographical plan. Had Aveni and Romano (2000) included the archaeological context as part of their publication, I believe they too may have come to this

² Available for download from <http://earth.google.com/>

conclusion, and possibly may have found another more historically meaningful correlation.

The recording of the cultural as well as topographical data means that analysis of the temples can be both carried out as an aggregate in the traditional green methodology, but also sub-divided into socially coherent sub-groups such as by deity, city, period or even whether the temple is to a celestial or chthonic god.

This seems to provide a route out of the arguments of 'green' versus 'brown' methods by focusing on the social aspect and purpose of astronomical practice (for criticisms of asocial approaches see Ruggles & Barclay, 2000). There still remains the question of how these statistical data, even when they can be interpreted, can be integrated with historical data for the temples. I believe this problem is actually symptomatic of Classical Archaeology and indeed any truly inter-disciplinary work. If you are combining two different or even incommensurate approaches to tackle a project then how can they be meaningfully integrated? Whitley (2006) has proposed that, as for rock art, archaeoastronomy would do well to embrace a post-positivist approach. I would add that his approach to rock art can also be used for the benefit of Classical Archaeology as a whole.

5. Post-Positivism and why it matters

The pioneer in artificial-life research, Steve Grand (2004:246) uses the phrase “non-disciplinary” rather than “inter-disciplinary” rather pointedly’. He argues that Leonardo da Vinci was not a polymath, but rather interested in one subject - nature. Similarly Grand regards the notion of ‘interdisciplinarity’ as justifying arbitrary boundaries dividing knowledge. I would dearly like to agree with Grand as my own interests are diverse when compared to the traditional fields of academia. Unfortunately I think he is wrong. There are recognised disciplines with methodologies that are coherent to a greater or less extent. It is also the case that some problems are more readily suited to some approaches than others. For example it may be conceded that mathematics is ‘unreasonably effective’ in matters of physics (Wigner, 1960, but see Sarukkai, 2005 for a rebuttal), but there is so far no mathematical equation for the French Revolution. Grand may be interested in one subject, artificial life, but nonetheless he works across disciplines and employs different methods to do so. Similarly my study may be into cosmology as an identifier of cultural identity, but to study this I use more than one discipline. This means that I must have a method of combining disciplines.

5.1 Why it matters

I believe any method I used must be capable of answering two questions posed by Iwaniszewski. They are good questions, and I believe they have wider implications. His first is:

Is it the interdisciplinary character of archaeoastronomy that impedes any deep and follow-through discussion leading to the establishment of its theoretical foundations?

Iwaniszewski (2003, p. 3)

This question can be asked because in archaeoastronomy theoretical debate has largely circled the issue of how best to produce useful data. The product is often atheoretical papers such as Chevalier's (1999) 'Orientations of 935 of Southern France', which largely consists of the descriptions of the state of preservation, structure and location of 935 dolmens with tables of their azimuths and horizon declinations. This is followed by a brief discussion by Hoskin of how these orientations compare to similar surveys of the western Mediterranean. The same can be said of Hoskin's work. For example, Hoskin (2001) is largely a descriptive work.

This is the result of a conscious decision by Hoskin to tackle criticisms made of earlier archaeoastronomical surveys made by Thom by separating facts from interpretations. He is aware of the concept of hermeneutics in archaeology, including the claim that archaeological data are theory-laden (Hodder, 1992, pp. 135-139), but disregards it as irrelevant (Hoskin, 1996, p. 586). This is a position I have some sympathy with - the orientation is not going to change if one takes a sufficiently Marxist viewpoint - but it highlights a difficulty alluded to by Kintigh (1992). The orientation data are not, from the perspective of the humanities, inherently meaningful. Rather than integrating work into social programmes, this approach leaves archaeoastronomical data isolated. The astronomical data and the historical or social data are incommensurate. It is not possible to analyse Chevalier's work (and by extension my own data) by historical means without some form of interpretative framework. Iwaniszewski's question points to the fact that this isolation means that no dialogue exists showing how to integrate the astronomical and social data. For this reason I believe I need a better approach than throwing everything together and picking out what I feel is obvious.

Iwaniszewski's second question is equally pointed when applied to archaeoastronomical research and its publication:

Is it the predominance of the utilitarian and cognitive model of astronomy (derived from the research paradigm of the sciences) that impedes any dialogue with humanists in the interdisciplinary framework of archaeoastronomy?

Iwaniszewski (2003, p. 9)

Iwaniszewski uses this as a departure point for a debate on the fundamental differences in approach between astronomers and archaeologists, and on whether the dominance of astronomers reduces the utility of the field's findings to archaeologists and historians. The former, not unreasonably, feel that the existences of astronomical phenomena are ontologically independent of humans. Put bluntly, the Sun will rise over the land regardless of whether anyone is around to make sure it is doing its job. Archaeologists, in contrast, work with data that are socially constructed. Archaeoastronomy, as the study of what people made of the sky in the past (Sinclair, 2006, p. 13), is a study of social practice and any meaning we give to astronomical phenomena is social. Iwaniszewski does not deny the importance of astronomical method, but does question its primacy. Interdisciplinarity has been described as a buzzword (Rauch 1996, p. 273, Moran 2002, p. 1), therefore an explicit statement of how an interdisciplinary project will work is necessary. What therefore should an interdisciplinary research project look like?

Bruce *et al.* (2004, p. 459) define interdisciplinary research as something which 'approaches an issue from a range of disciplinary perspectives but in this case the contributions of the various disciplines are integrated to provide a holistic or systemic outcome.' Yet this does not help describe how it should work. I shall take my own solution from their comments on multidisciplinary which : 'involves low levels of collaboration, does not challenge the structure or functioning of academic communities and does not require any changes in the academic worldviews of the researchers themselves,' (Bruce *et al.* 2004, p. 459)

I believe the best way to examine whether a cosmological approach can inform us of how colonisation occurred is to pursue different independent methodologies and then attempt to integrate them using a postpositivist approach. This has been proposed by Whitley (2006) for archaeoastronomy, but I intend to take this further and argue that it is necessary for classical archaeology as a whole, if archaeological data are to be meaningfully incorporated with historical texts to produce one narrative.

5.2 Introducing Postpositivism

Whitley (2006, p. 87) identifies three principles of a postpositivist scientific method:

- 1) Hypotheses are accepted or rejected through inference to the best hypothesis, not through experimentation and falsification.
- 2) Arguments are based upon multiple lines of evidence rather than chains of logic.
- 3) An inference is best explained through convergent methodologies.

I believe none of these proposals is particularly radical as a statement in itself, but stating them explicitly poses a challenge to Classical Archaeology as an interdisciplinary process. The reason we would want to do this is explained in the third principle. Application of divergent methodologies is seen usually seen as desirable (Campbell & Fiske, 1959). Whitley (2006, p. 87) cites Lakoff and Johnson's (1999) work showing that confidence in a conclusion increases geometrically with each additional method or data set. This has not been quantified as such in the work of Classicists, but nonetheless independent lines of inquiry are welcome, especially if they come to the right conclusions. Thus Boardman (1999, p. 161) is happy to see archaeologists fill out the literary record, so long as they pay due deference to ancient historians when assigning dates to material. This approach, which is endemic in Classics, sees archaeology as being a tool to fill in gaps in classical knowledge.

That means I believe much Classical Archaeology fails to be truly interdisciplinary when we examine the second principle, multiple independent lines of evidence.

The danger in Classical Archaeology is over-reliance on the historical sources, especially in ahistorical contexts such as much of the Archaic period of Greek history. The fact is that the historical record of Greece is extremely rich in data and there is a long tradition of interpreting archaeological finds within a historical context. Yet if archaeological data are interpreted through history, they cannot then stand as independent lines of evidence. The historical record need not be rejected wholesale, but if archaeological data are to be used to independently corroborate historical hypotheses then that does entail the development of independent archaeological lines of enquiry. This approach is becoming more common and I suspect that some debate is an expression of frustration by some classicists with the inherently vague and imprecise nature of some archaeological evidence. This is understandable if they believe they already know the right answer to some of these archaeological puzzles. Yet there should be a degree of forbearance. Judging archaeological investigations by historical criteria makes as much epistemological sense as judging historical narratives by their anthropological merits. To benefit from another perspective on the same problem requires acceptance that there can be other perspectives.

The last statement above sounds like a form of relativism and this is why the first principle is the most challenging for realist philosophers of science. Removing falsification as a criterion potentially opens to the door to relativist or postmodernist excesses (Brieschke, 1992). This concern is not alleviated by Cook's (1983, p. 89) observation that the process of defining which hypothesis is the best is social and the result of debate. Against this I would refer back to Whitley's own justifications which he draws from Newton-Smith (1981). A hypothesis may be preferred for the amount

of data explained, the diversity of the data explained, how the hypothesis fits with other accepted theories and internal consistency and coherence. There may indeed be other 'ways of knowing', but that does not mean each way is equally valid.

For my own conclusions I shall attempt to find explanations that are simplest when viewed *across the range of techniques used*. This means that from the perspective of the single-discipline archaeologist or the historian the explanation may be less plausible than previously accepted ideas - if the net effect is to reduce improbability. To give a hypothetical example: if an authenticated site possessing all the archaeological hallmarks of a major archaic Greek city had been found deep in the interior then, regardless of the lack of historical evidence, I would conclude that a Greek city had been hitherto unrecorded, because the probability that the historical record of archaic Sicily is imperfect is greater than the possibility of the native population building a perfect replica of a Greek city in antiquity.

I believe that an explicitly postpositivist approach can serve two purposes in this study. Firstly it provides the tools to take diverse methods and lines of evidence that are to be corralled to create one narrative. Secondly it also makes explicit the methods I will be using to do this. I shall be trying to find the explanations I find most plausible, from a background in various fields. The reader's own academic background is almost certainly different and I therefore need to make it possible for him or her to be able to question not only the data but also the method of combining it into one conclusion.

6. Temple Data

Having a hypothesis, a method and a theoretical framework for interpretation, I now need data. The data presented below are presented in a uniform manner. Each temple will have data on its host city, deity (where known), the date of its construction, azimuth and the declination point on the horizon that the temple faces. Approximate dates are given for days when the temple would face sunrise. Where these are not qualified, they are dates in the *Gregorian* calendar. This differs from the usual practice of giving dates in the *Julian* calendar. Neither calendar was in use in this period. The reason I have chosen the Gregorian calendar is that it is simply the better fit with the tropical year. In all periods discussed in this thesis the solstices will happen around 21 or 22 June and 21 or 22 December. In contrast the Julian calendar diverges from the tropical year the further back from AD 1 you go. In the case of the earliest dates of the colonies this divergence could be almost a week.

Unfortunately, typical home planetarium software uses the Julian calendar for BC dates. Therefore, where appropriate, I have added footnotes to give relevant Julian calendar dates to allow easy replication of the night sky, if the reader wishes. Conversions were calculated using a tool provided by Fourmilab.³

The temples are referred to by their city and local designation. The temples are not numbered to allow the easy insertion of other temples in future surveys.

The aims of the survey were to examine the following factors:

³ Accessible on the World Wide Web at «<http://www.fourmilab.ch/documents/calendar>»

1) When will the sun rise over the part of the horizon temple faces?
This may yield a pattern of alignments if temples were targeted towards sunrises on specific dates.

2) What constellations will be visible in the eastern sky when the sun rises in front of the temple?

This may reveal patterns based up the heliacal rising of stars, a similar method of astronomy to that used by Hesiod.

3) What stars is the temple aligned towards?

This may show that some stellar targets were significant to the ancient Greeks, though Evans and Berggren (2006, pp. 144-145) show that, in the Hellenistic period, only twenty stars were used by Geminus. Therefore the temples were perhaps aligned to constellations rather than specific stars, if at all.

6.1 Akragas Temple A (Herakles)

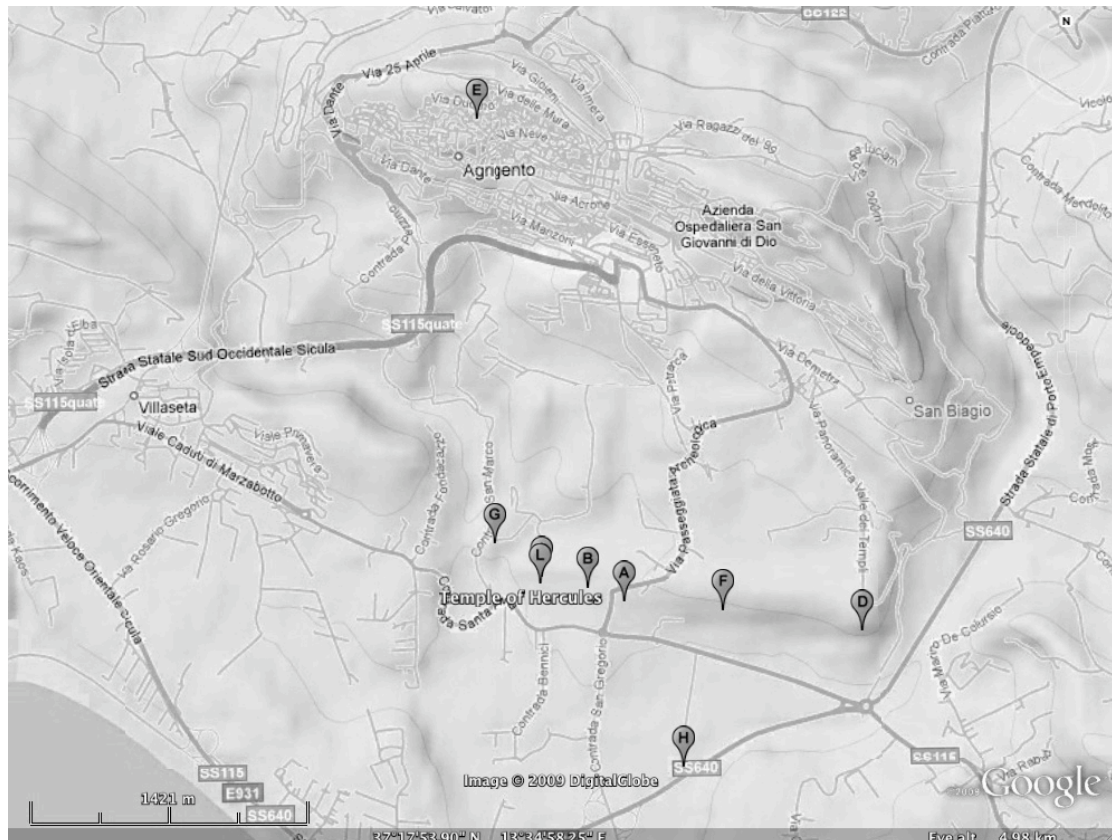
Location: Agrigento

Deity: Hercules

Date: Late Sixth-century BC

Azimuth: 90°

Declination: 0°



The Temple of Hercules (A) at Agrigento © Google.

Temple A is locally known as the Temple of Hercules at Agrigento. It sits on a ridge which marked the southern boundary of the city. Immediately to its west a road, known now as the Via Passeggiata Archeologica cuts through the ridge at the point where old southern gate to city could be found (Marconi, 1929a, p. 52). This ridge continues to the west to the Porta V and to the east to the site of the later Temple F (see section 6.5). Near to the north lay the Agora. From here the temple would have been impressive viewed from the side. Indeed the building of the temple may have been designed to produce such a view. Its size, 67m by 25m (Marconi, 1929a, p. 52)

with six by fifteen columns (De Miro, 1994, p. 50) would make it the largest of the temples to be completed in Akragas. The narrow proportions could be partly explained by the limitations of the building techniques of the time, but they could also have been an attempt to maximise the visible size of the temple, which would have been its length. The width, or lack of it, would not have been so apparent from the Agora or the coast. Today the base of the temple remains, along with eight columns along the southern side of the temple.



Temple A, the temple of Herakles, at Agrigento. Photo (cc) [Leandro Neumann Ciuffo](#).

Marconi (1929a, p. 31) dates it to the last days of the sixth-century based on stylistic examination of the surviving columns. He dates two lion heads associated with the temple stylistically to between 470-460 and 450-440 BC, but notes that this may be part of a later refitting of the temple. These refitting phases would have coincided with the building of the Temple of Olympian Zeus (see section 6.2) and then the building of Temple F (see section 6.5). These could have been responses intended to

renew a building which until this period had been the most prestigious temple in the city but was now at risk of being overshadowed by others, in particular the Olympieion.

Traditionally the temple is attributed to Hercules on the basis of a comment by Cicero (I. 4.94) describing a temple of Hercules not far from the Agora. Alas the phrase used, *non longe a foro*, is not precise enough to be certain about the temple to which he is referring. Of the temples at Akragas the temple of Zeus, a known attribution is closest and Temple A is the next proximate. Intriguingly De Miro (1994, p. 38) records Tanit and Lunar symbols in the *pronaos* of the temple. The reference to Tanit is puzzling. If the temple were of Hercules the initial expectation would be to see it adopted as a temple of Melkart. In later times Hercules was often the Greco-Romanised god placed in Melkart cults (Bonnet, 1988). In contrast Tanit is the goddess is associated with the Phoenician goddess Astarte (De Miro, 1994, p. 4), who is one of the 'Venus' deities of the Near East. The temple would look out to the rising of Venus too, but this is not significant as Venus can appear either side of the Sun. An alternative cultural connection may be found in considering how the Greeks related to Astarte. She is assimilated in a Graeco-Roman context as many goddesses (Bonnet, 1996, pp. 87-96). Bonnet (1996, p. 95) notes West's (1991, pp. 379-381) suggestion of a connection with Artemis. Rather than a goddess in the form of Venus, Diana / Artemis was a lunar goddess (Cashford, 2003, pp. 220-221). The symbols left by the Punic occupiers could therefore be a record of this temple's connection to the Moon, which would also explain the lunar symbols. Given the lack of a clear equivalence between eastern and Greek deities, this would be a highly speculative attribution. There are also known to be references to an Eryxian Venus related to Tanit (Zucca, 1989).

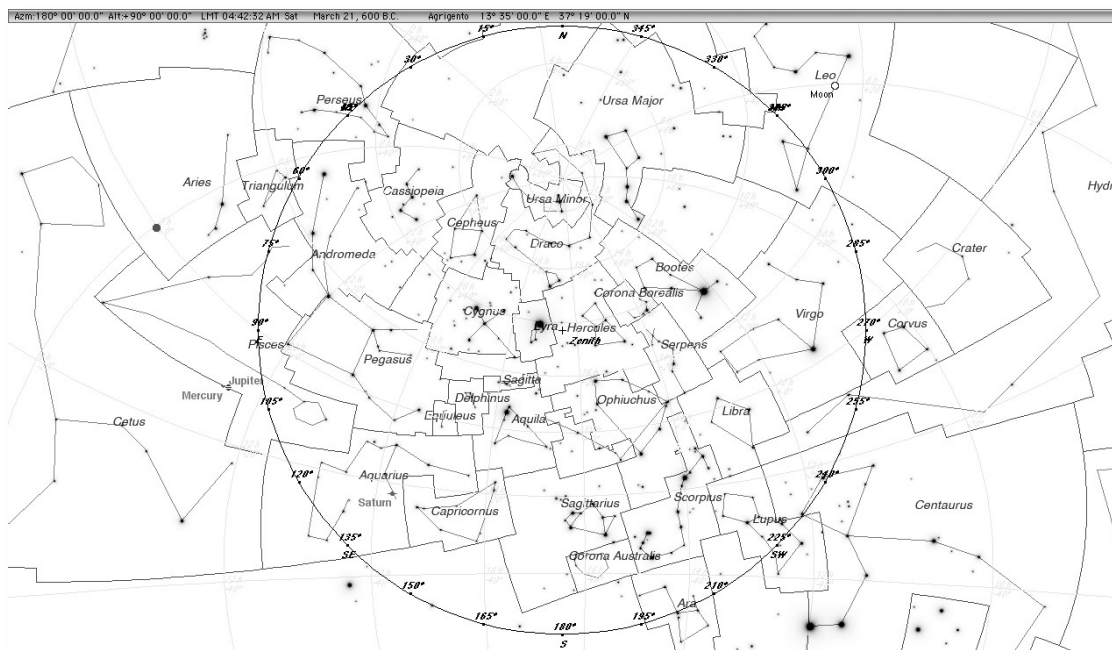
The alignment is almost perfectly east, 90° to the nearest degree. Unfortunately local conditions prevented measurement of the eastern horizon altitude. The horizon altitude to the west is 0° . The temple is one measured by Aveni and Romano in their survey; using a theodolite (Aveni & Romano, 2000, p. S54) rather than a magnetic compass, they measured the alignment to be 90.5° with a horizon altitude of 0° to the east. Koldewey and Puchstein (1899, p. T21) record an azimuth of 96° . Penrose (1897, p. 56) records an azimuth of $269^\circ 56'$ but his reference is from south. Rendered to a comparable datum and precision he records 90° . The ridge the temple sits upon runs slightly north of east, so this would appear to be accurate. This faces sunrise on 21 March and 23 September in the Gregorian Calendar⁴ within an accuracy of a day or two. This could arguably be an equinoctial alignment, though this would be a couple of centuries before the advent of geometrical astronomy. Further, a closer analysis of the plans in the 1929 report by Marconi shows an oddity which makes the alignment uncertain.

The plan reproduced by Koldewey and Puchstein (1899:T21) and used by Marconi(1929:52) shows an entrance on the east, ghost columns on the north and east, and reconstructed columns with shadows falling away to the south-west. In contrast, the plan for temple D shows an entrance on the right and columns with shadows trailing to the north-east. The draughtsman of the plans could have followed no strict convention whilst drawing the plans. However for the shadows to fall due south-west, the Sun would have to be at an azimuth of 45° . This cannot occur in Sicily, as the sun would never rise far enough to the north. Cross-checking with plans published by De Miro (1994:50) reveals an entrance on the left of the plan, though there is no north indication. The plans therefore had to be corroborated by use

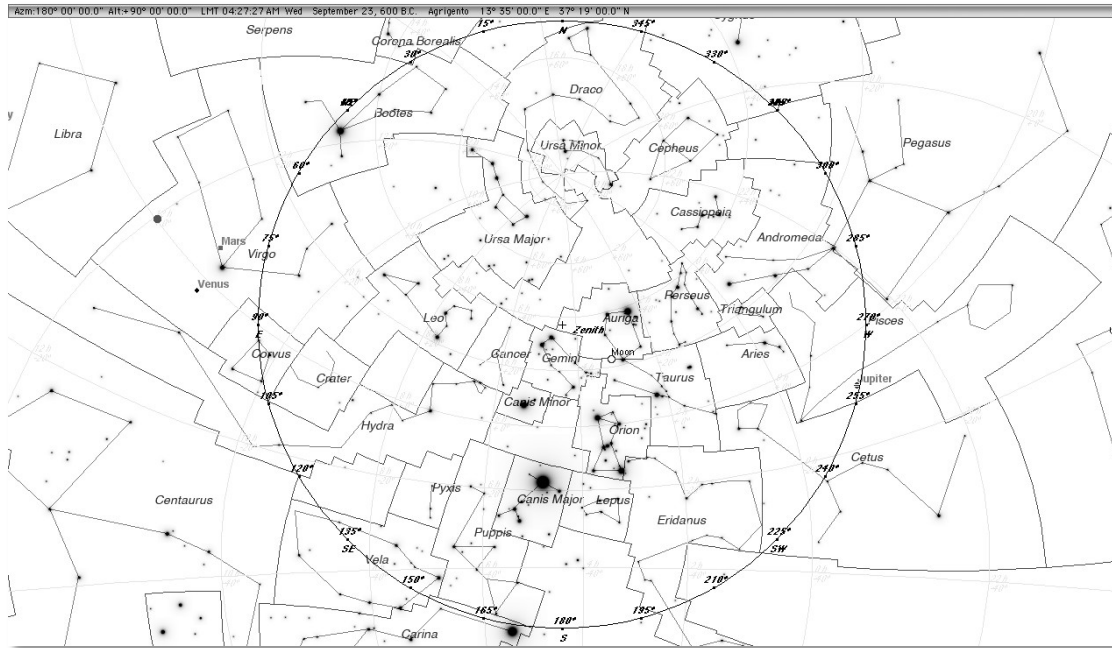
⁴ For 600 BC, the proposed date of foundation, this would be 27 March and 29 September in the Julian Calendar.

of satellite imagery which suggests that the East entrance is correct and that De Miro may have been the victim of a printing error.

The constellations that would have been rising at the time of the solar alignments were Pisces and Andromeda in the spring and Boötes, Crater and Virgo in the autumn. It is of interest to note that the declination of Spica in 600 BC was around 0° . The star probably had a strong presence in agricultural calendars. If this alignment were intentional and the religious practice were related to agricultural fertility, this may possibly explain the Carthaginian attribution of the temple to Tanit. However traditional thought in Classics remains that calendars started at solstices or equinoxes and any attempt to challenge this needs a wider discussion of Spica (see section 15.3).



Projection of the sky at Astronomical Dawn for 21 March 600 BC at Akragas



Projection of the sky at Astronomical Dawn for 23 September 600 BC at Akragas

The temple points towards α Hydrae *Alphard* (magnitude 1.99), γ Orionis *Bellatrix* (mag.1.65) and close to γ Pegasi *Algenib* (+1°, mag.2.82) and ϵ Pegasi *Enif* (+38', mag.2.39). The only star remotely connected to the cult of Heracles would be α Hydrae, which would heliacally rise around mid-August, but there is nothing about the temple or city that would suggest this is significant.

6.2 Akragas Temple B (Olympian Zeus)

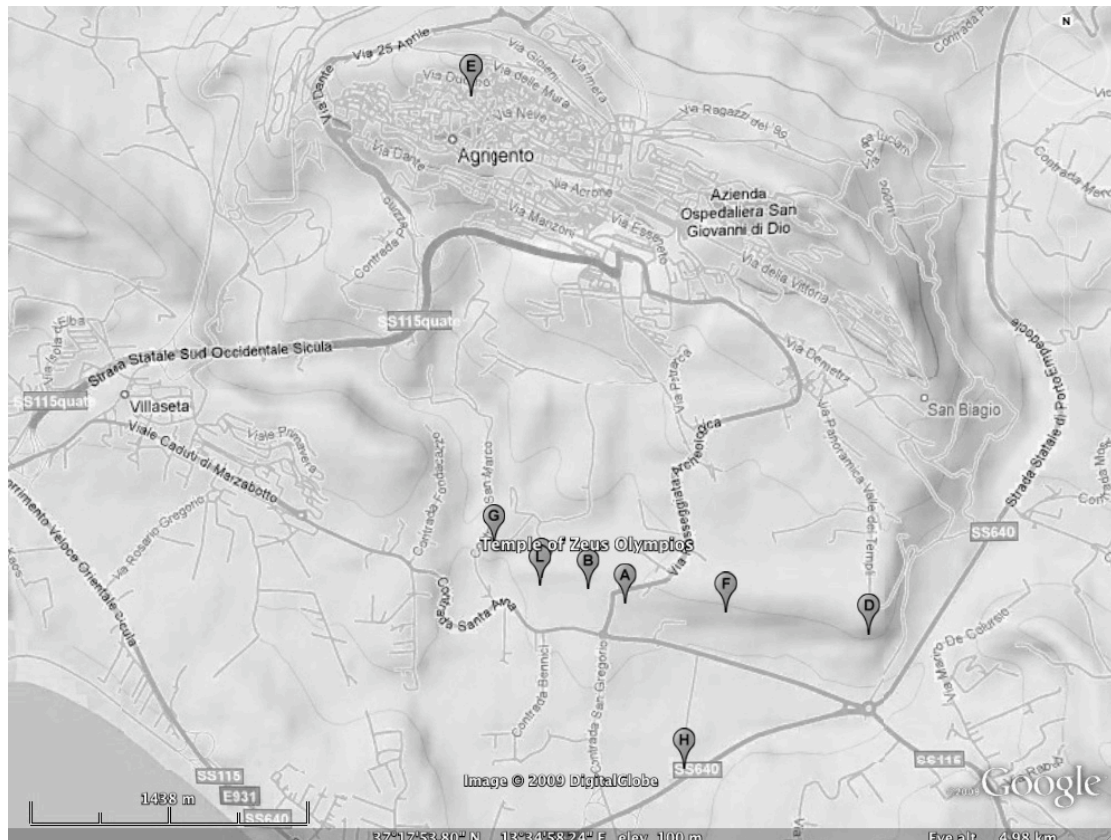
Location: Agrigento

Deity: Zeus

Date: 480 BC

Azimuth: 80°

Declination: +10°



The Temple of Zeus Olympeios (B) and Agrigento © Google.

The temple of Olympian Zeus is the closest to the Agora of all the temples, a short distance to the southwest. The attribution seems certain. Polybius (XI.27) describes the temple as “in its plan and dimensions it seems to be inferior to no temple whatever in all Greece”. Thus it can only be Temple B, which is clearly the largest temple on site, measuring a massive 113m by 56m (Marconi, 1929a, p. 38). It was to have been built with just fourteen by seven columns on the exterior facing (De Miro, 1994, p. 51). Similarly the date is more certain than for most temples. Following Diodorus Siculus (XI.26.2 , XIII.82.1-4) it can be dated to 480 BC after a victory over the Carthaginians at the Battle of Himera. It should also be noted that the Temples of

Athena at Himera (see section 6.16) and Syracuse (see section 6.32) were also built in celebration of victory in the same battle. It was never completed, but plan of the temple remains visible.



A wall of the temple of Olympian Zeus at Akragas (Temple B). Photo author.

This temple marked the apogee of temple building in Akragas. There is no evidence that any larger building was attempted. Whether this was because of reverence for the site or pragmatism is uncertain, but this temple was never completed. Unlike the Temple of Hercules, Temple A (see section 6.1), this temple was not built to be visible from both inside and outside the city. The traveller arriving from outside would have had his view of the temple obscured by the local geology until he had passed through the city gates. Nonetheless its proximity to the south gate would suggest that it was sited to be viewed by those who entered the city.

Aveni and Romano (Aveni & Romano, 2000, p. S52) record the temple as aligned at 77° with a horizon altitude of 3° to the east and 0° to the west. While I agree with horizon measurement, I record an azimuth of 80°. This would yield an alignment to a declination of +10°. Koldewey and Puchstein (1899:T22) record 97°. Penrose (1897, p. 76), 257° 35' from south which becomes 77°. This faced sunrise around 17 April and 28 August in the Gregorian Calendar.⁵

As we have a viable date for the alignment of the temple, it is possible to compare the dates of new moons to the alignment of the temple to see if there is any correlation. New Moons for 480 and the following year are:

480BC		479BC	
10 Jan	5 Jan	29 Jan	24 Jan
8 Feb	3 Feb	27 Feb	22 Feb
10 Mar	5 Mar	29 Mar	24 Mar
8 Apr	3 Apr	27 Apr	22 Apr
8 May	3 May	27 May	22 May
6 Jun	1 Jun	25 Jun	20 Jun
5 Jul	30 Jun	24 Jul	18 Jul
4 Aug	30 Jul	23 Aug	18 Aug
2 Sep	28 Aug	21 Sep	16 Sep
2 Oct	27 Sep	21 Oct	16 Oct
1 Nov	26 Oct	19 Nov	14 Nov
30 Nov	25 Nov	19 Dec	14 Dec
30 Dec	25 Dec		

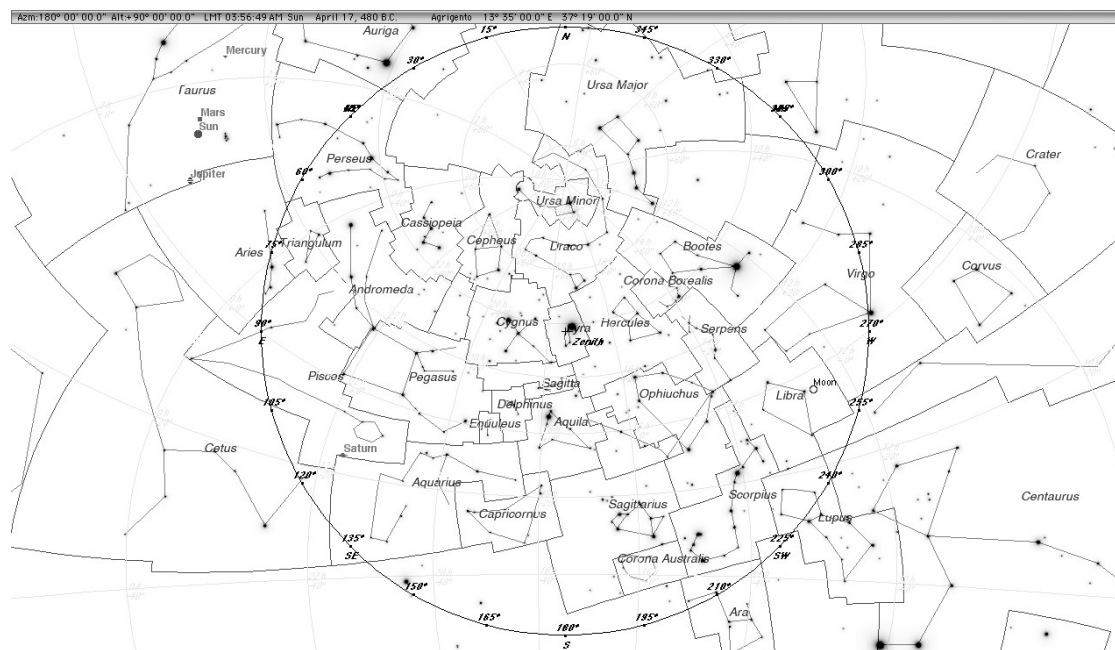
Table: New Moons in 480 and 479 BC

Proposed dates for the Battle of Himera are coincidental with those of Thermopylae and Salamis (Feeney, 2007, p. 51). For reasons explored elsewhere (see section 15.1) I prefer an earlier date for the battle of Himera based on the relationship between the alignment of this temple and the temples built after the battle at Himera and

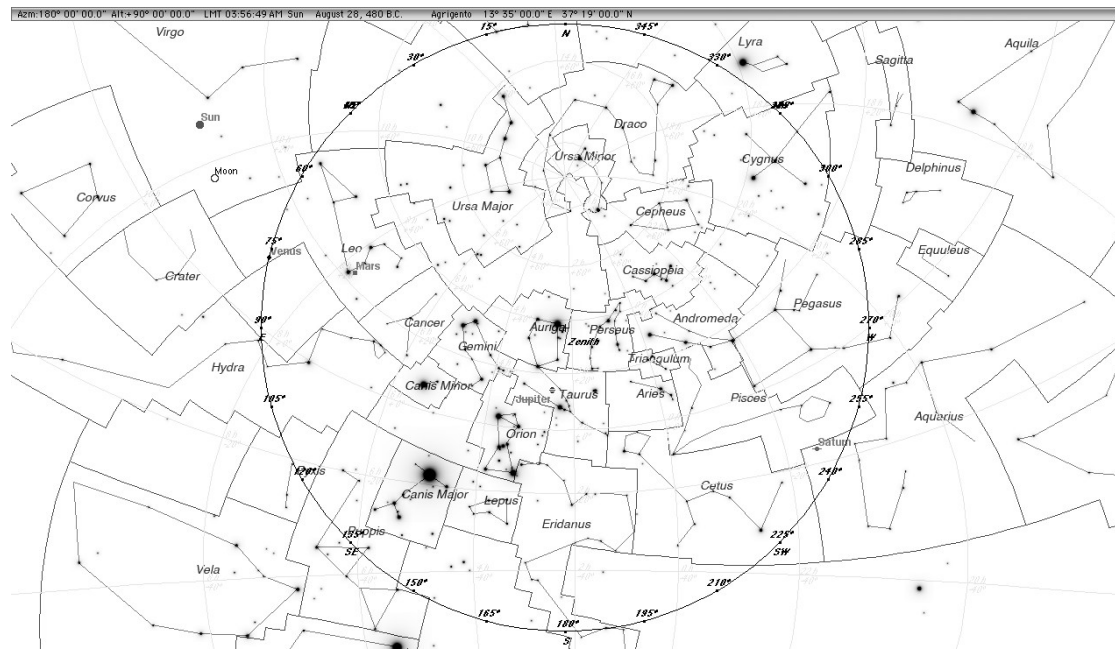
⁵ In 480 BC this would be 22 April and 2 September in the Julian Calendar

Syracuse. The autumn alignment date of August 28 is consistent with the dedication of a temple on Theron's return from battle. This date could be also consistent with the laying out of a temple at the start of a New Year. Vindemiatrix would be rising in the following days, and so this may also coincide with the start of a new Agrigentine year (see section 15.3 for a discussion of the calendar).

The constellations which would have been rising around the autumnal sunrise were Leo and Hydra. For the vernal solar alignment the rising constellations would have been Perseus, Triangulum and Pisces. While these may have all had calendrical functions there is no reason to assume that they had any special significance for the temple.



Projection of the sky at Astronomical Dawn for 17 April 480 BC at Akragas.



Projection of the sky at Astronomical Dawn for 28 August 480 BC at Akragas.

The temple points towards α Arietis *Hamal* (mag.2.01) and α Delphini (3.77). Other visible stars within a degree of $+10^\circ$ declination are, β Canis Minoris *Gomeisa* ($+9^\circ 27'$, mag.2.89), β Ophiuchi *Cebelrai* ($+9^\circ 6'$, 2.76) and λ Ophiuchi ($+10^\circ 21'$, 3.9). α Arietis would later mark the start of the astrological year. The influence of mathematical astrology is unlikely to be relevant at the start of the Classical period, but combination of heliacal rising and sunrise alignment for a star with a possible calendrical function provides a possible alternative to the autumnal alignment suggested by the connection with the Battle of Himera (section 15.1).

6.3 Akragas Temple D (Juno Lacinia)

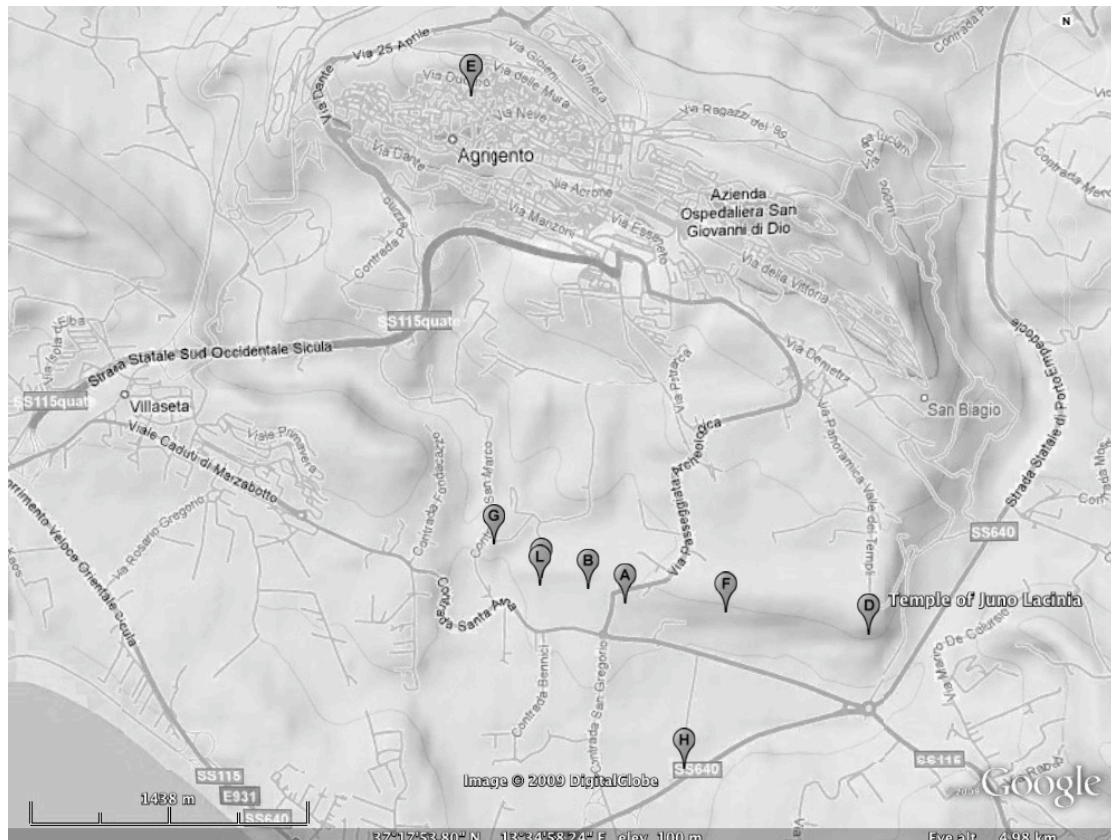
Location: Agrigento

Deity: Unknown

Date: 460-440 BC

Azimuth: 82°

Declination: +8°



The Temple of Juno Lacinia (D) and Agrigento © Google.

Temple D is popularly known as the Temple of Juno Lacinia. It lies at the eastern most point of the ridge which also bears the temples of Hercules (see section 6.1) and the temple of Concord (see section 6.5). It is assumed to be very close in date to the temple of Concord and they may have been under construction contemporaneously. Marconi (Marconi, 1929a, p. 72) dates it stylistically to a period between 460 and 440 BC. Spawforth (2006, p. 126) proposes a narrower range of dates, 460-450 BC, after Mertens' (Mertens, 1984, pp. 98-108) analysis of architectural styles. De Miro (1994, p. 34) also favours a date around 450 BC. The temple is attributed to Juno Lacinia, which is highly unlikely. Marconi (1929a, p. 76) states this is due to a confusion with

the temple of the same name in Croton. The temple measures 38m by 17m and was planned to six by thirteen columns (De Miro, 1994, pp. 50-51; Marconi, 1929a, p. 72). It remains in good condition.



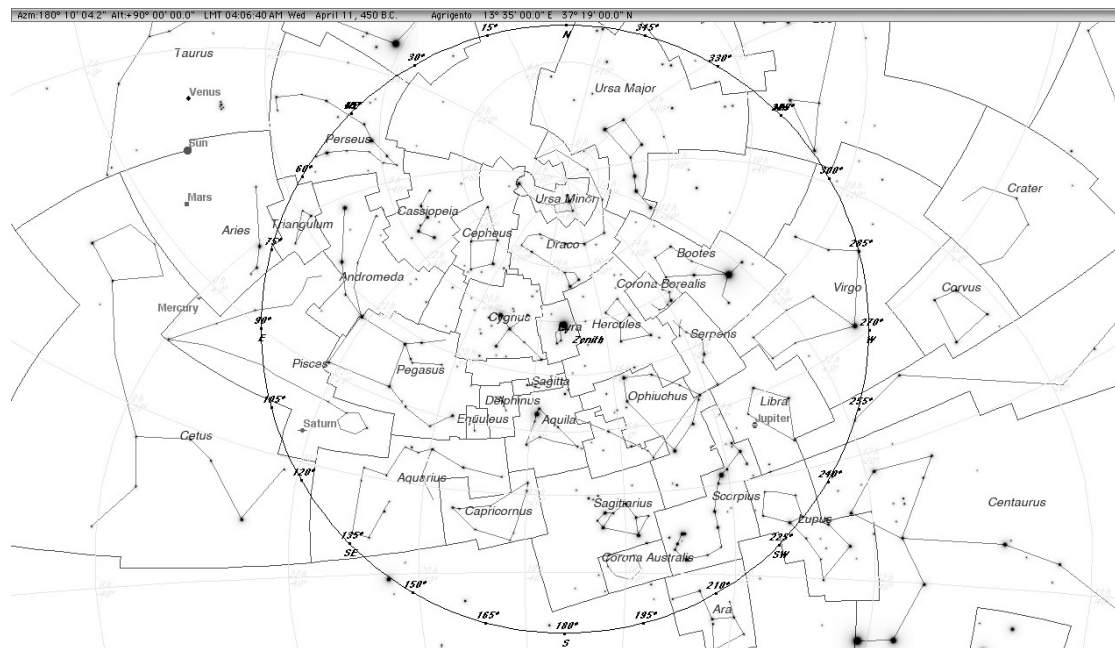
Temple D, the temple of Juno Lacinia. Photo (cc) [David Holt](#).

The temple faces an azimuth of 82° from north with an easterly horizon 2° high and a westerly horizon 0° high. Aveni and Romano (2000, p. S54) record an alignment of 81° . This gives a declination of $+8^\circ$. Koldewey and Puchstein (1899, p. T42) record 90° . Penrose (1897, p. 55) records $264^\circ 0'$ which becomes 84° , but also records a declination of $+7^\circ$. This converts to facing sun rise on 11 April and 3 September in the Gregorian Calendar.⁶ It would seem to be a candidate to test whether the construction of a temple coincided with the start of a new Month. This would be done by examining the dates of New Moons between 460 BC and 440 BC. There

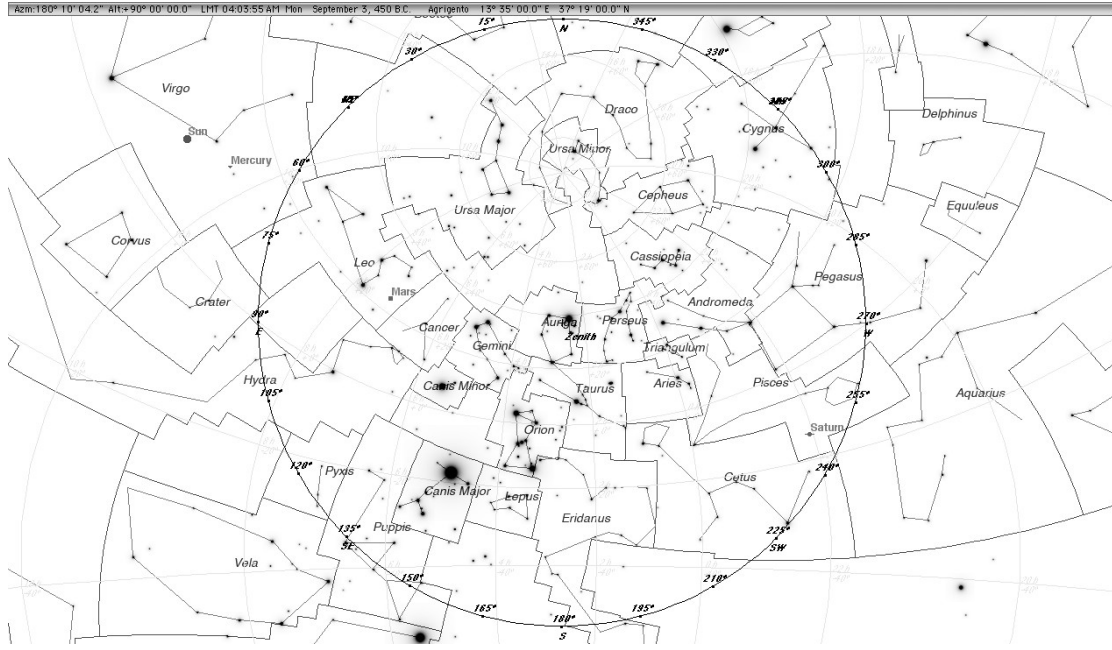
⁶ 16 April and 8 September for the Julian Calendar in 450 BC.

would need to be an allowance of two or three days to see the New Moon in the western sky, which would be the trigger for the alignment of the temple the following day. Unfortunately the wide range of possible construction dates over twenty years mean that it is impossible to corroborate a New Moon sighting with a construction date.

On the days when the temple faced the rising sun, the rising constellations would have been Triangulum, Perseus and Pisces in the spring with Hydra and Leo in the autumn. There is no reason to believe these were significant, especially as there is no reliable attribution for the temple.



Projection of the sky at Astronomical Dawn for 11 April 450 BC at Akragas.



Projection of the sky at Astronomical Dawn for 3 September 450 BC at Akragas.

The temple points towards α Tauri *Aldebaran* ($8^{\circ} 11'$ mag.0.99), β Arietis *Sheratan* ($+7^{\circ} 36'$ mag.2.66) and γ Aquilae *Tarazed* ($+7^{\circ} 48'$ mag.2.71) and close to α Canis Minoris *Procyon* ($+7^{\circ} 13'$, mag.0.40), ι Hydrae ($+7^{\circ} 24'$ mag.3.90), β Delphini *Rotanev* ($+8^{\circ} 51'$ mag.3.63), $\delta 1$ Tauri *Hyadum II* ($+8^{\circ} 37'$ mag.3.75) and $\theta 2$ Tauri ($7^{\circ} 13'$ mag.3.41). The stars in Taurus are part of the distinctive Hyades asterism. Had the temple dedication to Juno been reliable it would have been interesting to speculate on a possible connection with $\beta\omicron\omega\pi\iota\varsigma \pi\acute{o}\tau\nu\iota\alpha$ *cow-eyed* Hera. β Arietis could be a marker for spring, but there is no reason to consider it any more significant than the Hyades. γ Aquilae and β Delphini could also be used as calendrical markers for the winter solstice, though Geminus III.10 states that the constellation and α Aquilae share the same name, $\text{\AA}\epsilon\tau\acute{o}\varsigma$ *Aëtos*, which would argue against γ Aquilae being the intended target if Aquilae were the significant constellation. While it has been argued that the stars of Delphinus have collectively been used for calendrical purposes (Salt & Boutsikas, 2005), no alignment of any temple has been argued for, instead the marker being purely via the observation of helical and cosmical events. It is therefore not possible to argue for any significant stellar alignments.

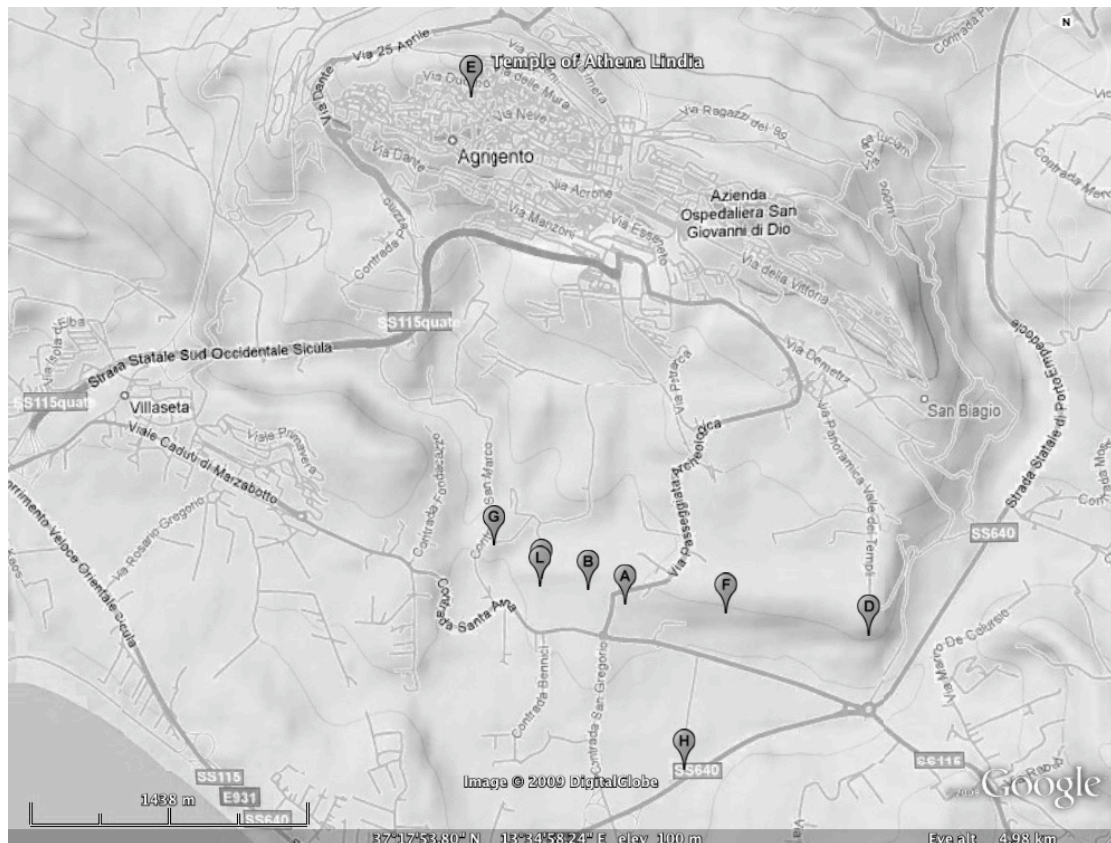
6.4 Akragas Temple E (Athena Lindia)

Location: Agrigento

Deity: Athena Date: 490-470 BC

Azimuth: 110°

Declination: -16°



The Temple of Athena Lindia (E) and Agrigento © Google

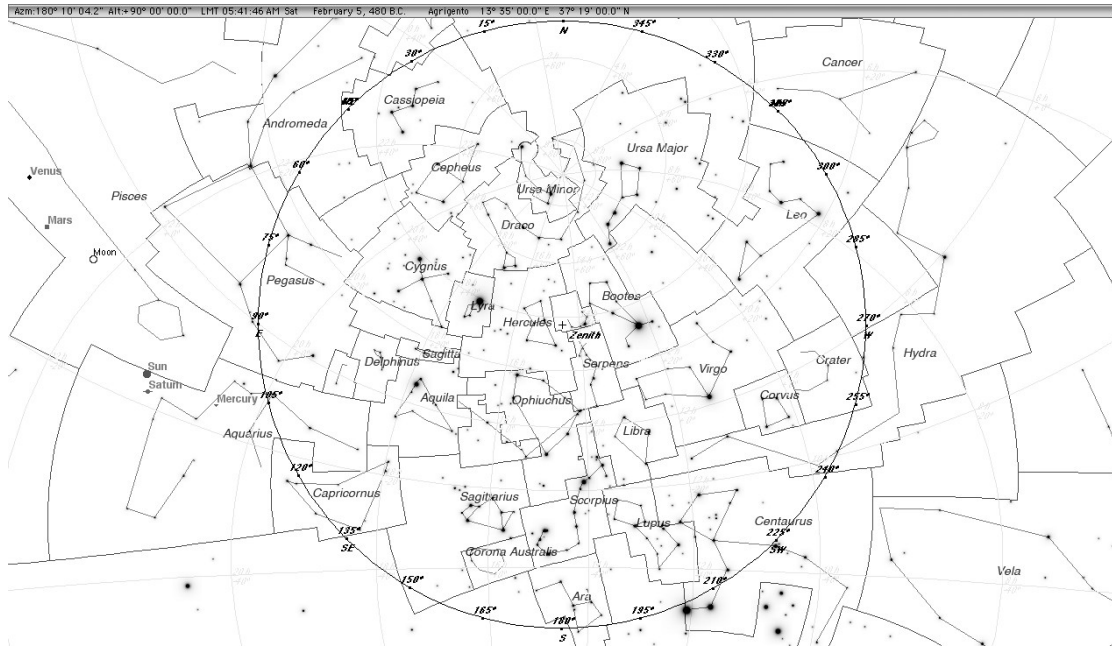
Temple E is one of the more difficult temples to analyse in Akragas. It lies under the church of Santa Maria dei Greci. All that remains of the original temple is the cella (Marconi, 1929a, p. 77). If the orientation faithfully matches that of the original building then it is aligned at an azimuth of 110°. Koldewey and Puchstein (1899, p. T20) record an azimuth of 119°, but for reasons given above in the discussion of Temple C, this is not persuasive. The attribution of the temple is uncertain. From its position at the top of the ancient town it is likely to be one of the temples on the Acropolis either that of Zeus or Athena. Marconi (1929a, p. 80) suggests that Athena is the more likely candidate with the temple of Zeus beneath the cathedral. In light of

the feminine saint, Maria dei Greci (Mary of the Greeks) associated with the church Athena would be the more likely candidate. From the style of the *cella* Marconi (1929:27) dates the temple to between 490 and 460 BC. He further argues that if the temple were built under the rule of Theron then it would date between 488 and 472 BC. The presence of the modern church makes measurement of the size of temple difficult, though Marconi suggests a length of 23m.

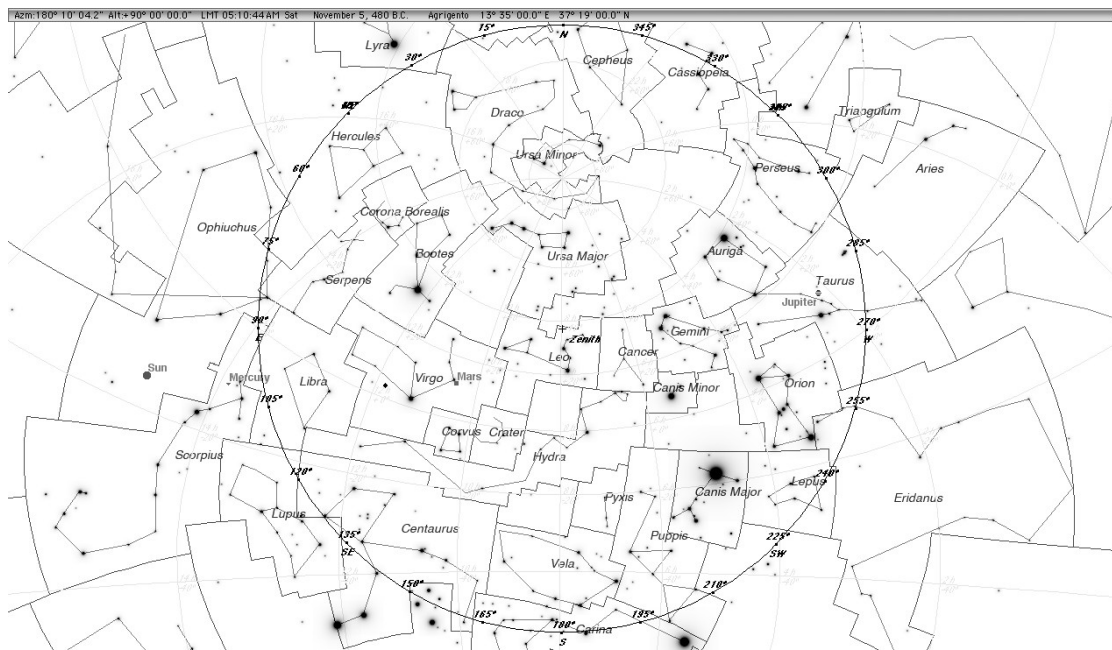
An altitude for the site is unobtainable, the church is in urban Agrigento. If a flat horizon is assumed then it faces declination -16° . In the Gregorian calendar this would be the declination of the Sun on 5 February and 5 November.⁷ The orientation is more to the north than other comparable temples in Gela (see section 6.13) and Camarina (see section 6.10), however there potentially may be enough coherence to suggest that the alignment indicative of a cult (see section 13.4). The orientation would probably face sunrise in the local months of Karneios and Artemitios if the Agrigentine calendar was typical of a Rhodian colonial calendar (see section 15.3). This creates the possibility of connecting this temple to a local festival. Simon (1983, p. 38) follows Deubner (1932, pp. 35-36) and Parke (1977, p. 38.92) in assigning the celebration of the Chalkeia in Athens to the end of Pyanopsion. Cross-dated using Trümper's (1997, p. 178) work, this would be held around the month of Karneios in the calendar Rhodes and her colonies. Thus Akragas is one of the cities that may indicate that intermarriage of Greeks and natives was part of the locally created civic identity (see section 13.4).

Rising constellations when the temple faced sunrise would have been, in 480 BC, Cassiopeia, Pegasus and Capricornus in the spring and Hercules, Libra and Centaurus in the autumn. None of these would suggest an important stellar connection for the temple.

⁷ In 480 BC this would be 10 February or 10 November in the Julian calendar.



Projection of the sky at Astronomical Dawn for 5 February 480 BC at Agrigento.



Projection of the sky at Astronomical Dawn for 5 November 480 BC at Agrigento.

The temple faces the rising points of the stars σ Scorpii *Al Niyat* (mag.2.91), α 2 Capricornii *Algedi Secunda* (-16° 32' mag.3.57), ϵ Aquarii *Albali* (-15° 14' 3.76), γ Canis Majoris *Mulphain* (-15° 10' mag.4.11). The name Antares for α Scorpii suggests that had Scorpio been the intended target the temple would have faced closer to a declination of -17° or -18°. σ Scorpii was unnamed by the ancient Greeks, which

strongly suggests a lack of interest. ϵ Aquarii is more likely to have been part of the stream of water poured by the figure of Aquarius than the figure itself. The stars α 2 Capricornii and γ Canis Majoris would both have been outshone by the brighter stars in their constellation. This does not make intentional targeting of the stars impossible, but does mean that strong cultural evidence, of which we have none, would be needed to argue that the alignment was meaningful.

6.5 Akragas Temple F (Concord)

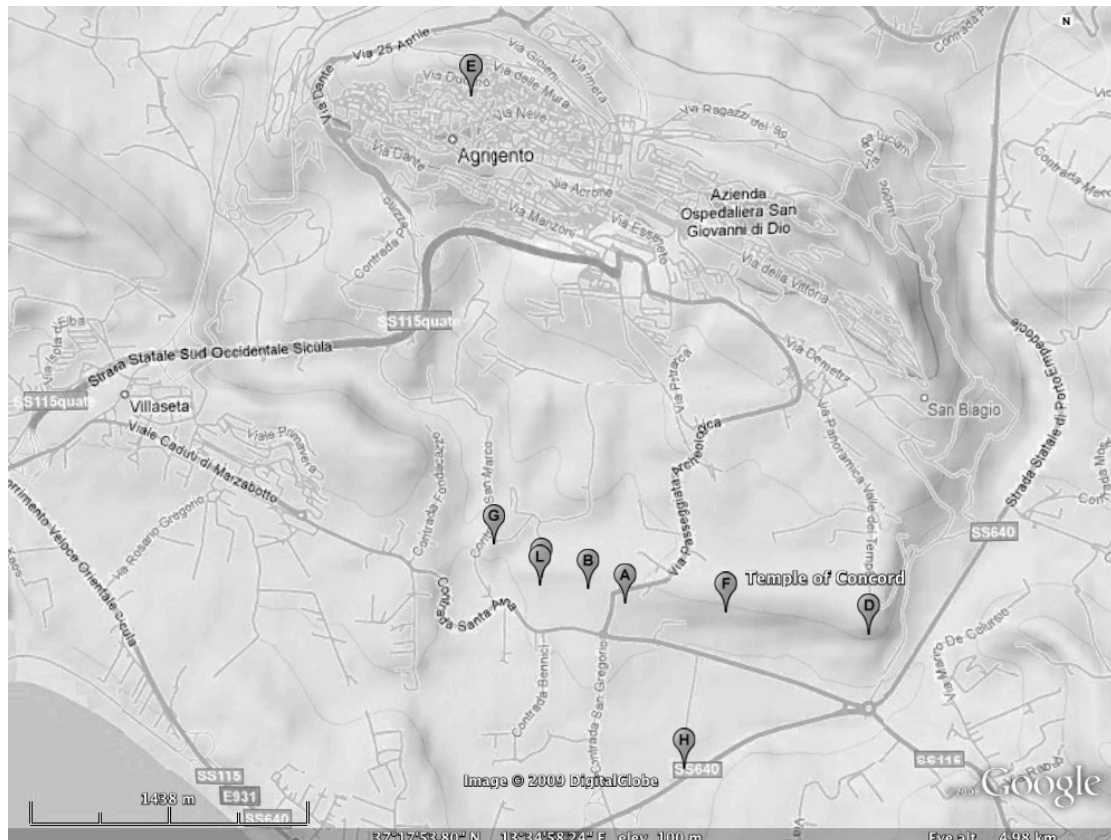
Location: Agrigento

Deity: Dioscuri?

Date: 450-430 BC

Azimuth: 87°

Declination: 3°



The Temple of Concord (F) and Agrigento © Google

Temple F is commonly called the Temple of Concord. It is stylistically dated to 450-440 BC by Marconi (1929a, p. 80). The imprecise nature of dating means that this is still open to debate. De Miro (1994, p. 34) and Holloway (2000, p. 116) argue for a marginally later date of around 430 BC, but Spawforth (2006, p. 126) still favours a date between 450 and 440 BC. Regardless of the precise date, there is strong agreement that this temple post-dates Temple D on the same ridge by a decade or two. It lies on the southern ridge of the Valley of the Temples approximately halfway between the temples A (see section 6.1) and D (see section 6.3). The temple is extremely similar in size to the Temple D, being 39m by 17m. It too is built to a six by

thirteen column plan (Marconi 1929, p. 80; De Miro 1994, pp. 50-1). It is the most complete temple still standing at Akragas, though railings by the temple cause some problems for compass readings.



Temple F, the *Temple of Concord*, at Agrigento. Photo Author.

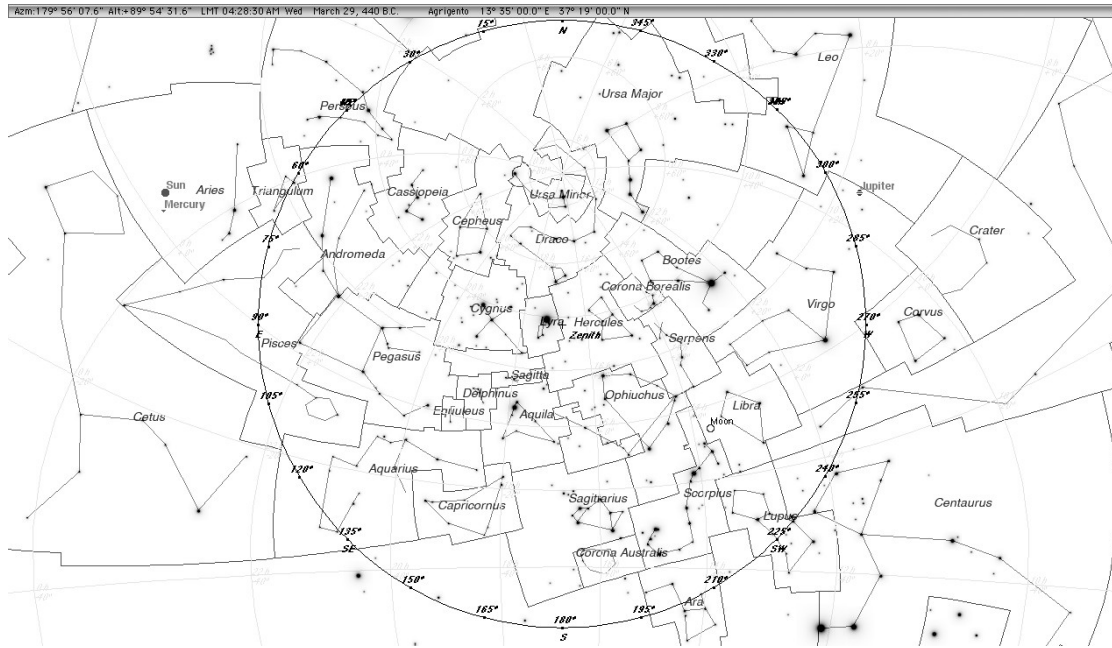
The attribution of the temple to Concord is unlikely and the result of an interpretation of an inscription discovered near the temple (Marconi, 1929a, p. 86). An attribution may still be possible. Delle Cave and Golin (2004, p. 31) state that in the sixth-century AD the bishop Gregorius consecrated the temple as a basilica. As part of the process he removed two Carthaginian idols to Eber and Raps. These idols Dell Cave and Golin suggest could mean the temple was a temple to the Dioscuri. However the confusion of Tanit symbols with Hercules at Temple A (see section 6.1) indicates that attributions do not easily map from one culture to another.

Measuring an alignment could potentially be contentious. This is because like Temple A, Marconi's plan of the temple shows impossible shadowing. Once again De Miro's plan (1994, p. 51) lacks a north indicator, but does clearly show an entrance at the left of the plan. After examining satellite data and aerial imagery this would seem highly unlikely, which would suggest another printing error.

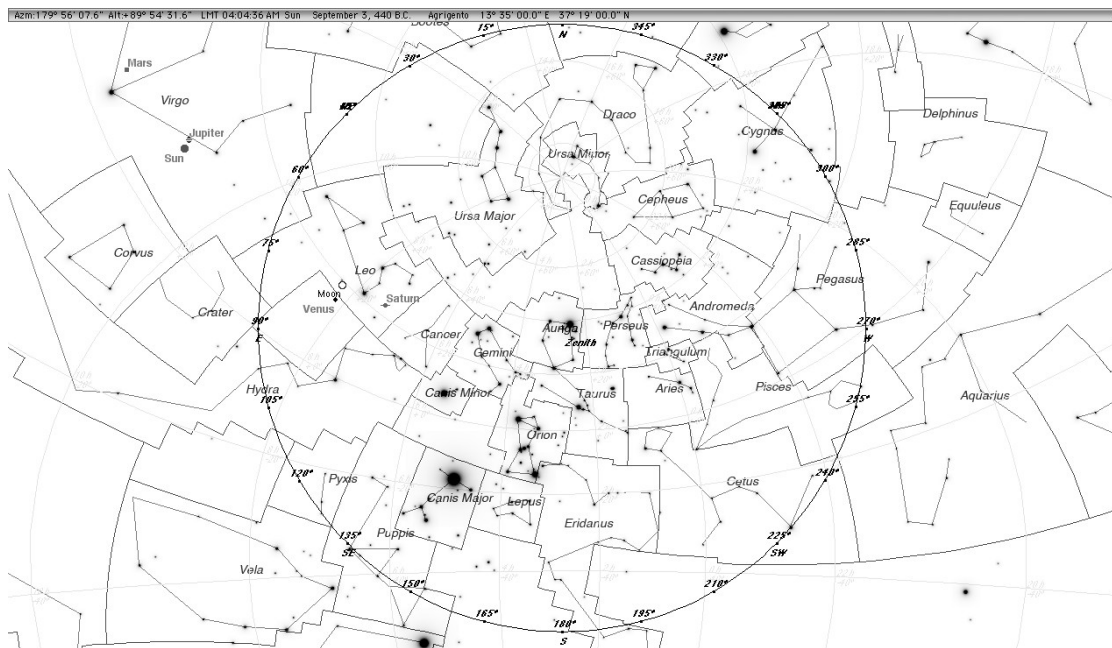
Aveni and Romano (2000, p. S52) record the orientation as 87° . My own observation revealed an orientation of 87° with an altitude of $+1^\circ$ to the East. Koldewey and Puchstein (1899, p. T26) record 97° . Penrose (1897, p. 56) records $270^\circ 4'$ which translates to 90° . This reduces to a declination of $+3^\circ$. In the Gregorian calendar the temple would face sunrise on 29 March and 16 September.⁸

The constellations rising in the pre-dawn sky before the spring alignment are Triangulum and Pisces. Gemini, the constellation of the Dioscuri, would not be visible in the dawn sky till late June, and too far to the north for the temple to be aligned to these stars. In the autumn alignment Crater is rising, with Corvus and Virgo to follow a week later. At this time Gemini has not yet set before the sun rises. There is no astronomical reason to connect this temple with Gemini, and thus the Dioscuri, but it is not necessary for a temple of Demeter and Kore to face the rising of Virgo, so this is inconclusive.

⁸ 3 April and 21 September for 440 BC in the Julian calendar.



Projection of the sky at Astronomical Dawn for 29 March 440 BC at Akragas.



Projection of the sky at Astronomical Dawn for 16 September 440 BC at Akragas.

The temple points to the rising of the stars α Virginis *Spica* (ancient *Stachys*) ($2^{\circ} 15'$ mag.1.05) β Aquilae *Alshain* mag.3.72, γ Pegasi *Algenib* (2° mag.2.82), λ Tauri *Elthor* (mag.3.42), α Orionis *Betelgeuse* (mag.0.56). While α Virginis may have had a calendrical use (see section 15.3) it does not have any obvious connection to a temple of the Dioscuri. The same can be said of the other stars aligned with the temple.

In contrast there might arguably be a topographical connection. The slight skew of the temple away from east-west means that the alignment to the west faces the port. When the sun sets over the port, when it lies at -3° , this is approximately the end of the sailing season, and the Dioscuri were among other things, the patron gods of sailors. In the context of this study the argument is unconvincing, coming as a post hoc justification based on one data point, but it could be tested against other temples dedicated to the Dioscuri in other port cities. This would require a wider geographical range than this study as Sicily lacks comparable temples.

6.6 Akragas Temple G (Vulcan)

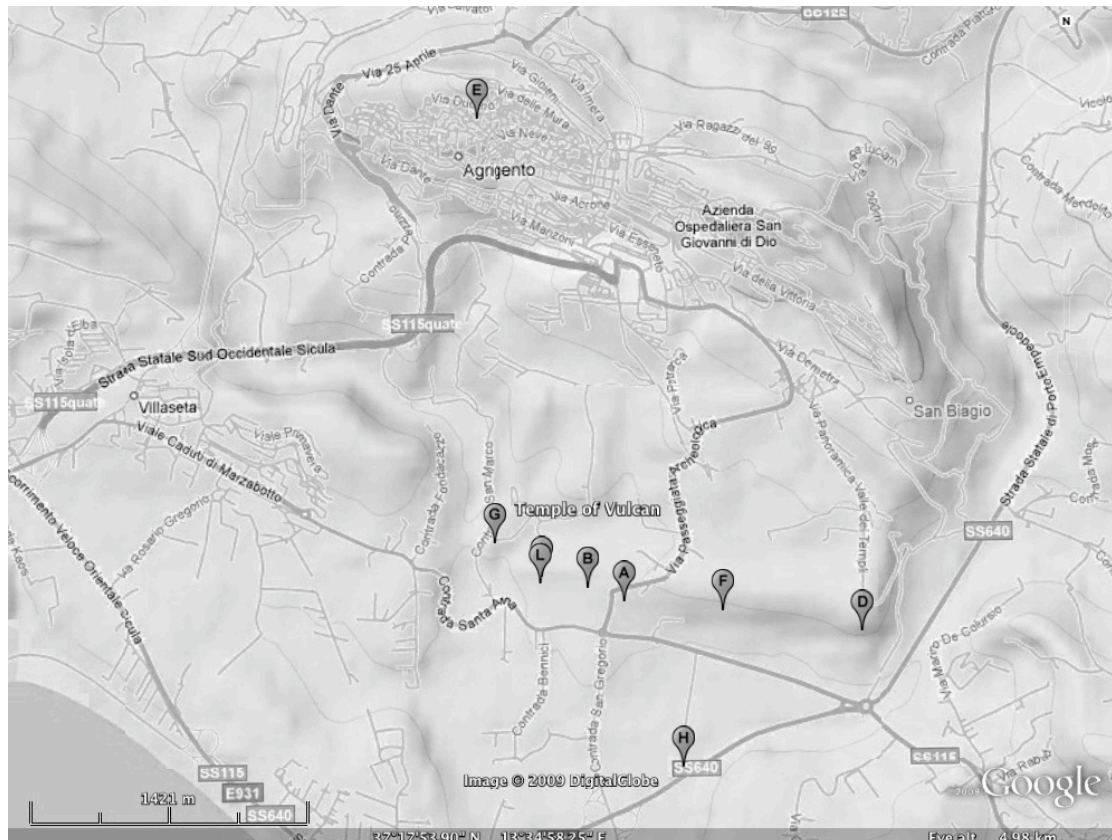
Location: Agrigento

Deity: Hephaistos?

Date: 600 or 440-400 BC

Azimuth: 87°

Declination: 2°

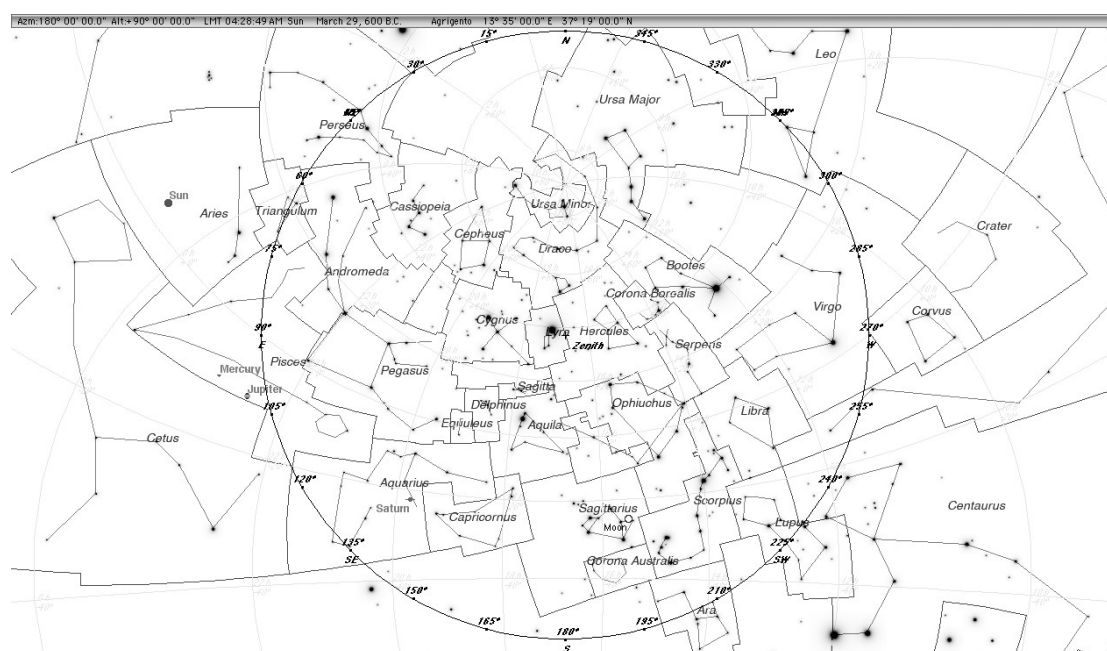


The Temple of Vulcan (G) and Agrigento © Google

Temple G is the Temple of Vulcan, a multi-phase temple. The later phase is dated from study of the architecture to the final third of the fifth-century BC, which Marconi (1933:122) states is consistent with the data from his excavation. In the centre of this temple is found another smaller temple slightly off alignment. This is dated to the archaic period, again typologically by Marconi (1929a, p. 126) to the start of the sixth-century BC. Given the proposed foundation date for the city, this would be possibly the earliest stone temple on site. The attribution to Vulcan or Hephaistos appears to be uncertain (Marconi, 1929a, p. 86). De Miro (1994, p. 52) proposes a plan of six by thirteen columns.

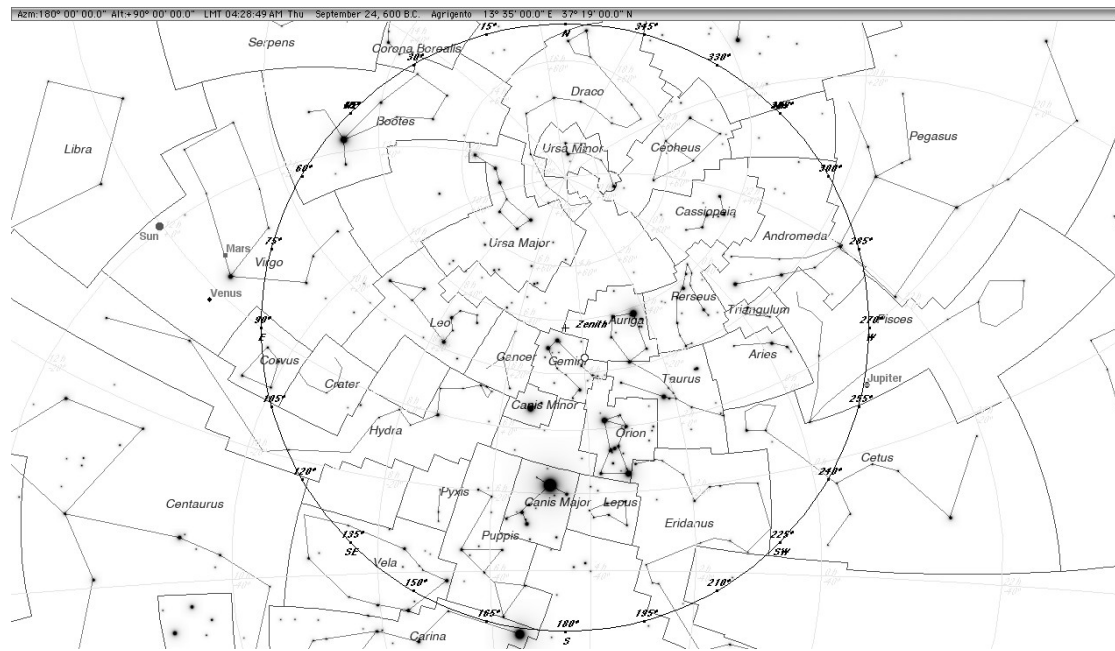
The difference in time between the two phases poses a potential difficulty in searching for stellar alignments. Precession of the equinoxes means that the positions of the stars could have moved significantly over the passing of two centuries. For this study the significant date is the start of the sixth-century BC, as this is when the foundations for the temple were laid down.

This temple was measured from plans (De Miro, 1994, pp. 22-3) rather than on site as it was not accessible at the time. The orientation is 87° which, with a flat horizon, faces declination $+2^\circ$. Aveni and Romano (2000, p. S54) measure the alignment at 86° . Koldewey and Puchstein (1899, p. T27) record the azimuth at 95° . Penrose does not record a measurement. By my measurements this would face sunrises on 26 March and 19 September in the modern calendar.⁹ This could face sunrise following the rising of Arcturus, marking the start of a new year (see section 15.3 for information on the calendar).



Projection of the sky at Astronomical Dawn for 26 March 600 BC at Akragas.

⁹ 31 March or 24 September in for the start of the sixth century BC in the Julian calendar.



Projection of the sky at Astronomical Dawn for 19 September 600 BC at Akragas.

The temple points to the rising of the stars, α Pegasi *Markab* ($2^{\circ} 45'$ mag.2.49), γ Pegasi *Algenib* ($1^{\circ} 12'$ mag.2.82), λ Tauri *Elthor* (mag.3.42), α Orionis *Betelgeuse* ($2^{\circ} 50'$ mag.0.56), η Piscium *Kullat Nunu* ($1^{\circ} 5'$ mag.3.63). None of these stars has any notable connection with Hephaistos. In 599BC the temple would see Arcturus in Boötes, and Crater and Corvus rising before dawn in the autumn. Spica in Virgo would not be visible, but Vindemiatrix (Protrygetor) another star recognised by Aratus may have been visible in the eastern sky. For the spring alignment the rising constellations were Andromeda and Aquarius. Alternatively it could simply be a general easterly orientation.

6.7 Akragas Temple H (Asklepeion)

Location: Agrigento

Deity: Asklepios

Date: Hellenistic

Azimuth: 90°

Declination: 0°



The Asklepeion and Agrigento © Google

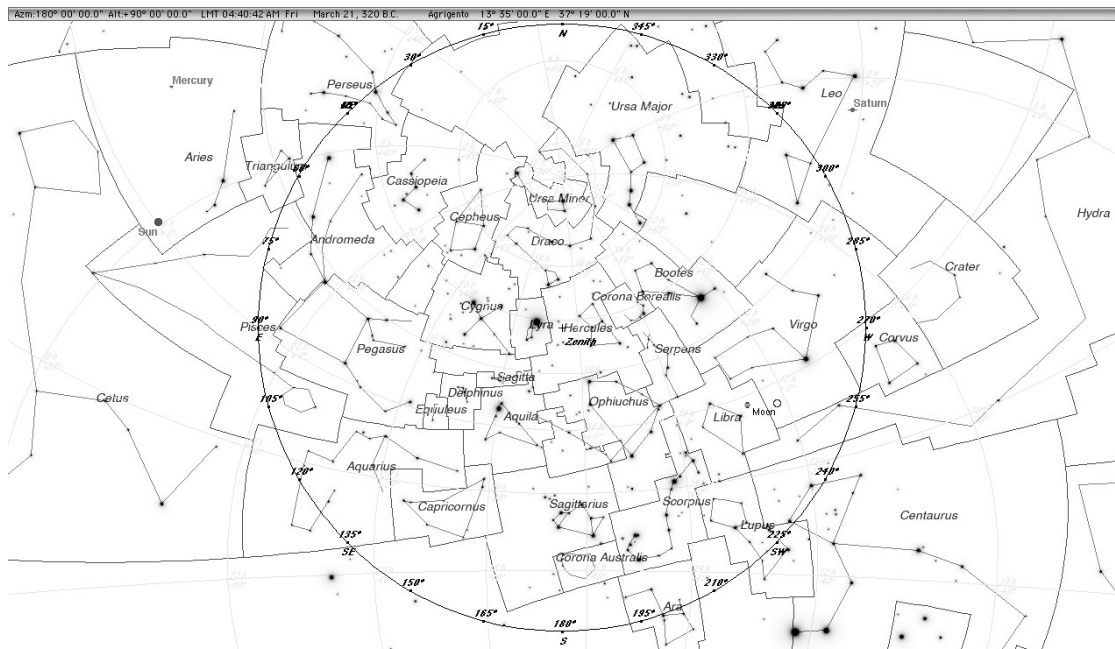
Temple H is identified as the Asklepeion outside of the city. The temple is comparatively small, Marconi (1929a, p. 28) measures it as 22m by 11m. This has been subject to excavations which have recently been published by De Miro (2003). The temple, which appears not to be colonnaded, opens to the east (2003, p. 37) and De Miro's plans indicate that it opens at an azimuth of 90°. Aveni and Romano record no alignment. Koldewey and Puchstein (1899, p. T27) record an alignment of 96°. Given that de Miro's own measurements are accurate when corroborated with Aveni and Romano, who in turn are broadly in concordance with my own measurements, his alignment is likely to be accurate rather than a broad indication

adopted for convenience. The date of the monumental sanctuary appears to be a rebuild over and older site (De Miro, 2003, p. 74) from the second half of the fourth-century BC, with work continuing to the third century BC (De Miro, 2003, p. 73) based on architectural forms. This would be in the era of geometrical astronomy and so the alignment could be consistent with a geometrical notion of East rather than East as the site of the rising sun. There is also an interesting hypothesis that visitors proceeded around the site in a clockwise fashion (De Miro, 2003, pp. 77-80), but it would be highly speculative to conclude that visitors followed the sun around the sanctuary without further study of contemporary Asklepeions at other sites.

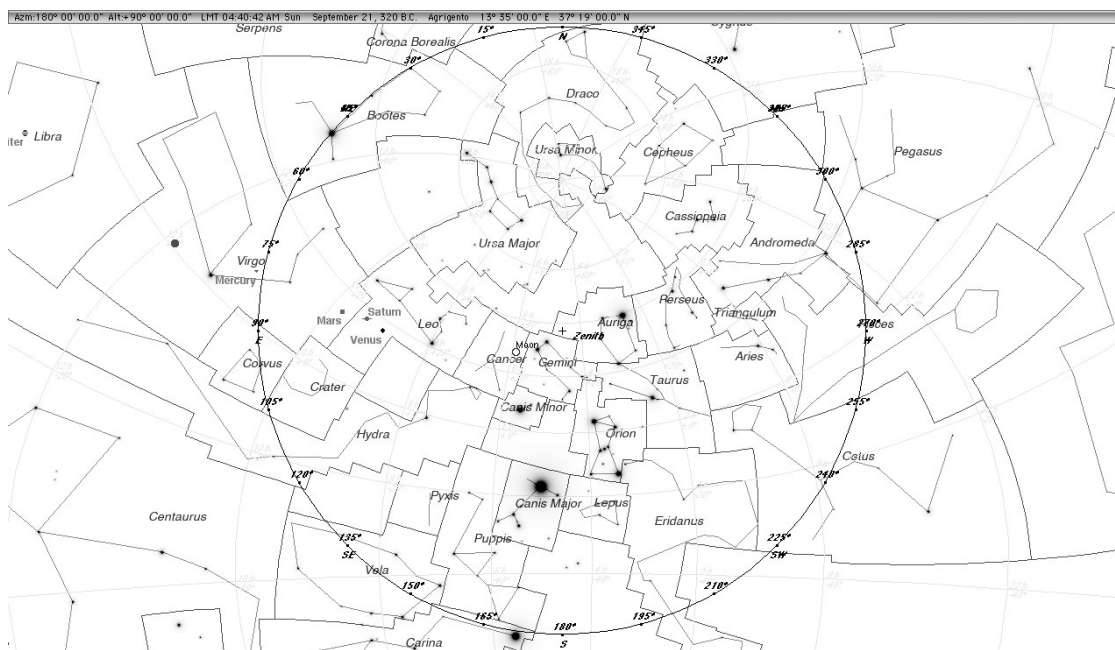
The alignment would be to the astronomical equinoxes 21 March and 21 September in the Gregorian calendar.¹⁰ Stellar alignments, and correlations with the Julian calendar depend on what date is assumed for the temple. In this case I am taking a figure of 320 BC, though correlations with the Julian calendar will be out by a day if the temple dates after 300 BC.

The temple faces the rising of α Hydrae *Alphard* ($-0^{\circ} 50'$ mag.1.99), ζ Pegasi *Homam* (mag.3.42), η Serpentis ($=0^{\circ} 45'$ mag.3.25), χ Tauri ($-0^{\circ} 34'$ mag.3.73), $\pi 3$ Orionis *Tabit* (mag.3.19). It could be possible to draw a connection between Asklepios and Serpens, the snake. However Hoskin (2001, pp. 43-45) has argued that the significant direction for many Mediterranean healing sanctuaries is to the south and the constellation of Chiron. In light of this the alignment towards a specific star in Serpens seems unlikely.

¹⁰ This would be 24 March and 24 September in the Julian calendar for dates before 300 BC.



Projection of the sky at Astronomical Dawn for 21 March 320 BC at Akragas.

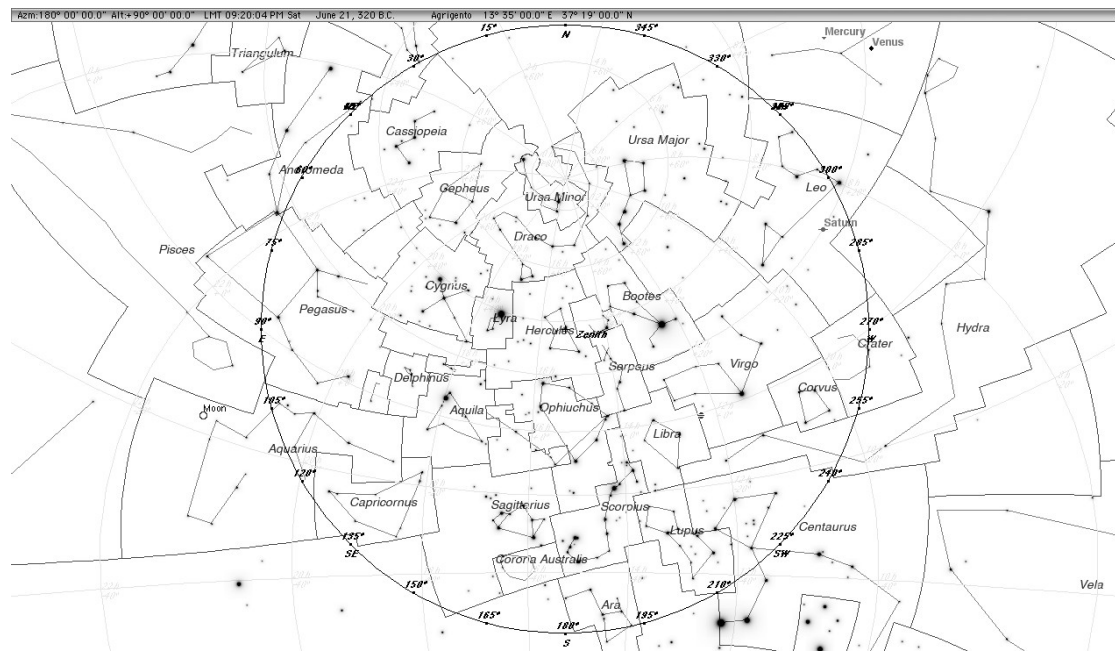


Projection of the sky at Astronomical Dawn for 21 September 320 BC at Akragas.

The spring rising constellations are Andromeda, Pegasus and Pisces, none of which have any obvious connection with Asklepios. The autumnal rising constellations are Boötes, Virgo and Crater, which are also not particularly associated with Askelepios.

Of more interest could be the alignment in a general sense with the constellations Serpens and in particular, Ophiuchus.

Serpens is a peculiar constellation as it is split in two by Ophiuchus, the serpent bearer. Given that the name *Ophiuchus* makes it clear his job is to hold the serpent, it is perhaps anachronistic to consider it a separate constellation from Serpens. This changes things, as Ophiuchus is extremely relevant to an Asklepios. Ovid in *Fasti* 6.733-7.62 devotes a whole day to the description of catasermism of Asklepios as Ophiuchus. This is also the origin of the constellation given by Ps.Eratosthenes (*The Constellations* 6). Ovid's description is of particular interest as it marks June 21.



Projection of the sky at Astronomical Dusk for 21 June 320 BC at Akragas.

At astronomical dusk on the day of summer solstice Ophiuchus is overhead when the Sun's glow leaves the sky. In contrast to Ovid's description of the youth soaring from the Earth, the constellation can only be seen falling in the evening sky. A, highly speculative, suggestion I could make is that the god is visible returning to the Earth. This may be significant with him being both catasermised and a chthonic god. The common use of oracles of Asklepios was by incubation (Nutton, 2004, pp. 103-4).

Therefore it is possible that the falling constellation symbolised the entrance of the god from the heavens into the body. However this is *post hoc* reasoning and requires a meaningful connection made with the sky to be accepted as a fact. It does not *support* the proposal that the constellation was meaningfully involved in local ritual in any way. However, a similar proposal that the alignment of a temple is less significant than the use of the temple at certain seasons, related to celestial movement, has been made in the context of Delphi (Salt & Boutsikas, 2005). If this is the case here then further investigation is required to show seasonal variation of use. In particular this notion would predict that the summer solstice would mark an event of particular significance.

If this interpretation is correct then the alignment with η Serpentis is entirely fortuitous and it is the movement of the constellation as a whole over the site which was considered significant.

6.8 Akragas Temples I and L (Demeter and Kore)

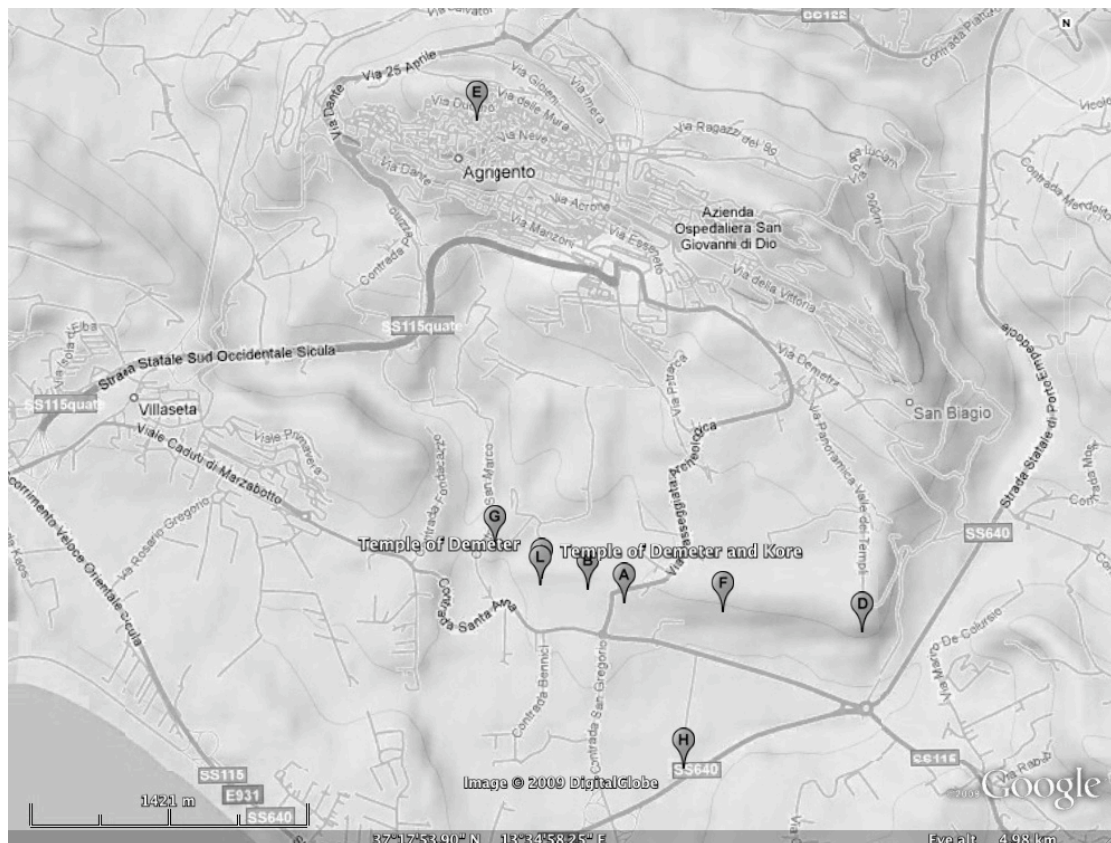
Location: Agrigento

Deity: Demeter and Persephone

Date: Temple I: 470s BC / Temple L: Hellenistic

Azimuth: Temple I: 80° / Temple L: 81°

Declination: Temple I: 9° / Temple L: 8°



The Temples of Demeter and Kore (I/L) and Agrigento © Google

Temples I and L lie alongside each other in the sanctuary to the Chthonic deities. Remains of Temple I stand after an enthusiastic reconstruction in the 19th century. The alignment for Temple I was taken along the cut of the visible foundations to avoid any errors from the reconstruction, and the errors inherent in measuring was is a small corner of a temple rather than a long wall. Temple L was measured from

plans (De Miro, 1994, p. 35) using the measurements of Temple I as a check. Hence I shall discuss the two temples together.



Temple I, the *Temple of the Dioscuri*, at Akragas. Photo Author.

The common attribution for Temple I, to the Dioscuri, is not accepted Marconi (1929a, p. 98) which is ironic given that a twin temple has been discovered to the south of it. De Miro (1994, pp. 31,35) argues that the temples were dedicated to Demeter and Persephone due to the presence of bothroi in front of the temples. These are also found in Helorus (see section 6.11) and are ritual pits for the laying down of sacrifices. The act of ceremonially laying down a sacrifice is a significant part of the Demeter cult having its own festival, the Skira (Brumfield, 1981, p. 160), preceding the Thesmophoria by four months. Both festivals are part of a cycle of agricultural events relating to the annual cycle of life which is personified in Persephone who moves between the worlds of the living and dead.

Temple I, Marconi (1929a, p. 26) notes, is unusual in that it is built into the bedrock which could be seen as indicative of a chthonic deity. The foundations gouged into the rock suggest a size of 28m by 10m (Marconi 1929:96). He also argues (1929a, p. 93) for a six by thirteen column plan. Marconi declines to date the temple, but argues from finds that it could be of Hellenistic date, possibly of the time of Hieron II. This could possibly be due to confusion with material from the proximate Temple L (see below). De Miro dates the temple as early as the 470s, referring to Diodorus (XI.26.7) who describes a temple to Demeter and Kore built on site after victory over Carthage. He also dates one of the bothroi to 475-470 BC (De Miro, 1994, p. 32). Temple L is of considerably later date, being finished in the Hellenistic period (De Miro, 1994, p. 35).

Temple I faces an azimuth of 80°, Temple L faces 81°. Aveni and Romano (2000, p. S54) measure Temple I as facing 81°. Koldewey and Puchstein (1899, p. T26) give a figure of 91° for Temple I and 93° for Temple L. Penrose (1897, p. 56) gives an azimuth of 266°, for Temple I, which is 86° from north. Both temples point to a horizon 2° high and away from a 0° horizon. This means that in 470 BC Temple I faces declination +9° or sunrise on 15 April and 1 September 1.¹¹ Temple L faces declination +8° where the sun would rise around 11 April and 3 September.¹² The proximity of the autumn dates for the alignment would support an autumnal target around 2 September.

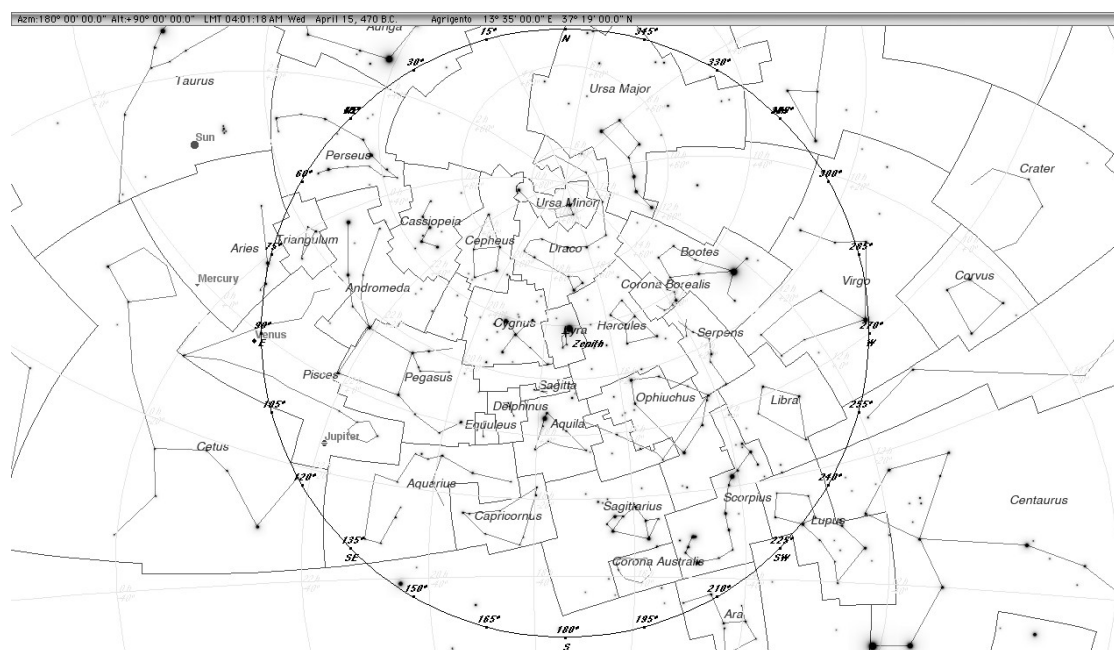
Connecting the temple to a stellar correlate is difficult. At the time when the temples face sunrise the sun is entering Virgo. This may sound significant, the constellation was identified with Ceres by the Romans (Ps. Eratosthenes 9 and Hyginus 2.25) and

¹¹ 20 April and 6 September in the Julian calendar for 470 BC.

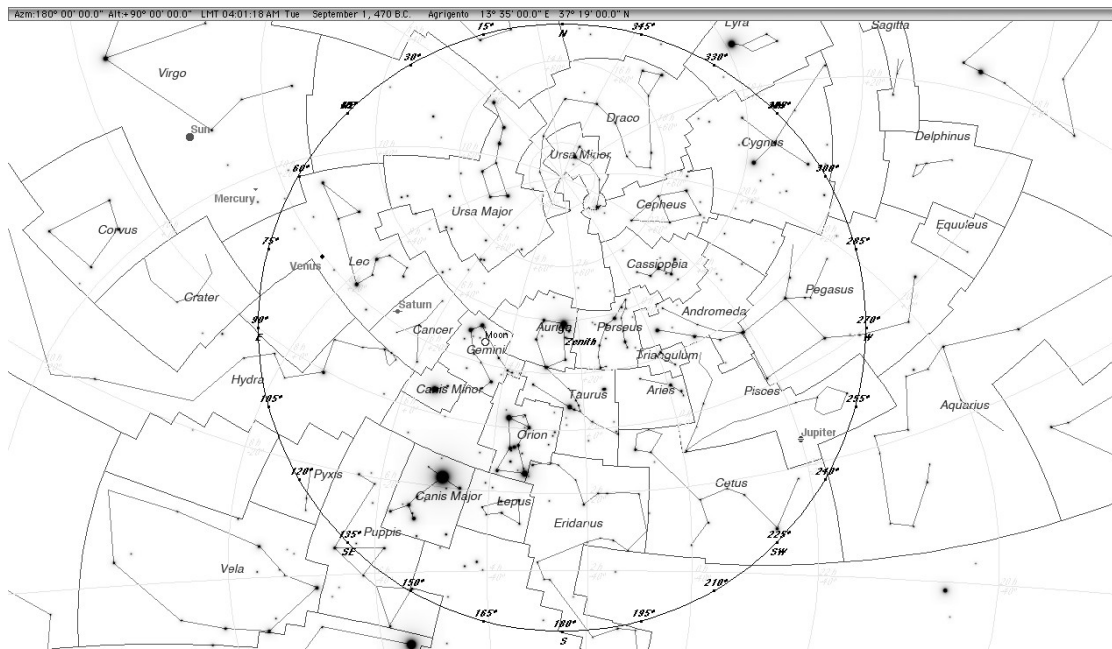
¹² 15 April or 7 September in the Julian calendar for 300 BC.

with agriculture by the Greeks (Aratus 97). Yet, the arrival of the sun would obscure the constellation.

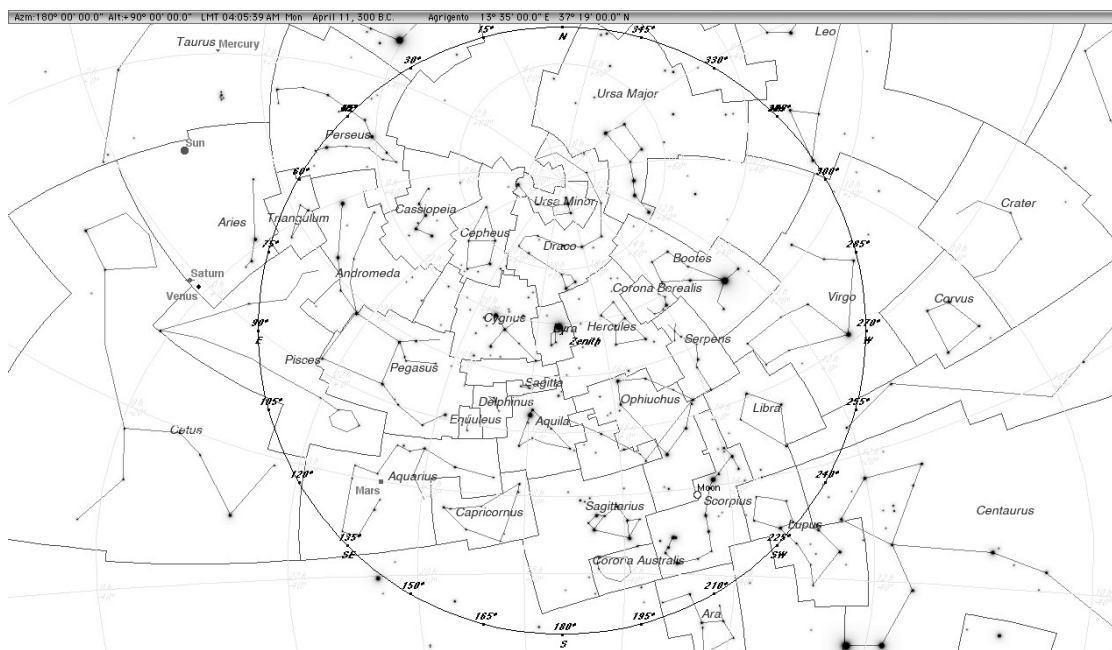
This obscurity may be important. Hesiod (*Works and Days* 385) mentions a similar phenomenon for the Pleiades in *Works and Days*. This is specifically in connection with agricultural practice and relates to the time between spring ploughing and the preparing the sickle. In the case of these temples, they both face sunrise a period of two or three weeks when Spica could not be seen in the night sky, before it rose ahead of the sun towards the end of September. The slight difference in orientation could be a case of correcting for the precession of the equinoxes in the construction of the new temple. The background stars would have slipped slightly round the year in comparison to the tropical year meaning the sunrise coinciding with Spica occurred slightly later. However this is speculative and cannot be expected to stand as a plausible idea alone, though there could supporting evidence from other Greek calendars (see section 15.3).



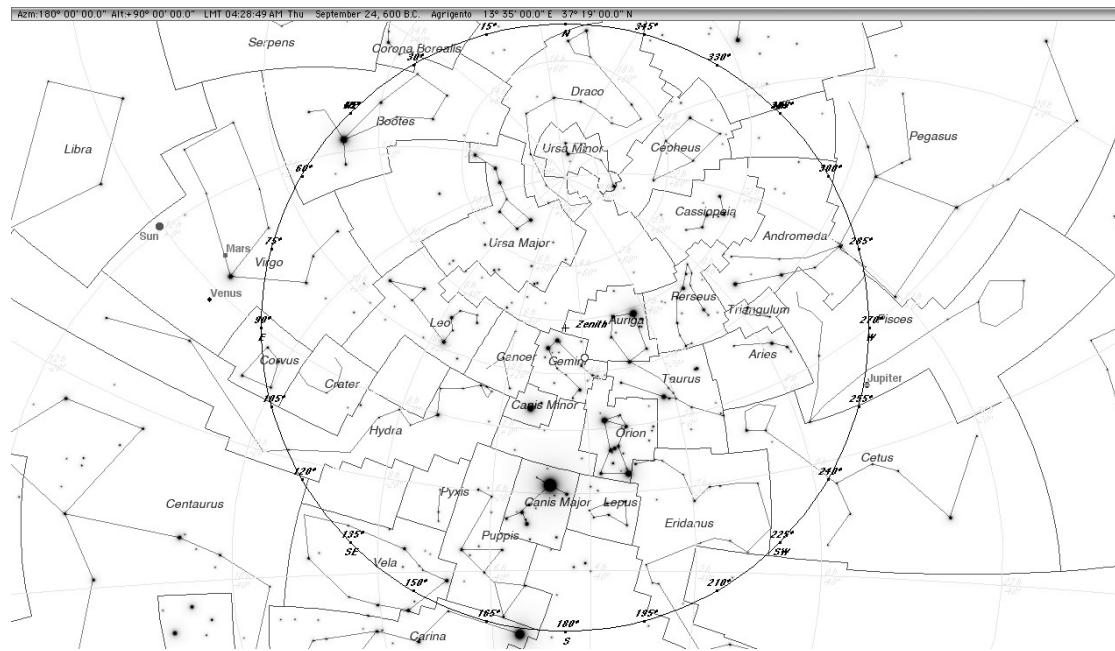
Projection of the sky at Astronomical Dawn for 15 April 450 BC at Akragas.



Projection of the sky at Astronomical Dawn for 1 September 470 BC at Akragas.



Projection of the sky at Astronomical Dawn for 11 April 300 BC at Akragas.



Projection of the sky at Astronomical Dawn for 3 September 300 BC at Akragas.

Temple I would face the rising of α Tauri *Aldebaran* ($8^{\circ} 44'$ mag.0.99), θ Hydrae ($9^{\circ} 35'$ mag.3.89), α Delphini *Sualocin* (10° mag.3.77), and β Delphini *Rotanev* (mag.3.63). Temple L would face α Canis Minoris *Procyon* ($7^{\circ} 18'$ mag.0.40), β Ophiuci *Cebalrai* ($8^{\circ} 33'$ mag.2.76), γ Aquilae *Tarazed* (mag.2.71), β Arietis *Sheratan* (mag.2.66), and γ Tauri ($7^{\circ} 18'$ mag.3.65). They share a common target in the Hyades, but this says more about the spread of the Hyades in Taurus than of any intentional target. Had Aldebaran been the intentional target of temple I and temple L were a replacement then the temple would have tracked the star's movement slightly to the north as its declination rose fractionally to $8^{\circ} 51'$ by 300 BC.

6.9 Akrai Temple of Aphrodite

Location: Palazzolo Acreide Deity: Aphrodite Date: Late Sixth-century BC

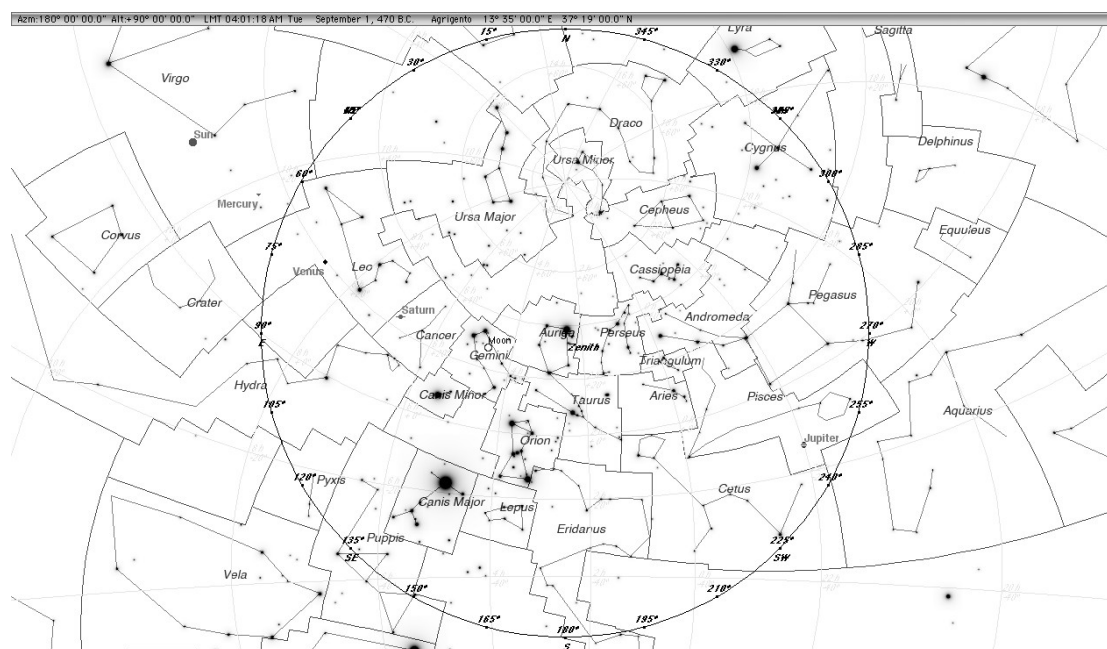
Azimuth: 67° Declination: 18°

The temple of Aphrodite sits on the western side of the hilltop that overlooks the modern town of Palazzolo Acreide. The attribution rests on inscriptions and many votive offerings. However Bernabò Brea (1986, p. 12) also notes there were offerings found to Kore and Artemis. He argues that these were secondary divinities due to the place they were found, to the east of the temple. The votive offerings allow Bernabò Brea (1986, p. 36) to date the temple to the second half of the sixth-century.



Temple and Topography at Akrai. © Google

The alignment for the temple is to the north of east, facing 67° . Unfortunately this could not be measured directly as the temple was inaccessible. Instead the alignment of the local theatre was measured and this used to calibrate the plans published by Bernabò Brea. Assuming a flat horizon the sun would have passed in front of the temple when it was at a declination of 18° . This would be around 12 May in the Spring.¹³ This may have coincided with the heliacal rising of the Pleiades. The other rising constellations are Aries and Perseus. In the autumn the Sun would pass around 3 August.¹⁴ This would be around the time of the heliacal rising of α Leonis, *Regulus*.



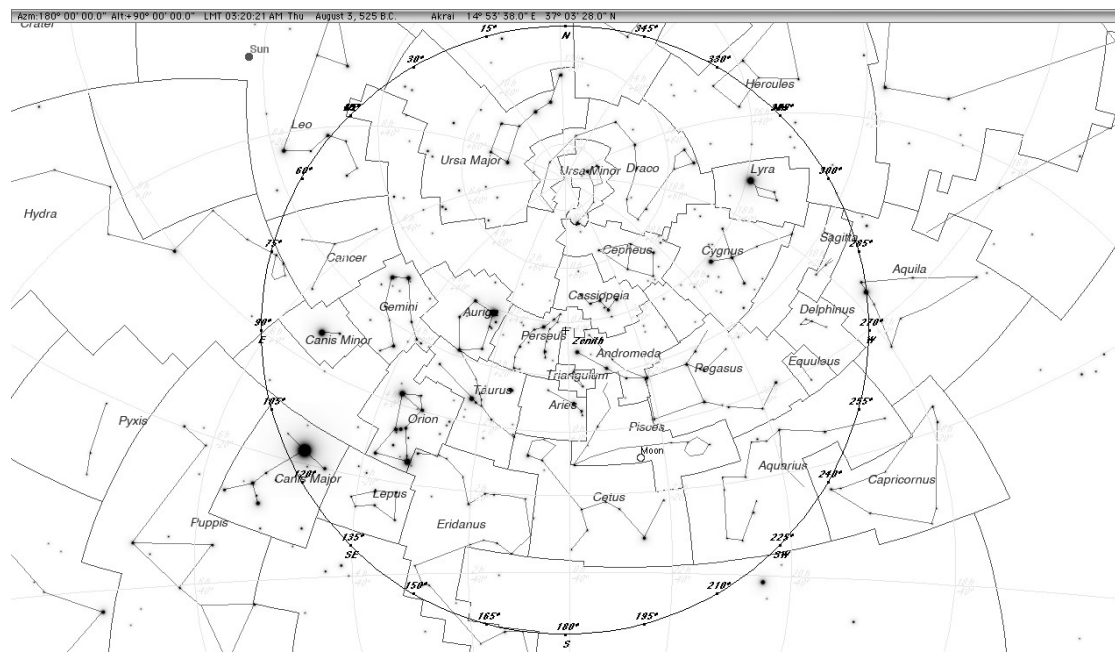
Projection of the sky at Astronomical Dawn for 12 May 525 BC at Akrai.

The constellations rising in spring for this period are Aries, Perseus and Cetus. However also rising to the north-east is the constellation of Auriga. In particular the stars α Aurigae *Capella* and the twin stars of ζ Aurigae *Haedus I* and η Aurigae *Haedus II*, known in antiquity as *The Kids* were rising (see also Himera A/B in section 6.14). It is possible the connection is significant. Lucian (*Dial. Meret.* 7) records that white goats were offered to Aphrodite Pandemos. Pausanias refers to the cult of Aphrodite

¹³ In the Julian calendar for the mid-sixth century this would be 17 May.

¹⁴ 8 August, for the same year in the Julian calendar.

Pandemos in Elis (6.25.1) and Athens (1.22.3) where Theseus was said to have unified Attica under the goddess (Simon, 1996, pp. 15-7), Rosenzweig (2004, pp. 73-4) describes a double shouldered hydra featuring a goat. This, along with other evidence she argues, connects both Aphrodite Ourania and Aphrodite Pandemos to the goat. Whether or not this is the case it would suggest that the symbolism was known in Sicily. For comparison there are temples to Aphrodite at Naxos (see Section 6.23).



Projection of the sky at Astronomical Dawn for 3 August 525 BC at Akrai.

For the autumn Sirius would have been low over the eastern horizon at the start of astronomical twilight at Akrai. However, given its brightness (mag.-1.44) it would have been visible in the morning sky earlier in the summer. Also if interest is the presence of Regulus below the horizon. It would have risen and its brightness (mag.1.40) it too would have been visible in the lightening sky. Apart from the rising of Leo, there appears to be little of interest rising in the sky at this time. The blank constellation to the top and left of Cancer is Sextans. This region of the sky is so dull it was unnamed until the 17th century AD by Hevelius (Allen, 1963, p. 376).

The temple would face the rising of α Ophiuchi *Raselhague* (mag.2.08), η Pegasi *Matar* ($18^{\circ} 36'$ mag.2.94), η Geminorum *Propus* ($18^{\circ} 52'$ mag.3.29), α Cancri *Acubens* (mag.4.26), σ Leonis *Subra* (mag.3.52) and δ Virginis *Auva* ($17^{\circ} 19'$ mag.3.42). The only particularly distinctive star is α Ophiuchi, but this would be pointing to the northerly extreme of the constellation. If the connection with the constellation were significant then a more southerly alignment would be expected.

6.10 Camarina Temple of Athena Pallas

Location: Camarina

Deity: Athena Pallas Date: Middle 5th Century

Azimuth: 107°

Declination: -14°



Topography of Camarina, south of Scoglitti © Google

This is the sole temple to survive at Camarina. These days it lies overlooking a bay near the modern resort of Scoglitti. It can mainly be found hidden beneath the site's museum that straddles the front of the temple (Di Vita, Stefano, & D'Andrea, 1995, p. 18). The rear pokes out beyond the museum walls and is exposed to the elements. This makes reconstruction of the local topography difficult, but it would appear that the entrance to the temple is at the crest of a slope. The rest of the temple sits on the slope that descends to the shore. In relation to the rest of the city, the temple would

have stood in the upper part of the town and would have been the most prominent landmark.

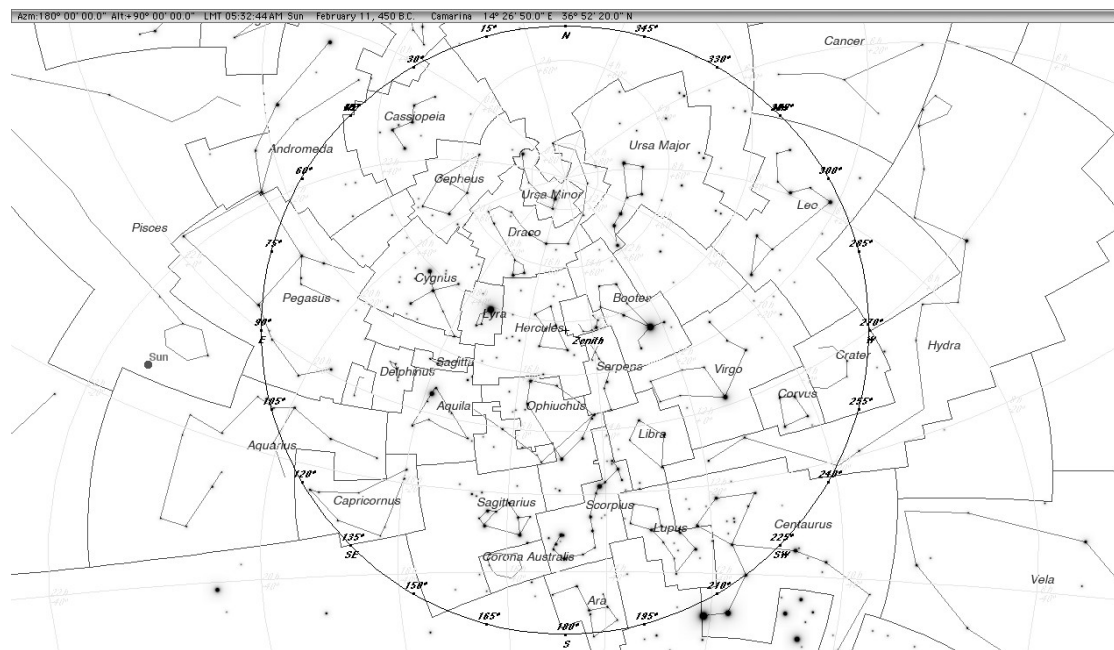
Pelagatti (1968-69, p. 354) dates the temple to the fifth-century BC on the basis of the cella. This is critical to our understanding of the temple as Camarina has had a chequered history, being settled three times (see section 8.3). This date would place the temple in the period shortly following the third settlement of the site, making it the product of Geloan settlers. It also means that the attribution of the temple can be determined with some probability. Pindar (Ol. 5) names Pallas as the protector of the city a name associated with Athena (Plato Crat. 406d). It would seem most plausible that the only major temple surviving, and which broadly matches this date is dedicated to the same deity.

Measurement of the temple's alignment was problematic. The internal structure of the museum building meant that sighting along the longest walls of the temple was impossible. Therefore only the alignment of the rear wall could be measured and its result turned through 90° to yield the azimuth of the temple. Unfortunately while this was visible, there was a metal fence embedded within the hedge next to the temple, and so a close inspection would not give accurate results. The solution was to site through a gap in the hedge from across the road outside the site. This was checked with the plans of Pelagatti (1968-69, p. 354), whose plan shows that the building appears to be orthogonal and the measurement reasonable. Unfortunately this temple was not surveyed by Aveni and Romano, and so there is no further check on the measurement.

The azimuth of 107° and the distant horizon in front of the temple indicates that the temple faces a declination of -14° . In 450BC this would face sunrise around 11

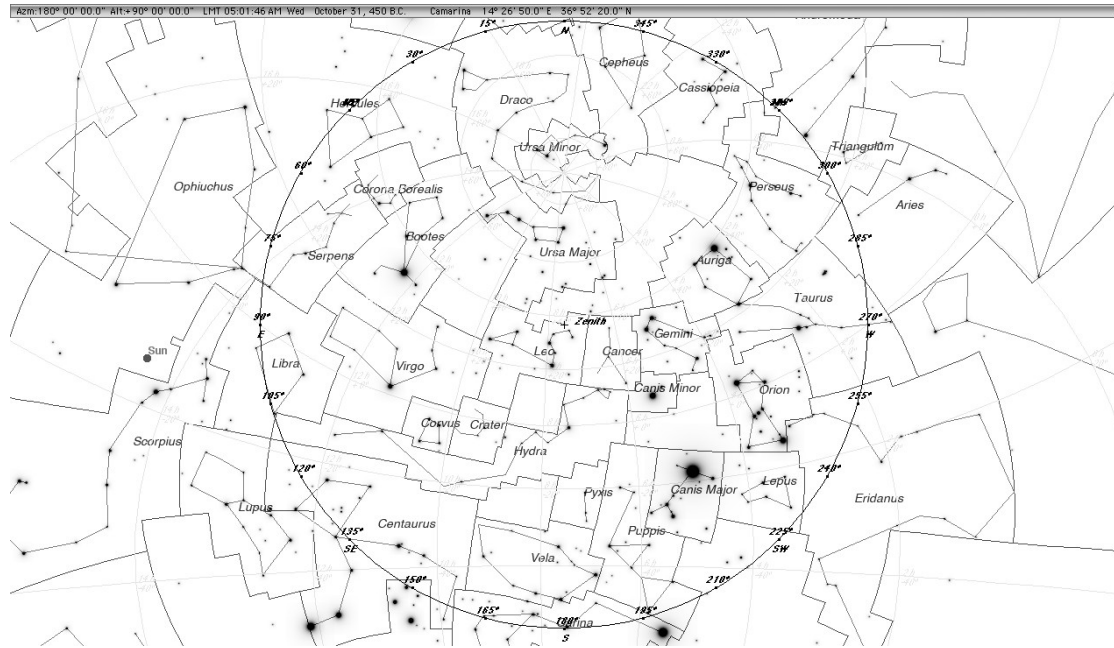
February and 31 October in the Gregorian calendar.¹⁵ This would coincide with the rising of Aquarius and Andromeda in the spring and Hercules, Libra and Centaurus in the autumn. These constellations may have served a calendrical function, but there is no reason to assume a definite link with cult practice at the temple.

The temple faces the risings of the stars π Hydrae (mag.3.25), σ Librae *Brachium* (-13° 26' mag.3.27), β Aquarii *Sadalsuud* (mag.2.89), β Orionis *Rigel* (mag.0.28) and κ Orionis *Saiph* (mag.2.05). None of these have an obvious connection with Athena Pallas.



Projection of the sky at Astronomical Dawn for 11 February 450 BC at Camrina.

¹⁵ 16 February and 5 November in the Julian calendar for the mid fifth century BC.



Projection of the sky at Astronomical Dawn for 31 October 450 BC at Camarina.

There are New Moons around 453, 450, 445, 442 around the period the sun rises at -14° declination in the Spring, and 456, 453, 450, 445, 442 around the period the sun rises at -14° declination in the autumn. The lack of accurate dating and sheer number of events means that it is impossible to associate the temple with any specific event.

Nonetheless the orientation of the temple, the bulk of which is up a hill and off alignment from the street grid (see section 8.3) suggests that topographical restrictions were not a major concern in the alignment of the temple. The lack of other buildings in the vicinity till the fourth or third century BC would also suggest that the spot was specifically chosen, possibly suggesting that to the builders, if not their descendants, that an unobstructed view was important, but may not have been the sole motivation for the site.

The orientation of the temple would also give a broadside-on view of the building from the sea if Camarina were approached from the south. From the north the temple would be somewhat more face-on. The visibility of the temple could have

been of importance as the coast was known to be dangerous. Polybius (I.37) records the destruction of two hundred and eighty four vessels from a fleet of three hundred and eighty-four during the First Punic War. The coast, Polybius says, was known to be rough with no safe anchorages. This would make Camarina an important port for travel along the coast, but arguments can be raised to support the premise that it would be more important that it would be more advantageous to signal to shipping that they had reached the last port before sailing along a dangerous coast or that they had reached the first safe port after the difficult part of the journey. The lack of additional temples (see section 8.3) makes it difficult to argue that there was a civic strategy for presenting the monumental architecture of the city. The temple can only be usefully analysed as part of the pattern of temples in the Geloan lineage or as one of Sicily Athena temples.

6.11 Helorus Temple of Demeter

Location: Eloro

Deity: Demeter

Date: Late 4th century BC

Azimuth: 99°

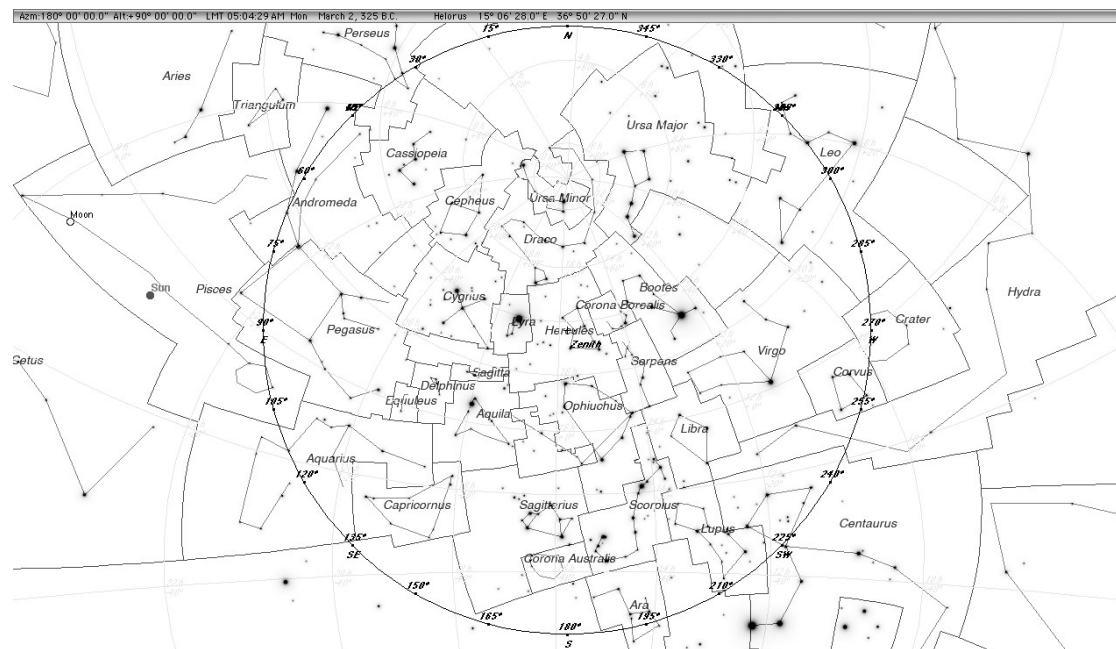
Declination: -7°



The Temple of Demeter at Helorus © Google

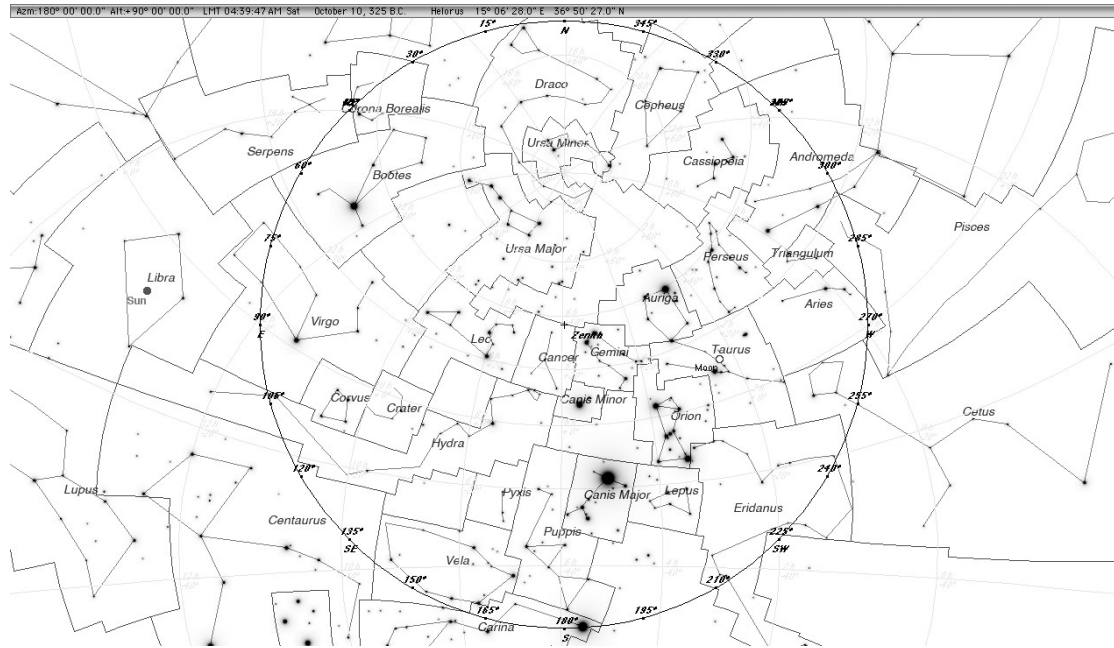
This is the only temple that can be said with any certainty to be a temple on site. It has been identified as the Temple of Demeter. The attribution rests on cultic material found in front of the temple, and fragments of inscriptions found nearby the terracottas being associated with Demeter (Voza, 1970 [1973], p. 300). Orlandini (1968-69) goes further and argues that it relates to Demeter Thesmophoros based on work at Bitalemi. This would match the most visible Demeter cult in Sicily. Stylistically the temple dates from the second half of the fourth-century BC (Voza, 1968-69, p. 361), which concurs with the dates of the offerings.

The temple sits at looking along the hillside with an azimuth of 99° . For Helorus this reduces to a declination of -7° . Aveni and Romano (2000, p. 554) in contrast gain measurements an azimuth 101° and a declination of -9° . They also date the temple to the 6th or 5th century for unspecified reasons. Using my measurements for the era 325 BC, the temple would face sunrise on March 2 and October 10.¹⁶ For the spring solar alignment Aquarius and Andromeda would be rising before sunrise. For the autumn solar alignment the stars visible before dawn would be those of Boötes, Corvus, Virgo and possibly Corona Borealis. Spica, the sheaf of grain in the Virgin's hand, would have heliacally risen around half a month before the sun rise in front of the temple at a declination of $+2^\circ$.



Projection of the sky at Astronomical Dawn for 2 March 325 BC at Helorus.

¹⁶ March 5 or October 13 for the late fourth century BC.



Projection of the sky at Astronomical Dawn for 10 October 325 BC at Helorus.

The temple faces the stars θ Librae (mag.4.13), ν Ophiuchi (-6° 13' mag.3.31), α Scuti *Ionnina* (mag.3.84), ι Piscium (-6° 28' mag.4.13), α Ceti *Menkar* (mag.2.54), ζ Orionis *Alnitak* (-6° 12' mag.1.74), μ Hydrae (mag.3.81), and α Crateris *Alkes* (4.07). None of these would appear to be significant to the temple.

6.12 Heraclea Minoa North and South Temples (Aphrodite/Minos)

Location: Eraclea Minoa Deity: Aphrodite/ Minos ? Date: Unknown

Azimuth: 114° / 142° Declination: -19° / -39°



Location of the Sanctuaries at Heraclea Minoa. © Google

These two temples were examined by a visit to the site where they were found in a region labelled Area Sacra overlooking the theatre. The temples are not fully exposed, but show enough of their walls to identify the presence of buildings. The promixity, the temple walls are less than half a metre apart at one corner, makes it possible but not certain that one temple may partially overlie the other. This would be consistent with a description by Diodorus Siculus (4.79.3) who recorded that a

shrine to Minos was camouflaged by a temple to Aphrodite. This would be eccentric and risking the wrath of Aphrodite, but may be better understood as an explanation from Diodorus Siculus's own time of how the temples came to be so close together. Unfortunately this does not allow us to identify which temple is which. Work on the site (De Miro 1958; 1966; Mistretta, 2004, pp. 55-6) has not provided any other useful evidence.



The walls of the southern temple at Heraclea Minoa. Photo author.

The southern temple is designated ERAMIN-S in the analysis and is orientated with an azimuth of 142° towards a slight rise in the horizon of around two degrees. This faces a declination of -39° , too far south for sunrise, but would face a climbing sun. The more northerly orientated temple is listed as ERAMIN-N and faces 114° and a lower horizon of zero degrees. This would face 27 January and 17 November plus or minus a couple of days at declination -19° .¹⁷ There is a month known, *Aphrodision*, which could occur around the January alignment, but this is in Iasos, Caria and this is not a typical Greek month (Trümper, 1997, p. 116). It is said that the Lupercalia was a fertility festival (Ovid Fasti II.267), but the sources do not claim to know to which god the festival is devoted. There no reason to assume that Aphrodite (or Minos) was that god.

¹⁷ A conversion to the Julian calendar is pointless given the lack of dating material

Very roughly for the classical period the rising constellations for Temple Eramin-N would have been Pegasus and Capricornus or Sagittarius in the spring and Hercules, Libra and Centaurus in the autumn. It is tempting to analyse Temple Eramin-S for a stellar correlation. However while the alignment points within the borders of some modern constellations, these cannot be extrapolated back to ancient times. This would suggest these were *amorphoi*, unformed stars (Aratus 370-385) and thus of no particular interest to the Greeks.

6.13 Gela Temples A, B and C (Athena Lindia)

Location: Gela

Deity: Athena Lindia

Date: 6th & 5th centuries

Azimuth: 117°, 111°, 114°

Declination: -21°, -17°, -18°



The temples and acropolis at Gela © Google

Gela is a problematic site for study, due to the existence of the modern city over the remains of the Greek colony. Excavations have revealed ritual architecture in two locations. The remains of three temples have been found in what is now the modern archaeological park. This is assumed to be the ancient acropolis (Dominguez 2004:194). These were excavated and published by Orlandini (1968). Additionally Orlandini reports on excavations of a sanctuary to Demeter and Kore. Like the sanctuary to Kore at Helorus (see section 8.4) this does not fit neatly into the scope of

this study. It is excluded from the temple survey, but discussed in more detail in the analysis of temples to Demeter and Kore.

The acropolis was first excavated by Orsi in 1906 (Orlandini, 1968, p. 21). In addition to the remains of the temple now designated Temple C he found another temple, now known as Temple B and later under this temple he found evidence of another temple slightly off-alignment, now designated Temple A.

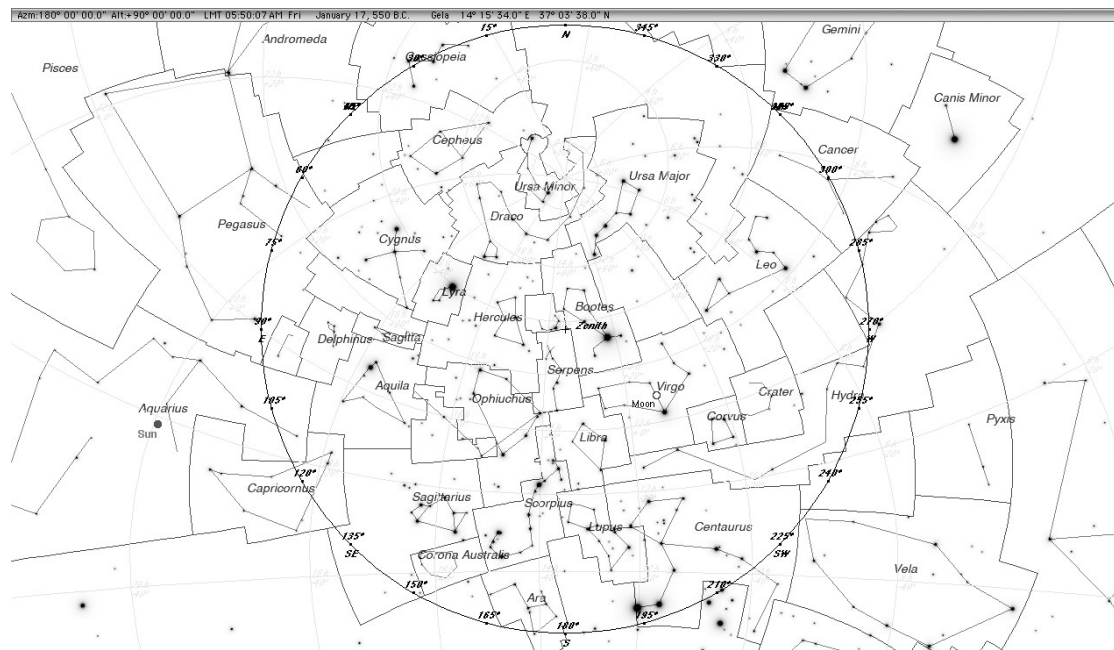
The dedication of the site of Temple A/B sites is said to be Athena due to finds such as a pithos inscribed with ATHENAIAS and terracottas of the goddess. Van Compernelle (1989:69) assigns an early date to this temple site, the end of the seventh-century BC. Orlandini's (1968, p. 21) work certainly shows that offerings date from this period. Terracottas to Athena Lindia would strongly suggest a phase of reconstruction on site in the second half of the sixth-century (Orlandini, 1968, pp. 24,28).

Temple C also seems to have been a temple to Athena. Orlandini notes the similarities with the Syracusan Athenaion (see section 6.32), and the temple to Athena at Himera (see section 6.16). Van Compernelle (1989) has expanded this analysis further to place the construction of Temple C in a phase of building following the defeat of the Carthaginians at Himera. He too notes the architectural similarities with other temples dedicated to Athena. The presence of booty may have funded a wave of temples in this period (see section 15.1).

Temple A faces 117°. The alignment was measured from Orlandini's plans. This was calibrated by cross-checking the plan for temple C with Aveni and Romano's (2000, p. 554) measurements. If the horizon was flat at the time of construction, this would face the horizon at a declination of -21°. This would face sunrise on 17 January and

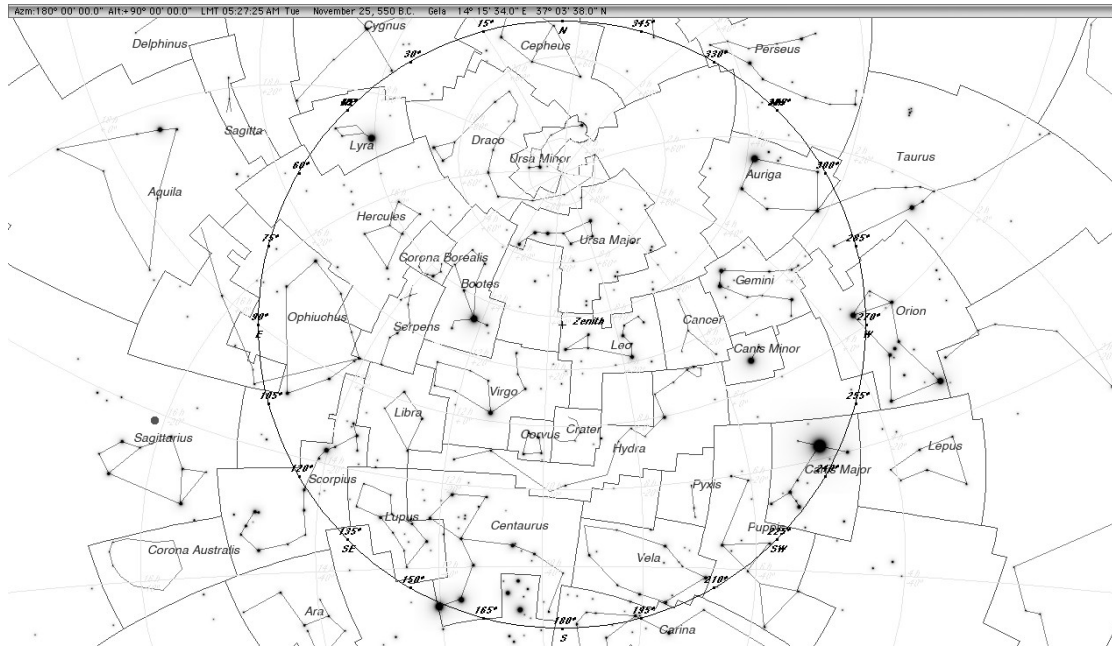
25 November.¹⁸ For autumn the rising constellations would have been Lyra, Ophiucus, Scorpius and Lupus. For the springsunrise they would be Sagittarius and possibly Delphinus. Lacerta also rises, but this was not an ancient constellation. None of these constellations would appear to have any special correlation with Athena.

The temple faces the rising of α Sagittarii (mag.3.76), ψ 1 Aquarii (mag.4.23), δ Eridani *Rana* ($20^{\circ} 27'$ mag.3.52) and ν 2 Canis Majoris ($-20^{\circ} 24'$ mag.3.95). None of these stars seem to be significant stellar targets.



Projection of the sky at Astronomical Dawn for 17 January 550 BC at Gela.

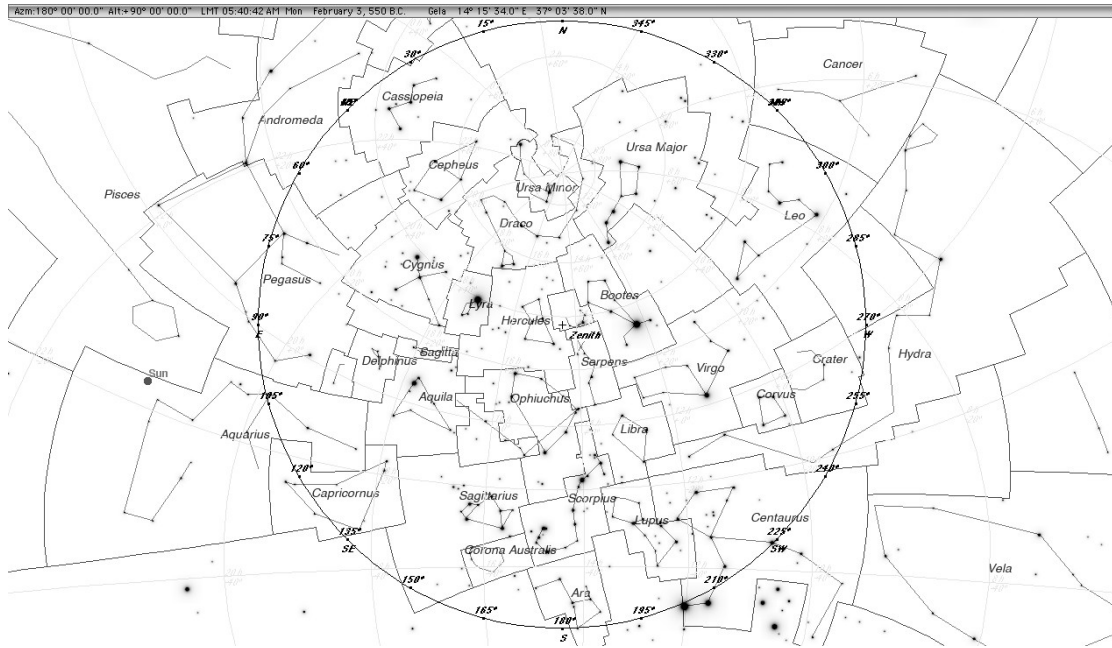
¹⁸ 22 January and 30 November in the Julian calendar for the sixth century.



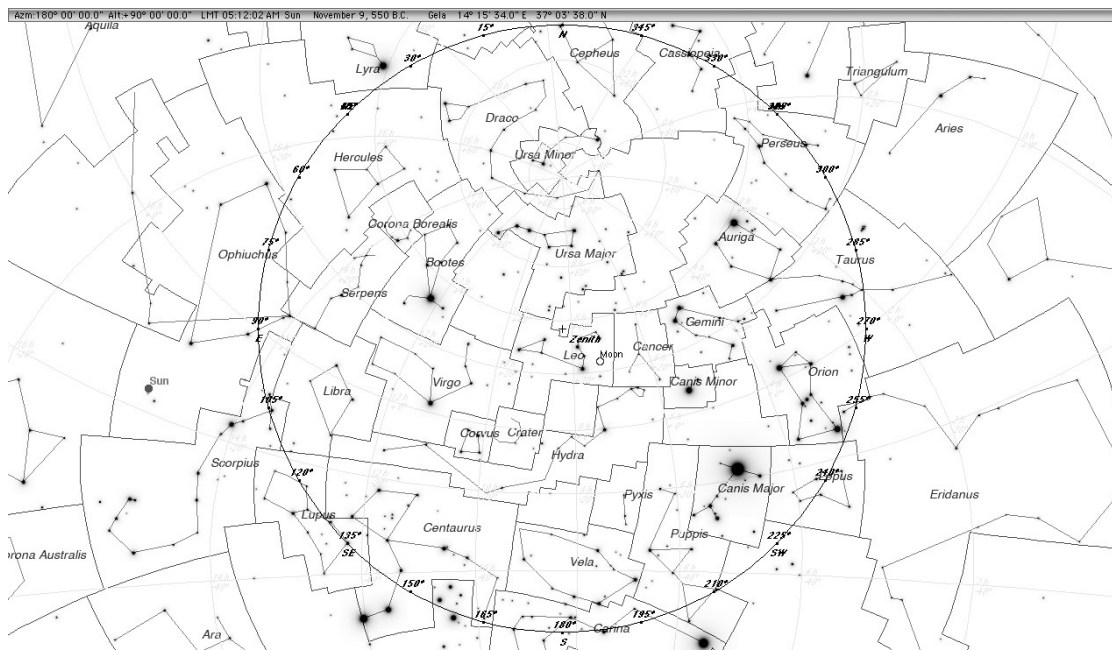
Projection of the sky at Astronomical Dawn for 25 November 550 BC at Gela.

Temple B faces 111° and a declination of -17° . Again these measurements were derived from the plan, as for Temple A. It would face sunrise around 3 February and 9 November.¹⁹ Autumn rising constellations are Hercules, Ophiuchus and Lupus. The springrising constellations would lie in Capricornus and Pegasus. Again none of these constellations would appear to be special to Athena. This temple is built over Temple A and so could arguably be the same data point (see section 15.1). I have included them separately as they face different alignments and so the orientation of the prior temple did not conclusively affect the direction of the later temple.

¹⁹ 8 February and 14 November in the Julian calendar for the sixth century BC



Projection of the sky at Astronomical Dawn for 3 February 550 B.C. at Gela.



Projection of the sky at Astronomical Dawn for 9 November 550 B.C. at Gela.

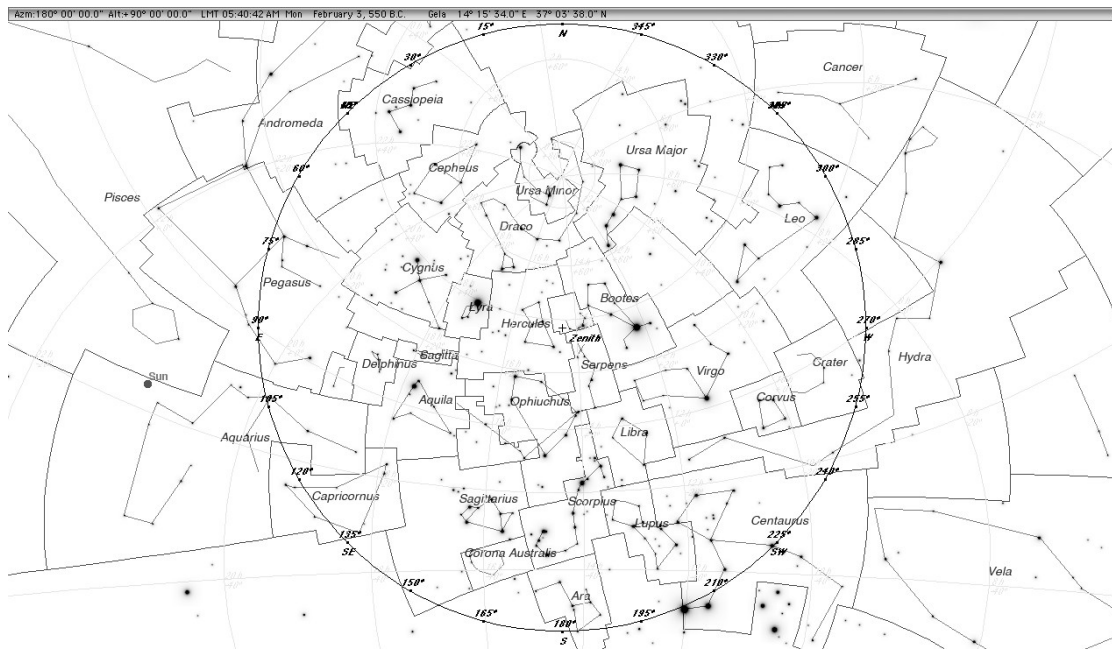
Temple B points to the rising of ν Librae *Zuben Hakrabi* (mag.3.59), α Scorpii *Antares* (mag.1.07), μ Sagittarii *Polis* (mag.3.83), $\alpha 2$ Capricorni *Algedi Secunda* (mag.3.57), $\phi 1$ Eridani *Beid* ($-16^{\circ} 20'$ mag.4.03), η Leporis ($-17^{\circ} 54'$ mag.3.72) and α Canis Majoris *Sirius* (mag.-1.44). Both *Sirius* and *Antares* bear Greek names and so could be plausible targets. However, there is no obvious connection between them and

Athena. Given enough temples and enough stars some will point at bright stars by chance. The lack of alignment for Temple A towards these stars suggests that the stellar alignment was not the original target. Given the short time span between temples A and B, it is unlikely that celestial targets became important for the construction for the latter temple.

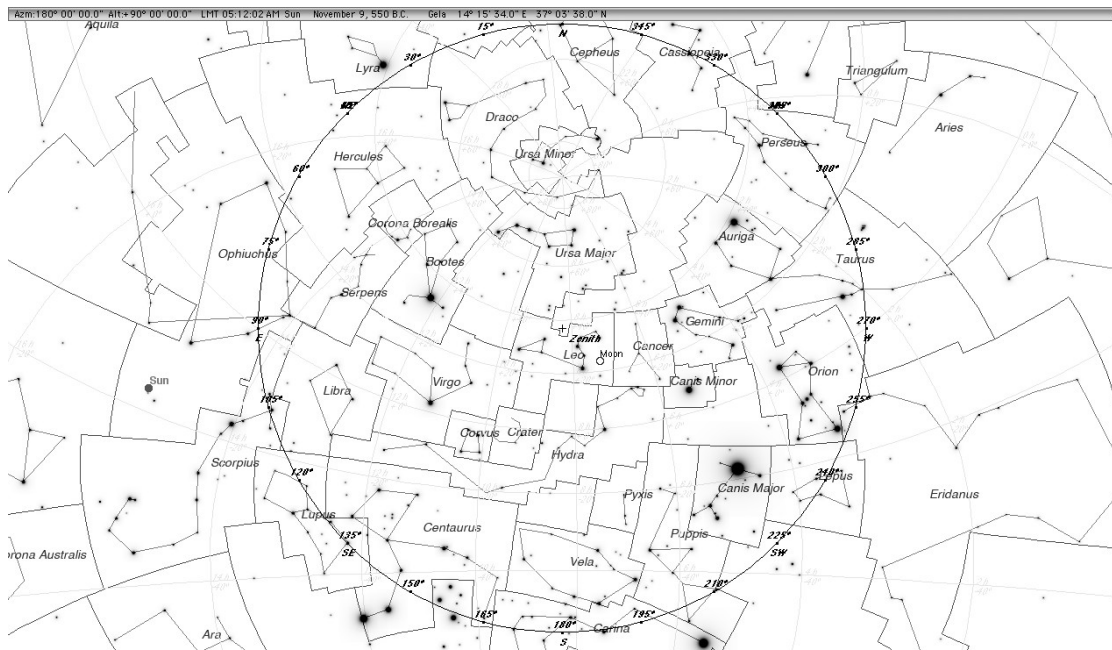
Temple C faces 114° and -19° declination if the horizon is flat. These measurements were taken from Google Earth and cross-checked with Aveni and Romano (2000, p. S54). This would place its alignment between Temples A and B, facing sunrise on 27 January and 17 November.²⁰ Ophiucus, Lupus and possibly Hercules would be the rising constellations in autumn, while Pegasus and Capricornus would rise in Spring. While it is the latest temple on site, its location to the east of Temple A/B means that its line of sight to the horizon is unimpeded.

The temple would have faced the rising of μ Sagittarii *Polis* (mag.3.83), ρ 1 Sagittarii (mag.3.93), β 1 Capricorni *Dabih* ($-18^\circ 53'$ mag.3.08), θ Aquarii *Ancha* (mag.4.17), λ Aquarii *Hydor* ($-18^\circ 54'$ mag.3.75), ζ Leporis ($18^\circ 47'$ mag.3.54), η Leporis (mag.3.72), α Canis Majoris *Sirius* ($17^\circ 16'$ mag.-1.44), ν Librae *Zuben Hakrabi* ($17^\circ 17'$ mag.3.59), α Scorpii *Antares* (mag.1.07) and γ Ophiuchi ($18^\circ 42'$ mag.3.25). Again, nothing with a striking connection to Athena appears to be present.

²⁰ 1 February and 22 November in the Julian calendar for the mid-fifth century BC.



Projection of the sky at Astronomical Dawn for 27 January 450 BC at Gela.



Projection of the sky at Astronomical Dawn for 17 November 450 BC at Gela.

6.14 Himera Temple A/B

Location: Himera

Deity: Unknown

Date: 7th Century

Azimuth: 67°

Declination: +18°



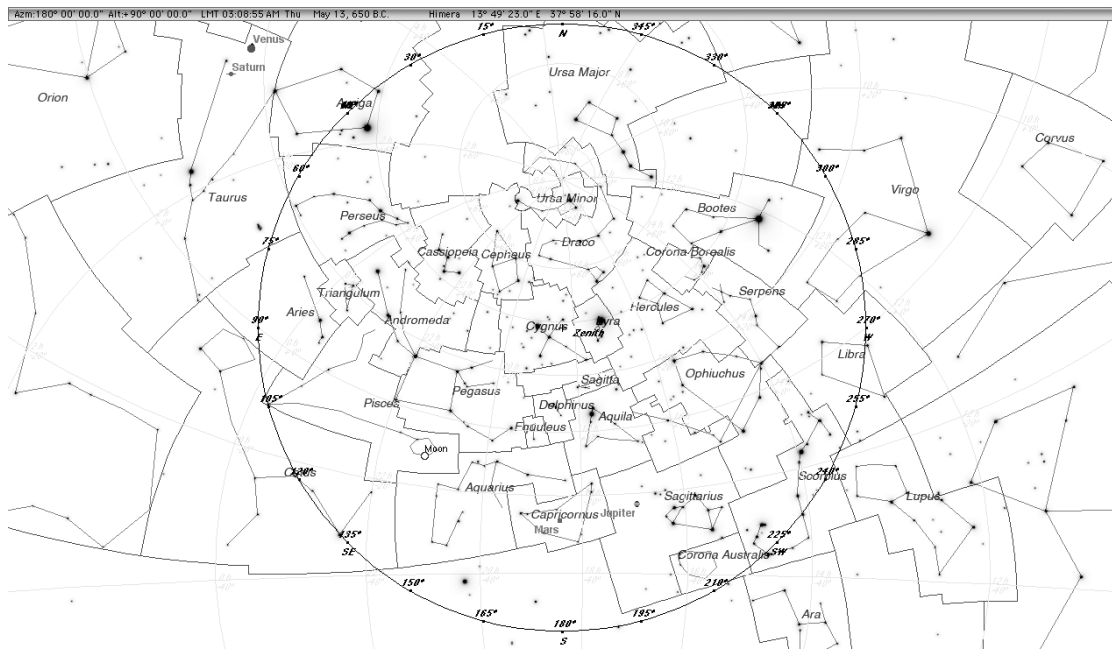
Temple A/B (A) at Himera © Google

The two temples A and B lie over the same location and share the same axis, which strongly suggests that they are not different data points, but phases of the same temple. Temple A is the smaller temple measuring 16m by 6m (Bonacasa, 1970, p. 77). Bonacasa (1970, p. 83) dates the temple to the earliest period of the site, being built some time during the third quarter of the seventh-century BC, through finds of votive offerings. The earliest date in is bounded by the foundation of Himera in 648BC (see section 8.7). The later Temple B is considerably larger, being 31m by 11m (Bonacasa, 1970, p. 122). Stylistically it dates from early in the sixth-century BC and is

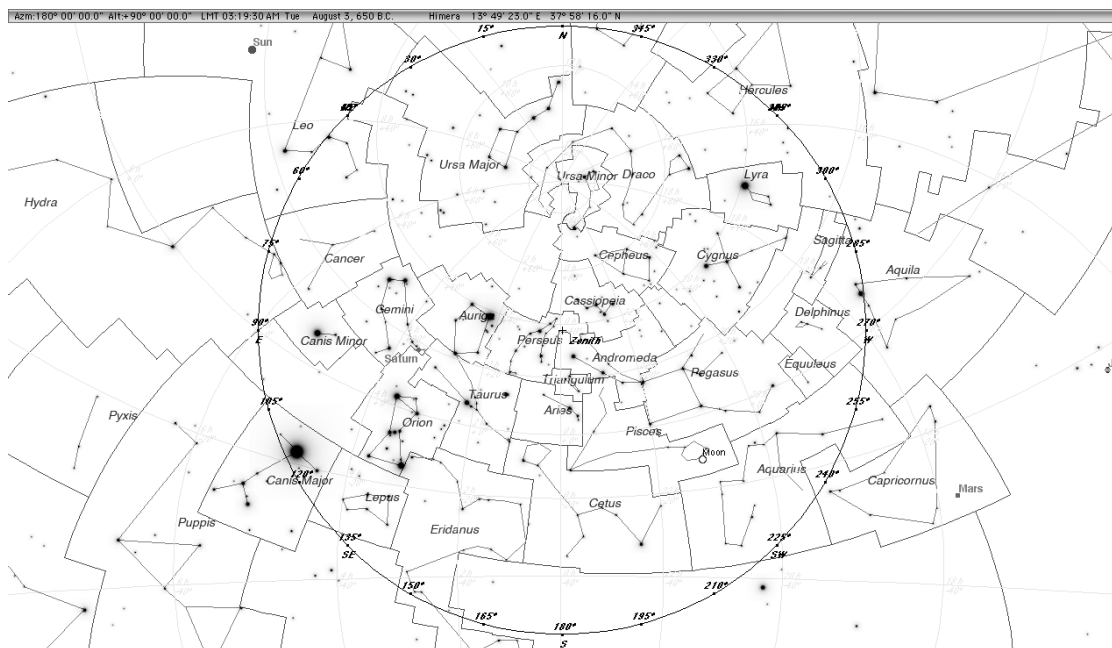
comparable to the temple of Demeter Malophoros (see section 6.28) (Bonacasa, 1970, p. 131). The orientation has been calculated from plans calibrated against the Temple of Victory. (see section 6.16). This gives an orientation of 67° and a likely declination of around 18°. This would be equivalent to 13 May and 3 August in the Gregorian calendar.²¹

In the spring the rising constellations would have been Aries, Perseus and possibly Cetus. Like the temple at Akrai the solar alignment would have also coincided with the heliacal rising of Capella and the Kids (see section 6.9). At the opposite side of the year, Cancer would have been low in the eastern sky in the autumn. Sirius would still be low having heliacally risen the previous month. Sirius is known from Hesiod to have performed a calendrical function (Hannah, 1994), but it is unlikely to be specifically linked to this temple as it would have risen much sooner than the date of sunrise in front of the temple. Its shared alignment with Temple C indicates that its direction may be more the result of urban planning which in the case of Himera (see section 8.7) would be peculiar. This alignment could also have implications for idea of an astronomical fingerprint for the worship of Aphrodite in Sicily (see section 13.1).

²¹ 19 May and 9 August for the Julian calendar for 650 BC.



Projection of the sky at Astronomical Dawn for 13 May 650 BC at Himera.



Projection of the sky at Astronomical Dawn for 3 August 650 BC at Himera.

The lack of attribution for the temple means that a search for significance in stellar alignments is futile.

6.15 Himera Temple C

Location: Himera

Deity: Unknown

Date: Late 6th or Early 5th Century Azimuth: 67° Declination: +18°



Temple C at Himera © Google

Temple C is the smallest temple on site measuring 14m by 7m (Bonacasa, 1970, p. 215). The temple is noteworthy for the discovery of a pedimental Gorgon head (Bonacasa, 1970, pp. 219-222). This, and the style of the temple suggest a date around the end of the sixth-century and the start of the fifth-century (Bonacasa, 1970, p. 224). A more recent analysis by Clemente (2006, pp. 214, 216-218) would favour an earlier date based on the popularity of Gorgon features in temple decoration in the sixth-century BC. Like Temples A/B calibration from the published plan suggests it is orientated to 67°, which with a flat horizon would face a declination of 18°. Like

Temple A/B, the orientation has been calculated from plans calibrated against the Temple of Victory (see section 6.16). This gives an orientation of 67° and a likely declination of around 18° . This would still be equivalent to 13 May and 3 August in the Gregorian calendar.²² Any astronomical significance it has is due to its shared alignment with Temple A/B indicates that it may say something of interest about planning in Himera (see section 8.7).

Again, the lack of attribution for the temple means that any stellar alignments found could not be meaningfully evaluated.

²² It would still be 19 May and 9 August for the Julian calendar for dates before 600 BC, but 12 May and 8 August for dates after 600 BC..

6.16 Himera Temple of Nike

Location: Himera

Deity: Nike

Date: 480 BC

Azimuth: 71°

Declination: $+15^{\circ}$



The Temple of Athena Nike at Himera © Google

The Tempio della Vittoria is the dominant temple at the site of Himera due to its physical remains remaining in better condition than those of the other temples. In contrast the other temples at the site, it seems the Temple of Victory can be securely dated, attributed and identified as a Greek temple. The temple was built by Gelon of Syracuse following the victory in 480BC over the Carthaginians. The date of the Battle of Himera is uncertain as it is said to have occurred on the same day as the battle of Thermopylae (Diod. 11.24.1) and the later battle of Salamis (Herod. 7.116). If

either of these dates were accurate it would be sufficient to draw some detailed astronomical data from the alignment.

Alas, Feeney (2007, pp. 43-52) has argued that the value of date may not be so much in recording when the battle happened but to emphasise the status of the battle and the Greeks who fought it. Just as the Spartans and Athenians defended the Greeks from the barbarians of the east, so too the Syracusans and Agrigentines defended Greece from the barbarians of the West. The battle is therefore likely to be around August or September in 480BC. If one takes the orientation and date of the Olympieion in Agrigento (see section 6.2) as meaningful, the battle occurred some time before August 28 in the Gregorian calendar. Archaeological evidence supporting the historical record is noted by Dinsmoor (1975, pp. 108-110) who detects many innovations built into the temple in Himera and the Athenaion (see section 6.32) said to have been built by Gelon around the same date. Marconi (1931:53) however warns that their building may have taken a long time and could date from anytime after 480 to the 460s.

Analysis of the plans of the temple show it is aligned to 71° (Marconi 1931, Bonacasa 1970), which gives a declination of 15° . Aveni and Romano (2000, p. S54) also took these measurements. In 480 BC this would face sunrise around 16 August in the modern calendar.²³ The date of the battle of Thermopylae is said to have been anywhere from July 31 to September 19 (Sacks, 1976 and see section 15.1 on the Battle of Himera) though it is uncertain if this is a Julian or Gregorian date. Feasibly if the temple was dedicated and laid out on the sunrise of the day following the battle at Himera, it would be expected to face in this direction. The correlation is extremely

²³ 20 August in the Julian calendar for 480 BC.

seductive even though it is based on a sole data point. To some extent this correlation can be tested by analysing the temples built following this battle as a wider set.

The temple would face sunrise when the constellations Aries and Perseus were rising, to coincide with a May 1 sunrise²⁴ if this faced a spring sunrise. If the important sunrise were in autumn it would face the rising sun when the constellations Leo and Columba, the Dove rise. It would be easy to see the dove as something significant as its rise coincides with the period when doves prepare to migrate and so making it dove-hunting season. No significance can however be drawn as the constellation was probably created by Royer in 1679 though Allen (1963, p. 166) argues it may have been known to Caesius. It is however unlikely to have been a constellation of fifth-century Greeks as Aratus [370-385] is emphatic that these stars are unformed and nameless.

²⁴ May 6 for the Julian calendar in 480 BC.

6.17 Megara Temple Ouest

Location: Megara Hyblaea

Deity: Unknown

Date: First half of the 6th Century BC

Azimuth: 92°

Declination: -2°



Temple Ouest at Megara Hyblaea © Google

This temple is named the Temple Ouest by Vallet (1976, pp. 25-26) and Building C by De Angelis (2004, p. 27). De Angelis (2004, p. 29) dates this building to the first quarter of the sixth-century for reasons which may be related to the demolition of seventh-century buildings to make space for the temple. Vallet (1976, p. 205) also records that the temple was built over houses, a house and a building he describes merely as rectangular to south of this house, built in the first half of the seventh-century BC. From an Ionic cup found in the foundations he tentatively dates this building to around 600BC. No data exists to say to whom the temple was dedicated.

The orientation has been derived from plans published by Vallet (1964), which were tested by magnetic compass survey. This survey found that the street alignments as recorded by Vallet were accurate and do the plans could be used to calculate azimuths. In the case of this temple it could not be identified at the site due to the reconstruction techniques used on site which run walls from different phases of settlement into each other.

The temple faces 92° and would have faced a flat horizon, if there were no houses in the line of sight at the time of building. It would have faced sunrise on 16 March or 29 September in the Gregorian calendar.²⁵ This is not certain. The temple was slightly off to the west of the agora. One question is when was the agora formed? While De Angelis (2004, pp. 17-20) sees intentional planning this may not be the case (see section 8.8). However the late seventh-century date for the East Stoa on the opposite side of the Agora would mean the natural horizon was not visible.

A 1° rise in height of the horizon would be caused by building 1.4m above the horizontal eyeline. This would mean if the observer were laying on the ground then the stoa would only have to be 1.4m tall to raise the horizon by a metre. If the observer were standing with eyes 1.6m from the floor then the stoa would have to be 3m high. With this azimuth a 1° rise in horizon height is a roughly 1° rise in declination. This would make spring sunrise alignments two to four days later, or a similar length of time earlier than the quoted date for the autumn.

²⁵ In 610 BC the Sun rose at this declination on 23 April and 4 September in the Julian calendar.

6.18 Megara Temple Heroon

Location: Megara Hyblaea Deity: Unknown Date: 630 BC?

Azimuth: 92°

Declination: -2°



The Heroon at Megara Hyblaea. Photo © Google

This building is described as a Heroon by Vallet (1976, pp. 209-211). De Angelis (2004, p. 26) notes Bergquist (1992, pp. 11-113) has argued the building is a Hestiatorion, but offers no opinion on the interpretation. The pottery found at the site may be a ritual assemblage, but its precise function is debatable. The building is referred to as a Heroon here to coincide with tradition. The layout suggests this is not an actual temple. Vallet (1976, p. 209) gives wall lengths from north going clockwise

of 12.8m, 9.85m, 12.60m and 9.6m. This would mean that while an axis may be stated, it may not have been intentionally of high accuracy. Another feature of the building is that it is divided in two, which challenges any notion of one alignment within the building. It is included as a temple as it is thought to have had a ritual function and an axis of alignment can be defined.

The building sits in the north-west corner of the agora. The northern half of the building would have faced into the length of the North Stoa, and the southern half along the front of the same stoa. Whether or not this was the case at the time of construction is uncertain. The date given by Vallet (1976, p. 210) is based in part through a lack of pottery such as SOS amphorae and some fragments in the foundations to around 630 BC. The stoa is dated on finds of an SOS amphora and protocorinthian pottery to the third quarter of the seventh-century BC. It is perfectly feasible that the two could have been part of the same building programme.

The alignment was calculated through calibrated examination of the plans (see section 4.1 for information on fieldwork). This gave an azimuth of 91° and a declination of -1° . In 630 BC this would face sunrise on March 18 and September 26.²⁶

²⁶ 25 March and 3 October in the seventh-century BC.

6.19 Megara Temple Sud

Location: Megara Hyblaea

Deity: Unknown

Date: Third quarter of the 7th Century BC Azimuth: 72° Declination: 14°



The Temple Sud at Megara Hyblaea © Google

This building was listed as the Temple Sud by Vallet (1976, p. 223) and is possibly the oldest temple on the site. It sits in the southern half of the agora, just over 10 metres west of where the East Stoa would later be built. The temple is dated to the third quarter of the seventh-century by pottery fragments found in the walls and votive offerings and protocorinthian pottery found in the temple. Unfortunately these offerings do not permit us to attribute the temple to a deity.

The temple's remains recorded by Vallet consists of five blocks along the south side of the temple. No further buildings have been found beneath the temple, which means there is frustratingly little which can be said about the site, which explains its brief entry in the site report.

The temple faces 72° , which gives an alignment of 14° . In 625 BC this would face 28 April and 17 August.²⁷ In the absence of any evidence it would be sheer speculation to propose any specific astronomical interpretation of this site. The temple only has value for this survey as being part of the greater sample that may reveal broad trends of astronomical orientation.

²⁷ 25 March and 3 October in the seventh-century BC.

6.20 Megara Temple Sud a Collonade

Location: Megara Hyblaea

Deity: Unknown

Date: Last quarter of the 7th Century BC

Azimuth: 77°

Declination: 10°



The Temple Sud a Collonade at Megara Hyblaea © Google

This temple is in the south-western part of the agora. It sits fifteen metres behind the Temple Sud (see section 6.19) and if the Temple Sud was standing at the time of construction it would have blocked the line of sight. The temple is larger and more ornate than its neighbour, hence the designation Temple Sud a Colonnade. This style and a find of a hydra in the temple led Vallet (1976, p. 228) to date it to the last quarter of the 7th-century BC.

It has an azimuth of 77° and faces a declination of $+10^{\circ}$. This is sunrise around 16 April and 28 August in the Gregorian calendar, assuming that the horizon was clear.²⁸ This is not certain, but Temple 24 is in considerably worse condition than this temple. It is possible that the earlier temple was partially demolished and this temple built as a replacement. The different in sunrise alignments is two weeks, which is well within the bounds of the movement of the calendar as it tracks the moon. The lack of material dedicated to a specific deity means that the temple's identity remains unknown.

²⁸ 23 April and 4 September in the Julian calendar for 610 BC.

6.21 Megara Temple Nord

Location: Megara Hyblaea

Deity: Unknown

Date: Third quarter of the 7th Century BC

Azimuth: 95°

Declination: -4°



Temple Nord at Megara Hyblaea © Google

Like Le Temple Sud (see section 6.19), Le Petit Temple Nord dates from the third quarter of the seventh-century BC. This date is based on the presence of fragments of protocorinthian and local pottery which date from the start of the seventh-century through to the third quarter (Vallet, Villard, & Auberson, 1976, p. 231).

The location of the classical city is away from the agora with a road between it and the northern boundary of the agora, as marked by the North Stoa. However if this temple pre-dates the stoa then the layout of the agora must be seen in a different light. In this case what was a road marking the boundary of the agora is a road passing through the agora. This temple could be a partner temple to the Temple Sud, though it is marginally smaller. The alignments of the two temples, if extended, would cross overlooking the beach to the east.

The temple has an azimuth of 95° and faces a declination of -4° . This in 630 BC this correlates with sunrises March 11 and October 3 in the Gregorian calendar.²⁹

²⁹ 10 March and 10 October in the Julian calendar in the seventh-century BC.

6.22 Megara Temple Sud-Est

Location: Megara Hyblaea

Deity: Unknown

Date: Second half of the 7th Century BC

Azimuth: 86°

Declination: 3°



The Temple Sud-Est at Megara Hyblaea. © Google

The dating for this temple is problematic. Vallet (1976, p. 239) dates the temple using local ceramics fragments found in the foundations. The fragments date from the first half of the seventh-century, but Vallet dates the temple to the second half of the seventh-century as this would then match the dates of the buildings around the agora. How he dates the building is uncertain. The reasoning is not helped by this temple being the most distant from the agora. However, the imprecision in dating is

not a problem for this study, the time periods examined are Early, 5th Century and Late temples, but it does highlight the difficulties in assigning dates to some temples. As with other temples at Megara Hyblaea no specific deity is known to be associated with this temple.

The alignment of the temple is toward 86° , which gives a declination of $+3^{\circ}$. The sun would rise at this point on March 29 and September 16.³⁰

³⁰ 5 April and 23 September for the Julian calendar in 630 BC.

6.23 Naxos Temples A, B and X

Location: Naxos

Deities: Probably Aphrodite

Date: 7th to 5th Centuries BC

Azimuth: 44°, 61°, 113°

Declination: 35°, 23°, -18°



Temple A/B at Naxos. © Google

Temples A and B are found in a sanctuary in the south-west of Naxos inside the city walls. The two temples occupy the same location, with Temple A, the earlier temple, facing a more northerly direction. The sanctuary they sit in has been identified as having three phases.



Temple B overlying Temple A (left) at Naxos. Photo author.

The first temenos dates from the last decade of the seventh century BC, according to Pelagatti (1972, p. 215). The plans of the site strongly indicate that much of this temenos must have been obliterated by the building of Temple B. Pelagatti (1972, p. 216) notes that only two walls of Temple A survive and its plan must be based on an assumption of symmetry. Pelagatti dates Temple A to the same phase as the first temenos.

The second phase is dated by a wall not quite perpendicular to the outer wall of the city. Despite its proximity to Temple B, its remains survived in good enough condition to follow its course at the north of the sanctuary. This wall runs parallel to Temple A, and so it is tempting to conclude the two date from the same construction phase. If this is the case the temple dates from the second quarter of the sixth-century

(Pelagatti, 1972, pp. 215-216). For the purposes of this study either date would place Temple A in the Early category.

Temple A would have faced an azimuth of 44° . This is too far north to face any sunrise or moonrise as it faces a declination of 35° . It would have faced the risings of Boötes, Hercules, Lyra and Perseus. Lyra is of interest as the god Apollo was of great importance to Naxos (see section 8.9), but finds in this sanctuary would seem to favour Aphrodite as the goddess.

There is the possible stellar target of Arcturus at declination 32° , which would heliacally rise in the last third of September, making it arguably a calendrical marker for calendars starting after the autumnal Equinox. Tentatively, it may be possible to argue that Naxos in Sicily did start its year at this time. Trümper (1997, p. 49) states that the first month of Euboean calendars might be cross-referenced to the months of Pyanopsion, Maimakterion or Posideon in the Athenian calendar. This would cover the periods for months four, five and six. Another possible source for the Naxian calendar would be the island of Naxos. However cross-referencing with the Greek island of Naxos is of little help as only two month names of its calendar survive (Trümper, 1997, pp. 72-73).

Pelagatti notes that a sterile layer follows phase two, which she dates to the third quarter of the sixth-century. This marks a period with a new orientation, which Pelagatti (1972, p. 216) connects with a new urban layout of houses to the north. This would suggest that Temple B was built as part of this plan meaning that the third phase of construction would coincide with the replanning of the city in the 5th Century BC (see section 8.9).

Temple B was measured as facing 61° which would mean that the alignment would be towards the summer solstice at 23° . The sun would be in Cancer, though Gemini would be the visible constellation rising in the morning.

Nothing has been mentioned of Temple X. This is in the centre of town and marked Tempietto. Beyond this nothing can be identified in the publications. It could date from any time between the seventh and fourth centuries BC. It faces 113° , which points to a declination of -18° . Around 500 BC this would face sunrise on 29 January in the spring³¹ which would see Pegasus and Carpricornus rising in the eastern sky. In the autumn the Sun would pass in front of the temple on 12 November 12.³² This would be the time when Ophiucus and Lupus would be rising.

³¹ 3 february for 500 BC in the Julian calendar.

³² 71 November for the Julian calendar in the same period.

6.24 Selinous Temple A/O

Location: Selinunte

Deity: Leda and Artemis?

Date: 490-460 BC

Azimuth: 96°

Declination: -5°



Temples A and O at Selinous. © Google

Temple A/O is both Temple A and Temple O. While the temples are two physically separate objects, they are not independent alignments. The two temples sit side by side, and so the orientation of one will by necessity affect the other. This proximity may well have reflected belief associated with the temples. Kerényi (1966) has argued that the two temples were intentionally paired with Temple A dedicated to represent Leda and Temple O with Artemis. This interpretation rests heavily on

Temple C (see section 6.25) being dedicated to Apollo. If this is the case then Kerényi (1966, p. 7) argues the metope of the small temple on the acropolis which depicts the triad of Apollo, Leda and Artemis, becomes extremely significant. Further he refers to a fragment of a figurine of a goddess found by Temple A which has a route between it and Temple C (1966:6).

This raises the question to what extent are we dealing with individual temples, and to what extent are we tackling one unified complex. If this is the latter then it is highly questionable whether or not we should refer to these temples as separate measurements. This is particularly important as temples A/O, C,D,E,F and G (see sections 6.24, 6.25, 6.26 and 6.27) all adhere to the city's grid plan.

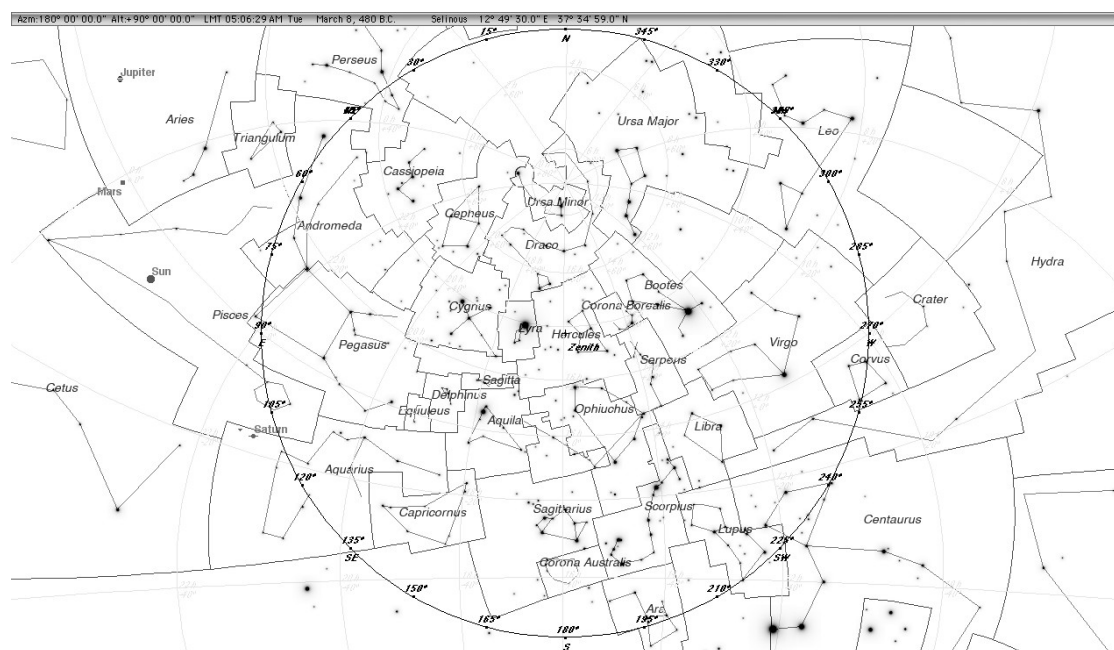
I have left them separated as they form distinct architectural units and the presence of temples which do not conform to the grid at Selinous leaves open the possibility that pairs of temples could have been ordered skew to the city street plan. Temples A and O lie at the southern end of the Acropolis and the nearby presence of the *Tempietto con Acroterii a Spirale* (De Angelis, 2004, pp. 129, 138-139) next to these temples would suggest they if there were aligned to adhere to the city plan, it still constituted an active choice at the time of building. I have however omitted the *Tempietto con Acroterii a Spirale* from this survey as it could not be identified from the ground and the exact orientation is unclear. Even temples A and O are in a ruinous state.

Another reason for considering Temple A/O as separate from the other acropolis temples is that the temples themselves are of the same size and notably a twin set. They sit to the south, but also to the east of Temple C. This lack of integration makes me wary of Kerényi's notion of a triple temple. The cult of Leda may have been

important in Selinous as the metopes suggest (Kerényi, 1966, p. 6), but this could have been comfortably served at temples to Apollo or Artemis. Unlike her offspring Leda is not a major goddess and is notable mainly for her role in the births of Apollo and Artemis rather than for independent achievements.

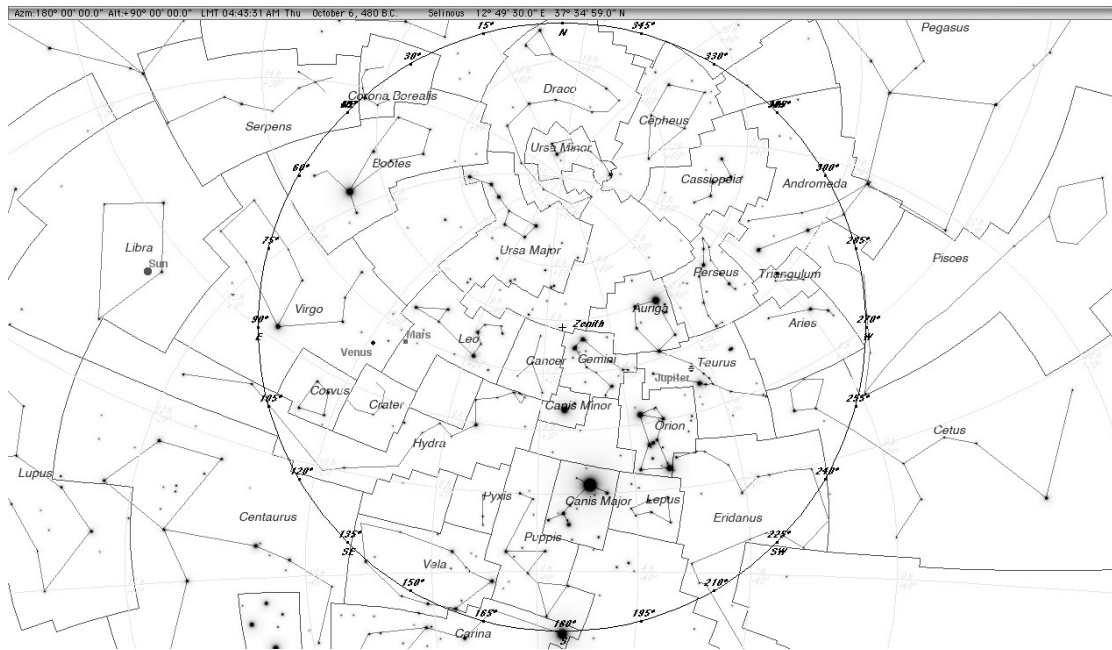
Sadly it is not possible to fix the time of building with much certainty. Di Vita (1984, p. 50) says that the favoured date for the temples is between 490 to 460 BC by styling, but also that there is little evidence to support this.

The temples face an azimuth of 96° and a declination of -5° . In 480 BC this would have faced sunrise on 8 March and 6 October.³³ The constellations rising on these days are Andromeda, Pegasus and Aquarius in the spring and Boötes, Corvus and Virgo in the autumn.



Projection of the sky at Astronomical Dawn for 8 March 480 BC at Selinous

³³ 13 March and 11 October in the Julian calendar for 480 BC.



Projection of the sky at Astronomical Dawn for 6 October 480 BC at Selinus

Stars that the temples are aligned towards include ν Ophiuchi ($-5^{\circ} 44'$, mag. 3.31), λ Aquilae (mag. 3.44), θ Aquilae (mag. 3.25), ϕ Piscium ($-4^{\circ} 19'$, mag. 4.26), $\pi 5$ Orionis (mag. 3.71), δ Orionis *Mintaka* ($-5^{\circ} 35'$, mag. 2.23), $\nu 1$ Hydrae (mag. 4.11), ν Hydra (mag. 3.10), γ Crateris (mag. 4.07) and γ Corvi ($-4^{\circ} 9'$, mag. 2.58). It is possible that Orion could have a connection with Artemis but, given the many other temples also aligned to the street grid at Selinus, it is unlikely to be a significant correlation.

6.25 Selinous Temples C and D

Location: Selinunte

Deity: Apollo?

Date: Late Sixth Century BC

Azimuth: 96° / 96°

Declination: -5° / -5°



Temples C and D at Selinous. © Google.

Like Temple A/O it could be argued that Temples C and D should be considered as one data point. Indeed they could even be included as components of Temple A/O. Like Temple A/O, both are aligned with the city grid at an azimuth of 96° and a declination of -5° . They are both fractionally earlier in date (Dinsmoor, 1975, pp. 80-83; Gabrici, 1956, pp. 274-5) dating within a decade of each other to the second half of the sixth-century, but not enough to alter their astronomical features in any way

from Temple A/O or Temples E and and F/G. They differ in being further apart from each other than Temples A and O. While they follow the street grid they could have been aligned independently from Temple A/O and from each other. The fact they were not is of interest and worth recording.

Temple C is possibly a temple of Apollo (Tusa, 1967, p. 192) from the evidence of offerings and an inscription. The dedication of Temple C to Apollo seems to be the firmest of any of the Acropolis temples.. Tusa (1967, pp. 188-189) records a variety of attributions for Temple D, which make any speculation for the purposes of this study impossible. The attributions, which include Apollo and Kore, mean that it is not even possible to assign a gender or celestial/chthonic aspect to the temple. Temple C is currently undergoing a degree of restoration.



Selinunte Temple C seen from the Marinella Hill. Photo author.

As with Temple A/O, temples C and D both face an azimuth of 96° and a declination of -5° . This means the stellar alignments are comparable to Selinunte A/O and tells us little about any possible celestial target. The Gregorian dates are for the sunrises are, as for temples A/O, E and F/G, 8 March ³⁴and 12 October. The constellations rising on these days are Pegasus and Aquarius in the spring and Boötes and Virgo in the autumn.

³⁴ 13 March and 11 October for the Julian calendar in the early sixth-century BC.

6.26 Selinous Temple E (Hera)

Location: Selinunte

Deity: Hera

Date: Late Seventh Century BC

Azimuth: 96°

Declination: -5°



Temple E on the Marinella hill at Selinous © Google

Temple E is one of three coaxial temples sites on the Marinella Hill. Seen in plan it would seem obvious that the three temples are part of a coherent architectural plan and it is common to see the three temples treated as a unit (e.g. Fischer-Hansen, Nielsen, & Ampolo, 2004, p. 223). If the temples were planned on the same axis it would be best to treat them as one point. This temple is in fact possibly a century older than Temple F/G (see section 6.27) dating from the last quarter of the seventh-

century in its original form, based on its architectural style (Gullini, 1985). This would make it around a century older than Temples F and G on the same hill. Therefore I believe that it is unreasonable to expect the same architectural guides, such as rope and ranging poles, to have survived for a century without re-planning. If this is the case and the temple is independently aligned, even though it shares an alignment with Temple F/G, it should be treated as an independent measurement.



Selinous's Temple E. Photo author.

Temple E is the only temple on the Marinella Hill to be standing in good condition. It is the southernmost of the three temples, though the terrain suggests that there is no special reason for requiring a specific position on the hill. The position may instead be derived from the agora. The southern edge of the agora may be aligned with the northern wall of the temple. A theodolite survey would be necessary to confirm or refute this.

The temple has been identified as a Heraion partly on the grounds of an inscription to Hera found in the temple (IG XIV 271) and partly due to a citation bottleneck where everyone cites back to Tusa's (1967) survey of Selinuntine dedications which gathers the opinions of scholars. This paper in turn is cited in other papers that cite the inscription. De Angelis (2004, p. 131) cites Tusa (1967) and Parisi Presicce (1985, p. 80), whose own contribution cites back to Tusa. De Angelis is entirely proper in doing this, reflecting post-Tusa publications on the identification of the temple, but without explanation it could give the impression that more evidence has been gathered rather than recycled. This is why De Angelis is right to sound a note of caution in stating the temple is probably dedicated to Hera.

As with Temple A/O, C, D and F/G the temple faces an azimuth of 96° and a declination of -5° . In the late sixth-century BC this would have faced sunrise on March 8 and October 6.³⁵ The constellations rising on these days are Pegasus and Aquarius in the spring and Boötes and Virgo in the autumn. The later date does not much alter the positions of the stars within a range $\pm 1^\circ$ declination of the later period. As one of the earlier temples on the hill, it could be argued that a stellar alignment might be significant, but as with many other temples on site, the alignment is likely to be topographical (pers. comm. Juan Antonia Belmonte & Robert Hannah separately).

³⁵ 14 March and 12 October in the Julian calendar for the late sixth century BC.

6.27 Temple Selinous-F/G

Location: Selinous

Deity: (F) Athena or Artemis and (G) Apollo

Date: Early Fifth Century BC

Azimuth: 96°

Declination: -5°

Temples F and G lie on the Marinella Hill a few metres to the north of Temple E. Both temples date from the late sixth-century (Gullini, 1985) based on style, with Temple F being slightly older. Spawforth (2006, pp. 130-131) in contrast dates Temple G to 490-480 BC based on letter forms in an inscription identifying it as an Apollonion. This is not entirely inconsistent with Gullini's date as the process of temple building could take generations.

As with Temple A/O these temples pose a problem as to whether they are independently aligned or if they were built from the same baseline. If it is the latter case then they cannot be treated as separate alignments, and so should only occupy one data point in the survey. The proximity of the dates would make it plausible that the temples were built to a common grid. Additionally the dedications may suggest they were part of the same plan.

Attribution is uncertain, but Temple F appears to have been female and celestial, being dedicated to either Athena or Artemis. The Athena attribution is highly questionable, resting on a statuette found at the temple when excavated and an assumption that the Temple E is to Zeus which would make Temple F's Athena attribution the mythologically correct solution (Kerényi, 1966, p. 5). Picard (1936, p. 24) in contrast prefers Artemis Eileithyia, as she would partner Apollo, who is the god of Temple G, according to Picard (1936, pp. 18-25). The Temple has an

inscription to Apollo and Athena (IG XIV 269), but Picard discounts Athena as a possible deity for Temple F as she is not Delphic. Picard also attributes Temple E to Dionysos (Picard, 1936, pp. 32-33) based on the temples being dedicated to Delphic gods. This idea has no support from any other archaeologists who have investigated the site (Tusa, 1967, pp. 188-189)

The Temple G has been assigned to a male celestial divinity either Apollo as mentioned above or Zeus (Tusa, 1967, p. 191) based on the proportions of the temple and an inscription describing it as an Apollonion IG XIV 268. The divinities could therefore be a complimentary pair. In light of this for the purposes of the survey the temple will be treated as one point Temple F/G. It falls into the early and celestial categories, though gender and deity will be unassigned. If the attributions are correct. It may be possible that the temple was aligned to adhere to one god, but it is impossible to say which god that is. The gender pairing would mean that it has no net effect on the statistical analysis.

Once again, as with Temples A/O, C, D and E, the temples face an azimuth of 96° and a declination of -5° . In 480 BC this would have faced sunrise on 8 March and 6 October.³⁶ The constellations rising on these days are Pegasus and Aquarius in the spring and Boötes and Virgo in the autumn.

³⁶ In the fifth-century BC this would have been 13 March and 11 October in the Julian calendar.

6.28 Selinous Temple of Demeter Malophoros

Location: Selinous

Deity: Demeter Malophoros

Date: The early sixth-century BC

Azimuth: 83°

Declination: 6°



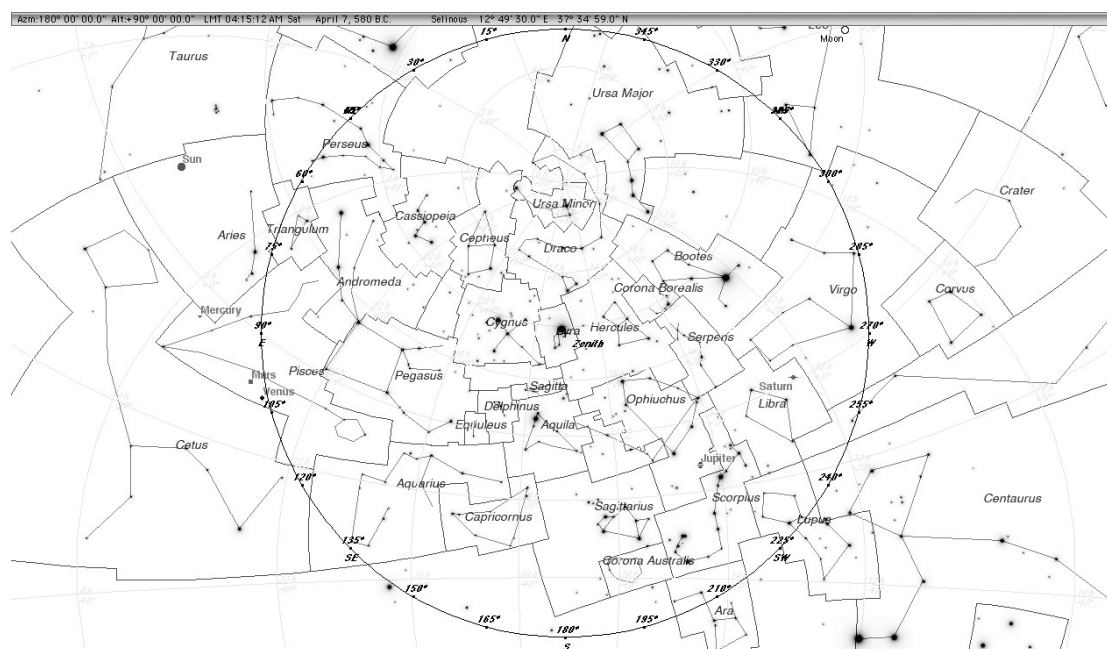
The Temple of Demeter *Malophoros* on the Gaggera Hill © Google

The temple of Demeter *Malophoros* lies on the Gaggera Hill, to the west of the Acropolis. It sits in a sanctuary with the temples of Zeus *Melikhios* and a Hekataion. The temple probably marks the start of a phase of intensive construction as it pre-dates the temples on the Marinella Hill, with the exception of Temple E, and the Acropolis. Gabrici (1927, p. 137) who dates the earliest phase of the temple to the end of the sixth-century BC, following deposits found at the base of the altar associated

with this temple. However the sanctuary appears to date from earlier given the existence of a seventh-century altar.

The dedication is confirmed by an inscription IGDS 54, though the many offerings would also indicate that the temple was to Demeter even if the exact epithet could not be determined. Additionally there are offerings of bird figures, lion heads and goat heads (Gabrici 1927:222-4). These may have significance (see below), but equally there are also offerings in the shapes of deer, dogs, and bulls, so this may be an example of cherry-picking data.

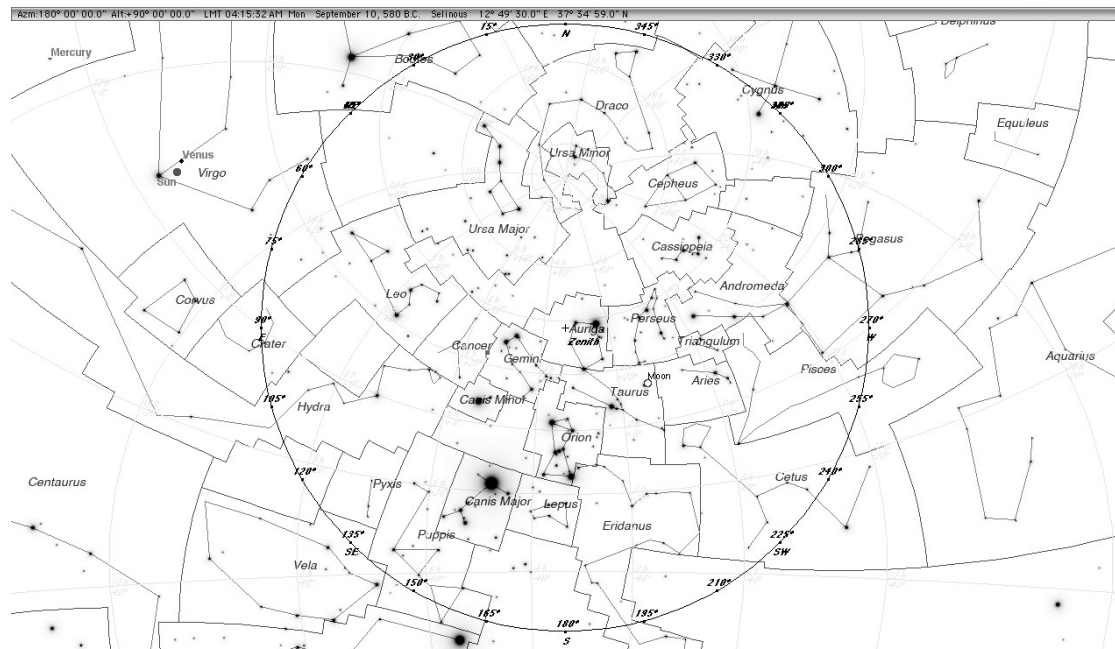
The temple faces 83°, which yields a declination of 6°. This would face sunrise on 7 Apr in the early sixth-century BC³⁷. This would be the time when Pisces and Perseus were rising in the morning sky. The autumn sunrise would be 10 Sept for the same year.³⁸ This would coincide with the rising of Leo and Cancer.



Projection of the sky at Astronomical Dawn for 7 April 580 BC at Selinous

³⁷ 12 April in the Julian calendar for the early sixth-century BC.

³⁸ 15 September in the Julian calendar.



Projection of the sky at Astronomical Dawn for 10 September 580 BC at Selinous

The temple faces the risings of δ Ophiuchi *Yed Prior* (mag. 2.73), α Aquilae *Altair* (mag. 0.93), ϵ Delphini (mag. 4.03), β Arietis *Sheratan* ($+6^{\circ} 52'$, mag. 2.66) and γ Tauri *Hyadum I* (mag. 3.65). Leo would be the visible constellation in the eastern sky, with *Spica*, a *Virgonis* not rising until towards the end of the month. However while Leo is the dominant constellation, it should be noted that *Regulus*, a *Leonis*, would have been visible for a full month at this point. While it is tempting to connect the votive offerings with a stellar regulated festival, the presence of other animal forms in the offerings, especially deer would indicate that the connection is speculative. The presence of bird forms may be of more interest as it would correlate nicely with bird migration and the timing of a festival to Demeter.

6.29 Selinous Temple of Zeus Melikhios

Location: Selinous

Deity: Zeus *Melikhios*

Date: The mid Sixth Century BC

Azimuth: 80°

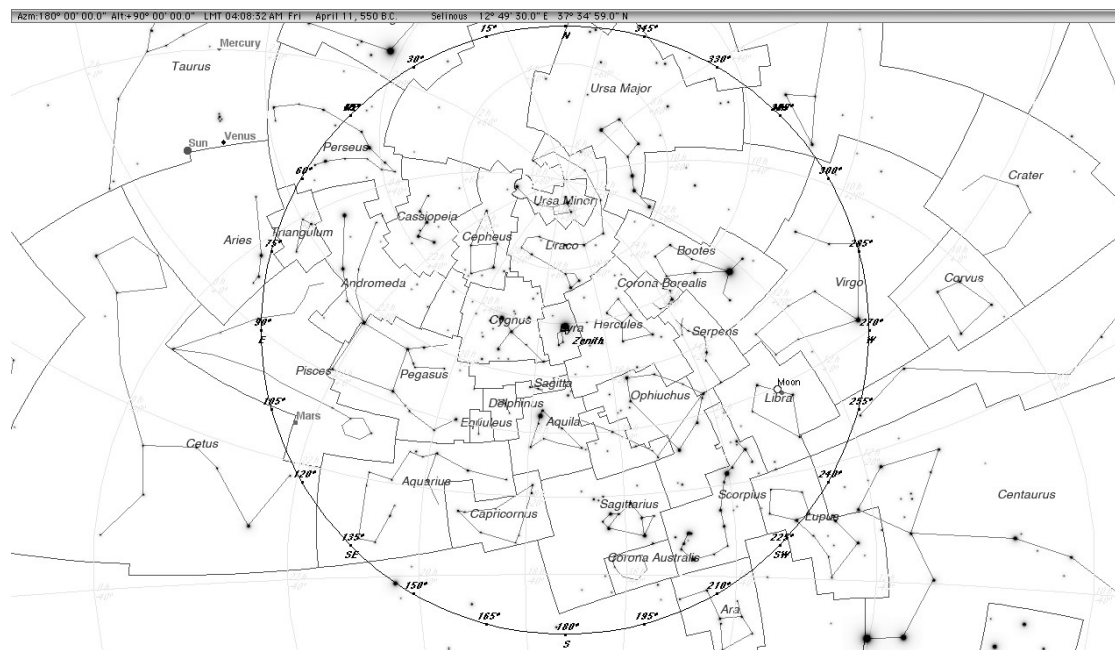
Declination: 8°



The Temple of Zeus *Melikhios* at Selinous © Google

The temple of Zeus *Melikhios* lies just to the north of the temple of Demeter Malophoros and is identified by an inscription (IGDS 45). The inscription dates from the sixth-century and is described as being contemporaneous with the monumental phase of the temple of Demeter by Gabrici (Gabrici, 1927, pp. 91-109). It lies slightly off the slope down the Gaggera Hill, which could suggest the alignment was intentional.

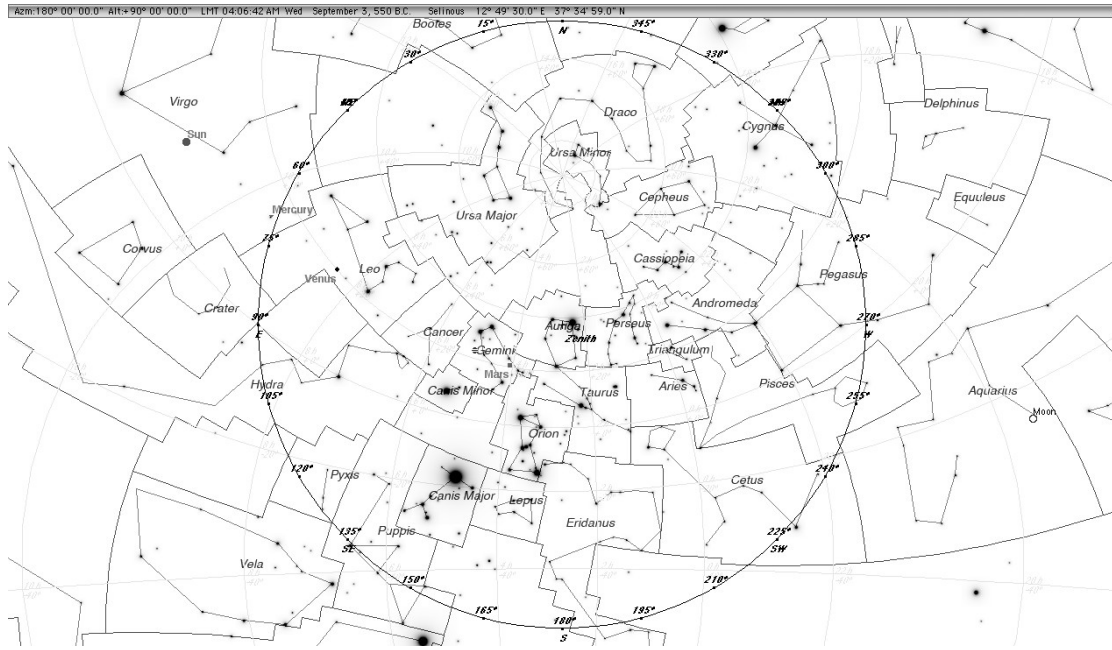
The temple faces 80° azimuth and so would face the rising sun as it passed a declination of 8°. This would give a spring sunrise date of 11 April.³⁹ This would coincide with the risings of Aries and Perseus. In the autumn the sun would pass this point on the horizon around September 3.⁴⁰ This would be when Crater rises. Myth says that Crater was the cup that Corvus the raven was sent to fetch so that Apollo could sacrifice to Zeus (Ovid *Fasti* II.14). This could connect Zeus with the return of the autumn rains.



Projection of the sky at Astronomical Dawn for 11 April 550 BC at Selinous

³⁹ 16 April in the Julian calendar for the mid-sixth century.

⁴⁰ 29 August for the same year.



Projection of the sky at Astronomical Dawn for 3 September 550 BC at Selinous

The temple faces the risings of γ Ophiuchi ($+7^{\circ} 16'$, mag.3.75), γ Aquilae *Tarazed* (mag. 2.71), β Delphini *Rotanev* ($8^{\circ}46'$, mag. 3.63), β Arietis *Sheratan* ($+7^{\circ} 2'$, mag. 2.66), $\delta 1$ Tauri *Hyadum II* (mag. 3.75), α Tauri *Aldebaran* (mag. 0.99), α Canis Minoris *Procyon* ($7^{\circ} 7'$, mag. 0.40), ι Hydrae (mag. 3.90), ι Virginis *Syrma* ($7^{\circ} 24'$, mag. 4.07), μ Virginis ($7^{\circ} 10'$ mag. 3.86) and μ Serpentis ($7^{\circ} 11'$, mag. 3.52).

It could be possible to argue that the temple follows the slow shift of position of β Arietis. However, that would be somewhat bold. The reason β Arietis appears for both this temple and Demeter Malophoros is that it lies at the extreme of $\pm 1^{\circ}$ in both cases. In the brief period between the building of the temples it would not have moved enough to be an observable problem. In light of its position next to the temple of Demeter Malophoros, if there is a celestial alignment it is more likely to be in the general direction of Virgo than to a particular star.

6.30 Selinous Hekataion

Location: Selinous

Deity: Hekate

Date: The mid Sixth Century BC

Azimuth: 338°

Declination: 47°



The location of the Hekataion at Selinous © Google

Like the temple of Zeus on the Gaggera Hill, the Hekataion is described as being of similar date to the temple of Demeter (Gabrici, 1927, pp. 73-75). Unlike the other sites on the Gaggera Hill, Gabrici's description is disappointingly brief, merely describing the masonry, and its setting along with the discovery of an inscription nearby which identifies the temple as being dedicated to Hekate. This last piece of information is invaluable as this is the most unusual temple of the entire data set.

Physically it is nothing unusual, being made of well cut blocks. It is somewhat smaller than the average temple, Gabrici (1927, p. 75) gives measurements of 4.35 by 2 metres. What makes the temple exceedingly odd is its orientation. The temple faces 338° , within half a degree of north-northwest. This makes it the only temple in the sample set to face west of north. The orientation cannot be explained topographically, the temple points slightly uphill, though not enough to cause any problems with a high horizon. Nor can it be facing sunset as it faces a declination of 47° . This is too far north both for sunset or moonset. Cepheus, Draco and Ursa Major would all skim the horizon, and Cassiopeia would set in this direction, but these are not traditional calendrical constellations.

The solution may be to look at the sanctuary of Demeter as one unit. This highlights the flaws of a rigid system which equates temples directly to data points.

6.31 Selinous Temple M

Location: Selinous

Deity: Unknown

Date: 2nd Quarter of the 6th Century BC

Azimuth: 76°

Declination: 11°

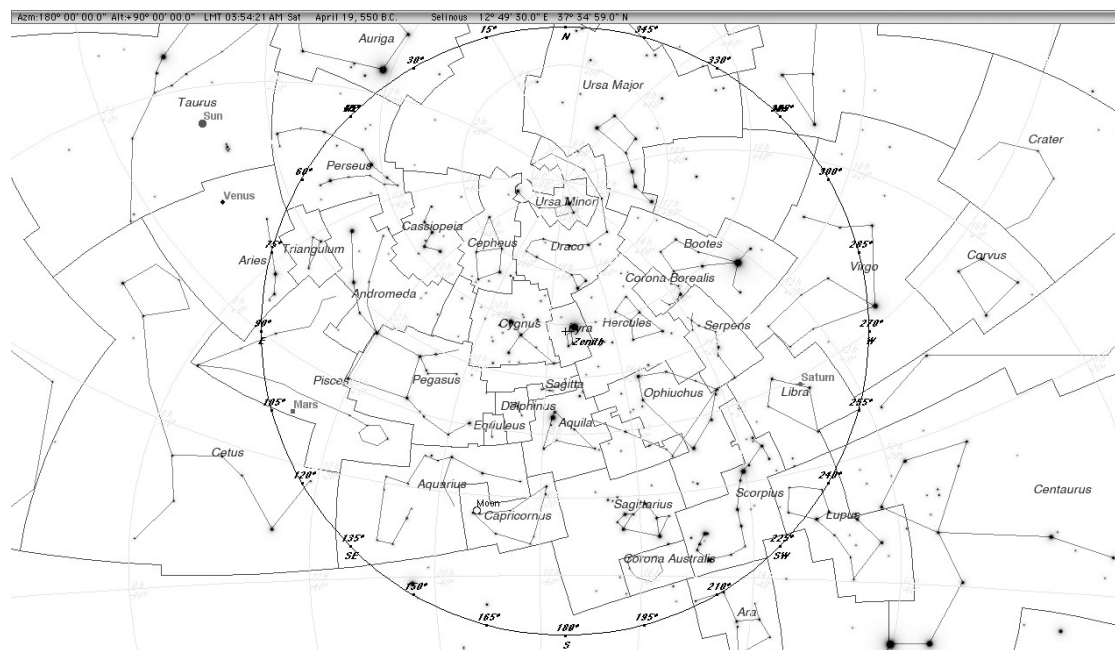


Temple M at Selinous © Google

The Temple M sits on the Gaggera Hill like the temples of Demeter Malophoros, Zeus Melikhios and Hekate. Unlike these temples however it sits away from the shared sanctuary. At the time of visiting it was closed and so measurements were taken from the published plans (Pompeo, 1999, p. 61) and cross-checked with wider maps of the site. The date of the temple has been ascribed through architectural evidence to the second quarter of the sixth-century BC, For the purposes of this study

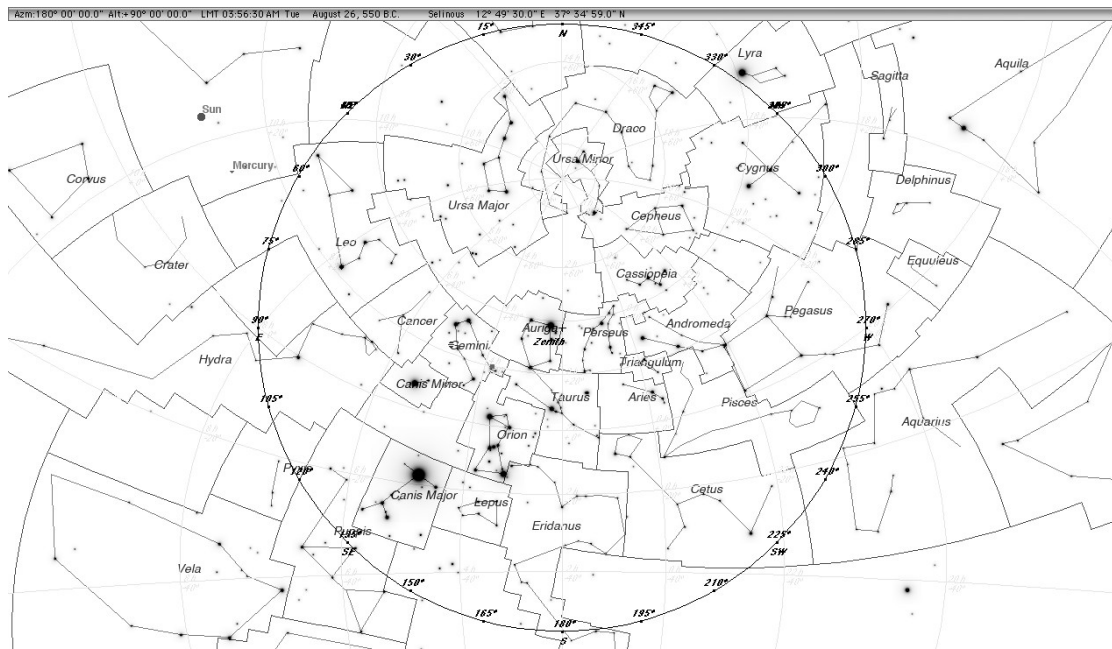
this is enough to place it in the early period. The attribution of the temple is uncertain, though reliefs hint at Hercules (Pompeo, 1999, p. 79).

The orientation of the temple is towards 76° , which with a flat horizon would point to a declination of 11° . This would face sunrise on 19 April and 26 August.⁴¹ The rising constellation in the spring would be Pisces and, for the autumn, Leo.



Projection of the sky at Astronomical Dawn for 19 April 550 BC at Selinous

⁴¹ 24 April and 31 August for the six-century BC in the Julian calendar.



Projection of the sky at Astronomical Dawn for 26 August 550 BC at Selinus

The temple would face the risings of the stars λ Ophiuchi (mag. 3.90), λ Pegasi ($11^{\circ} 48'$, mag. 3.96), ξ Geminorum *Alzirr* (mag. 3.33) and δ Hydrae (mag. 4.13). While bright is not a synonym for important, there is no reason to assume that any of these stars were of particular significance to the Greeks.

6.32 Syracuse Apollonion

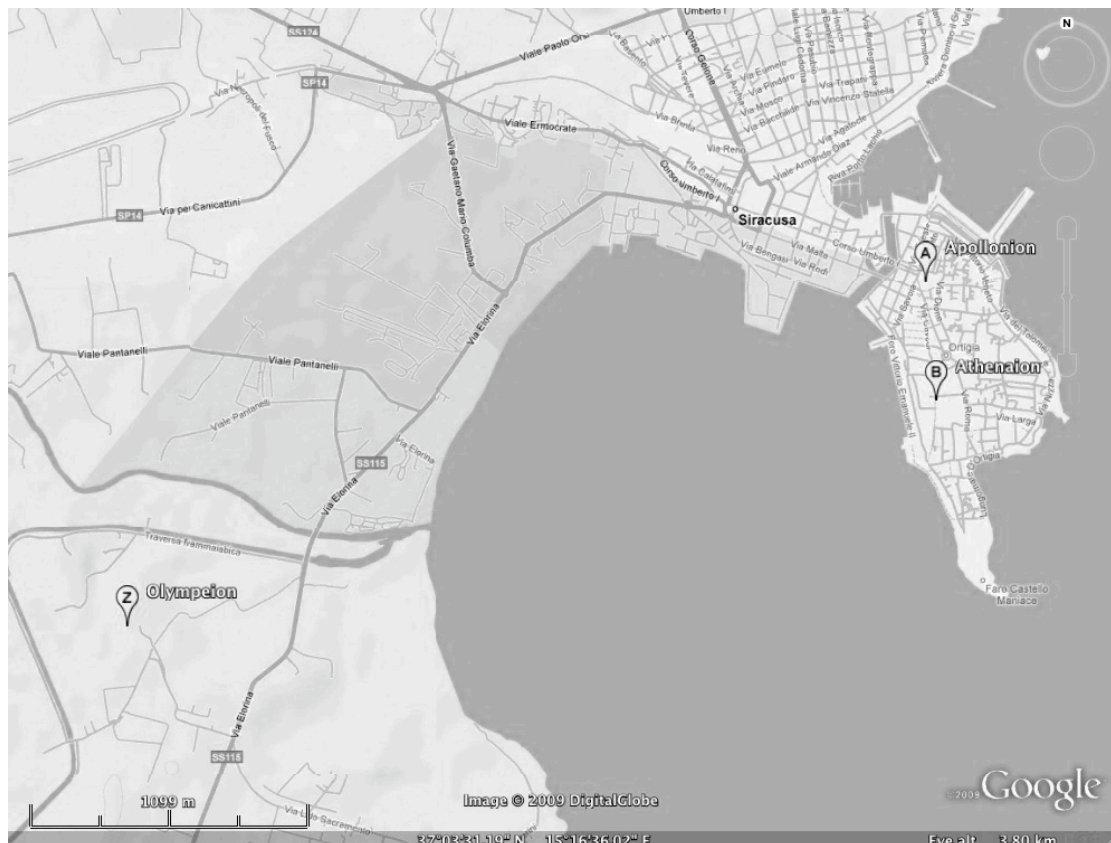
Location: Syracuse

Deity: Apollo

Date: 6th Century BC

Azimuth: 94°

Declination: -3°



Map of the temples at Syracuse © Google

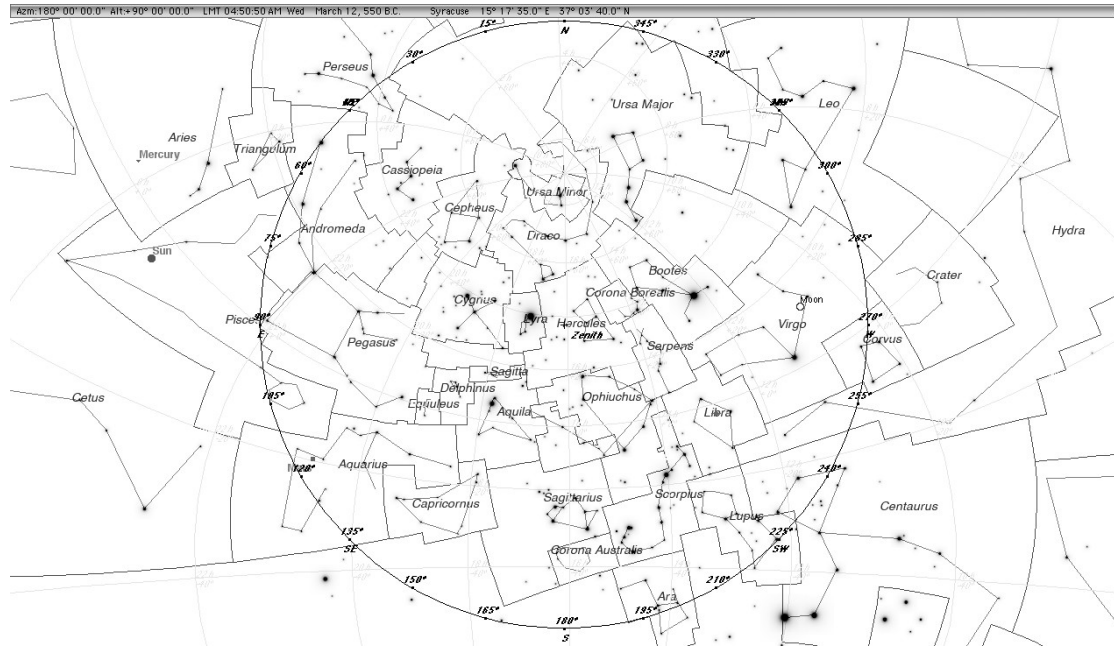
This temple is currently known as the Apollonion. The attribution of the temple has been contentious. Cultera (1951, p. 704) notes that from Renaissance this temple was attributed to Artemis Alpheia due to references by a Scholiast in Pindar's Pythian Ode II. He adds that Livy (XXV, 23) refers to a three-day festival of Artemis. However, Cultrera (1951, p. 704) presents evidence of inscriptions to Apollo and argues that from this evidence Apollo was the primary god. Yet this may not be

simple misattribution. He also comments that there are known to be temples to two gods. The most obvious examples are temples to the Dioscuri, Castor and Pollux. Yet Demeter and Kore were frequently paired and Cultrera talks of the Heraion at Olympia, which also was a temple to Zeus. It is possible that this temple was not specifically to Apollo, but to the offspring of Leto. He is cautious in dating the temple, as it has phases of rebuilding making it difficult to assign a firm date. Inscriptions in the temple would suggest a date from the start of the sixth-century for the building of the temple (Cultrera, 1951, pp. 850-851).

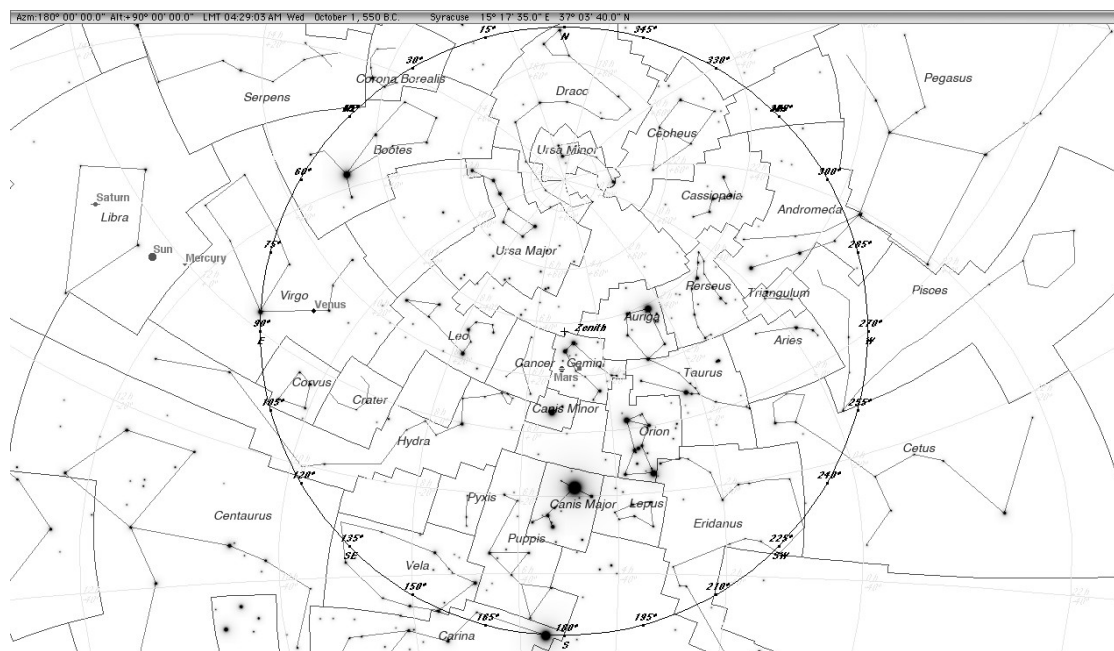
This temple poses problems in measuring its alignment. The area of Ortigia is an urban area in downtown Syracuse. Elements can be seen, but the presence of metals in abundance in the local area such as the local railings make accurate measurement by magnetic compass impossible. The tight streets not only provide plenty of cars to skew compass needles. They also mean that the horizon cannot meaningfully be measured either, but local topography would suggest that this was close to zero degrees. Therefore the measurements were taken from Cultrera's map, and a cross-check was attempted with Google Earth. The figure calculated was then compared to Aveni and Romano's measurements.

The temple would seem to be aligned to 94° , which is close to Aveni and Romano's (2000, p. S54) measurement of 94.3° . This means that the temple would have faced a declination of -3° if it has access to a clear horizon (see section 8.12). This would have faced sunrise on 13 March or 1 October.⁴² The rising constellations at these sunrise dates would be Andromeda and Aquarius or Boötes and Virgo in autumn.

⁴² In the sixth-century BC this is 18 March and 7 October in the Julian calendar.



Projection of the sky at Astronomical Dawn for 13 March 550 BC at Syracuse



Projection of the sky at Astronomical Dawn for 1 October 550 BC at Syracuse

The temple would have faced the rising stars γ Librae *Zuben Elakrab* (mag. 3.92), λ Aquilae ($-4^{\circ} 47'$, mag. 3.44), θ Aquilae ($-4^{\circ} 45'$, mag. 3.25), θ Pegasi *Baham* (mag. 3.52), α Piscium ($-4^{\circ} 42'$, mag. 4.26), ν Hydrae (mag. 3.10), γ Crateris ($-4^{\circ} 52'$, mag. 4.07) and γ Corvi (mag. 2.58). None of these stars would appear to be significant.

6.32 Syracuse Athenaion

Location: Syracuse

Deity: Athena

Date: 480 BC

Azimuth: 92°

Declination: -2°

The temple of Athena sits upon a site which has been in use since Neolithic times (Orsi, 1919, pp. 500-522), and is one of the places in Ortygia, which shows evidence of a destruction layer between a pre-hellenic and post-hellenic phase. Above the destruction layer a wide variety of pottery has been discovered. The earliest phase is marked by proto-corinthian zoomorphic pottery (Orsi, 1919, pp. 540-554), which is considered consistent with the dating of the Greek settlement of the site. Corinthian pottery sherds are also found (Orsi, 1919, pp. 554-563) showing continued use of the site.

Also found here were terracotta figurines (Orsi, 1910, p. 536; 1919, pp. 563-568), that he finds comparable to similar figurines found in Megara Hyblaea and Bitalemi. The latter was the sanctuary site of Demeter for Gela (see section 8.6), which indicates that while the temple may have had functions for multiple gods. These figurines are stylistically dated to the seventh and sixth centuries, but Orsi (Orsi, *Esplorazioni dentro ed intorno al tempio di Atena in Siracusa*, 1910, p. 536) follows Koldewey and Puchstein in dating the temple to the fifth-century BC. This would corroborate the date given by the historical sources (Diod. XI 25-26) which states that Gelon of Syracuse dedicated a temple to Athena after victory over the Carthaginians.

Measuring the temple directly through a compass survey was impossible, The structure of the temple is built in the Cathedral which now occupies the same site.

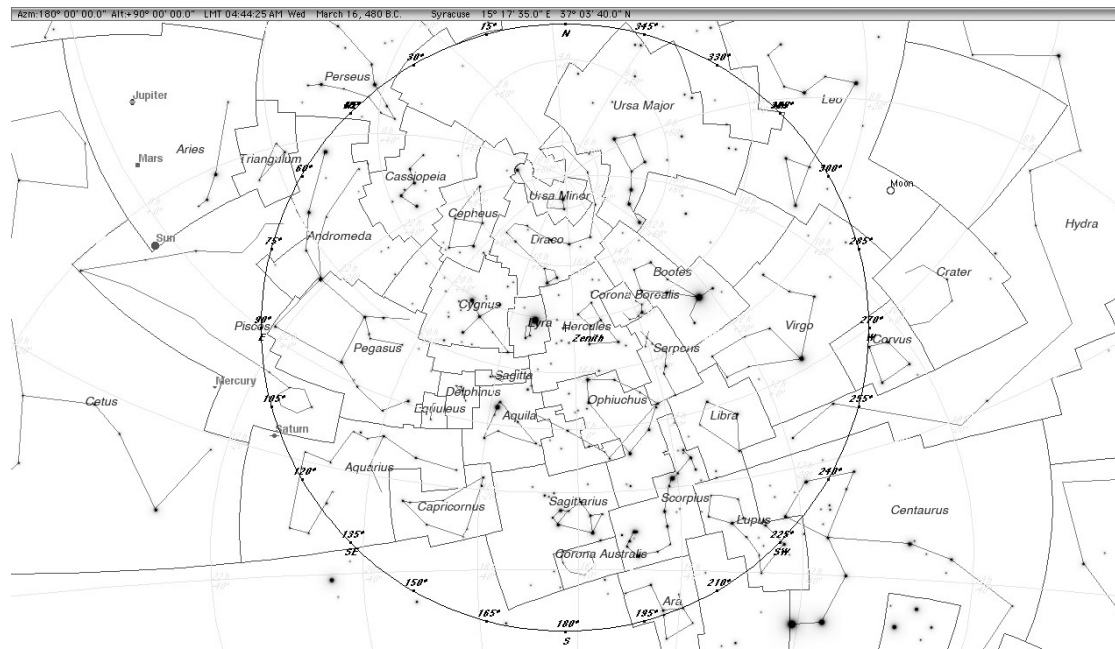
Additional the presence of cars in the streets render any accuracy of measurement impossible. As with the Apollonion (see section 6.32) the temple was measured using aerial photography from Google Earth and corroborated with the survey by Aveni and Romano (2000, p. S54). This gives an azimuth of 92° compared to Aveni and Romano's 91.8° . The temple would face a declination of -2° , if the temple had a view of a flat horizon (see section 8.12).

If the temple were laid out in 480 BC it would have faced sunrise on 16 March or 29 September in the Gregorian calendar.⁴³ This is of interest as there was a New Moon between 7am and 8am on 2 October, 480 BC in the Julian calendar.⁴⁴ This would have been too slight to be visible that evening but may have been old enough, 31 hours, to have been visible at sunset on 3 October (Julian) (29 September Gregorian). The Greek days officially started at sunset, and the months with the New Moon. This would make 4 October (Julian) the first morning of the month, meaning the temple was aligned on the first day of the month. Additionally this month would be the first month after the equinox and thus the first day of the New Year, making this a notable occasion. However, it should be remembered that the sunrise dates are approximate and so the alignment could be for 2 or 4 October in the Julian calendar.

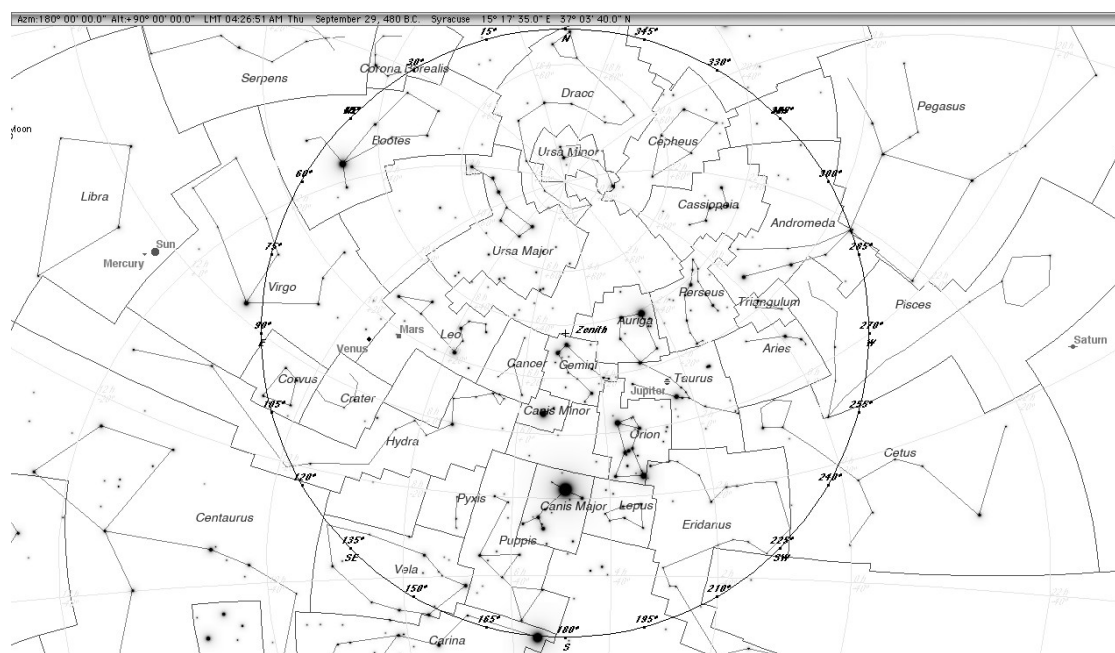
Rising constellations on the day of the solar alignments would have been Andromeda, Pegasus and Aquarius in the spring and Boötes, Virgo and Corvus in the autumn.

⁴³ 20 March or 3 October in 480 BC by the Julian calendar.

⁴⁴ Or 28 September in the Gregorian calendar. The Julian date is used here to allow easier reconstruction of the sky in planetarium software.



Projection of the sky at Astronomical Dawn for 16 March 480 BC at Syracuse



Projection of the sky at Astronomical Dawn for 29 September 480 BC at Syracuse

The temple faced the risings of ζ Ophiuchi (mag. 2.57), η Aquilae (mag. 3.86), μ Ceti (mag. 4.26), σ Tauri (mag. 3.60), λ Hydrae (mag. 3.60), δ Corvi *Algorab* ($-2^\circ 58'$, mag. 2.97). There is no reason to think any of these are significant.

6.33 Syracuse Olympieion

Location: Syracuse

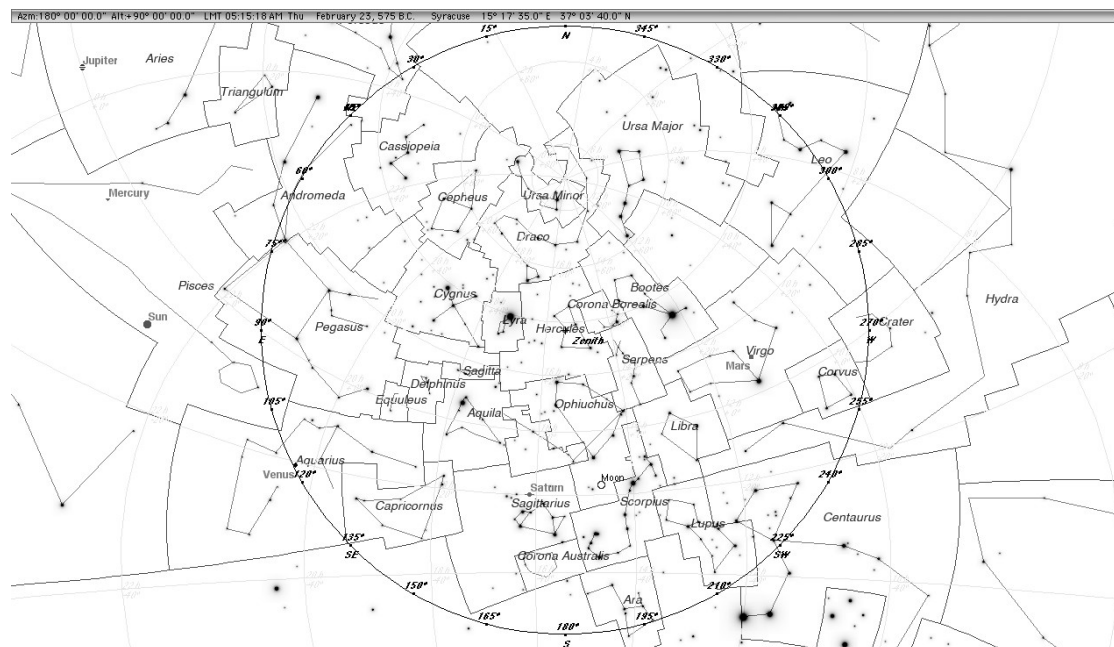
Deity: Zeus

Date: First half of the 6th Century BC

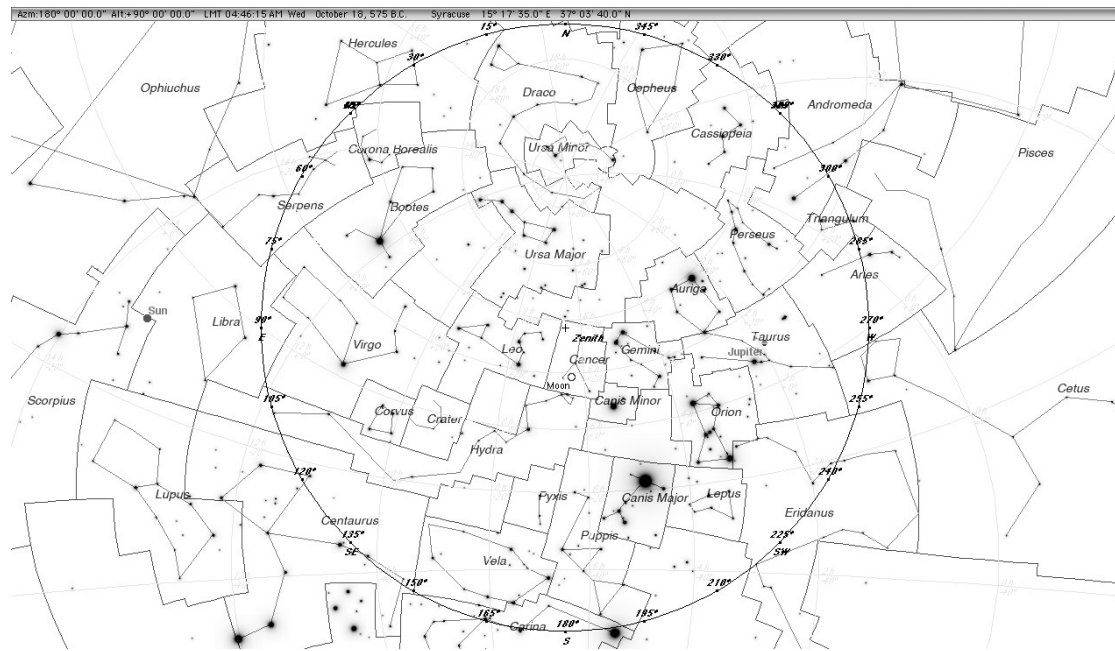
Azimuth: 103°

Declination: -10°

The Olympieion, lies west of temple of Athena and sits on the mainland of Sicily on the opposite side of what is now the bay of Syracuse, about 3 kilometres west-south-west of Ortygia. It's a long but narrow temple, being 62m by 22m. These proportions cause Orsi (1903, p. 392) to date the temple to the first quarter of the sixth-century BC. Dinsmoor (1975, p. 75) prefers a marginally earlier date of 565 BC, due to an inscription with a dedication to Kleo[sthen]es, Spawforth (2006, p. 124) notes that the double colonnade at the front of the temple should make the temple similar in date to the temple of Apollo (see section 6.32). Aveni and Romano (2000, p. S54) in contrast date the temple to 491 BC, but do not say why.



Projection of the sky at Astronomical Dawn for 23 February 575 BC at Syracuse



Projection of the sky at Astronomical Dawn for 18 October 575 BC at Syracuse

Aveni and Romano (2000, p. S54) measure the temple as being aligned to 103.5° giving a declination of -11° . My own measurements are 103° azimuth and -10° declination. This would mean that the temple would face sunrise on 23 February and 18 October.⁴⁵ Rising constellations at this time would have been Andromeda and Aquarius in the spring and Boötes and Virgo in the autumn. There does not appear to be an obvious connection with these constellations.

The temple faces the rising of the stars γ Librae *Zuben Elakrab* (mag. 3.92), α Equulei *Kitalpha* ($-2^\circ 26'$, mag. 3.94), μ Ceti (mag. 4.26), σ tauri (mag. 3.60), $\pi 4$ Orionis ($-2^\circ 21'$, mag. 3.68), γ Corvi ($-3^\circ 40'$, mag. 2.58), δ Corvi *Algorab* ($-2^\circ 29'$, mag. 2.97) and $\alpha 2$ Librae *Zubenelgenubi* (mag 2.75). It could be tempting to see the alignment to the *lumina* of Libra, the scales, as significant, being connected with Zeus in his role as ruler of the gods. However, in this period Libra was known as the Claws of the Scorpion, so such a connection would be anachronistic.

⁴⁵ 28 February and 23 October in the Julian calendar for 575 BC.

Table of all alignments

	Location	Period	Deity	Sex	Plane	Lat°	Az°	Alt°	Dec °
1	Akragas	Mid	Hercules?	M		37.29	90	0	0
2	Akragas	Mid	Zeus Olympios	M	H	37.29	80	3	10
3	Akragas	Mid	Juno Lacinia			37.29	82	2	8
4	Akragas	Mid	Athena	F	H	37.29	110	0	-16
5	Akragas	Mid	Concord			37.29	87	1	3
6	Akragas	Mid	Vulcan	M	U	37.29	87	0	2
7	Akragas	Late	Asklepios	M	U	37.29	90	0	0
8	Akragas	Mid	Diosocuri			37.29	80	2	9
9	Akragas	Late	Demeter	F	U	37.29	81	2	8
10	Camarina	Mid	Athena Pallas	F	H	36.82	107	0	-14
11	Helorus	Late	Demeter	F	U	36.84	99	0	-7
12	Heraclea Minoa		Minos			37.39	142	0	-39
13	Heraclea Minoa		Aphrodite			37.39	114	0	-19
14	Gela	Early	Athena	F	H	37.06	117	0	-21
15	Gela	Early	Athena	F	H	37.06	111	0	-17
16	Gela	Mid		F	H	37.06	114	0	-19
17	Himera	Early				37.96	67	0	18
18	Himera	Early				37.96	67	0	18
19	Himera	Mid	Athena Nike	F	H	37.96	71	0	15
20	Megara Hyblaea	Early				37.2	92	0	-2
21	Megara Hyblaea	Early				37.2	91	0	-1
22	Megara Hyblaea	Early				37.2	72	0	14
23	Megara Hyblaea	Early				37.2	77	0	10
24	Megara Hyblaea	Early				37.2	95	0	-4
25	Megara Hyblaea	Early				37.2	86	0	3
26	Naxos	Early	Aphrodite	F		37.82	44	0	35
27	Naxos	Mid	Aphrodite	F		37.82	61	0	23
28	Naxos					37.82	113	0	-18
29	Palazzolo Acreide		Aphrodite	F		37.06	67	0	18
30	Selinous	Mid	Apollo	M	H	37.58	96	0	-5
31	Selinous	Early	Apollo	M	H	37.58	96	0	-5
32	Selinous	Early				37.58	96	0	-5
33	Selinous	Early	Hera	F	H	37.58	96	0	-5

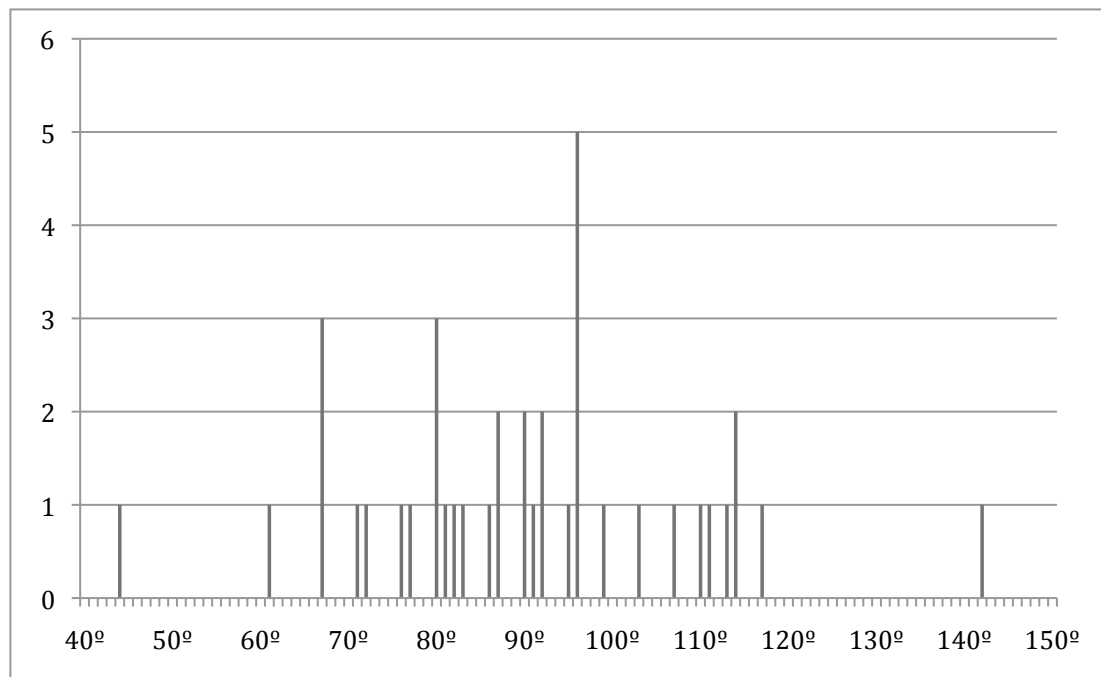
34	Selinous	Early				37.58	96	0	-5
35	Selinous	Early	Demeter Malophoros	F	U	37.58	83	0	6
36	Selinous	Early	Zeus Melikhios	M	U	37.58	80	0	8
37	Selinous	Early	Hekate	F	H	37.58	338	0	47
38	Selinous	Early				37.58	76	0	11
39	Syracuse	Early	Apollo	M	H	37.06	94	0	-3
40	Syracuse	Mid	Athena	F	H	37.06	92	0	-2
41	Syracuse	Early	Zeus Olympios	M	H	37.06	103	0	-10

Period Early >5th century BC, Mid = 5th century BC, Late < 5th century BC

Gender F = Female, M= Male

Plane H = Heavenly (Celestial), U = Underworld (Chthonic)

Graph of Alignments between 40° and 150°



7. Statistics

The old adage is that anything can be proven with statistics. If this were true then they would have long ceased to be a scientific tool. However it could be possible to argue that anything can fail to be explained using statistics. This is particularly true when presenting data to non-statisticians. Statistical argumentation is particularly difficult with astronomical data used for cultural arguments on two grounds. One is that there is not always an obvious connection made between the data and the cultural problem. The other is that the people who are the target audience are unlikely to be statisticians. This is not a fault of archaeologists or classicists, simply a reflection of the unsurprising truth that archaeologists and classicists tend to be more interested in archaeology and classics. If this work is to have a meaningful impact then it must be presented in a way that social scientists can follow, or if this is not possible, at least accept as plausible.

Recent work has tended to follow the latter of the two options, aiming for plausibility. This is usually attempted by reference to standard statistical tests such as Chi-squared or a t-test. For many historians the tests are rather like the output of a spreadsheet, one does not need to understand the workings for the results to be usable. Unfortunately misapplication of such tools can produce erroneous, but seemingly plausible results. A recent debate in the pages of the *Oxford Journal of Archaeology* shows how a study of the orientations of Roman camps can be problematic. Richardson (2005) has applied a chi-squared test to a sample size larger than the one used in this study. The use of the test is disputed by Peterson (2007) who argues that use of chi-squared would require a somewhat larger data set, probably up to thousands of points. Thus chi-squared is impractical for this study, for the thousands of temples required never existed. Another test is needed and this produces the second problem.

There is no commonly agreed standard as to what would be an appropriate test or how to measure the statistical significance of a data set. Therefore there is no acceptable tool to reach for in this instance. The analysis of astronomical data for archaeology has been the subject of some study (Higginbotham & Clay, 1999), and there are other tests that may be applicable (Fisher, 1993). The problem is that if the desired audience is the typical classicist or archaeologist interested in colonisation processes, then application of these methods either requires the reader's acceptance of a magic wand, or an accessible explanation of the statistical foundations of the method.

If the work is to be meaningfully challenged then it must be transparent. Therefore this chapter follows a series of steps:

1. I shall examine the results using the method employed by many archaeologists and astronomers. I shall examine the probability of my results occurring by chance and argue for significance from those findings.
2. I shall then explain why this method is flawed and question what we mean by a significant result.
3. I shall then introduce a new method. Instead of asking how significant the results are, I produce a method to show *a posteriori* what results would produce significant findings.

With this method I shall then move on to showing how it can be applied to samples drawn from the universal data set. This will allow me to pull out samples, such as all temples within a given city, or all temples dedicated to a certain god, and see if their distribution is significantly different to the other Greek Sicilian temples.

Statistical analysis is necessary as, given the orientation of any individual temple, it is impossible to say purely from statistics precisely what the motive for its orientation was. By its very nature any temple must have an opening facing in one direction and so who is to say that it was aligned intentionally rather than by chance or non-astronomical factors? However, it is possible to quantify the effects of chance when the data are aggregated. I start by tackling an anecdotal truth - that Greek temples point East.

7.1 Temples facing East

Do Greek temples face East? The answer depends to some extent on what you define as east. Is this azimuth 90° , or to the range of the horizon which faces sunrise? For this example I shall simply examine whether or not temples face the eastern half of the sky or the western half.



Figure. Diagram of categories 'East' and 'West' for calculation of significance below.

For the sake of this question I am assuming any temple which faces between 0° through 90° to 180° is facing East and that any temple facing between 180° through 270° to 0° is facing west. I should also clarify that 0° is due North as Penrose took his 0° reference to be due South.

In the absence of any a priori assumptions, the chance of any individual temple facing the eastern half of the sky should be 0.5, where 0 is complete impossibility and 1 is absolute certainty. This is a well known problem in probability akin to coin tossing and so it is easy to calculate what, on average will be the result if forty-four temples are aligned purely by chance. The relevant formula, where \bar{x} is the average, is:

$$\bar{x} = 0.5n$$

In this case n is 41 and so on average you would expect 20.5 to face the eastern half of the sky if the orientations were arranged in a purely random fashion. In these results 40 face the eastern horizon, which is more than is expected. The question usually asked is how significant is this?

To answer this we must examine the phase space of the data set. Phase space is the set of all possible combinations of results that the data set could take. The combinations of possible results expand rapidly as more temples are added to the test set. For example if we have just one temple in our test set then there are just two possible outcomes:

1. The temple points east.
2. The temple points west.

However if we add a second temple four outcomes are possible:

1. Both temples point east.
2. Temple A points east, but Temple B points west.
3. Temple A points west, but Temple B points east.
4. Both temples point west.

The number of combinations of potential East-West orientations in a set of n temples is 2^n . In the case of the Sicily data there are 241 potential combinations in the phase space. In all of this phase space just one combination has all 41 temples pointing east. There are 41 combinations in the same phase space where all except one temple point east. This is because the westerly facing temple could be the first temple in the data set, the second, the third... the forty-first. The odds of getting such a result are therefore $41 / 2^{41}$ which is approximately 1 in 53,600,000,000. Traditionally archaeologists have been happy applying statistics in this way.

While I believe this is an accurate way of calculating the odds of getting a specific result, I do not believe it is an accurate way of calculating the result's significance. This would only work if *significant* is the same as *forty*. If the area of phase space occupied by significant results is different to the area of phase space occupied by sets where 40 temples point east, then a different calculation is required. This is the case because usually calculations of probability include result which exceed the selection criteria as well as those that meet them. What then counts as a significant result?

If 40 temples is accepted as a significant finding then logically I would have to accept that had I found 41 temples facing the same direction, the result would be at least as significant. Therefore the area of phase space occupied by significant results must be at least $(41+1) / 2^{41}$. This is as close as to make no real difference. While the physical

results were that exactly 40 temples pointed east, the calculation of the significance must be the probability that at least 40 temples pointed east.

The reader then may ask why should significance start at forty? If I were to say that it was because that's the number of temples I found facing east, then my data would be influencing driving the analysis because forty only became significant after I found the ultimate answer. It's rather like predicting the winners of a horse race after the race has been run. If I am in error about the orientation of one of the temples and only thirty-nine face east would I still consider the result noteworthy? If so then the odds of finding significant results drop. There are 820 combinations where two temples would face away from East, plus the 41 cases of just one temple and the solitary case of all temples facing East to consider. This gives odds of $(820+41+1) / 2^{41}$ or around 1 in 2,550,000,000. This figure around is clearly considerably more probable than the original claim of one in fifty-three billion, but is nonetheless two and a half billion is still astonishingly improbable. I could continue lowering the threshold, but then at what point would I be forced to admit that the results were not significant?

The problem in defining significance using traditional methods is significance cannot be defined *after the results are known*, to match the results found. I have just spent five minutes looking out of my office window. Three cars with numbers 969, 212 and 249 on their numberplates have passed by. The odds of those three numbers passing in that order are roughly $(1/1000)^3$ which would be one in a billion. Improbable but hardly significant.

Returning to the temple sample set, I am looking at the odds of temples pointing east. The probability of a similar number of temples pointing west is equal to this

probability. So while I am confident my results are improbable, can I equally be sure they are significant or is this too post-hoc reasoning? It would be useful if there were a comparison set. I believe in this case, and with archaeoastronomical data in general, the data can be described as Binomial Distribution. This provides tools for defining what is significant before the data is analysed in a consistent manner.

7.2 The Binomial Distribution

A binomial distribution describes the distribution of probabilities that a set of results will happen where there is a probability p that it will happen and a probability q that it will not. The classic example would be to consider tossing coins.

If we exclude the edge, the probability that a coin will land 'heads' (p) is 0.5 and the probability it will land 'tails' (q) is 0.5. Therefore if we were repeatedly to simultaneously toss twenty coins, we would expect, on average, to find heads on ten coins in any single event. However, because each coin toss is independent, this would not always happen. If we found nine or eleven heads in an event then it would be a deviation from the mean, but would it be significant?

The standard deviation (σ) of a binomial distribution of coin tosses can be derived from the formula:

$$\sigma^2 = npq$$

where n is the number of coins tossed. In our case this would be 20, so σ would equal:

$$\sqrt{(20 \times 0.5 \times 0.5)} = \sqrt{5} = 2.24$$

This standard deviation allows us to make predictions about the number of times coin tosses would fall away from the mean. Two-thirds of events would yield ten heads plus or minus one standard deviation. We should therefore frequently expect to see eight, nine, eleven or twelve coins showing the same face. Ninety-five percent of events will fall within two standard deviations (4.47). In this instance you should expect to see fewer than six heads or more than fourteen heads only one time in twenty. At three standard deviations (6.70) would encompass ninety-nine percent of events. If you therefore toss fewer than four heads or more than sixteen then this is a

rare occurrence. A binomial distribution can be applied to any events with a probability of p occurring. Hence it describes the distribution of temple orientations.

$$\sigma^2 = 41 \times 0.5 \times 0.5 = 10.25$$

$$\therefore \sigma = 3.20$$

This indicates that if readers of this chapter were to build their own set of 41 temples aligned at random the average reader would have 20 or 21 easterly facing temples. However without intentional orientation two-thirds of them would have between 17 and 24 temples facing east. Only 1 in 20 would have 14 or fewer or 27 or greater temples facing east, and ninety-nine per cent of readers would have between 11 and 30 temples facing east.

In the case of the results from Sicily, there are nineteen (and a half) more temples facing east than expected. Rather than express this in terms of vanishingly small figures of improbability it can be expressed in terms of standard deviations from the mean. In this instance $20.5/3.2$ which is 6.4. What this does not explain is whether or not this is significant enough to merit attention, but does give a helpful quantification of a sample's significance. To a large extent significance is in the eye of the beholder. It is traditional in social sciences to declare anything with a probability of 5% or less to be significant (or the 95% confidence level), which would be 2σ or greater. Expressing the deviation from the norm in terms of σ allows other readers to apply their own criteria.

Schaefer (2006a; 2006b) and Aveni (2006a; 2006b) have vigorously discussed the importance of stats as proof in astronomical alignments. Schaefer (2006a, pp. 26-27) is scathing of 2σ significance. While 95% of a binomial distribution may fall with 2σ , he

argues that 50% of 3σ claims turn out to be false. This is because given a sufficiently large number of random samples with no controls unusual results will occur by chance, or unintentional error. He argues that in the absence of historical data 4σ or 5σ would be better criteria to use. In this case I can present my result as follows:

Alignment of Greek temples towards East:

$n = 41$, predicted $\bar{x} = 20.5$, result = 40, significant to 6.4σ

$3\sigma = 30.1$ temples, $2\sigma = 26.9$ temples

This method of presentation will allow the author to state his opinion of whether or not a result is significant, however it also means the reader is not obliged to accept it. In the case above if the reader is only persuaded by claims significant to 8σ or higher he may reject this statement without having to redo the calculations himself. It easily illustrates the effect unknown errors have on the robustness of the result. In this case nine temples could be erroneously measured and the result would still exceed a 3σ criterion for significance.

Schaefer (2006a:29) also states: “a word of ethnography is worth a thousand alignments.” In this we have historical and archaeological data that these are temples rather than buildings with another function and a similar phenotype. This could be used to justify a low value σ of for acceptance. This is problematic. If claims to 2σ cover 95% of cases, then if I apply enough tests I should get some positive results purely by chance. After fourteen tests it would be more likely than not that at least one of the results would be a false positive and with a sufficiently large number of tests one in twenty would be false positives. This can be troublesome given the human tendency to pursue tests until something significant is found. Therefore I

propose that this 5% criterion is only used as a filter. If the proposal surpasses this criterion then there is still an imperative to provide a historical justification for the result. In this case the result, only one temple faces away from East, appears compelling, but that means there is a need to explain why this temple – the Hekataion at Seliinous – is facing the opposite way to the other temples.

The Hekataion at Selinous is dedicated to Hekate Triformis⁴⁶ (1927, pp. 73-75). Triformis refers to the three phases of the Moon (Cashford, 2003, p. 126), waxing, full and waning. At the same time Hesiod (Theogony 404-452) records here as being three-fold receiving tribute from sea, land and sky. crescent. She was known as the guardian of Hades (Cashford, 2003, p. 113) and played a role in the quest to recover Persephone from Hades. This is significant as the Hekataion is part of a complex at Selinous, the other two major gods there being Demeter Malophoros (see section 6.28) and Zeus Melikhios (see section 6.29) who both played a role in the mysteries of Eleusis (Simon 1983:13-14) and elsewhere (Cosmopoulos, 2004). By facing the setting side of the sky, this orientation could be intentionally contrary to the typical cult practices. However it should also be noted that despite being a lunar goddess the temple points too far to the north to face the most northerly moonsets. This may not be a problem when considered in the wider context of the sanctuary (see section 8.11).

It would seem justifiable to therefore claim that Greek temples typically face the eastern half of the sky.

⁴⁶ The is a Latin name. The Greek is unknown, but is likely to be Hekate Propylaia, given the position of the sanctuary next to the gate.

7.3 Temples facing Sunrise

To test the applicability of this method further I shall now consider a marginally different hypothesis, that Greek temples faced sunrise. This is different from facing the eastern half of the sky as the sun only rises and sets within a specific range. For the latitude of Sicily, assuming the local horizon is flat, this range would be between 59° and 119° . This is a range 58° wide, approximately one-sixth of the horizon. In the universal set 38 of the 41 temples face within this range. This would be rather like throwing a typical die 41 times and throwing a six 38 times. This is highly unlikely to be due to chance, and can be checked by comparing the sample result to the binomial distribution.

In this example n remains 41, but p is now $58/360$ and q is $302/360$. Typically in any set of 41 randomly aligned temples, np temples would be expected to face within the range due to chance, in this case 6.60. The standard deviation would be 2.35. Therefore there is a greater than 95% probability the sample will have between 1.90 and 11.31 temples. The observed figure, thirty-eight is significant to 13.43σ . This would appear to be highly significant and therefore needs explaining.

One aberrant temple is obviously the temple of Hekate at Selinous, which has already been discussed. If it does not face East then clearly it will not face sunrise.

Another temple outside the set is found along the coast at Heraclea Minoa. This is a colony founded by the citizens of Selinous and the name Minoa refers to it being the supposed site of King Minos's death (Diod. 16.9.4 and see section 8.5). There are two temples on site, one thought to be dedicated to Aphrodite and the other to Minos. One is therefore to a deity and one to a hero, as well as one facing a sunrise and the other not. Vitruvius in *De Architectura* (IV.5) specifically says that temples should be

aligned to the rising sun so that gods face the rising sun. It is therefore tempting to conclude that the temple facing at 142° is the temple to Minos. There is no certainty in this though, and so the attribution remains questionable.

On the east coast there is a temple at Naxos which faces 44° azimuth and 34° declination on the horizon. This is beyond the ranges for the Sun, Moon and Venus. It could be aligned to Arcturus (see section 8.9). This would be puzzling and poses a serious problem for a claimed correlation with sunrise. However this temple may not have properly reflected Greek cosmology. As mentioned in the survey (see section 6.23) this was later rebuilt upon and its orientation altered to face 61° and the midsummer sunrise. It is possible that this rebuild was a correction of the misalignment of the earlier temple. If this is so, then it would appear to be inconsistent to argue that the alignment of the earlier temple was meaningful in a celestial sense. My inability to uncover a motive for the alignment of Temple A at Naxos is a problem. In the absence of historical evidence it is for the reader to decide to what extent the statistical evidence supports the assertion that Greek temples typically face sunrise.

Alignment of Greek temples towards sunrise:

$n = 41$, predicted $\bar{x} = 6.83$, result = 38, significant to 13.0σ

$3\sigma = 14.0$ temples, $2\sigma = 11.6$ temples

In this instance I believe the statistical evidence is strong enough to say that in this case the misalignments of the temple of Hecate at Selinous and Eraclea Minoa and the unexplained misalignment of the Temple A at Naxos are sufficiently minor to allow me to state that Greek temples in Sicily facing within the range of sunrise were usually deliberately aligned to do so. In this instance I would have to have most of

my measurements badly wrong for the result to not be significant, which shows the conclusion is highly robust.

7.4 Comparisons with the Homeland

No comparable dataset has been published for temple orientations in the Greek homeland, though researchers such as Boutsikas (2007), Hoskin (2001) and Liritzis (2001; 2003; 2006) among others are building a corpus of material. The data I shall use for the comparison sample are derived from Retallack's (2008) recently published paper which examines 84 Greek temples from the mainland, Aegean islands and Cyprus.

Retallack's sample set has the advantages of being large and clearly defined. The temples Retallack examines are defined as classical temples dating between 480 BC and 338 BC, and so form a historically meaningful sample. Retallack's own interest in palaeosols would further suggest that selection of temples for their astronomical interest is unlikely and therefore there should be no strong astronomical bias in the sample. Moreover the definition of the sample area is a suitable comparison site as the colonies of Sicily are thought to be the productions of Greek society in the Peloponnese and the Aegean. The exception is the sole temple from Cyprus, the temple of Aphrodite at Paphos, which can be excluded from the sample to provide a source which is centred on the presumed colonising cities.

Adapting Retallack's survey does pose some problems as his research focus is considerably broader in scope than this thesis, including data on topography, soils and vegetation as well as a brief examination of orientation. Unfortunately the necessary brevity of the paper means that much information about the orientations is missing. The orientations themselves are in ten categories rather than measured, the

eight compass directions, unknown and irrelevant. These were categorised from the published plans (Retallack pers.comm.). This is sufficiently accurate for Retallack's argument, but means that orientations of the Greek temples cannot be directly compared to the Sicily sample set. Still it is possible, with some interpretation to perform the two most general analyses of the sample.

My first question of the Greek set is therefore "Do Greek temples indicate a preference for one hemisphere of the horizon?" In the case of the Sicilian data this could be applied to all temples as the accuracy enabled the temples to be sorted into two categories. For this sample I shall compare two categories as well. The 'easterly' sample will be those temples Retallack lists as facing northeast, east and southeast. The 'westerly' sample will be those temples facing northwest, west and southwest. This excludes the 41 temples which Retallack lists as Unknown, Irrelevant, North or South. The latter are excluded as there is no way to be sure if these temples face east or west of their cardinal point. One solution would be to divide them evenly between the two sample sets, but this could build the assumption that the temples were evenly divided between easterly and westerly orientations into the analysis. Instead by rejecting those temples we avoid building a bias in. The assumption is that the unknown orientations will be in the same proportions as the known orientations. Excluding the temple at Paphos leaves 42 temples remaining in the sample, comparable to the Sicilian dataset of 41.

If the temples were randomly distributed in the Greek dataset we would expect twenty-one temples in each category with a standard deviation of 3.24. In fact thirty-eight temples face an easterly direction in comparison to just four that face towards the west. This would be significant to 5.24 σ , less than the Sicilian sample but nonetheless striking. This would suggest that the orientations of the temples of Apollo at Argos and Ptoon and of Athena at Argos and Dionysos at Eretria would all

be worth examining in greater detail to see if their positions were due to specific local conditions.

However, the notion that the north and south temples are equally distributed between the east and west categories could be wrong too. The fact that they are classified as 'north' and 'south' would suggest that the variation a few degrees to the east or the west is irrelevant. Therefore it could be useful to distribute the temples in these two categories to see how robust the result is. This would give a larger data set of 51 temples with 8.5 facing westerly and 42.5 facing east. The expected result would be 25.5 temples in each category with a standard deviation of 3.57 so the result is significant to 4.57σ . This is on the borderline of significance for purely astronomical data (Schaefer, 2006a, p.27). It would suggest that there is a real preference for the easterly horizon in orientation, but that it is not absolute and that many other factors may have precedence over this desire.

The second analysis, whether the temples of Greece face a rising sun, is also slightly complicated by the recording of orientations. As Greece is approximately at the same latitude as Sicily we should expect that the sun would rise over a similar proportion of the horizon, one-sixth. However, the distribution of the temples is recorded in blocks of one-eighth of a horizon. Therefore rather than setting p to $1/6$ as with the Sicilian sample, here I shall use a sample of east-facing temples alone and set the value of p to $1/8$. This will not give a directly transferable result, but will give a comparison figure. In this analysis the north and south facing temples can be used with no concerns. While it may be uncertain whether they face slightly west or east of north or south it will be certain they will not be facing east.

The expected result for a random distribution would be 6.38 with a standard distribution of 2.14. The actual result is twenty-six. This is significant to 8.31σ . Again this is both high enough to be striking and lower than the Sicilian sample. A more precise survey is required to be able to directly compare this result to the Sicilian result and this will become possible as fieldwork progresses in the region.

This would indicate that there is a common expectation of how a Greek temple should be aligned amongst the inhabitants of Sicily in the archaic and classical periods as well as the homeland. What it does not tell us is if the buildings were generally aligned towards sunrise or if they were aligned towards specific sunrises. It is known that the cities had different calendars. Given that calendars were primarily a matter of social and ritual, rather than agricultural concern, could the temples also show variation which reveals differences in local ritual or political behaviour?

7.5 Testing Samples

The next step is to be able to test ideas against data drawn from the sample. Initially it would seem simplest to draw out the relevant data and treat it as an isolated sample. This would allow a repeat of the proven method above. This is however problematic, which I will demonstrate with a faulty analysis.

The full set of results has temples at 44°, 61°, 67°, 67°, 71°, 72°, 76°, 77°, 80°, 80°, 80°, 81°, 82°, 83°, 86°, 87°, 87°, 90°, 90°, 91°, 92°, 92°, 94°, 95°, 96°, 96°, 96°, 96°, 96°, 99°, 103°, 107°, 110°, 111°, 113°, 114°, 114°, 117°, 142°, and 338°.

From this set I have drawn two samples for a demonstration:

Sample A has temples at 91°, 94°, 96° and 96°, a five degree span.

Sample B has temples at 113°, 114° and 142°, a twenty-nine degree span.

A simplistic analysis would state that p , the probability that a sample will fall in the tested range, for Sample A is $5^\circ/360^\circ$ while p for Sample B is $29^\circ/360^\circ$. If this is the case we should expect 0.57 ± 1.5 temples in the region of sample A and 3.30 ± 3.49 temples in the region of Sample B, giving a σ of 1.83. Instinctively this seems wrong. Indeed if I had put all three temples which lie outside the range of sunrise into one sample then I could conclude that there was nothing at all special about it and that Sample A is highly significant, when in fact it is selected from a cluster of many temples all facing in roughly the same direction.

The mistake is in the p values. The values given for p assume that temples are being compared to a purely binomial distribution. This is not the case as it has already been shown above that Greek temples as a class are not randomly aligned, but face

around east. The samples must therefore be compared to a typical sample set of Sicilian Greek temples. Given the purpose of this thesis is to examine Sicilian Greek temples it would appear that the sample and control are inextricably linked. There is however a method for pulling the two apart.

If we extract a sample set from a universal set, then the remainder would seem to fill the requirements of being a set of typical Sicilian Greek temples. There is now a comparison sample to compare the test sample against and the value of p can be meaningfully discussed. The question is now how likely a temple in the sample set would match a temple in the comparison set. This depends on how one defines match. For an initial test I shall consider the accuracy of the measurement of the temple alignments.

The measurements are accurate to $\pm 1^\circ$. This means that a temple at 91° may match a temple facing at 90° , 91° or 92° . Considering Sample A the control sample is:

44°, 61°, 67°, 67°, 67°, 71°, 72°, 76°, 77°, 80°, 80°, 80°, 81°, 82°, 83°, 86°, 87°, 87°, **90°, 90°, 92°, 92°, 95°, 96°, 96°, 96°**, 99°, 103°, 107°, 110°, 111°, 113°, 114°, 114°, 117°, 142°, and 338°.

From the control set eight temples (in bold) may be considered matches, therefore $p = 8/37$. If this is the case, then the predicted number of temples matching a sample in a set of 41 temples is, np , 8.86 with a σ of 2.64. When we add the four temples from the sample to the control to see if this is the case, the observed value is 12, 8 in the comparison sample and 4 in the test sample. This will exceed the probable number of temples in the sample, but the question is: "Is the test sample size large enough to distort the total significantly?" Two standard deviations would expect us to have between 3.59 and 14.14 temples. This means the sample lies well within two standard

deviations (only significant to 1.19σ), and so can be dismissed as statistically irrelevant.

For Sample B the control set is:

44°, 61°, 67°, 67°, 67°, 71°, 72°, 76°, 77°, 80°, 80°, 80°, 81°, 82°, 83°, 86°, 87°, 87°, 90°, 90°, 91°, 92°, 92°, 94°, 95°, 96°, 96°, 96°, 96°, 99°, 103°, 107°, 110°, 111°, **114°**, 117°, and 338°.

This gives one potential match in thirty-eight and so $p = 1/38$ giving a predicted observation of 1.08 temples and a σ value of 1.02. The observed value in the universal set is four, one from the comparison sample and three from the test sample. This is significant to 2.85σ and so, despite covering a wider range of the horizon, the comparative rarity in the sample of such temples would suggest that Sample B could be significant. To be more sure Sample B would have to be shown to be a historically meaningful sample, rather than one chosen specifically to make this point.

This would solve the problem were it not for the fact there is a questionable assumption built into the method above. I assumed that the accuracy of $\pm 1^\circ$ was sufficient to detect a match, Mary Blomberg and Goran Henriksson have argued that the accuracy of Greek astronomy was originally $\pm 2.5^\circ$ (Henriksson & Blomberg, 2000, p. 304). While I find their reasoning unconvincing – they choose $\pm 2.5^\circ$ because it gives the best results for their analysis – the possibility that the error is greater than 1° remains. This could increase the number of potential matches. For ease of calculation I have rounded this error up to 3° . In the case of Sample B the p value must now be $3/38$ as the temples at 110° and 117° are within 3° of the temples at 113° and 114° in the test set. This now means the sample is only significant to 1.60σ . Any argument that such a sample was significant would then rest on how accurately the Greeks aligned their temples. Calculation of the σ value of a sample against proposed

accuracy would provide some means of demonstrating the importance of the underlying assumptions in the calculation.

8. City Analysis

The following sections contain aggregate sample data. These may be temples from specific sites, temples to specific deities or temples of certain periods. The flexibility of this system will allow the statistical significance or otherwise of each sample to be calculated with varying values of assumed accuracy and hence p , which may indicate the robustness of some of the conclusions. There are problems. This method will not cope well when samples take out large chunks from the universal set. However if these are sufficiently large samples then they will hopefully be significant in themselves and the discussion will ask why it is a meaningful example. A sample of this size may also be compared to a typical binomial distribution. The great asset of this approach is that while it put figures to the significance of samples, the result is explicitly dependent on the value of p . This value must be justified with reference to the social aspect of the astronomy practiced in reference to the historical and archaeological data. Thus rather than separating the statistical analysis from the social analysis, the two work in combination with each other.

8.1 City Analysis: Akragas

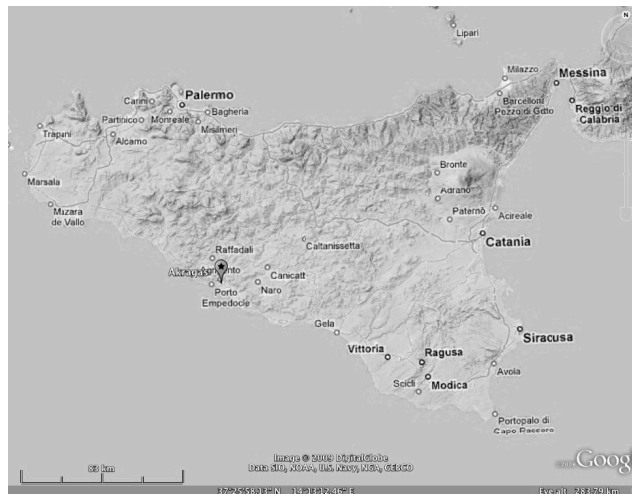
Latitude: 37.29

Longitude: 13.59

Founded: ~580 BC

Metropolis: Gela

Ethnos: Dorian



Map © Google

Akragas, on the southern coast of Sicily, is one of the most problematic sites in this study. It is not merely unusual, but unusual in many different but interdependent ways. It boasts the finest collection of surviving Greek temples in the Mediterranean. This is no doubt due to its wealth in antiquity, which funded the unparalleled building programme. It also is one of the better documented sites in Sicily. Its wealth drew interest from the wider Greek world and it exported philosophy in the teachings of Empedocles. It is therefore perhaps the most amenable city for this study.

Akragas is said to have been founded with the name Akragas around 580 BC following Thucydides (6.4.4) who places the foundation around one hundred and eight years after the foundation of Gela. Fischer-Hansen, Nielsen and Ampolo (2004, p. 186) refer to Pindar's Olympic Ode to Theron (*Ol* 2.166-69 with Schol.) which places Theron's victory in 476 BC one hundred years after the foundation of the city. However there is evidence that the site was known to the Greeks much earlier. Mycenaean pottery has been found associated with Early Bronze Age burials in the

region (De Miro, 1968). Further recent work has revealed settlement on site which appears to date before the recorded foundation of the city, but whether this is Greek or native settlement, or how much earlier the settlement is, is not yet known (ANSA 2006). This would suggest that if there was a difference in initial layout of cities due to native influence then, after a century of co-existence at Gela, Akragas should show the extent of native cosmologies in public architecture. The city was named after the local river which, in turn, had been named after a Greek river. The dates given by Thucydides are broadly corroborated by the archaeological evidence. Greek funerary ware at Akragas does not appear before the early sixth-century (De Miro, 1994, pp. 21-22).

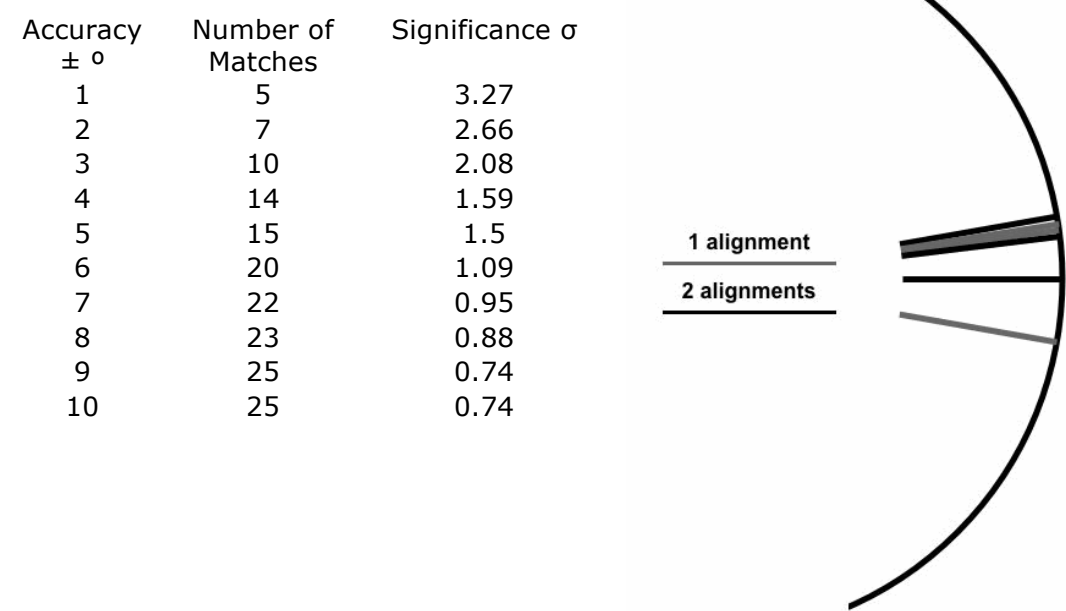
Cultural continuity with Gela is to be expected from the ancient sources. Polybius (IX.27) records the existence of a temple of Zeus Atabyrion along with a temple of Athena. Atabyrion may be a reference to the local acropolis (Dunbabin, 1948, p. 316). While Atabyrion is an unusual epithet it is found elsewhere at Rhodes (Strabo XIV.2.12; Appian *Mithrid.* 26; Apollod. III.2.1; Pind. *Ol.* vii.85).

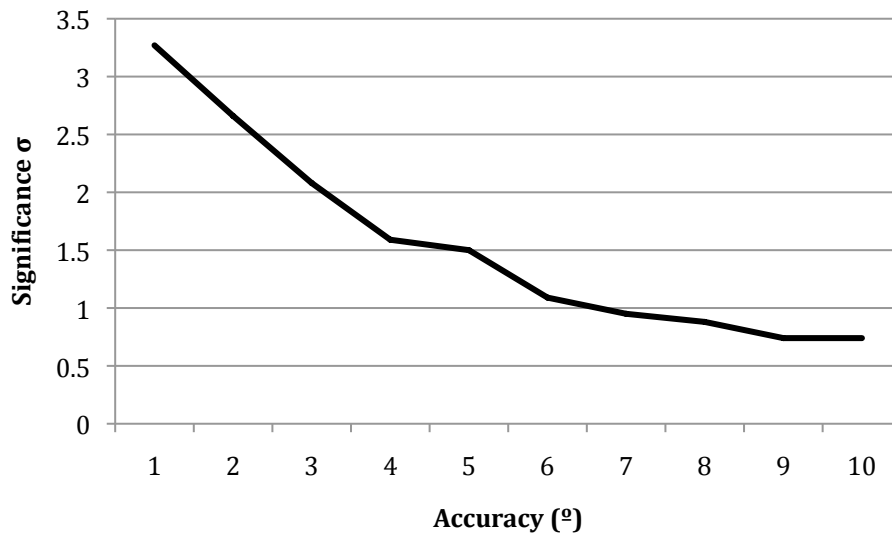
There is also debate in the ancient texts on whether or not there existed bronze bulls on the hill. Polybius attributes the existence of a bronze bull to the tyrant Phalaris, a ruler whose name appears to have been a byword for cruelty. The bull was hollow to admit a victim who would be roasted alive inside, his wails sounding like the bellowing of a bull (Polybius XII.25). This was disputed by Timaios, though his work is scorned at great length by Polybius (XII 24-28). Whatever the truth of the tale, it suggests that, for later Greeks, bronze bulls would not be out of place in Akragas. This can be compared to descriptions of the bronze bulls of Rhodes on Mount Atabyrion (Schol. ad Pind. *Ol.* vii. 159) and evidence of worship of Zeus as a bull (IG xii.1, 31, 161, 891). This in turn would be testimony to a sense of Rhodian origins in the historical period.

Given that Akragas was founded by Geloans, it would be expected that the connections came through this intermediary and so there should be a strong degree of similarity between Agrigentine and Geloan cosmologies. This would connect Akragas to Rhodes, via Akragas’s mother city Gela (see section 8.6). Whether or not in reality such a connection can be shown is difficult due to the great disparity in preservation of sacred sites. Gela has very only a few known sacred sites. Akragas in contrast is replete with an astonishing number of temples, many of them extremely well preserved. For the purposes of this study the following description of temples will be referred to by designated letter rather than attribution as not all temples discussed have a formal attribution. Indeed, many of the proposed dedications of temples in the city are likely to be incorrect.

8.1.1 Orientations

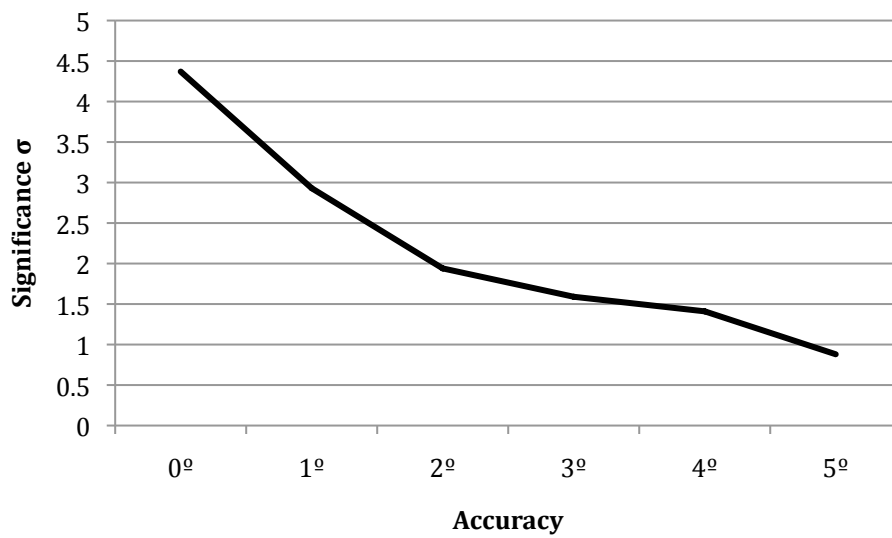
Azimuths





Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	3	4.37
1	6	2.93
2	11	1.94
3	14	1.59
4	16	1.41
5	23	0.88



8.1.2 Discussion

If the temples were laid out to an accuracy of $\pm 3^\circ$, then it would seem that the orientation of Agrigentine temples is significantly different from the orientations of other Greek Sicilian colonies. This would seem to be an argument in favour of a topographical explanation of the temple alignments rather than an astronomical reason.

The temples of Akragas can be divided into three categories. Temples A, D and F are built along the southern ridge of the city. There are temples on the high ground to the north, of which only Temple E, the temple to Athena Lindia could be measured for this survey, and some temples in the valley between these two ridges.

Temples A, D and F considered

Traditionally these three temples are considered as a group as they are sited along the same ridge. The chronology of building would appear to confirm this. Temple F's near identical size and plan would indicate that this was built with the nearby Temple D in mind. The refitting of the temple A around the same time as the building of Temple D would also suggest that the two temples were built as part of a plan. The nature of the planning is however speculative, given the lack of reliable attribution for the temples. Temple A occupies a prominent position within the Agrigentine landscape, overlooking entry into the city. Temple D was built at the very opposite edge of the ridge. Whether or not this made the Temple D conceptually a partner temple to Temple A is questionable.

At the time Temple D was being built, Temple B had already been planned near Temple A. This temple was intentionally massive and was probably built with the intention of dwarfing Temple A which stood just 200 metres away. Temple D in

contrast was isolated at the south-eastern corner of the city over 1.2 kilometres away from Temple A.

Temple D is of different proportions to Temple A, and the ability to refit one temple whilst building another would not suggest that this was due to poverty. The wealth of the colony is underlined by the building of the third temple, Temple F. This temple does appear to be a close twin of Temple D. Both its form and position strongly suggest it was built with a topographical relationship to Temple D in mind. However Temple F is physically closer to Temple A by some 200 metres and closer in alignment to Temple A. It is possible that Temple F's style and position was therefore chosen create the visual impression of a row of temples along this ridge, rather than for astronomical reasons.

The Northern Temples

Of the three temples to the north of the city, only one can be assigned an orientation. The temple of Zeus is buried under the modern city. The remains of a temple of Demeter can still be seen beneath a church. but unfortunately neither Aveni and Romano nor myself have been able to measure this orientation. Koldewey and Puchstein (1899:T11) record an orientation of 133° for this temple. This would be striking if correct, but their measurements are in disagreement with both my own and Aveni and Romano's. Additionally they are not consistent in their errors. Google Earth shows an image of a church orientated to around 125°, but the resolution is far too low to be sure beyond $\pm 5^\circ$. What it would indicate is that the temples on the hill overlooking the city can be said to face south-east. This too could be a topographical imperative. However it could be that the dedications of these temples were chosen because they were suited to a south-easterly orientated temple.

The Valley Temples

These would initially seem to be emphatically aligned with respect to the local topography. The rises to the north and south mean that any temples not facing between 75° and 90° will be facing a close horizon. It is however the funnelling of orientations for Temples G, H, I, and L which indicates a distant horizon was desirable. All four of these temples are deities associated with the underworld. This is interesting given that the Asklepieion and Temple of Vulcan are quite distant from the sanctuary of the chthonic deities. It may suggest that while the topography dictated which way temples could face, the site of a temple may have been chosen to permit a specific astronomical target.

The Temple of Zeus Olympios

The temple of Olympian Zeus is puzzling because it can be interpreted in a number of contexts. Within the city of Akragas the temple would have been planned at the start of an extensive building programme. As a result it means the temple could have been built in a few places, including next to the sanctuary of the Chthonic deities. Instead it sits behind the southern gate. This would have overlooked the agora which lay close to the north. However it could have been built close to the Porta V and been visible from outside the city. Being behind the southern ridge, it would seem to be placed to be seen from within the city.

To the west it overlooks the domestic quarter, and so it is tempting to conclude that it was built to be a visible symbol of power overlooking the residences of the city. This is not necessarily the case. When completed the temple would have had its back to the domestic quarter. Built to the north of the domestic quarter it would have been broadside on, and thus more visible. This could be an argument for placing the

temple to the south of the Agora. Here it would have been close to the Temple of Herakles, which could emphasise the size of the temple.

In a wider Sicilian context this temple would have been planned shortly after Selinous's Temple G, the temple of Apollo or Zeus. Temple G would have been of similar length, but Akragas's temple would be slightly wider. Diodorus Siculus (XI.26.2; XIII.82.1-4) also allows us to place the temple in the context of the victory of Himera. Two temples were built by Gelon with booty won from the battle (see sections 6.16 and 6.32). This temple would have been built with the Agrigentine share of the spoils. Comparing the dates with the other post-Himera temples would be useful. (see section 15.1).

8.2 City Analysis: Akrai

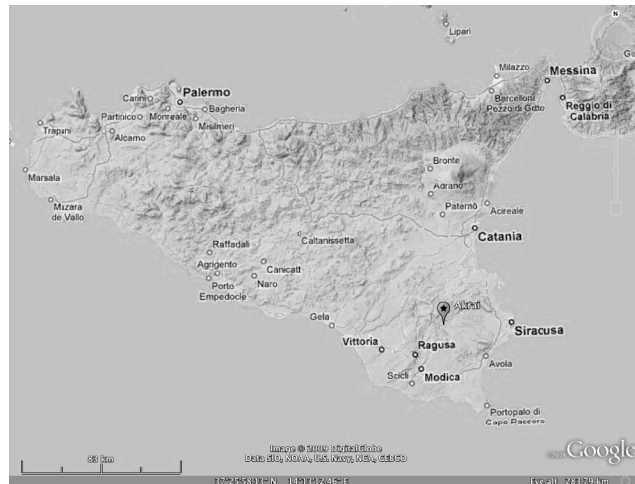
Latitude: 37.82

Longitude: 15.27

Founded: ~663 BC

Metropolis: Syracuse

Ethnos: Dorian



Map © Google

Akrai is traditionally to be considered one of the four daughter colonies of Syracuse. Its history is highly problematic to record because this colony is perhaps the strongest example of archaeology being interpreted through a historical filter rather than independently. The traditional foundation date is given as 663 BC, extrapolated from the history of Thucydides (6.5.2) written more than two hundred years after the proposed event. All interpretation of Akrai's archaeological record is made to fit this chronology.

There is however difficulty in accepting this chronology. Bernabo Brea (1957:165-9) describes a series of Pre-Greek necropoleis in the South-east of the island. Settlement from the start of the first millennium to the arrival of the Greeks appears to have shifted around the Akrai plateau. Of particular interest is the site of Monte Finochitto, which Bernabo Brea (1957:166) dates to 750-650 BC, immediately preceding the foundation of Akrai. The burials are noteworthy as the fibulae found at in burials at the site were identical with those from the Greek tombs at Syracuse and Megara Hyblaea (Bernabo Brea 1957:166). Dominguez (2006:285) also notes that

the earliest Greek tombs at Akrai in the necropolis of Pinita followed native use of the site. If no historical record existed it would be considered plausible that the material did not indicate movement of people but new economic activity.

Domínguez (2006: 284-5) argues that the scant record of the foundation of Akrai, especially the lack of names of the oikists, indicates that the city was not formally independent of Syracuse. An alternative explanation would be that no Greek oikists existed and that the notion of Greek foundation is an expression of affinity with the local power. However, this would beg the question why no oikists were created to expand upon the foundation story.

The status of the colony of Akrai as a Syracusan settlement is thus questionable. The presence of the lone temple to Aphrodite will not by itself settle the question, but a comparison of the Syracusan genealogy (see section 9.1) with the later settlements of colonies from Gela (see section 9.2) and Megara Hyblaea (see section 9.3) may lend weight to one interpretation.

8.3 City Analysis: Camarina

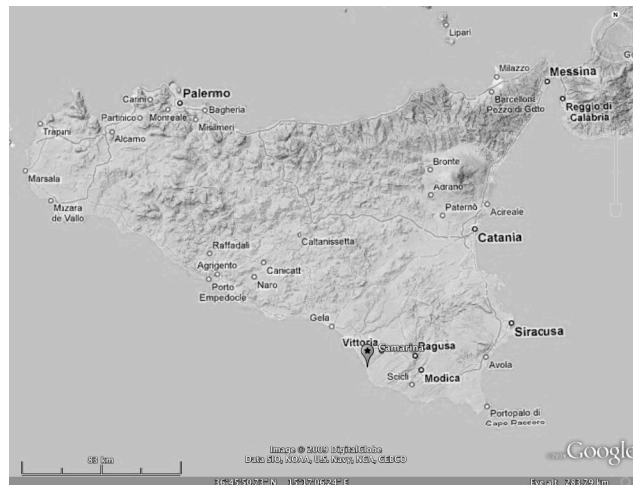
Latitude: 36.82

Longitude: 14.44

Founded: 598 BC / 492 BC

Metropolis: Syracuse / Gela

Ethnos: Dorian



Map © Google

Camarina lies in the territory between Gela and Syracuse. The ruins lie by a natural bay, a few kilometres south of the modern resort of Scoglitti. The city rises along a gentle hillside to the east where the museum, overlying the ruins of the temple of Athena can be found. From this location there is a view field of view to the distant horizon, and so if astronomical orientation is important, this site should be an appropriate test.

Unfortunately in considering the people who built the site, Camarina proves to be a confusing city for the purpose of this study. Thucydides (VI.1.5) records that it was founded from Syracuse in around 599-598 BC by Dascon and Menecolus. However he notes that it was later re-settled by colonists from Gela by Hippocrates of Gela. Herodotus (VII.154) states the territory was won from the Syracusans as part of a settlement for the return of prisoners. This has an important effect in interpreting the archaeological remains.

Pelagatti has recovered evidence of settlement and re-settlement in his excavations. The later re-settlement was evidently not viewed as a new settlement but of taking an existed constructed place. This is shown in Pelagatti's examination of the street plan (Pelagatti, 1966), which in the Geloan strata respects the alignment of the Syracusan built defences. If infrastructure defines the space within which architects work (see section 8.11) then the question is raised the remains reflect Geloan or Syracusan beliefs or, more likely, a hybrid of the two. In this case archaeological remains need not be indicative of a specifically Camerinan cosmology.

The settlement of Hippocrates was brief. Once Hippocrates became master of Syracuse he resettled the Camerinans for whom he was oikist and gave them Syracusan citizenship (Herodotus VII.156). There was a third settlement again from Gela. The date of this settlement is uncertain but it can be no later than 460 BC given Pindar's *Olympian Ode* 5 for Psaumis of Camarina which dates to this period. It was for a while successful as a city. It was awarded Morgantina by the Syracusans in gratitude in their military assistance (Thuc. VI.65). By the time of Strabo (VI.5) it was a shadow of its former self.

The street grid is aligned on an azimuth of 115.5°. This, according to Pelagatti (1966), dates from the original Syracusan foundation and is confirmed by its concordance with the alignment of the archaic fortifications. The grid is broadly in line or perpendicular to the local topography and does not indicate any targeted alignment. The Syracusans who were ultimately responsible for this alignment do not appear to have expressed cosmological beliefs through infrastructure. The natives, if they did, would appear to have had no influence in the city.

Despite the notion of resettlement and well-defined phasing suggesting potential to tease out differing identities in the city, the archaeological evidence simply does not survive that allows us to do this. The historical record is sufficient to hint at these differences but too sparse to allow further study. While Camarina's temple can contribute to studies of Athenian temples (see section 13.4) and the Lindian genealogy (see section 9.2) it can tell us nothing of Camarina itself.

8.4 City Analysis: Helorus

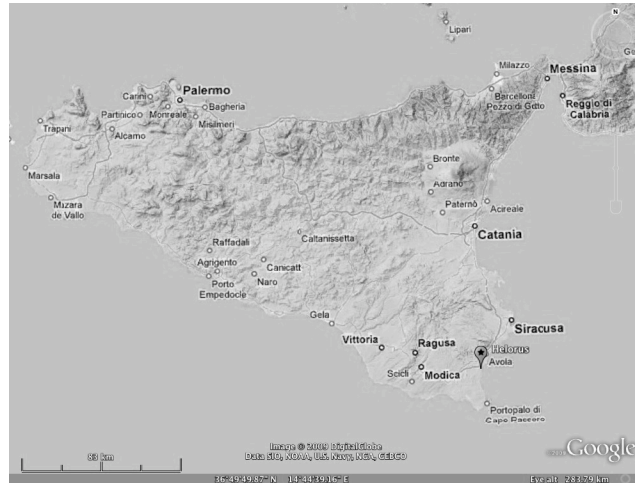
Latitude: 36.84

Longitude: 15.11

Founded: trad. 700 BC

Metropolis: Syracuse

Ethnos: Dorian



Map © Google

Helorus lies on the coast, around 30 km south of Siracusa. The site is a low promontory on the flat plains that lie between the Iblea Massif and the Ionian Sea. Little of site remains aside from the foundations of a stoa, the temple of Demeter and part of the theatre.

The site cannot be dated from the historical record as unlike Akrai or Casmenae its foundation is not mentioned in Thucydides. There are references to the site Diodorus Siculus (X.28) refers to a battle at Helorus between Gela and Syracuse in 491 BC. Pindar *Nemean Ode* 9 for Chromius of Aetna's chariot race also refers to the steep banks of the river after which the site is named. From pot-sherds the site is dated to the end of the eighth-century and would have been one of Syracuse's earliest colonies (Orsi, 1899). Mitello (1966, pp. 301-304) reports finds of proto-Corinthian ware including skyphoi and kylikes in the early strata, which roughly correlates with this date, though the dating of this pottery is in turn derived from the histories (Voza, 1970 [1973]).

The temple of Demeter sits on the south side of the major hill on site. There are two other buildings of interest a treasury and a Koreion. The treasury was excavated in 1927 (Orsi, 1966, pp. 217-218). Militello (1966, p. 320) observes that the building is rather small (9.8x5.6m) and its alignment is unusual. Plans (Currò Pisanò, 1966, pp. 289-290) show that the building faces up a gentle slope with an azimuth of 44°. This azimuth was calculated from the published plans as the site could not be identified on the ground. This would mean the temple would face a declination of 35°, far too far north to face any sunrise or moonrise. One could argue for an alignment on Boötes or Lyra, the former being tempting as a ploughman to be connected with Demeter, but with no corroborating data this is no more persuasive than arguing for an alignment on any constellation.

Figurines found in this location are of Artemis (Mitello, 1966, p. 321), which reduces the plausibility of an alignment on Boötes still further. However from the finds Mitello argues this is a treasury and so the building has not been included in the aggregated analyses. If it were it would match Temple A of Naxos.

Another building excluded from the analysis is the Koreion to the north of the city. This has been identified as such by Currò (1966) who records offerings and bothroi, pits for chthonic offerings. The plan of the building (Hinz, 1988, p. 114) initially appears to be aligned to the north-east. However the offerings are clearly all to the south-east of the building and it is in this direction that the doors of the building open. The elongation would therefore be due to successive additional buildings being built alongside the original building to ensure a clear view south-east. This view is approximately to 125° which faces a horizon declination of -27°. This is be too far south to face a point on the horizon where the sun rises, but faces in the direction of the sun as it climbs higher in the morning sky. It faces within the range of moonrise. The intentionality of either proposed alignment could be

questioned. Why would a deity associated with the underworld for part of the time require an intentional astronomical alignment? A possible answer could be that the alignment is related to the Haloa, a midwinter festival. The offerings allow the site to be dated to the sixth-century BC (Orsi, 1899, p. 242). The winter solstice would be close to the Haloa (Brumfield, 1981, pp. 104-131).

While these features are worth considering in relation to Demeter (see section 13.3) the solitary certain temple means that an analysis of the city itself would be fruitless.

8.5 City Analysis: Heraclea Minoa

Latitude: 37.39

Longitude: 13.28

Founded: After 570 BC

Metropolis: Selinous

Ethnos: Dorian



Map © Google

With the name referring to two legendary figures Heraclea Minoa would have been the perfect site to observe the process of acculturation through cosmology and myth if more of it had survived. The site today consists of a few roads scratching the surface, a theatre currently crumbling under a protective cover and the remains of a couple of sanctuaries. The city lies about 50 km south-east of Selinous and 30 km north-west of Akragas at the mouth of the river Platani known in antiquity as the Halykos. The sanctuaries at the site can be found at the top of the promontory Capo Bianco.

The city is the daughter of Selinous (Herodotus V.46), itself the daughter of Megara Hyblaea. Following the historical record it is assumed that the date of foundation was some time after 570 BC in the time of Theron's tyranny at Akragas as a means to block expansion westward into the territory of Selinous (De Angelis, 2004, p. 159). It was therefore founded long after the arrival of the Greeks on the island. This would suggest that the settlers of Heraclea Minoa were very much Sikeliote Greeks, rather than homeland Greeks. Unfortunately historical sources are silent on the foundation

itself and so the precise date of foundation is uncertain. The city was the subject of a survey in the in the post-war years (De Miro, 1955; 1958; 1962). Excavation suggested the city was founded in the mid sixth-century BC and a later survey of its hinterland in the 1970s found no settlement immediately prior to the Greek foundation (Wilson & Leonard Jr, 1980).

The name Minoa is a reference to King Minos of Crete (Diod. 16.9.4). It is said that King Minos died in the area while pursuing Daedalus and so gave the locality his name. This has been argued to suggest that a Bronze Age settlement existed here, but no such evidence has been found to support the assertion (Wilson and Leonard Jr. 1980: get page). The prefix Herakleia is thought to date from resettlement of the town by a party from Cefalú (Orlandini 1976:385). Adding the prefix Herakleia may have been a conscious referral to the tale told by Herodotus (V.43-6) of the Spartan Dorieus. Dorieus first attempted to settle in the territory of Eryx as he had been informed by an oracle that the land was rightfully the property of the descendants of Heracles.

The Street Grid

The road is fractionally off north, being orientated at an azimuth of 355 degrees. This is comparable in accuracy to Selinous (see section 8.11) and suggests that they may have been laid out using a similar method. The archaeological record indicates that the site was very consciously planned to control a specific territory in reaction to a specific threat. The comparatively late date of foundation suggests in this instance it may be reasonable to talk about a specific moment of creation and a coherent plan to the city from the outset. Ito (2002, p. 60) has identified the earliest evidence of axial planning at Selinous, and a conscious territorial grab would be consistent with the conscious concept of creating a polis. It is therefore feasible that the western cities (see section 8.7 for Himera, 8.11 for Selinous) may have been the first planned cities.

The Theatre

The theatre posed a particular problem in measuring an orientation. It is currently under a plastic shelter supported by metal scaffolding. The presence of so much metal rendered the magnetic compass useless for accurate work. More distant measurement indicates the theatre is aligned south. This is corroborated by satellite imagery. As with street grids this poses a problem in interpretation as it is a single data point, but may be useful when correlated with other theatre sites.

8.6 City Analysis: Gela

Latitude: 37.06

Longitude: 14.26

Founded: 688 BC

Metropolis: Rhodes / Crete

Ethnos: Dorian



Map © Google

Gela is unusual among the Greek settlements of the southern coast in having a modern city obscure most of it. While Akragas lies beneath the modern city of Agrigento, its temples remain exposed. At Gela little of the ancient city is open. The primary ancient site at the city is the ancient acropolis which bears evidence of three ancient temples. Across the river from the acropolis lies a sacred area at Bitalemi (Orlandini 1966). This has yielded offerings of terracotta figurines suggesting that it was sacred to Demeter and Kore. However no temple-like structures have been recorded. On the other side of the city the surviving ancient architecture belongs to the Hellenistic fortifications (Panvini, 1996, pp. 117-120).

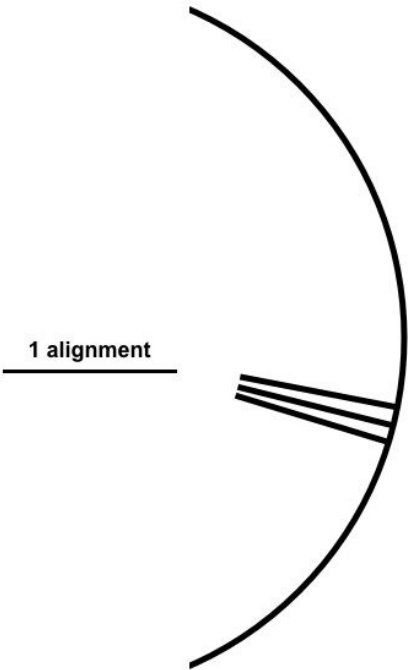
The traditional foundation date for the city is 688 BC. Thucydides (VI.4.3) credits Antiphemus from Rhodes and Entimus from Crete with founding the city forty five-years after Syracuse. The archaeological evidence does not directly contradict this statement but nor does it necessarily confirm it. Protocorinthian amphorae have been found at Gela. This style is dated to the late eight and seventh-centuries BC. However this style is dated to this period precisely because it is found in the foundation layers of sites in Sicily and Southern Italy such as Gela (Adamesteanu,

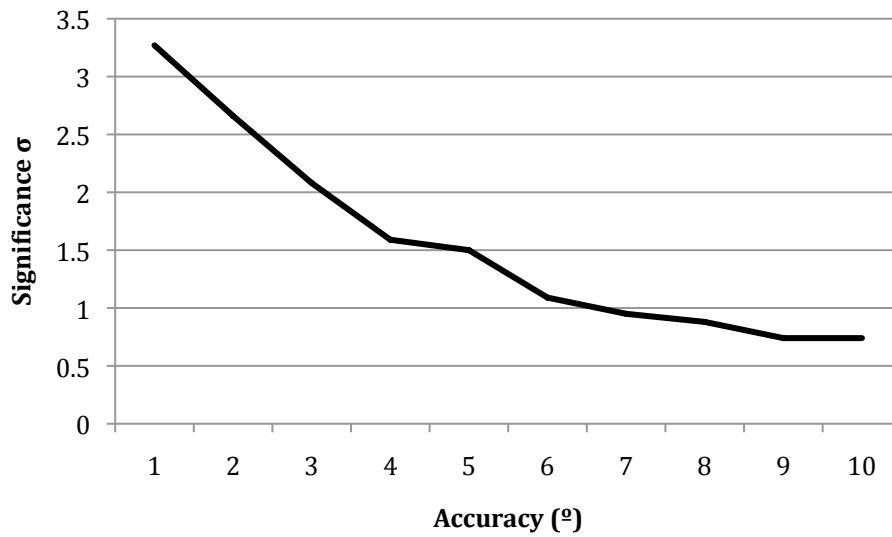
1956). Therefore the archaeological dating cannot be said to be independent of the historical dating. Nor can this be argued to necessarily be indicative of Greek settlement, rather than Greek trade. If the settlement was a Greek foundation then a large degree of intentional cultural continuity should be expected. In the same passage in which he records the foundation (VI.4.3), Thucydides notes that the fortifications were originally called Lindioi, after Lindos on Rhodes and that their institutions were explicitly Dorian.

8.6.1 Orientations

Azimuths

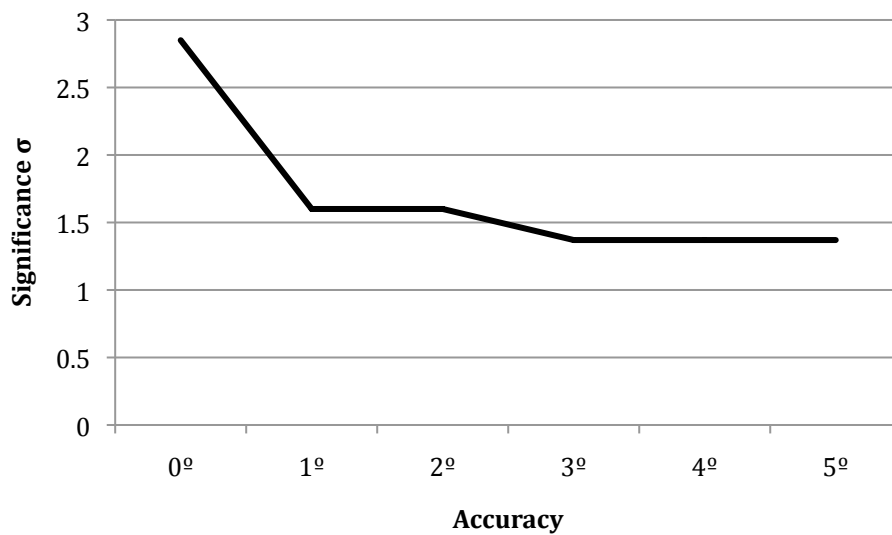
Accuracy \pm °	Number of Matches	Significance σ
1	3	3.27
2	3	2.66
3	3	2.08
4	4	1.59
5	4	1.5
6	4	1.09
7	4	0.95
8	5	0.88
9	5	0.74
10	5	0.74





Declinations

Accuracy	Number of Matches	Significance σ
0°	1	2.85
1°	3	1.6
2°	3	1.6
3°	4	1.37
4°	4	1.37
5°	4	1.37



8.6.2 Discussion

Regardless of the proposed accuracy of the alignments, there is insufficient data to argue for an intentional alignment specific to Gela. It is tempting to argue that the

alignment of the three temples broadly along the line of the hill that held the Acropolis, However shared alignments with temples at Akragas (see section 6.4) at $\pm 1^\circ$ and Camarina (see section 6.10) at $\pm 4^\circ$, indicate that there may be another factor involved associated with the Goddess Athena (see section 13.4), or possibly specifically Athenia Lindia. The declination data hints at a possible significance to the site, but if the temples were aligned to no better than $\pm 2^\circ$ then it is unlikely this significance would hold. Given the lack of historical evidence for extreme accuracy in alignment, it would seem likely that the 0° reading of 2.85σ is a false positive result.

8.7 City Analysis: Himera

Latitude: 37.96

Longitude: 13.82

Founded: trad. 648 BC

Metropolis: Zancle

Ethnos: Ionian?



Map © Google

Like Palazzolo Acreide (see section 8.2), Himera is a Greek colony whose origins are hard to determine. Thucydides (6.5.1) records it was founded by Zancle, with the assistance of some defeated Syracusans. While he names oikists, he does not however give a foundation date. The traditional date is implied by Diodorus Siculus, who notes that it had been founded two hundred and forty years before its destruction in 409 BC. The colony sat in an area recognised as non-Greek by Thucydides (6.62.2). During the Athenian expedition Thucydides (7.58.1) again notes that Himera is the only Greek city of the north coast. This contrasts with the notion that Sikel independence ended with the defeat of Ducetius, and that the Sicels were Hellenised. The proposed history of Himera as a centuries-old isolated outpost of Hellas amongst the barbarians thus seems peculiar and requires an explanation.

One possible solution is to question the hybridity of the site. Thucydides states that the institutions of Himera were Chalcidian, whilst the language was a mixture of Doric and Ionian, which is reminiscent of the Dorian attribution given to Akrai by Athenian authors. Also like Akrai its territory had numerous indigenous settlements

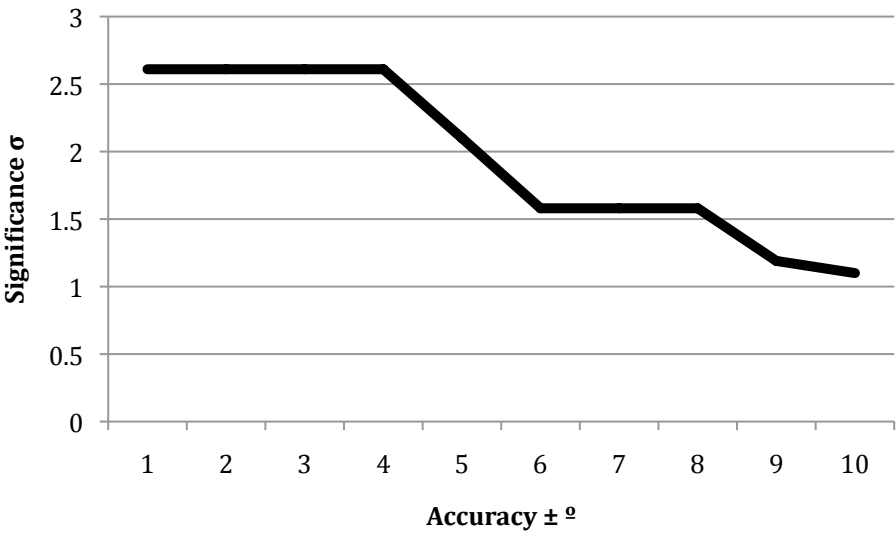
(Vassallo, 1996). This is also a city which was resettled by colonists from stronger cities such as Akragas (Diodorus Siculus 11.48.6-49.4), which would make a Greek past desirable in order to justify both interference and claims on the land. This does negate that there was certainly Hellenic activity in the sixth-century, The city had an Olympic winner in 516 BC (Fischer-Hansen, Nielsen and Ampolo 2004, p. 200 cite *Olympionikai* 137). However the historical record does not indicate if this was a victory from a Greek-founded city or from a native city where the elites had chosen to Hellenise to improve trade with the eastern Hellenic poleis. Indeed to compete in the Olympics it would be likely that the city would have at the very least hellenised to the extent that it did not recognise a native origin for the city. Like Akrai, while the Greek nature of the city cannot be ignored, not can it be assumed to be inherent to the city rather than a constructed past. It would appear from its isolation and surroundings to be some form of hybrid city.

8.7.1 Orientations

Azimuths

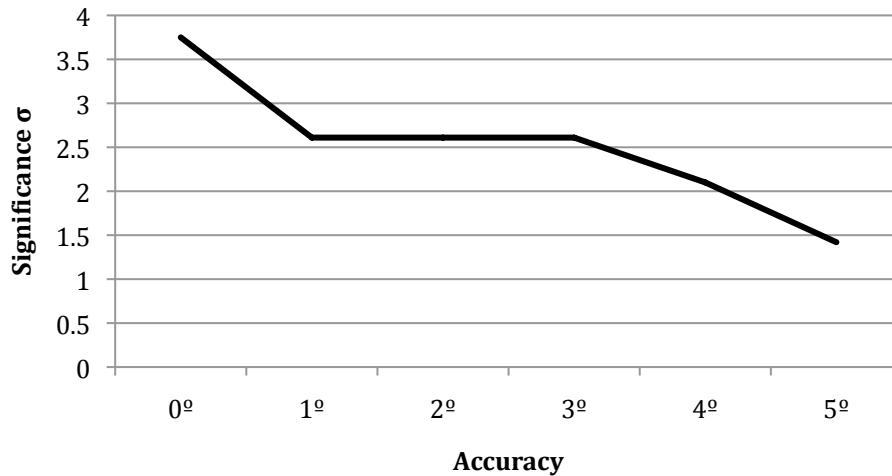
Accuracy \pm °	Number of Matches	Significance σ
1	2	2.61
2	2	2.61
3	2	2.61
4	2	2.61
5	3	2.1
6	6	1.58
7	6	1.58
8	6	1.58
9	8	1.19
10	9	1.1

1 alignment
2 alignments



Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	1	3.75
1	2	2.61
2	2	2.61
3	2	2.61
4	3	2.1
5	6	1.42



8.7.2 Discussion

If an accuracy of alignment to $\pm 5^\circ$ or less is assumed then the azimuths of the Himera temples would appear to be significant. Further the chart of declinations show a that an accuracy in target declination to $\pm 4^\circ$ would also suggest that the temples within the city were pointing to a significance astronomical target. These two findings initially appear to conflict. If the temples are pointing to significantly different azimuths when grouped by city, this would suggest that the local orientation is topographic. Why then would astronomically significant results occur?

The answer would appear to be found in the alignment of the city grid. This appears in the earliest stages of the colony (Fischer-Hansen et al 2004) and is dated to the end of the seventh-century. This would be consistent with the earliest phase of the sanctuary in the colony (Allegro 1991:65-67) and is striking as it pre-dates the traditional start of Hippodamian planning. The city grid is even more significant as it is aligned to 67° . When compared to Selinous (see section 8.11), the other major colony in the west and its correlation between temple and street alignments, this would seem to be evidence for the ability plan within a grid to an accuracy of $\pm 1^\circ$. It would also strongly support the notion that the planning of the Temples A/B (see section 6.14) and C (see section 6.15) was topographical. Why then would there be a

specific astronomical alignment? A possible solution is that they face sunrise around the time of the heliacal rising of Capella and the Kids. The goat connection would matter of Himera was primarily interested in Aphrodite Pandemos.

The exception to the 67° alignment is the Temple of Victory, Its alignment the reason why so many temples from the comparison sample match the azimuths of the Himera sample. Without this exceptional alignment of the Temple of Victory, the temples of Himera would be facing in a unique direction, and so by default facing an otherwise ignored part of the sky. The Temple of Victory is different from these other temples, being built later. It was also recorded as being built by someone who specifically identified himself as a Greek and was intentionally acting within a Greek way. Therefore the unusually usual alignment of this temple may be explained in comparison to other temples of Athena (section 13.4), or post-Battle of Himera temples (section 15.1).

The other temples certainly were Greek in style according to excavators, but were they expressive of a Greek cosmology? It is interesting that the historical records are ambiguous about the 'ethnicity' of the colony. The city was said to be Ionian, but also there are tales that the city owed much of its ethnicity to the settlement of refugees from Syracuse (Thuc. 6.5.1; Malkin, 2003). This could be indicative of a hybrid city. If the city were Greek it could be Doric, Achaean or Ionian or its ethnicity may have been more fluid and changeable than the typical Greek city. If the city were settled by natives who aspired to be Greek would their approach be more eclectic? Certainly trade along the coast would expose the city to the Ionians as the exemplars of what it was to be Greek, but later settlement by the many more Doric colonies could lead to a pick 'n' mix attitude where the natives chose what they felt was emphasising their Hellenic nature in contrast to their surroundings rather than emphasise a more subtle Ionian identity.

8.8 City Analysis: Megara Hyblaea

Latitude: 37.20

Longitude: 15.27

Founded: trad. 734 BC

Metropolis: Megara

Ethnos: Dorian



Map © Google

Megara Hyblaea lies 20 km north of Syracuse (see section 8.10) on the east coast of Sicily. Yet despite their close proximity, the fate of the two sites has been quite different. In contrast to prosperous Syracuse, Megara Hyblaea in contrast lies abandoned by its inhabitants after Gelon's victory in 483BC (Finley, 1968, p. 99). In modern times petrochemical plants lie around the periphery of the site. The historical record in interesting as it paints a picture of a colony doomed to fail.

The foundation of the site, as recorded by Thucydides, was inauspicious. Colonists from the Greek city of Megara, Thucydides says, were granted the site by the king Hyblos after failed attempts to settle at nearby Thapsos and Leontini (Thuc. 6.4.1-2), hence the suffix. The faltering start to the colony is the usual explanation for the choice of site, given the presumed foundation of Syracuse down the shore a few years earlier which accounts for the date of 728 BC, placing it five years after the foundation of Syracuse. In contrast Strabo (6.2) counts Megara and Naxos as the earliest colonies.

The archaeological evidence is more ambiguous. There is nothing to suggest that a city was founded, (De Angelis, 2004, pp. 41-44) estimates there were between eleven and fourteen houses in the earliest phase of the colony. From this he estimates a population of 225 people. His estimate may be a little low. He conservatively estimates that the first generation settlement was male, and so halves the number of people per household unit. Against this Snodgrass (2000, p. 175) points to evidence of child burials in the earliest phases of the Fusco cemetery in Syracuse. In any event it would seem that the initial settlement must have been small. This illustrates the danger of digging by the book with Thucydides as a guide. This was not a city.

Thucydides was an excellent analyst, but the history he wrote was to explain the state of affairs at the end of the fifth-century BC. In the case of Megara Hyblaea his history was a record of a site which had failed, and therefore it should be unsurprising that Thucydides should record details of its failings. Yet many failings are anachronistic. To the classical authors Megara Hyblaea, with its lack of harbours, was clearly the poor neighbour of Syracuse. However, settlers in the Geometric and early Archaic periods traded on beaches rather than harbours (e.g Herod. VI.116 on the use of Phaleron). The two beaches of Megara Hyblaea made it a prime site, with fine views to the north and south. It was later reoccupied and refortified by Syracuse (Talbert 1974:149) which also indicates that it was considered an attractive location. Finally, it was such a success that it was the metropolis for another colony on the opposite side of the island after just a century according to Thucydides. Today, the stench of oil and sight of ugly metal and concrete reconstruction gives the site an aura of ruination. A better perspective would be to recognise that not only was Megara Hyblaea a living city, when it was occupied it was vibrant. The end of the site as an independent polis was not of a failure of agriculture or trade, but a failure of politics. Its end, at the hands of a conflict with Syracuse (Thuc. VI.4.2) was untimely.

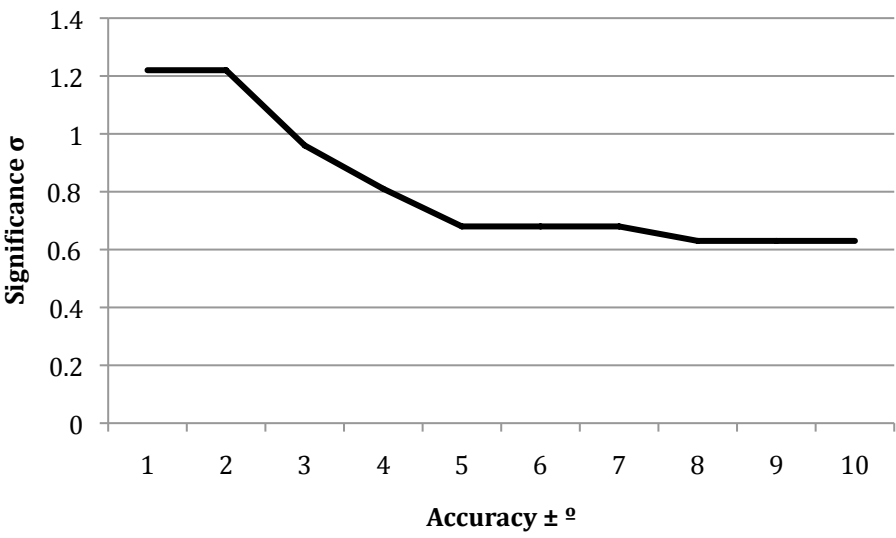
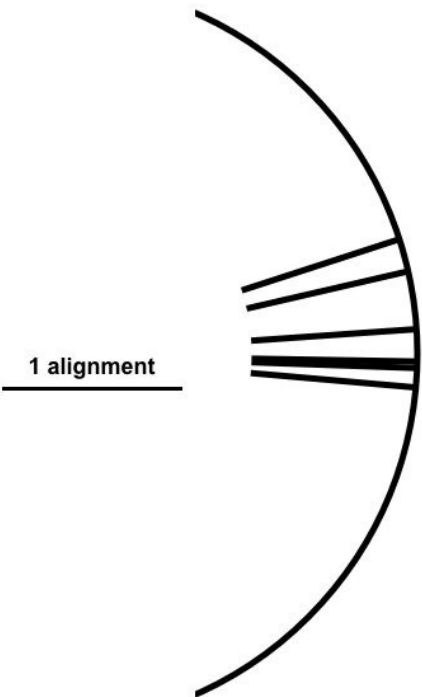
This terminus to the history of Megara Hyblaea makes it effectively a time capsule for the early period of Greek colonisation in the west. The site has been extensively excavated and published by the French School in Rome (Vallet 1976. Gras 2004). There is unquestionably social change during the period of its occupation, but this period ends well before the increasing influences of the Roman and Punic forces take hold. In this way Megara Hyblaea makes an excellent test case. If there is such a thing as 'cosmological fingerprint' then it should be impressed deeply in the city.

Measurement of orientations and azimuths posed a challenge on this site. As mentioned above, the site has been enthusiastically reconstructed in concrete with little regard for phasing of the site. Additionally it sits in an exposed hollow below the modern surface level of the surrounding fields which are used for agriculture. This makes horizon measurement difficult as the local horizon varies according to the depth of the section of the site stood in. Standing on one of the many metallic bridges which scar the site gives a better view of the horizon, but is not suitable for measurement of horizons at the relevant buildings. Nonetheless, it would be safe to assume that local horizons were flat to the east facing the shores of the Ionian Sea. The same bridges also made the measurement of the azimuths by magnetic compass difficult. The solution was to stand at a great distance from any embedded metal without backing too close to the other metal pipes and girders on site. These measurements were cross-checked with mapping published by the French School and satellite imaging.

8.8.1 Orientations

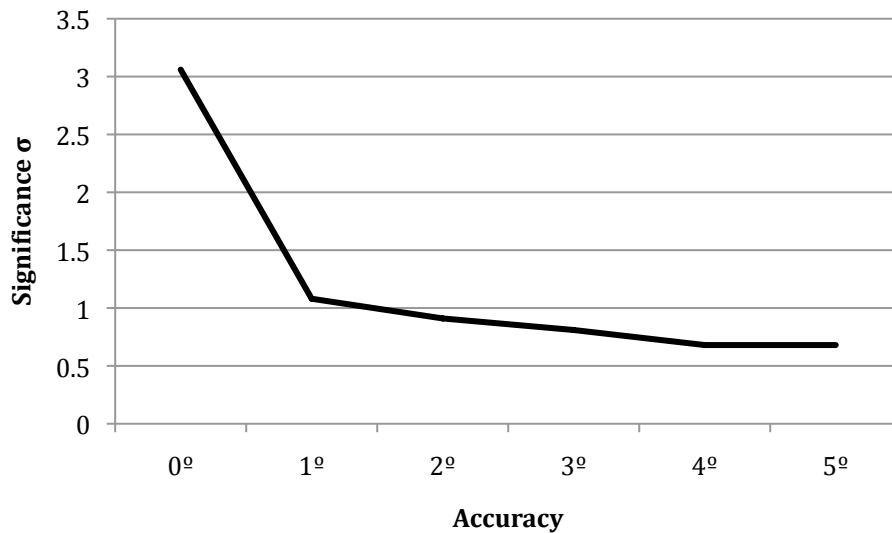
Azimuths

Accuracy \pm °	Number of Matches	Significance σ
1	13	1.22
2	13	1.22
3	17	0.96
4	20	0.81
5	23	0.68
6	23	0.68
7	23	0.68
8	24	0.63
9	24	0.63
10	24	0.63



Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	3	3.06
1	15	1.08
2	18	0.91
3	20	0.81
4	23	0.68
5	23	0.68



8.8.2 The City Grid of Megara Hyblaea

Analysing the city grid of Megara Hyblaea through the archaeological records is problematic. Records were made of the infrastructure, finds and topography. The recording reflects the methodology of the time, in that the data are largely separate. This separation perhaps an understandable attempt to bring order to an inherently chaotic and contradictory site. This chaos makes Megara Hyblaea an excellent site to test grid theories upon. If patterns can be found and tested in Megara Hyblaea, then they should be applicable in the more orderly sites.

Megara Hyblaea poses two major problems for any attempt at a coherent theory of grid design. The first is that there is no coherent grid. It has been argued that that there are five or more grids present at Megara Hyblaea (ref). The other is that there is no orthogonal plan. The lack of right angles and the irregular plan both work to confound any neat attempt at classification and, in this way, perhaps provide a guiding hand in understanding archaic city layouts.

To understand and quantify how many grids are present at Megara Hyblaea, we should first define what we mean by a 'grid'. Given the lack of orthogonal layout,

right angles are no necessity. The kinks in the road give no indication as to how long a grid segment is. There is no regularity of pattern on any large scale to identify. The question is whether the layouts are planned or crystalline. A planned grid exists conceptually and is filled in on the ground as required. A crystalline grid is, despite the name, a more organic growth. A crystal does not fill out a plan of what a crystal should look like as it grows. The extra growth is orientated to accommodate the structure of the existing material. Applied to Megara Hyblaea, if someone laid out one primary road, then it would make sense for the next plot to be laid along the same alignment, simply because it is most appropriate to the local structure of the settlement (see Shipley, 2005). If Megara Hyblaea was originally five settlements we should then expect to see five grids growing from the nuclei. Where they meet we would find flaws.

The grid of Megara Hyblaea is probably neither crystalline nor astronomically defined. The grid shows a large degree of concordance of ideas of movement through the landscape, which would not be expected from purely crystalline growth. The lack of shared astronomical orientations, the grids are not aligned in the same directions with respect to the cardinal points, would also discount this method of construction. Examining the maps, a third option of loose central planning would appear possible. In the south-easternmost corner the north-south roads are aligned perpendicular to the steep incline bounding the site. In the north-west the grid is angled to run in a more perpendicular manner to its local slope. The east-west roads then would be an attempt to roughly reconcile the two askew grids into one plan.

8.8.3 Discussion

Megara Hyblaea would seem to be the most difficult of all the colonies. The lack of attributions for the temples would eliminate much of the usefulness of the data.

Further the alignments seem to suggest there is little specifically interesting about Megara Hyblaea itself, which would indicate that if there are things to be found from these temples they would be by examining in the wider context of the other temples. To some extent the dating evidence still provides some useful data and it can be compared against Selinous and Heraclea Minoa for patterning within the orientations of temples drawn from the same colonial lineage.

The city grid such as it is, is a mess. Tréziny (1999) has argued for planned plots of land of similar size being distributed at Megara Hyblaea, though the plots appear to be irregular in shape. Greater organisation is proposed by Lamboly (2006, pp. 6-7) who identifies five districts, each with their own grid. This looks more convincing if you examine the redrawn plans of Vallet's original plans, rather than the original plans themselves, which suggest a more irregular layout. While there are certainly long routes through the city, it would be optimistic to consider them axes for a grid, especially when the two longest north-south routes are clearly not parallel to each other. Despite the large amount of work at the site in the twentieth-century, Megara Hyblaea reveals frustratingly little for this survey.

8.9 City Analysis: Naxos

Latitude: 37.82

Longitude: 15.27

Founded: ~734 BC

Metropolis: Rhodes / Crete /

Naxos?

Ethnos: Dorian



Map © Google

The city of Naxos is traditionally said to have been found around 734BC by settlers from and Chalkis and Naxos Thuc 6.3.1), This would coincide with the arrival of Greek pottery on the site (Pelagatti, 1981, pp. 304-311). However the correlation between the history and archaeology does not conclusively indicate a Greek foundation for the site. Lentini (2004, p. 29) has found evidence of indigenous settlement at Naxos at the end of the eighth-century BC. The indigenous settlers were living in a city with what appears to be a grid pattern centuries before such patterning is found in the Greek homeland. This grid was aligned in a close to cardinal orientation (Lentini, 2004, p. 31), not unlike Selinous, Syracuse, Heraclea Minoa, and perhaps Akragas.

Further, the *archaeological* material found at the site does not support a Euboean or Naxian foundation. Coldstream (2004, p. 41) states that, unlike settlements in Italy, no Sicilian sites on the east coast show any sign of connection with their mother city, other than Syracuse as they all seem to take their imports from Corinth. Coldstream has identified pottery of the Thapsos type as being the pottery of choice which he finds puzzling as this pottery is not popular in Corinth at the time. Nonetheless

chemical tests have provenanced this material to Corinth. He concludes it was made for export to Greek colonies on the eastern shores of Sicily. If export for non-Corinthian markets is a viable explanation for the pottery styles, it cannot identify the ethnicity of the importing market.

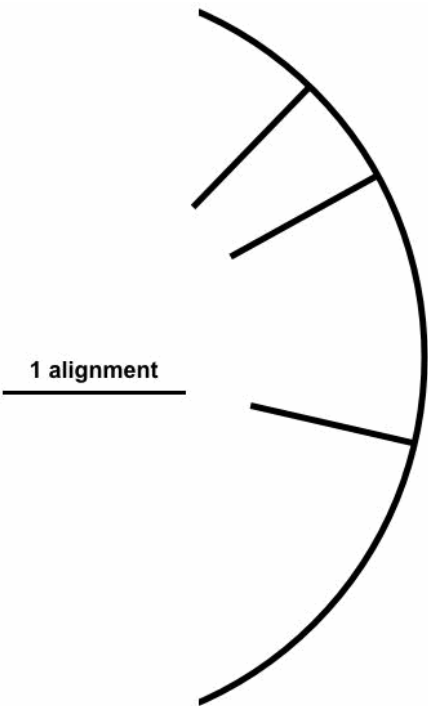
Along with the temples analysed, the city was also known for its sanctuary to Apollo Archegetes (Thuc. 6.3.1). While there site has not been identified Fischer-Hansen *et al.* (2004, p. 220) follow Pelagatti (1978, p. 178) and Valenza Mele (1977, p. 505) in placing the site on the north site of the city near an anchorage. While this cannot be confirmed, the local topography may suggest why Apollo Archegetes was in Naxos. (see section 8.12.3) However, it cannot contribute to the astronomical analysis of the site.

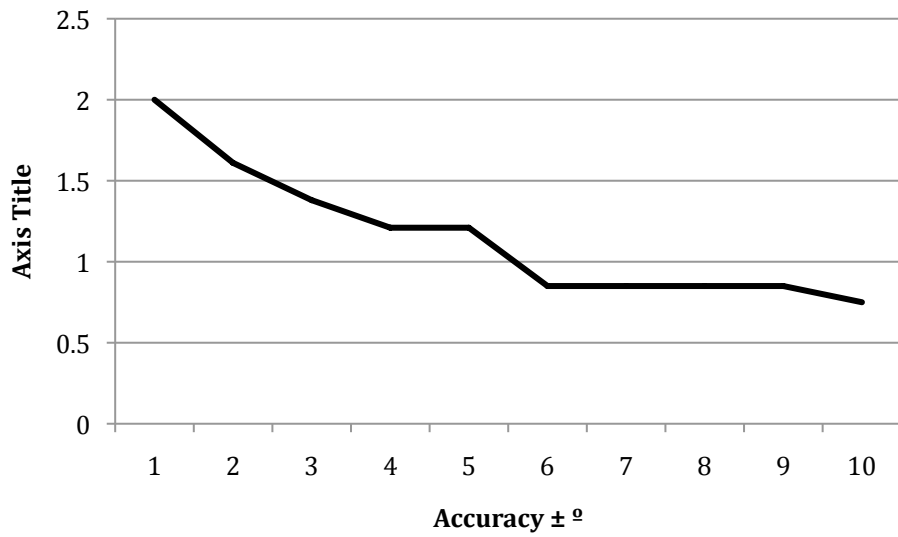
The temples were all measured on site with a compass clinometer, but lush vegetation meant the natural horizon was not visible.

8.9.1 Orientations

Azimuths

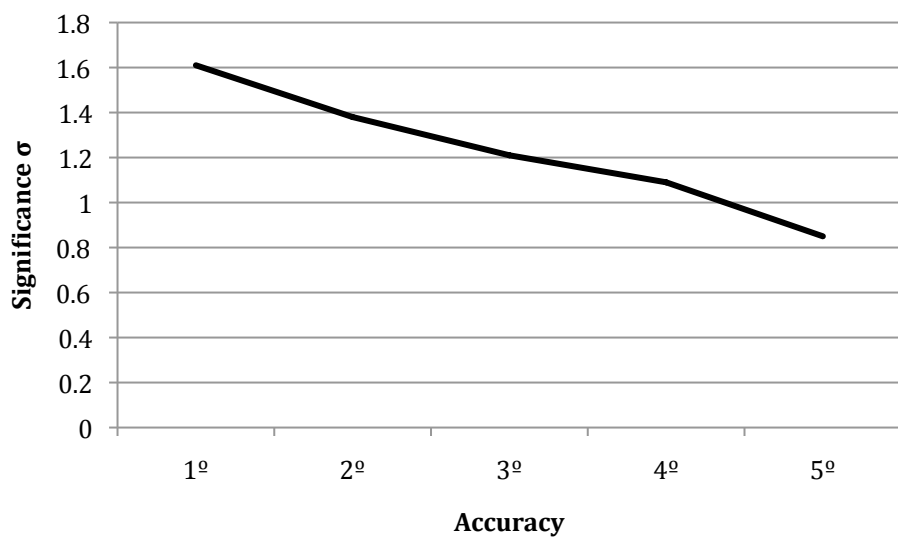
Accuracy \pm °	Number of Matches	Significance σ
1	2	2
2	3	1.61
3	4	1.38
4	5	1.21
5	5	1.21
6	9	0.85
7	9	0.85
8	9	0.85
9	9	0.85
10	11	0.75





Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	0	N/A
1	3	1.61
2	4	1.38
3	5	1.21
4	6	1.09
5	9	0.85



The data from Naxos tell us little about the city. This should be little surprise. Temples A and B are clearly developments of the same sacred space, and Tempietto C is the only other site in the same. Effectively there is only a comparison between a suburban and an urban sanctuary. The re-planning of Temple A to Temple B would be of interest, however there are few comparable temples to meaningfully draw any conclusions other than that they face different directions and so must have been re-planned. The only comparable temples are Temple A/B at Himera (see section 6.14) and Temples A and B at Gela (see section 6.13).

What Naxos does provide is a series of puzzles if the traditional story of Greek colonisation is to be believed. Lentini (2004, p. 29) has found evidence of indigenous settlement at Naxos at the end of the eighth-century BC. The indigenous settlers were living in a city with what appears to be a grid pattern centuries before such patterning is found in the Greek homeland. This grid was aligned in a close to cardinal orientation (Lentini, 2004, p. 31) not unlike Selinous, Syracuse, Heraclea Minoa, and perhaps Akragas.

8.9.2 The City Grid of Naxos

The city grid is of interest. The early grid would seem to correlate with close-to-cardinal orientations at a variety of other sites. In this instance the re-planning of the city in the 5th century BC shows that the orientation was not immediately obvious. The later planning used an orthogonal grid, but this time perpendicular and parallel to the shore. This therefore creates a puzzle as to why the earlier city grid was almost forty-five degrees skew to the later grid. Comparison with other city grids may reveal a commonality with other sites.

8.10 City Analysis: Syracuse

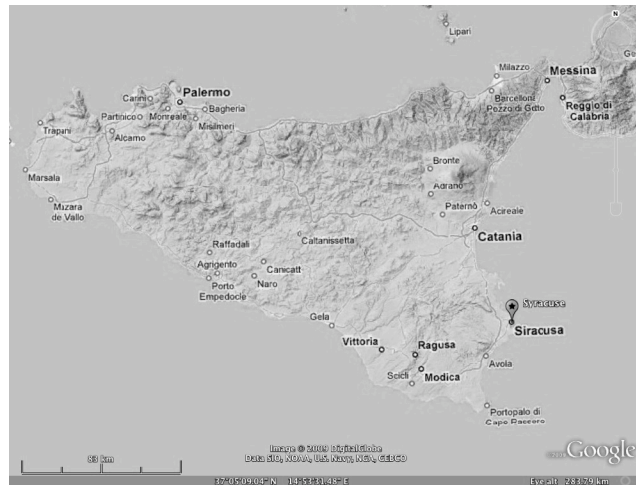
Latitude: 37.05

Longitude: 15.17

Founded: ~734/33 BC

Metropolis: Corinth

Ethnos: Dorian



Map © Google

Syracuse is traditionally considered the earliest known Corinthian settlement on the island. It is said by Thucydides (6.3.2) to be slightly earlier in foundation than Megara Hyblaea. Strabo (6.2.4) is more vague, saying that the site was colonised around the same time as Naxos and Megara. However the archaeological evidence cannot confirm this. Orsi (1910, pp. 513-537) records that Ortygia, the island, now a peninsula off Sicily, at least since the archaic Greek period (Voza, 1989, p. 12), had been occupied before the traditional Greek settlement date. The Greek settlement he places in strata above a destruction layer, and the Sikel settlement below it. However Frasca (1983, pp. 597-598) states that there continues to be indigenous pottery dating from the Finocchito period, which he places between 730 BC and 650 BC.

The ongoing presence raises the question, as at other Greek sites of whether or not this is a foundation or continuation of settlement, or even if Greeks arrived at all and whether or not we are being misled by a change in economic activity. In the case of Syracuse there is corroborating evidence for an early Greek presence at the site. Shepherd (1995:52-6) provides data that over a quarter of early burials, mainly from the Fusco necropolis, share similarities with burial practices in Corinth. This falls in

later periods, a process which Shepherd (1995:54) explains as a deliberate deviation from Corinthian burial practices. Nonetheless it would be hard to explain why burial practices deviated from Corinthian practice if there was little Corinthian influx into the early period of the colony to deviate from. The complete disregard for homeland burial practices at Megara Hyblaea (see section 8.8, Shepherd 1995:57) would indicate that there is a Corinthian correlation which needs to be explained.

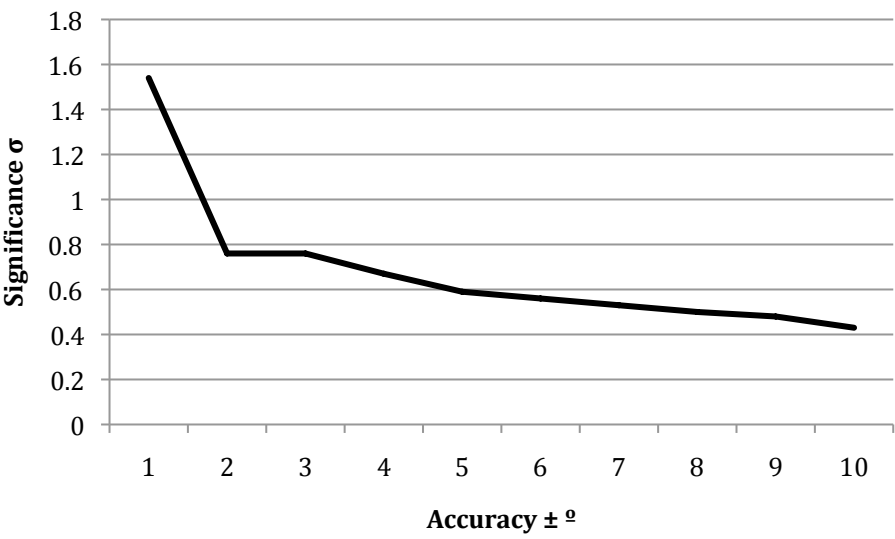
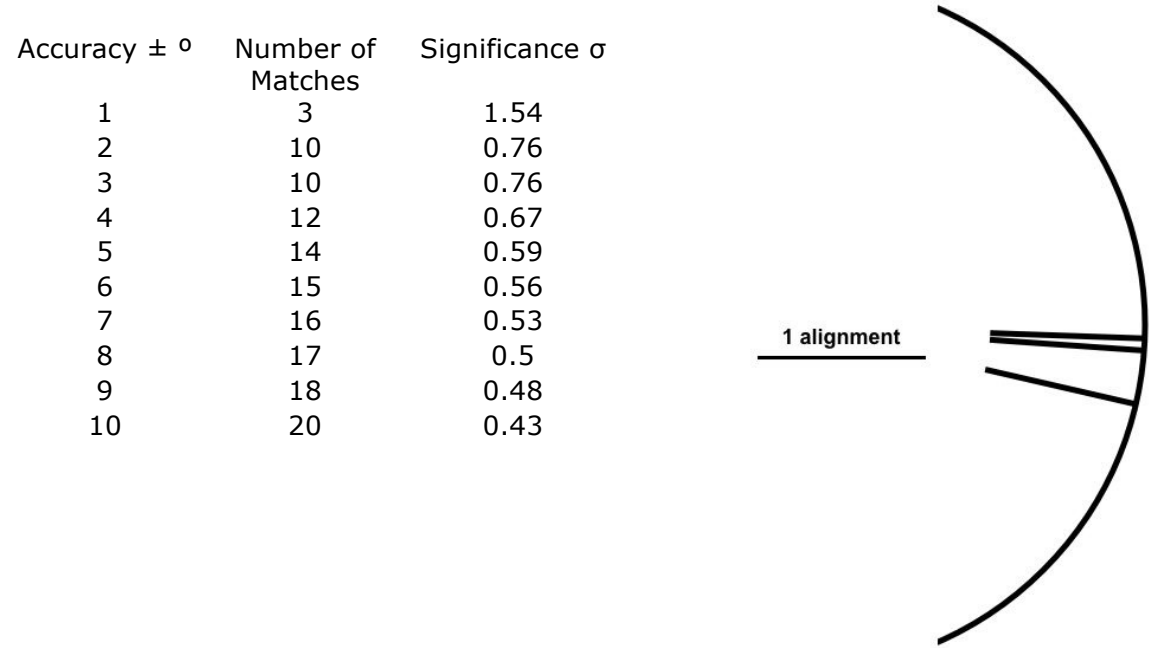
The Thucydidean explanation of a Corinthian conquest is initially tempting. The fire layer would be consistent with the attack of a hostile power and the peninsula would be a defensible site. A difficulty with such a story is that native-style houses seem to be occupied in the Greek era (Wescoat 1989:18). Being the biggest market in Sicily the city would be likely to be cosmopolitan anyway, and so perhaps should be thought of as a hybrid of cultures rather than Corinth's hold on Sicilian produce.

Syracuse's wealth and power meant that more often it was influencing rather than influenced. It is said to have established colonies in its hinterland early in its history. Akrai was founded 30 km inland on a steep hilltop to control the local territory. Helorus (see section 6.11) is thought to have been founded around a century later along the coast and Casmenae in 644/3 BC (Thuc 6.5.3) inland which implies that Syracuse had both the power and the resources to impose control on a large tranche of the interior. Whether this is true is questionable, settlement at Akrai did not disrupt local settlement patterns, which would be odd given an influx of new colonists, but even if native sites assimilated to Syracusan control rather than being true daughter colonies, it would still speak of a colonisation of identity if not of blood.

Surprisingly few temples form the sample set in this city. However the presence of temples at two of its local colonies suggests that it could form a part of a useful test for cultural continuity. Against this hypothesis is the problem of the attribution of the temples. The known deities at colonies of Syracuse are Demeter and Aphrodite, and neither are found in the archaeological reports of excavations in Syracuse.

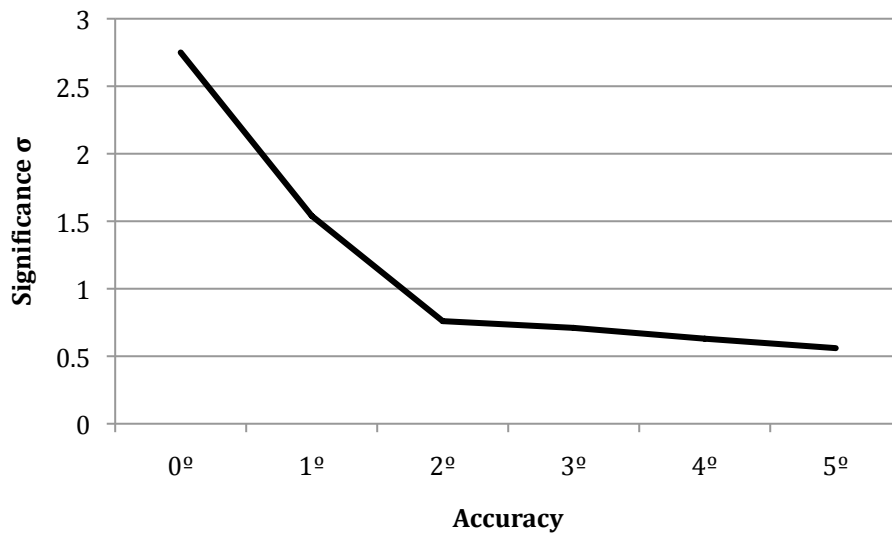
8.10.1 Orientations

Azimuths



Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	1	2.75
1	3	1.54
2	10	0.76
3	11	0.71
4	13	0.63
5	15	0.56



It is possible to conclude that something is significant if one assumes the temples were planned with the highest level of accuracy. Against this I would argue that the results are not very robust and an argument based upon declination would have the problem that local horizons cannot be seen from the urban temples. Additionally there is a plausible historical explanation for the alignment of the Athenaion, which is not based in civic identity. This would weaken the significance further. There would appear to be no distinctly Syracusan pattern of orientation.

8.11 City Analysis: Selinous

Latitude: 35.37

Longitude: 12.49

Founded: ~650-620 BC

Metropolis: Megara Hyblaea

Ethnos: Dorian



Map © Google

The foundation date of Selinous is uncertain. According to Thucydides it was founded with the aid of a Megarian oikist, Pamillus, a hundred years after the foundation of Megara Hyblaea by settlers from that city. Taken literally this would suggest a foundation date of 628 BC. The site on the west on Sicily makes Selinous an unusually distant colony. cities such as Gela and Syracuse colonised local territories, and later Syracuse would found Heraclea Minoa along the coast to the east. Domínguez (2006, p. 301) has argued that control of territory by Syracuse and Lentini, along with the lack of suitable sites in the north, meant that the Megarians were moving into the only available space. This would not appear to be a full explanation.

The site grew to be extremely rich enabling the construction of many temples. It would suggest that this was a prime site. Additionally the territory was fought over. It could be dismissed as inevitable and it was on the frontier of Phoenician territory, but there was also conflict with the Elymians shortly after the city's foundation in 580BC (Diod. v. 9). In light of this it seems peculiar there was not local interest in a fertile landscape between two rivers conveniently located on the shore.

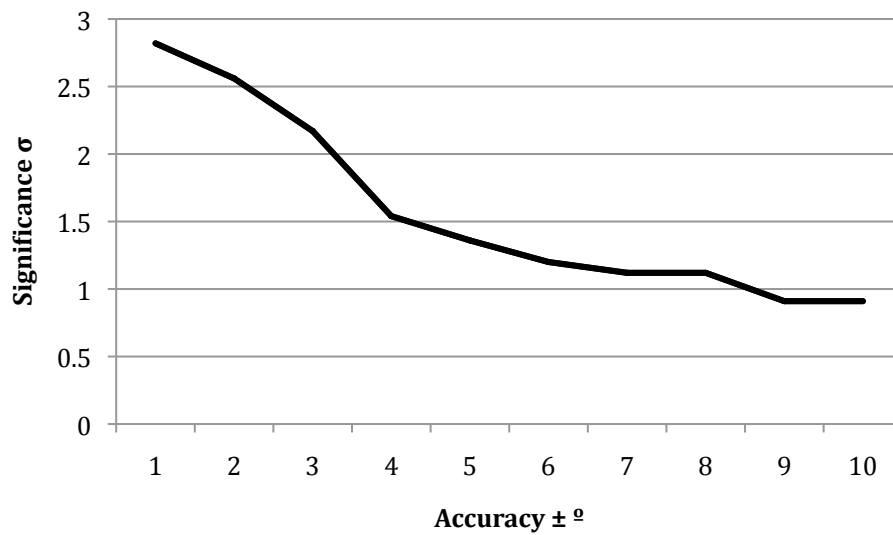
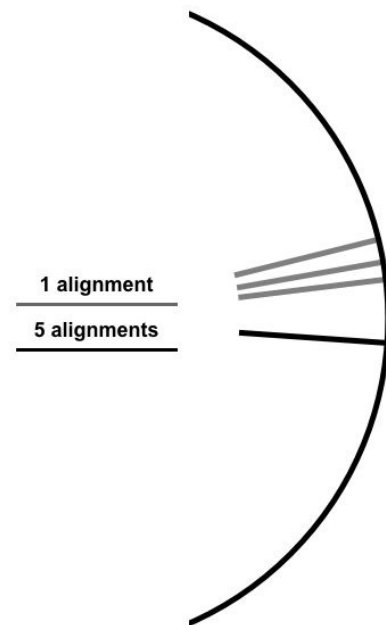
The archaeological evidence for settlement is poor due to a combination of lack of publishing (De Angelis, 2004, pp. 101-102) and partly due to a conceptual divide between classical and prehistoric archaeology which means that scholars such as Domínguez (2006, pp. 302-303) only mention the proximity of native houses to the earliest Greek houses in passing, referencing the Greek material. The presence of an earlier megaron beneath the temple of Demeter Malophoros, which Gabrici (1927, p. 52) cannot date back to the Mycenaean period, would also suggest a local presence.

The city is both extremely early in date and extremely extensive. The grid is dated to the beginning of the sixth-century BC, based on the dates of the domestic buildings which align with it (De Angelis, 2004, pp. 132-134). Domínguez (2006, p. 303) attributes this to deliberate planning as the city grew, with early settlement being too scattered to be gridded. Given that the grid emerges from the spaces between the buildings this would appear reasonable. However measurements of temples E and F/G show that the city grid was respected over a kilometre away and the early date for Temple E, from the late seventh-century BC, would suggest that the gridding was conceptually in place from the earliest phases of the colony. Additionally the architect Ito (2002, p. 58) notes that the temple of Demeter Malophoros in Selinous is one of the earliest examples of axial planning in the classical world.

8.11.1 Orientations

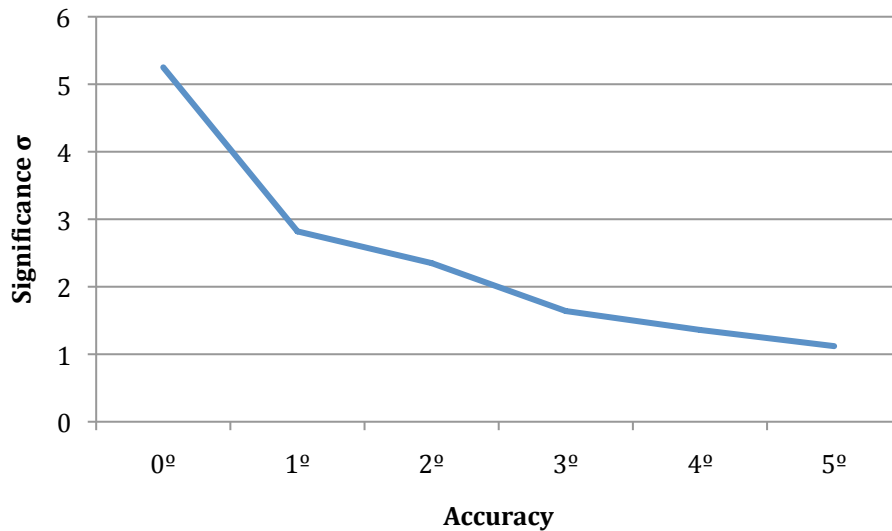
Azimuths

Accuracy \pm °	Number of Matches	Significance σ
1	6	2.82
2	7	2.56
3	9	2.17
4	14	1.54
5	16	1.36
6	18	1.2
7	19	1.12
8	19	1.12
9	22	0.91
10	22	0.91



Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	2	5.25
1	6	2.82
2	8	2.35
3	13	1.64
4	16	1.36
5	19	1.12



The azimuth alignments are only significant above 2σ if you believe that the temples were aligned to within an accuracy of $\pm 3^\circ$ or less. However the topographical survey and archaeological data show that the temples do appear to be aligned to within $\pm 1^\circ$. This is significant to over 5σ . This would mean that the probability of this result happening purely by chance is excess of a million to one. This would suggest that the astronomical significance noted in the declination graph is irrelevant and that the alignment of the temples is topographical. They are only astronomically significant in as far as they all point east.

8.12 Temples and their Urban Environment

There are several features that are common to the temples within this sample. They are all assumed to be of Greek origin. They are rectilinear stone structures. This is a necessity of creating a coherent sample set. There are certainly other sanctuaries associated with the Greeks in Sicily, such as the sanctuary of Demeter at Bitalemi, Gela or the Koreion north of Helorus. However the temples have another feature was not defined prior to the sample.

All the temples are firmly associated with a specific polis - there are no temples in the sample in rural locations where the builders were unknown. Indeed nearly all temples are urban, with a few temples such as those at Selinous being suburban. De Polignac (1995, pp. 21-23) identifies three classes of sanctuary, urban, suburban and extra-urban. It is this final category, sanctuaries founded in rural territories that De Polignac (1995, p. 23) identifies as the most ancient. On the contrary in Sicily the major sites are all closely associated with a city. Nor are they necessarily associated with an acropolis. It is possible that temples in Sicily were performing a very different role to those in the Greek homeland.

8.12.1 The location of temples within a territory

Every Greek city has a temple within the city. However it is uncertain if the urban sanctuaries always precede the suburban sanctuaries. At Syracuse the Apollonion is dated to the start of the sixth-century (see section 6.32) while the more distant temple of Zeus is dated towards the middle of the sixth-century (see section 6.33). While this gives the Apollonion precedence, the dating is far from certain and it would be more cautious to consider the sites contemporaneous as it is only the stone setting that is dated. At Selinous the Temple of Hera on the Marinella Hill (see section 6.26) may

precede the temples of the Acropolis (see sections 6.24, 6.25). On the Gaggera Hill to the west the temple of Demeter is of a slightly later date, but the presence of possible pre-Hellenic foundations would indicate that the site was sacred before the temple was built. In both cases the temples are hardly rural, being within a mile of the Acropolis, and it would be better to consider the temples as being on the fringe of urban settlement. The temple of Aphrodite at Naxos (see section 6.23) could also be considered to be a fringe temple as while it is inside the city walls, it is tucked away in the south-west quarter of the city.

Whilst temples are found within the boundaries of all the colonies, there is no common pattern as to where the temples can be found. De Polignac (1995:21) considers the sanctuaries on the Acropolis the most important. This is a seductive idea and may be true in some cases such as the Lindian colonies which may have placed special importance on the Acropolis. However while all south coast cities and Akrai have temples on the acropolis, the same cannot be said of cities on the east coast.

Helorus may arguably have a temple on its Acropolis, but this is questionable as the site in question has a gently rolling hill rather than an acropolis. This is even more pronounced in the other east coast colonies. The temples at Syracuse, Megara Hyblaea and Naxos are all close to the shore line. In the case of Syracuse there is high ground which could have been used in the Neapolis. A spring overlooks the hill which the theatre was built upon. At Heraclea Minoa the high ground above the theatre was occupied by the temples. This is not the case at Syracuse where the temples lie on the low ground.

Akrai has been mentioned above as having a temple on the Acropolis, but the nature of the city is that it would be difficult to build it elsewhere. The ancient city as a whole is at top of a steep hill, which has a plateau at the top. Given the need to build a temple on reasonably flat ground it would be hard to build the temple elsewhere without making it a rural sanctuary.

Both Lentini and Tyndaris would potentially add more to this debate had they any identifiable temples. Both cities are built over steeply undulating ground. In the case of Lentini burials were made in the ground overlooked by the Acropolis. However no temple has been found on top of the Acropolis. Much of Tyndaris is missing following a landslide but the lack of identifiable temples here would suggest if any had existed they were not on the high ground. The land overlooking the theatre, which still survives at Tyndaris, has no identifiable temples.

It is this lack of temples, along with the unused land at Syracuse, which suggests that the elevation of the temples was not a consideration on the east coast. It does not automatically follow that the elevation was important at the south coast sites. Local peculiarities of geology or personal preferences may have caused the temples to be sited where they were. It does leave open the possibility of a cultural difference between the south and east coasts. This may have implications for the ability to use sites for astronomy.

8.12.2 The problems of urban astronomy

Astronomy within an urban context is a problem twice over. There was a problem with the survey. The observations were made within the modern period, which is so blindingly obvious that it hardly seems worth mentioning. However it causes a problem in that these observations cannot therefore be of ancient sightlines. Holtorf

(2000-2009) has argued that archaeological sites exist within the present and are not specifically the product of a given era but also of neglect and rebuild in successive years. The practical effect is that at Naxos the distant horizon was blocked by lush foliage and modern construction. At Selinous an artificial bank has been built specifically to block a view from the outside of the site in. Even if these intrusions could be stripped away the problem would remain. Not only are there modern intrusions, there are also issues with the ancient skyline.

It would seem reasonable to assume that the temples were built with the purpose of having a view to the east. In the case of Akragas the temples fall into three major categories, the temples on the Acropolis which had a view to the south-east, temples on the southern ridge all of which faced different directions; leaving a clear line of sight and the temples in the sanctuary of the Chthonic deities. These temples were on comparatively low ground but face the horizon between the acropolis and the southern ridge, ensuring a distant horizon. They also faced north of east avoiding overlooking the domestic quarter. This would be consistent with a requirement for a clear view to the horizon.

In contrast the temples at Megara Hyblaea are within the heart of the city and this poses a serious problem. One solution could be that in the period when the temples were laid out the city has yet to be fully urbanised. Therefore they were laid out facing horizons which disappeared as building added more houses to the city. This explanation would explain the layout of the temple of Demeter at Helorus where houses were built in front of the temple a couple of centuries after the temple was built.

Unfortunately this explanation is unlikely to be sound. The temples on Ortygia must have been built within an urban environment. The same is true for the temple of Aphrodite at Naxos. Sitting in the south-west and looking to the north-east the temple would have overlooked the city, and this alignment may have been chosen for this specific purpose. The earliest alignment of the temple of Aphrodite at Naxos has no obvious astronomical explanation (see section 6.23). The temples at Selinous also pose a puzzle.

The temples on the acropolis sit on the east side of the acropolis suggesting that the line of sight could have been important. The temples on the Marinella hill would have also had clear lines of sight, though their adherence to the urban grid would suggest that astronomy was not necessarily a prime concern. The temples on the Gaggera hill to the west would appear to have even worse prospects for astronomical observations. These temples would have been facing towards the acropolis hill. It is possible that these temples were placed for geological or historical reasons and then orientated to maximise the astronomical utility of the site. This is possible but it builds in the prior assumption that the temples had astronomical significance. The fact is that while azimuth can be plotted to within a degree (see section 8.11), the declinations are more uncertain. While the Greeks may have aligned their temples to within a degree of an astronomical target, that accuracy cannot be recovered from modern measurements. If the alignments were topographical then this may be irrelevant anyway. There are reasons to believe that the temples were built to be seen as much as to see.

8.12.3 Temples and urban display

The colonies shared a similar sense of chronological inferiority. In the case of some cities this may have been justified, but in others their formation as a polis, a

meaningful political unit was contemporaneous with the reforms of a Solon or a Lycurgus figure. The foundation dates of the earliest colonies fall within the same era as the foundation of the Olympics, or the lawgivers of Greece. The dates may therefore not be accurate in stating the origin of the cities, but used as a means of indicating social precedence. An effect of this is that while the cities of Sicily may have had mythological origins, their myths were rooted in human rather than divine time. The Greeks of the homeland would be Greek by birth, but the Greeks of the colonies would be Greeks in a foreign land. This may have created pressures to display a Hellenic identity. Not only would there be the matter of emphasising difference from the natives, but also affinity to the homeland Greeks, in order to gain a competitive advantage in trade.

The temples would not appear to be created for display to their near neighbours. This would be in contrast to symbolic architecture in some other cultures. For example analysis of prehistoric burial mounds shows that the positioning of the mounds makes sense as boundary marking, rather than as the social centre of a territory (Johnston, 2005). This would sit nicely with De Polignac's view of the extra-urban sanctuary, but this is clearly not the motivation in Sicily.

The most visible temples from outside the city would be those found on the south coast. All the south coast cities have temples on an Acropolis. In the case of Camarina this meant building the temple away from the agora. It is interesting to note that the temple is built slightly uphill ensuring its visibility from the agora. This would also mean that it was visible from the coast and it could be argued that these temples were placed as landmarks.

The temples A, D and F of Akragas would appear to support this. These temples collectively occupy the southern ridge of the site and would have been visible from the shore. In fact their closer position may have made them more visible than the temples found on the more distant acropolis. Yet Akragas also shows that not all temples could have been made for external display.

The temple of Zeus Olympios was clearly built to impress, and had it been completed it would have been the largest Greek temple ever. This was clearly a point of ego for Theron who wished to demonstrate his power following the battle of Himera. It is the closest temple to the agora and would have completely dominated the site. It's therefore curious that while it was highly visible from the agora it was not likely to have been visible from outside the city. Unlike temple A which overlooked the main gate, the temple of Zeus was inside the gates and a little way down from the southern ridge. It was still high enough to overlook the domestic quarter to the west and the agora to the north, but the loss of height may have rendered it invisible from the sea behind the city walls. Certainly the steep approach to the city would have obscured the temple. It would be possible to build a phenomenological explanation perhaps indicating a sense of revelation when the visitor entered the city. The problem with this explanation is then why does the same not apply to the visible temples?

It may therefore be possible that it was visibility from within the city that mattered and any external visibility was an unlooked-for bonus.

This would correlate with the locations of the eastern temples. The temple of Aphrodite at Akrai is on the western side of the city, behind the buildings of the Acropolis. It could have been placed in a higher location. The temples of Syracuse,

Megara Hyblaea and the temples of Aphrodite at Naxos all also seem to be built to be viewed from within the city.

An exception may be the sanctuary of Apollo Archegetes. The location is unknown but Thucydides (VI.3.1) says that it was outside of the town and a place where people would sacrifice before leaving for Greece. This was the place where ships travelling to and from Greece would be expected to dock and so on their itineraries Naxos was the first place in Sicily. This may explain the early foundation date given to the site as it could conceptually be the first place in Sicily and so also the first in time. The proximity of Mount Etna would provide a useful target to aim for as ships sailed around Cape Spartivento. If this is the case then the position of the sanctuary of Apollo can be explained as being essential to the process of travel and so located in a practical location. This would not be a domestic use and therefore its location on the fringe of the city where foreigners could see it is not a difficult circumstance to explain.

Therefore the location of the temples in the cities would indicate that they played an important role in the heart of civic life. Their presence would provide a visible indication that this was a Greek city, even if they collective consciousness acknowledged that they were not in a Greek land. However as the citizens were making their territory Greek, the use of land might also show evidence that the Greeks were also adopting native practices.

8.12.4 The use of city grids

The use of city grids is closely associated with Greek urban planning. In its classic form it is expressed as Hippodamian planning with wide *plateiai*, crossed by narrower *stenopoi*, creating rectangular urban blocks (Castagnoli, 1971; Owens, 1991)

(Castagnoli 1971, Owens 1991:74-93). While this is certainly a Greek ideal in the classical period, the archaic origins are less certain. One thing that can be said with certainty is that the style could not have originated with Hippodamos. Even the city plans associated with Hippodamos, Miletus, Piraeus and Rhodes, are unlikely to have been designed by the same man (though Gorman (2001, p. 162) disagrees based on a belief that Hippodamos was a precocious planner at Miletos). He could have codified a tradition, but which tradition was it? The origins of Greek urban planning might not lie in Greece but in Sicily. Assigning ethnicity to city planning is difficult. Certainly Selinous and Himera display early city grids (Domínguez, 2006), originating in the seventh-century (see sections 8.7 and 8.11). However if these are cities built by Greeks then surely the urban plan is a Greek concept?

The answer may lie in the east at the cities of Syracuse, Megara Hyblaea and Naxos. Fitzjohn (2007) comments on a re-organisation of urban form in Sicily in the seventh and sixth centuries BC, particularly at Megara Hyblaea and Leontini. This, he argues, is part of a reconciliation of settlers and a response to hybridisation. Therefore it would be helpful to consider exactly what the form of colonisation was. Traditionally in classical archaeology the discussion has centred on the difference between the *apoikia*, the home from home, and the *emporion*, the trading settlement. An alternative division may be more helpful.

Chris Gosden has identified two forms of interaction between colonisers and natives. He argues that land may be seen as *terra nullius* (Gosden, 2004, pp. 22-33) a blank canvas for the colonisers for whom the natives are hazard in much the same way as the rest of local wild fauna. The alternative is colonisation within a shared cultural milieu. This would require a partnership between colonisers and locals. The two forms are not mutually exclusive and strategies may be flexible and contingent.

In the historical texts there is evidence of both approaches. The foundation tale of Megara Hyblaea is clearly a tale of colonisation within a shared cultural milieu. The land is given by the grace of the local king. There is also the proposal by Bias of Priene who argued the Ionian colonies should flee the Persians and settle Sardinia, creating the space by driving out the natives (Herod. 1.170 Plut. Solon 26). Even so when mass evacuation is said to have occurred such as the Phocaeen settlement of Massalia, the event is portrayed as a partnership. In the case of Massalia the oikist Protis marries the native Gyptis (Pompeius Trogus ap. Justin, *Hist Phil Epit*, XLIII.3.4–12; Briggs, 2003, p. 247).

The archaeological evidence is also indicative of a shared environment. At Syracuse native settlement persists into the Greek colony despite the presence of a destruction layer (Cultrera, 1951). This could mean that the destruction was an accidental or ritual event rather than intentional violence directed against the natives. More intriguingly the colony of Megara Hyblaea has a far more visible native population than Megarian population in its earliest phase. Shepherd (1995, pp. 56-60) notes that Megara Hyblaea citizens adopt Megarian burial customs rather than bring them from the home colony. It is also notable that the inscriptions found do not seem follow Megarian style until the sixth-century.

While the histories refer to Greek settlement, the earliest historical evidence is from the fifth-century and therefore is a record of what fifth-century Greeks thought about the past, not evidence from the eighth-century. Given the lack of evidence of Greek settlement, as opposed to Greek trade at Megara Hyblaea and the contemporary presence of natives, could the presence of grids reflect native organisation?

The city grids of poleis dating from the seventh-century and earlier appear to be roughly cardinal, though there is no firmly identified city grid at Gela. Three cities deviate from the cardinal orientation. Camarina is aligned along the local topography rather than cardinally. This is a later foundation by Syracuse at the start of the sixth-century BC and therefore could be early evidence of division between what is thought to be native and what is Greek. Naxos, the earliest settlement, is also not cardinally aligned. Instead the grid is orientated so that roads are orthogonal to the shore. However this grid is a later layout of the civic grid. The earliest phase is out of alignment by 45°, making it roughly cardinal.

The only serious exception is Himera, which is said to be a seventh-century foundation (Bonacasa, 1970), and highly likely to have had a large native element in its population (see section 8.7). Despite this the early city grid is aligned 23° off the cardinal alignment. This may not seem much. In the case of city grids there is the problem of rotational symmetry. A city with wide *plateiai* looks the same if these roads are aligned east to west or if they are aligned west to east. This would mean that the grid could only be out of alignment by a maximum of 90° before returning towards cardinal. If all roads are equal the grid has a rotational symmetry of four, meaning that the maximum deviation from cardinal is 45°. In this light the variance of 23° is difficult to ignore. A possible explanation is that remoteness of the local means that rather than a Sikel population, this was settled in a Sicanian area. Unfortunately there are no corroborating archaeological reasons to identify a settlement as Sicanian rather than Sikel. This would appear to be post hoc reasoning.

The reason city planning is interesting is that it requires people to think about the landscape in a different way from temple orientation. The orientation of a temple is the orientation of superstructure. It imposes order onto a location. This is seen in Sicily in the many temples which have their own orientations regardless of the local

city grids. In contrast a road is about movement within a landscape and may be about codifying natural order rather than imposition of order upon it. Equally a road frequently follows the easiest route between two points. This implies that roads amplify natural order rather than create it. At the time of building there is no evidence that the Greeks had an opinion on order within a landscape. Therefore unlike a contrary tradition, such as the orientation of native temples to north (see section 15.2 on the case of the Temple of Diana at Cefalù), there was no reason to question the gridding of cities. In later periods when it was accepted that Greeks founded the cities, the grids would have been seen as evidence of Greek planning regardless of whether or not this was true.

By itself the appearance of city grids in Sicily before they appear in the Greek homeland is astonishingly tenuous evidence of native influence on the Greeks. However combined with burial evidence (Coldstream, 1993; Shepherd, 1995), economic evidence (Hodos, 1999) and evidence of religious syncretism (see sections 6.28, 8.11 and 15.2) it does suggest that searching for 'Sikelisation' of the Greeks may be fruitful.

8.12.5 Topography and planning

The analysis of the topographical context of the temples is problematic. There is clearly an astronomical motive to temple orientations (see section 7), but the analysis of the topography of individual temples shows that this orientation was also highly contingent upon local factors. It is possible sites were chosen for their astronomical contexts (see sections 13 and 15), but a purely astronomical explanation of temple placing is clearly insufficient.

Further analysis of temple locations is required. The use of geological features should prove interesting in revealing possible locations for temples. The selection or

rejection of geologically suitable or significant sites would not only reveal how the Greeks thought about the underworld, but also how it connected with the terrestrial and celestial planes. Not only may sites be chosen for their geometrical properties, sites could be discarded for astronomical reasons. Is the distant horizon significant or merely a by-product of other concerns? The evidence from Akragas would suggest that distant horizons were intentionally sought, but equally the problems of the urban environment could be said to argue against such a conclusion. Rather than revealing the importance of astronomy, the topographical analysis reiterates the need for an integrated approach to the study of Greek cosmology and that the cosmos includes not just the sky, but the interplay of sky, earth and underworld.

9. Genealogies and Alignments

While individual cities may or may not have significant local orientations, it is also worth asking if some colonies share alignment patterns. If temples are aligned to sunrise for ritual purposes then cities that share similar rituals may share patterns of alignment. For the purposes of this analysis three genealogies of colonies will be examined. The Corinthian colonies are Syracuse and her daughter colonies Helorus and Akrai. The Lindian colonies are Gela, Agrigento and, despite being a Syracusan foundation, Camarina (see section 6.10). The Megarian colonies will be Megara Hyblaea, Selinous and Heraclea Minoa. In each case a genealogy will be compared against a comparison set comprised of all temples outwith that genealogy. This means that the temples at Naxos and Himera will always be in this comparison sample, along with the temples from the other cities when appropriate.

The reason for such an analysis can be found following the work of Trümper (1997). Her analysis of Greek calendars shows that colonies borrowed much of the local calendar from the parent city. Local adaptations could be made but, with the exception of Heraclea Minoa, all cities in the genealogies are either first generation settlements or else once removed from the first generation.

If there is a sharing of rituals and alignment patterning **and** these rituals are distinctive to their parent cities, then groups of Greek settlements should be distinctively different from each other. If alignment is not connected to ritual or if the major rituals are all essentially held at the same time with different names then no such difference will be found. There is also a third possibility. If the cities incorporate native practices into their religious year, and the native practices are similar across the region, then there should be nothing distinctive about their alignments, as the

various genealogies will be reflecting native practices rather than their own imported ideals.

9.1 Corinthian colonies

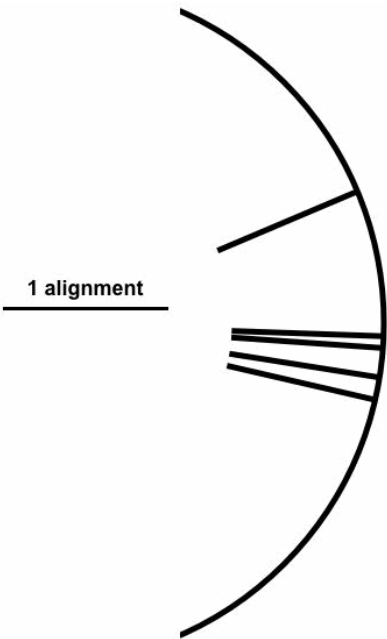
Syracuse, Helorus and Akrai

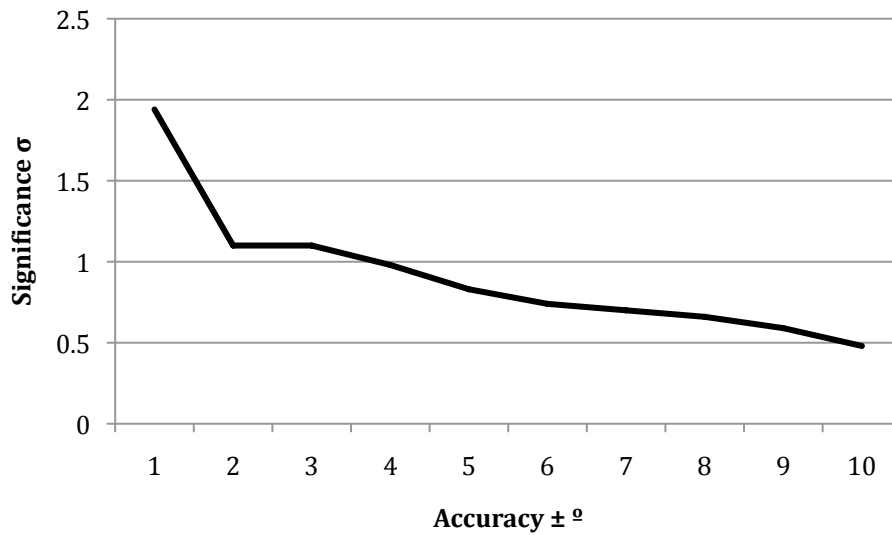
These colonies represent some of the earliest Greek settlements on the island. Traditionally Syracuse itself was said to be founded a few years after Naxos (Janelli & Longo, 2004, p. 58), though this is not archaeologically discernable. The archaeological record shows that this was originally a native site (see section 8.10). Helorus also seems to be of early date and Akrai represents an early penetration into the interior. At the same time Syracuse was also settling Casmenae and Camarina, which would suggest there was either an astonishing outflow of citizens from the homeland to build new poleis amongst tolerant or cowed natives, or that the natives themselves were part of the drive to build the new cities. In the case of Syracuse the continuing presence of native settlement in Ortygia would suggest that co-operation was occurring.

9.1.1 Orientations

Azimuths

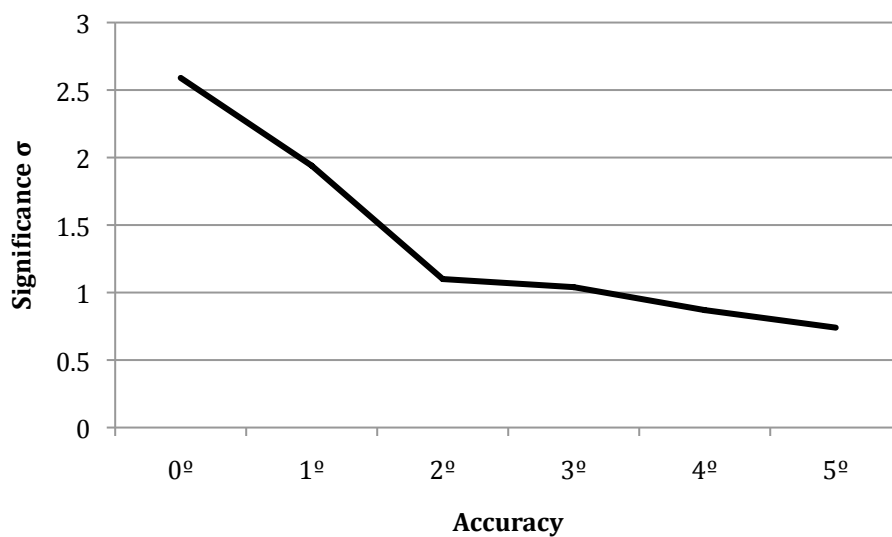
Accuracy \pm °	Number of Matches	Significance σ
1	5	1.94
2	12	1.1
3	12	1.1
4	14	0.98
5	17	0.83
6	19	0.74
7	20	0.7
8	21	0.66
9	23	0.59
10	26	0.48





Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	3	2.59
1	5	1.94
2	12	1.1
3	13	1.04
4	16	0.87
5	19	0.74



At no accuracy are the azimuths significant. The declinations could appear to be significant in the highest-accuracy interpretations of temple alignments, but these are not robust results and collapse if any error is allowed. The high-accuracy declination

interpretation would require the temples to be intentionally orientated to within a degree. Syracuse and Helorus probably had flat horizons for their orientations. Akrai is less certain, but the lack of significance in the azimuth analysis suggests that the declination analysis has produced a false positive rather than a sign of meaningful intent. This would suggest there is nothing particularly distinctive about the Corinthian colonies as a group, but would be consistent with a Syracusan or Corinthian identity being adopted at a later date.

9.2 Lindian Colonies

Gela, Akragas, Camarina

In contrast to the Corinthian colonies the Lindian colonies are slightly later. Gela was founded around fifty years after Syracuse (see section 8.6). Akragas was traditionally thought to have been settled in the early sixth-century and Camarina was re-settled from Gela in the fifth-century. The latter colony was originally founded by the Syracusans (see section 8.3) but is included with the Lindian colonies as the temple post-dates the Geloan settlement of the colony and so is more likely to reflect the Geloan cosmology rather than the Syracusan world-view.

The relatively late settlements pose a difficulty in determining the historical accuracy of the accounts of foundation. While the foundations of Akragas and Gela are protohistoric, are they close enough to historical record to be more reliable than the tales of earlier foundations? A useful example may be the settlement of Cyrene by Battus of Thera. Massalia around 600 BC by the Greeks. In this tale the Greeks were lead by the oikist Battus whose name translated as 'king' (Herod. IV.155.1-2). Either Battus was uniquely qualified for his job, or else the foundations of Cyrene are a cocktail of history and later invention. Finley (1964; 1965), and more recently Osborne (2009, pp. 8-16), have shown the extraordinary malleability of mythologised history, so beyond saying that Akragas was a relatively late foundation, there is perhaps little that can be said with certainty about the conditions of its foundation.

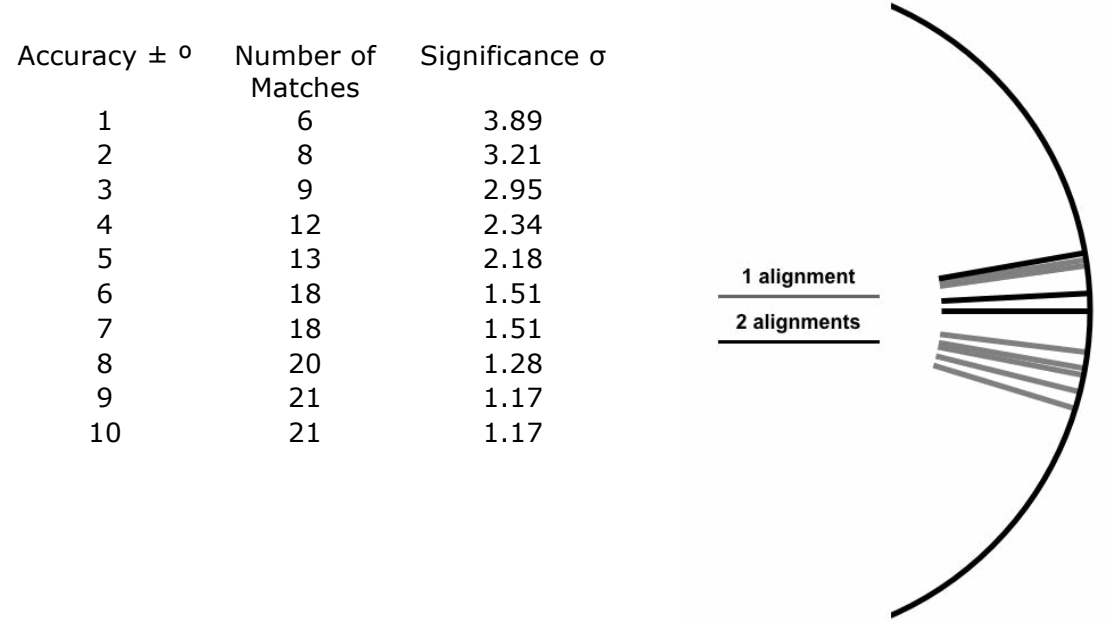
The same may even be said for the Geloan settlement of Camarina. The historical record is emphatic that this was a Greek settlement, but it also problematic. It was settled from Gela more than once, and the first settlement by Hippocrates, tyrant of Gela, in 492 may be a later justification for the second settlement by Gela in the mid-

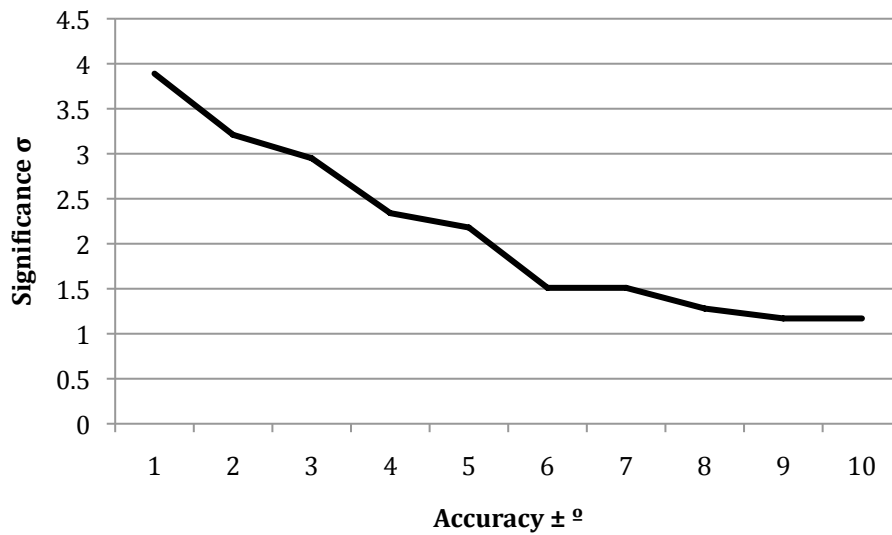
fifth-century. In particular the tale that Hippocrates was killed by the natives may be true, or it may be a convenient political fiction used to justify expansion into other territories at later dates.

This sceptical approach to history may be particularly controversial in this instance. In the Greek homeland the Persian wars, of earlier date are firmly treated by Classicists as historical events. However, this is at best a protohistoric period for Sicily. Its early history is based largely on the work of, an Athenian writing at the end of the fifth-century. Further, Thucydides was writing about Sicily to explain how it related specifically to the problems of Athens in the Peloponnesian War. His history may be an accurate account of how people thought about Sicilian origins in the late fifth and early fourth centuries, but to place him as authority upon archaic Sicily could be somewhat unfair to him. Other sources such as Herodotus are not notably closer to the foundations and in the case of Ps-Skymnos (90 BC) considerably later.

9.2.1 Orientations

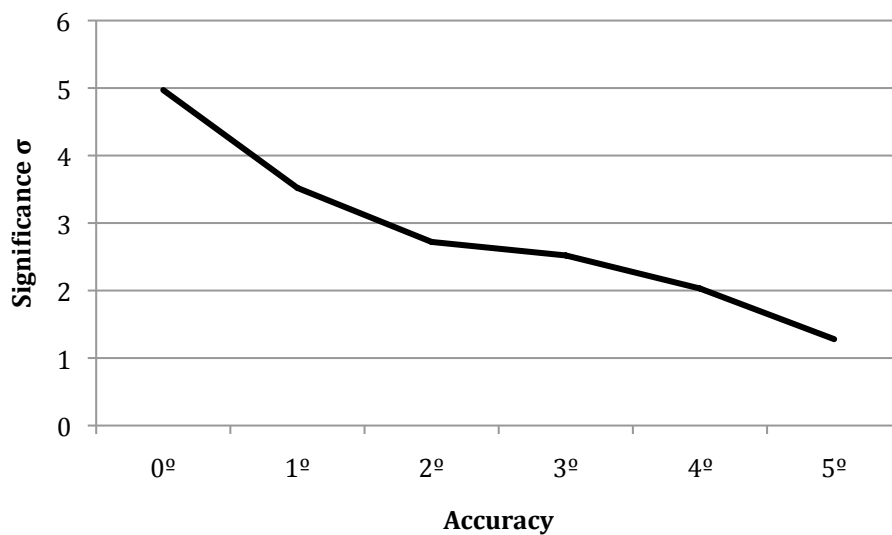
Azimuths





Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	4	4.97
1	7	3.52
2	10	2.72
3	11	2.52
4	14	2.03
5	20	1.28



Despite the caveats above, the results are positive if the temples were planned with an accuracy better than $\pm 5^\circ$. This could have been expected to some extent, as the Agrigentine temples were shown to be significantly different, and these make up the

bulk of the Lindian sample. However, what is noticeable is that adding the Geloan and Camarine temples to the sample increases its significance. This would suggest there is element common to all the colonies. This could be the temple of Athena on the acropolis, which in Gela was named Lindioi in Gela (Thucydides VI.4.1). This would strongly suggest that there are possibly shared alignments between colonies and therefore poses questions about the results for the Corinthian and Megarian colonies.

9.3 Megarian Colonies

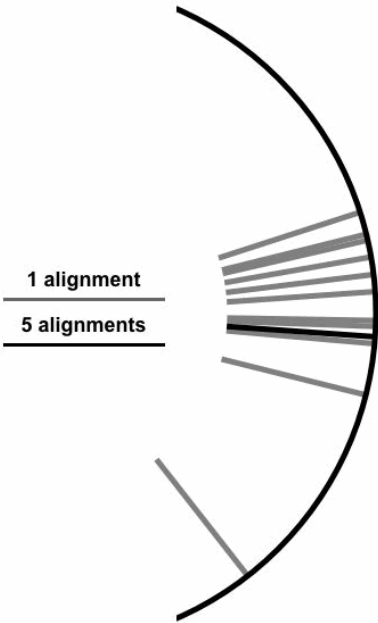
Megara Hyblaea, Selinous, Heraclea Minoa

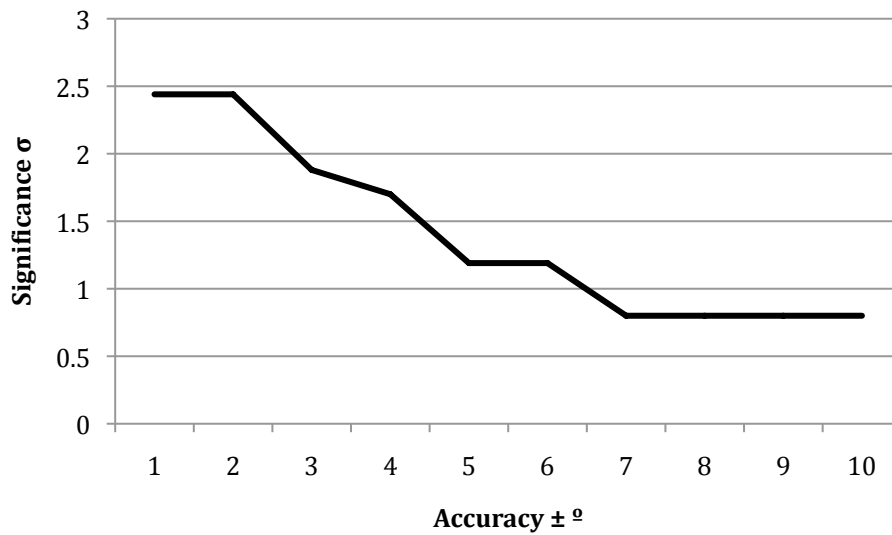
The Megarian colonies pose a similar challenge to the Syracusan colonies. Megara Hyblaea was one of the first wave of Greek settlements, and like Syracuse shows evidence of a strong native presence before and during its early years (see section 8.8). Selinous too may have had a native presence (see section 8.11) and tales tell of settlement from Cefalù to Heraclea Minoa, which all points to the existence of hybrid colonies rather than purely Greek settlements. In all cases the cities have viewable distant horizons to the east, so there should be no topographical restraint on their collective orientations.

9.3.1 Orientations

Azimuths

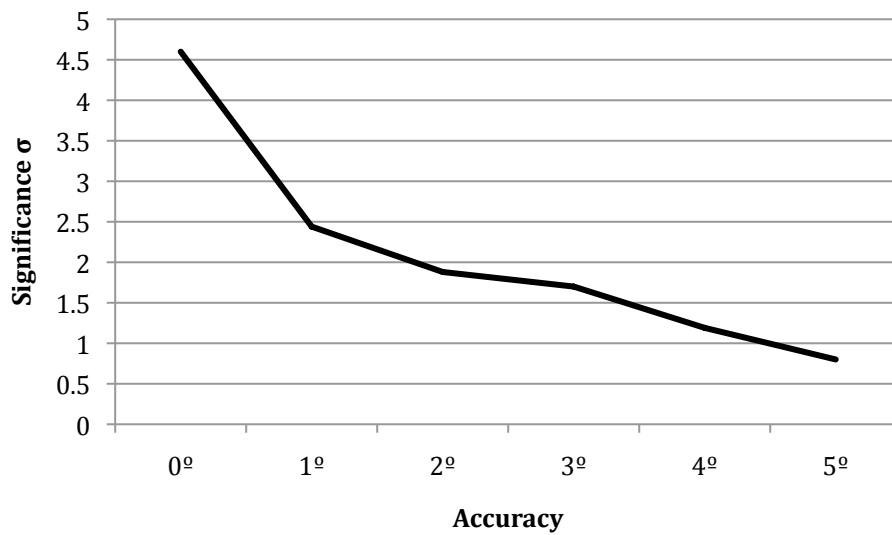
Accuracy \pm °	Number of Matches	Significance σ
1	13	2.44
2	13	2.44
3	16	1.88
4	17	1.7
5	20	1.19
6	20	1.19
7	22	8
8	22	0.8
9	22	8
10	22	8





Declination

Accuracy \pm °	Number of Matches	Significance σ
0	6	4.6
1	13	2.44
2	16	1.88
3	17	1.7
4	20	1.19
5	22	0.8



At first glance there would appear to be a significant clustering of orientations, if one accepts high accuracy alignments. Further this can be demonstrated as plausible

following the results from Selinous which show the Greeks could align temples to within a degree over long distances. However the results from Selinous should also suggest caution in accepting these results.

The Selinuntine sample makes up a major part of the Megarian sample and it is significant to 2.82σ at 1° accuracy and 2.56σ at 2° accuracy. In contrast the Megarian colonies as a whole are only significant to 2.44σ at these accuracies. Therefore it is reasonable to question if the Selinuntine temples are skewing the sample. The Megarian sample, which is never significantly aligned, appears to clash with the Agrigentine temples as much as it does the Selinuntine sample. The reason that the sample is not somewhat less significant is that the temples at Heraclea Minoa have no temples that share alignments with sanctuaries at other sites. In this instance the lack of historical data from Megara Hyblaea would suggest that, despite the significance exceeding 2σ there are no plausible grounds to accept that the cluster of alignments is significant. This would appear to be a clear case of a false positive generated by throwing a sufficiently large number of tests at a subject.

9.4 Genealogies and alignments?

The results are frustratingly ambiguous. Had all three analyses returned the same result a conclusion would be simple. Instead we have a positive, negative and false positive result. The result from the Lindian colonies shows that it is plausible for the Greeks to have similar alignments in cities that have a shared genealogy. Given this result the simplest solution would be to declare that the Lindian colonies are examples of genuine Greek colonisation and that the other colonies are hybrid settlements or even hellenised native settlements. Unfortunately while this is a possible interpretation it is not the sole possible interpretation.

The assumption above is that Greeks expressed their cosmology and religion through temples. While this would appear to be true, they also expressed their religion and cosmology through other means too. Trümper's (1997) work clearly shows that there were similarities in the calendars of the Corinthian colonies and the same too for Megarian colonies. Therefore it is entirely feasible that while they were not expressing local or shared identity through their temples they were expressing it through other religious practices. It has also been noted elsewhere (Salt & Boutsikas, 2005) that temple alignment and religious practice need not be associated with each other.

So why, when the Lindian results are so positive, were similar results not found for Corinthian and Megarian colonies? It is possible that the Lindian results are a combination of Akragas's specific properties and the presence of temples to Athena on the acropoleis specifically dedicated to the goddess of Lindos. While they are architecturally similar, it may be that the temples of the Corinthian and Megarian colonies fulfilled a different function.

The Corinthian colonies all have temples built long after the foundation, therefore it may be that the temples need not refer to specific origins, but to an ideal of 'Hellenicity' to contrast to the native settlements in the hinterland. This would explain the lack of significant alignments. Rather than being distinctive the temples could have been built expressly to emphasise a Greek character to the cities they were built in.

The Megarian temples are more difficult to interpret. The early grid at Selinous shows that not only early temples, but also later temples may have been ordered to cohere to a cosmology embedded in the city in its earliest period. Additionally the lack of historical evidence gives no clues as the use of the temples at Megara Hyblaea or Heraclea Minoa. The presence of so many temples at Megara Hyblaea indicates there was a complicated religious environment. Even if not all the temples were in use at the same time, there is still clear evidence that new temples were being built to fulfil some need which prior temples were not meeting. This need may have been religious or cosmological or it may have been competitive euergetism between opposing families. The lack of local context means we cannot say if these were built to a specific religious injunction or simply to satisfy generic requirements of Greek temples, such as the need to point east.

The problems of the Megarian temples highlight the problems of the interpretation of all the genealogies. These results could show evidence of a Hellenic veneer over native hellenised sites in Sicily, or they could be attempts to reaffirm connections with the homeland by Greeks who saw themselves as being surrounded by the hostile 'other'. In either event the striking adherence to pointing east by all the temples, bar one, does show that the Sicilian temples show a cohesion unmatched by temples in the homeland. The negative results for the Corinthian and Megarian temples are indicative of a mature Sikeliote identity rather than identities rigidly

bound to the progenitor cities. Whether or not this Sikeliote identity is built on a native foundation remains an open question.

10. The Historical Development of Temple

Alignments

The temples not only have a place in topography and genealogy, they also have a place in a wider Greek context which may be accessible by looking at their development over time. The earliest temples were founded at the same time as writing was being introduced to the Greeks. This had many effects, but one major effect is that astronomy, as systematic observation of the sky, became possible in ancient Greece. Writing allowed the creation of long term records of astronomical events. The temples built in the Hellenistic period were built under conceptually very different skies to the early temples of the archaic period.

In the Classical period Dunn (1999, p. 375) notes a major change in the concept of time, remarking that Meton discovered his luni-solar cycle (though he questions how accurately Meton could observe solstices). This makes a significant difference as it makes the length of the year known, and this is certainly true by Herodotus' time as he complains about the inaccuracies of the Greek calendar of twelve or thirteen months compared to the Egyptian calendar of three-hundred and sixty-five or sixty-six days. It is therefore possible to make the argument that temples of the archaic period functioned as calendrical observatories, revealing the correct time to sacrifice. This role would have been unnecessary by the Hellenistic period.

For this study the temples were divided into three periods:

Early - all temples built before the fifth-century BC; twenty temples were in this category.

Mid- all fifth-century BC temples; twelve temples were in this category.

Late - all temples built after the fifth-century only three temples were in this category.

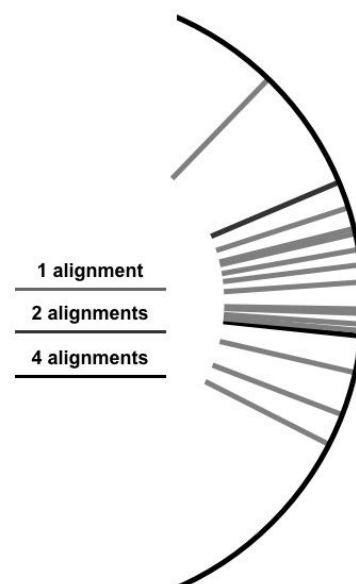
The categorisation was made after the dates of the temples were ascertained, and made because they were possible to date. This is therefore quite possibly an entirely arbitrary categorisation as there is no historical reason to assume a temple from the late sixth-century was built in a radically different socio-political environment from those built in the fifth-century.

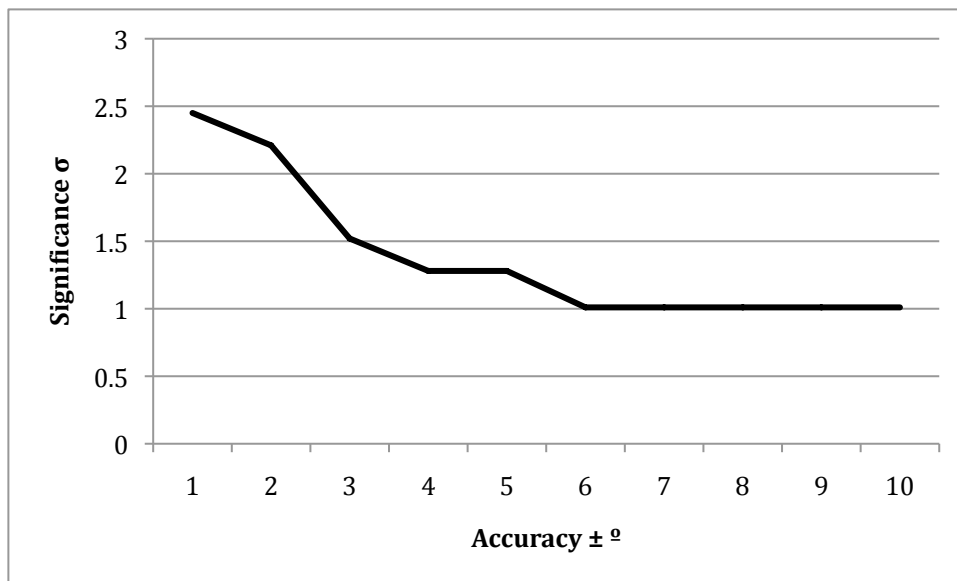
The results are shown together as it may not be reasonable to interpret them independently.

10.1 Early Temples

Azimuths

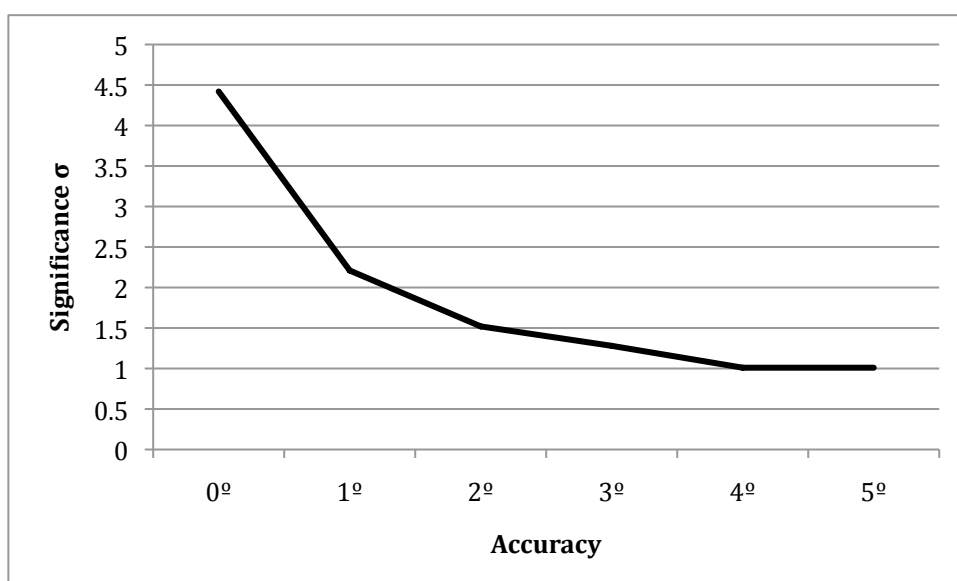
Accuracy \pm °	Number of Matches	Significance σ
1	13	2.45
2	14	2.21
3	17	1.52
4	18	1.28
5	18	1.28
6	19	1.01
7	19	1.01
8	19	1.01
9	19	1.01
10	19	1.01





Declinations

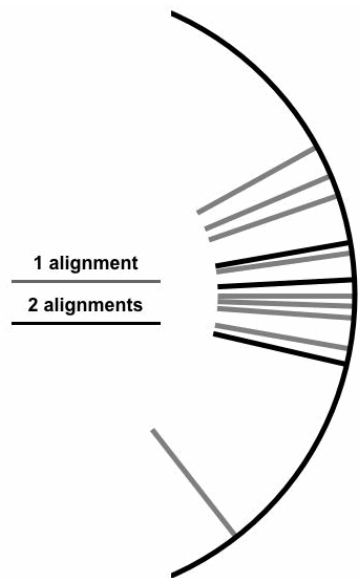
Accuracy \pm °	Number of Matches	Significance σ
0	7	4.42
1	14	2.21
2	17	1.52
3	18	1.28
4	19	1.01
5	19	1.01



10.2 Fifth-century temples

Azimuths

Accuracy \pm °	Number of Matches	Significance σ
1	16	1.69
2	17	1.57
3	20	1.26
4	25	0.75
5	25	0.75
6	25	0.75
7	25	0.75
8	25	0.75
9	25	0.75
10	26	0.64

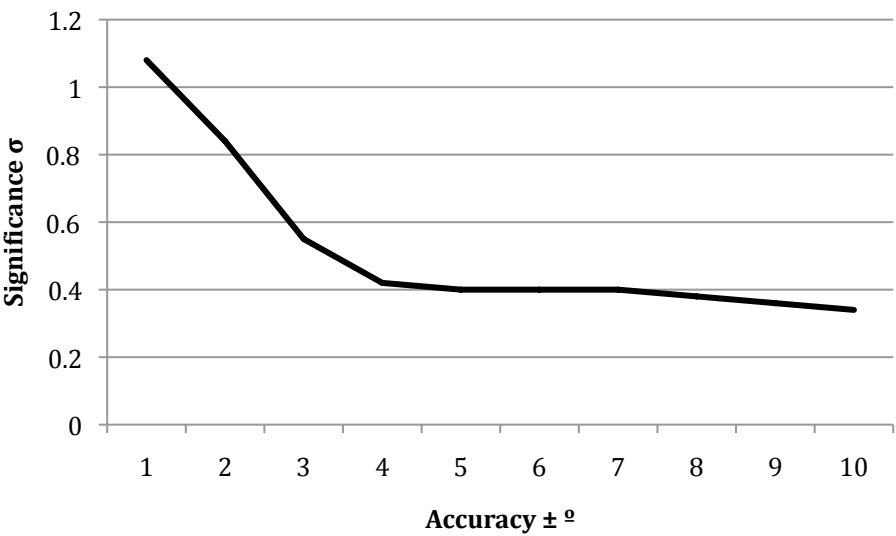
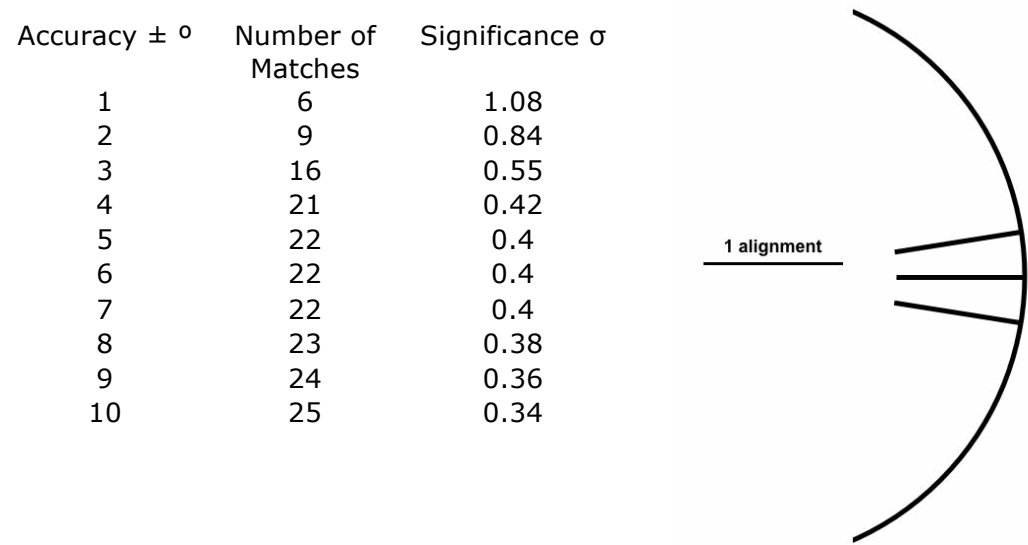


Declinations

Accuracy \pm °	Number of Matches	Significance σ
1	16	1.69
2	17	1.57
3	20	1.26
4	25	0.75
5	25	0.75
6	25	0.75
7	25	0.75
8	25	0.75
9	25	0.75
10	26	0.64

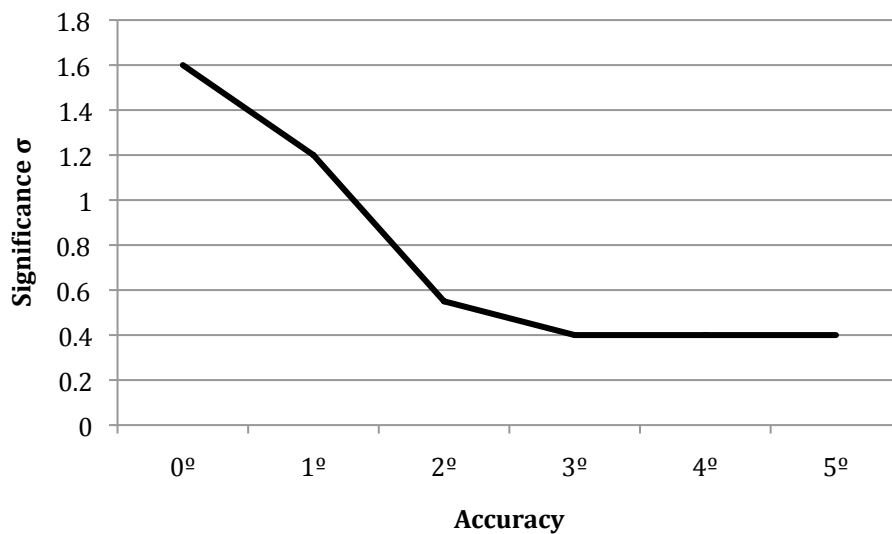
10.3 Late Temples

Azimuths



Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	3	1.6
1	5	1.2
2	16	0.55
3	22	0.4
4	22	0.4
5	22	0.4



10.4 Analysis of chronological changes in alignment patterns

Of the samples only the early set shows any significant features, exceeding 2σ at accuracies of 1° and 2° azimuth. This is counter-intuitive as the more geometrical model of Hellenistic astronomy would suggest that greater accuracy and purpose of alignment would be possible in the later periods. Nonetheless it would be possible to spin a tale justifying the higher significance of early temples. It is possible that being built in more sparsely populated landscapes they were more easily pointed at desired targets. The temples of later periods were being built into urban environments and so would be more likely to be compromised in layout. I would be wary of such an interpretation. The later results are certainly not of any significance at all. Therefore it might be worthwhile what, apart from era, is different about the first sample.

The early temples data set is much larger than the other samples, the twenty temples comprising almost half the data set. This reduces the number of potential matches in the comparison data set to twenty-one and the sample matches nineteen temples

when an accuracy of 4° or greater is assumed. Despite matching all bar two of the temples this still shows a σ value of 1.09 and may show a flaw in the analysis when it comes to analysing large samples. Alternatively this may be the influence of the aberrant alignment for the temple of Hekate (see sections 6.30 and 15.2).

Given the extreme lack of significant results for the other periods and the lack of an *a priori* reason to expect significant results from a sample of early temples, and the lack of robustness in the results, it would seem likely that the early temples result is another false positive.

11. The Alignments of Temples to Chthonic and Celestial Deities

Here again the temples have been divided into three groups. The first group is made of those temples which are aligned to celestial divinities. The second is the group of temples dedicated to chthonic deities. These two groups have been analysed. The third group are the unassigned temples, which have no known dedication. They only appear in the comparison samples.

The reason for this test is that the Greeks had a very clear concept of planes of reality (Mikalson, 2005, pp. 5-6). This has been referred to as the division of the sky, sea and underworld between Zeus, Poseidon and Hades. The Greeks usually existed at the meeting place of these three planes, at the shores above the underworld but beneath the heavens. Of the major gods most can be neatly divided between celestial and chthonic gods. Poseidon would pose a problem but fortunately for the purposes of this study there are no temples firmly identified with Poseidon.

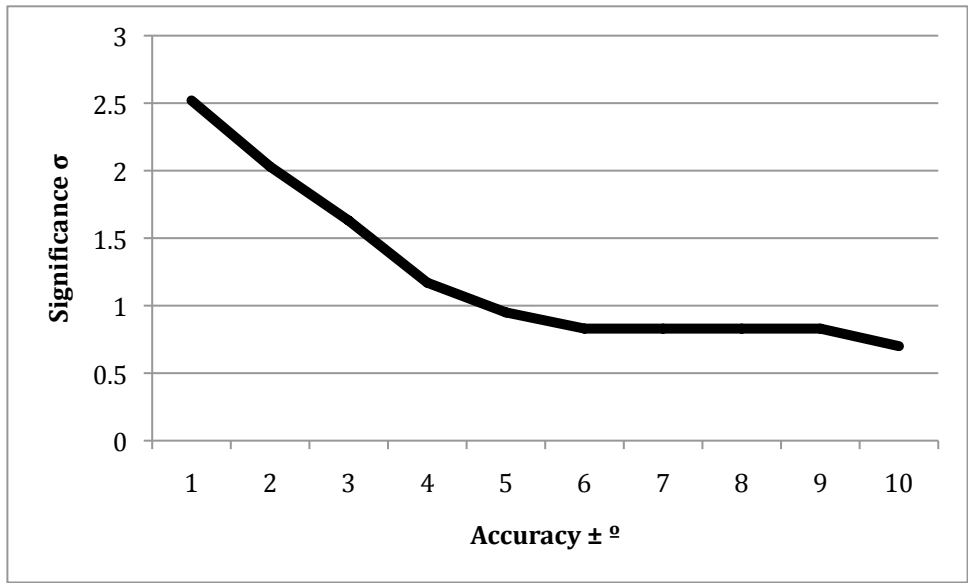
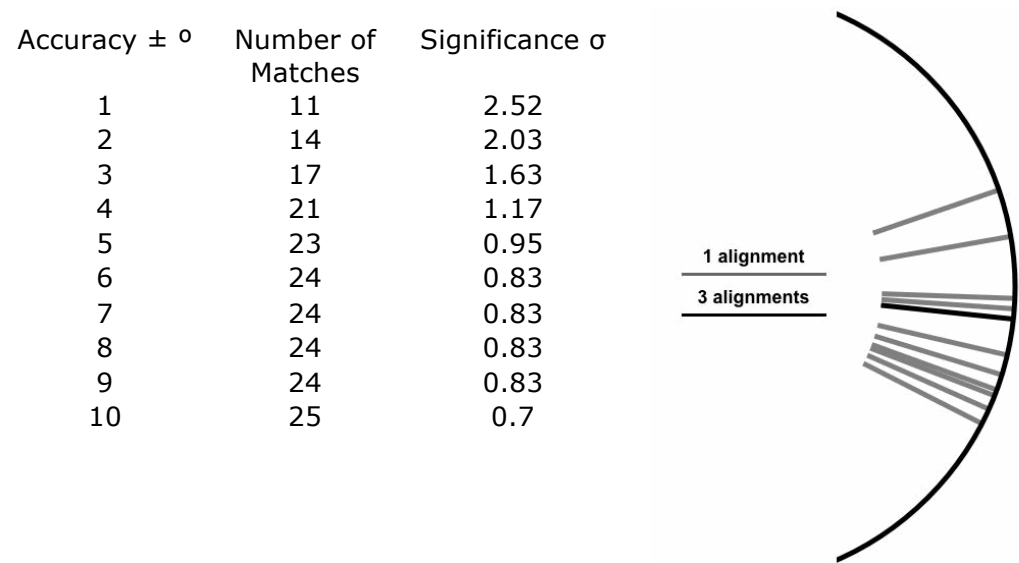
The celestial gods are (usually) Zeus, the Sky-father, Apollo who amongst other things is a sun god, Artemis who is a moon goddess, and Aphrodite. Athena has been added to this group as she has a lunar aspect and Hera who is an Olympian Goddess. The Chthonic gods are Demeter and Kore. Additionally I have added Zeus Melikhios at Selinous, who in this aspect is definitely chthonic (see section 6.29). The obvious choice of Hades is omitted purely for the reason that there are no identified temples dedicated to him.

A less obvious omission is the temple of Hekate at Selinous. Hekate is problematic. She is a lunar goddess, however she is also the goddess who helped Demeter in her search for Kore. The presence of the Hekataion in a sanctuary with Demeter and Zeus Melikhios is highly suggestive of a connection to the underworld. The way out of this problem is simply to not include Hekate in either category. It is already known that this alignment is highly distinctive and so including it in any sample will only distort the results whilst confirming what is already known, that this temple is rather odd.

The value of performing this analysis is that it cannot be assumed that all temples served the same social role with the dedication simply being a matter of interior decoration. Gods have different values and associate with different locations. In the case of Selinous it would seem reasonable to assume that the gathering of chthonic deities in one sanctuary on the opposite side of the city to the celestial temples of the Marinella Hill is, in some way significant.

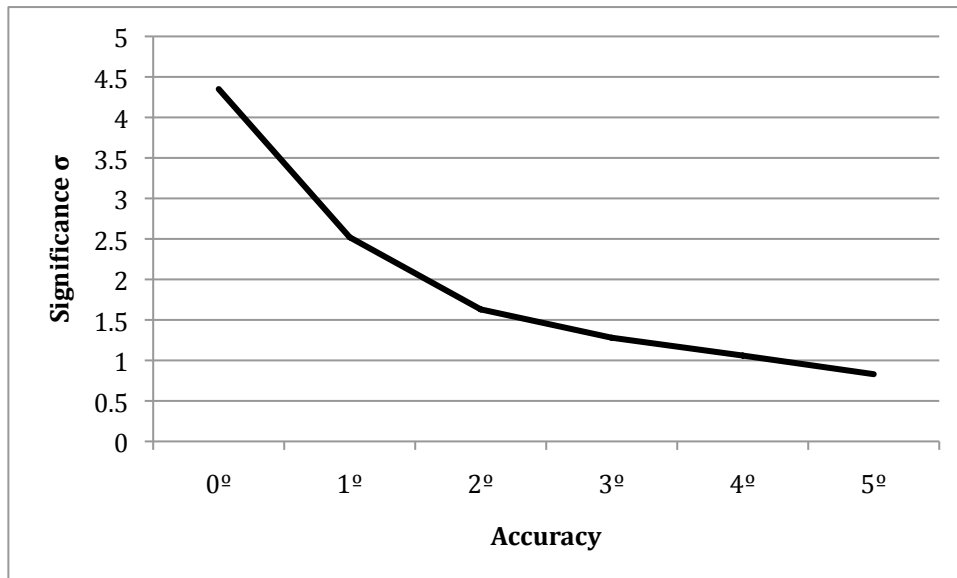
11.1 Celestial Temples

Azimuths



Declinations

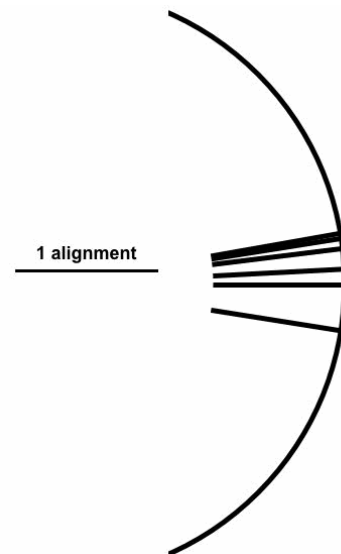
Accuracy \pm °	Number of Matches	Significance σ
0	5	4.35
1	11	2.52
2	17	1.63
3	20	1.28
4	22	1.06
5	24	0.83

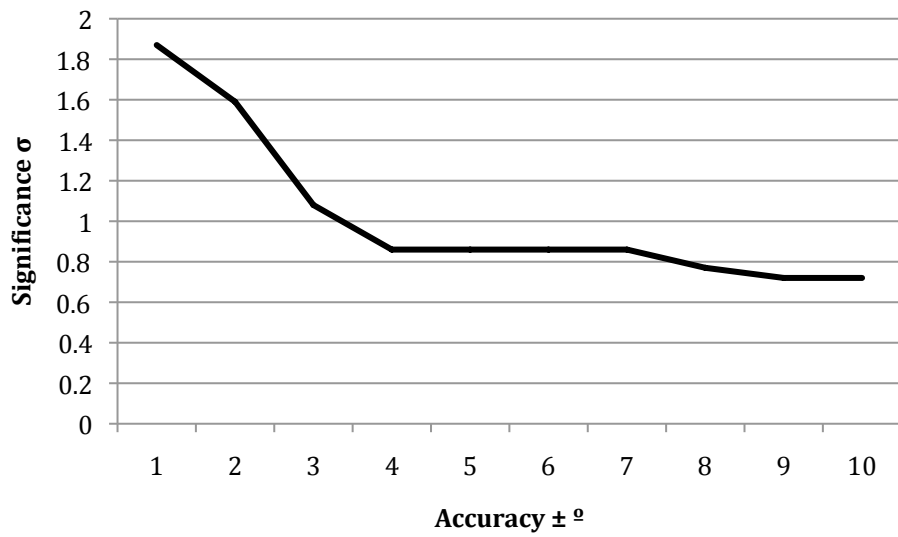


11.2 Chthonic temples

Azimuths

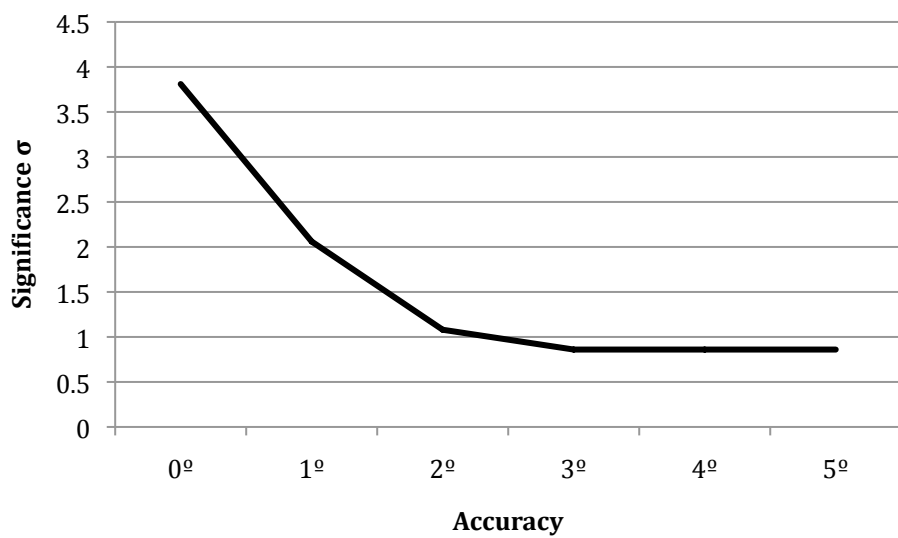
Accuracy \pm °	Number of Matches	Significance σ
1	7	1.87
2	9	1.59
3	15	1.08
4	19	0.86
5	19	0.86
6	19	0.86
7	19	0.86
8	21	0.77
9	22	0.72
10	22	0.72





Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	2	3.81
1	6	2.06
2	15	1.08
3	19	0.86
4	19	0.86
5	19	0.86



11.3 Combined Analysis of Chthonic and Celestial Deities

The results of this analysis are inconclusive, but intriguing and show the necessity for a flexible presentation of results, because in this case the conclusion depends very much on the initial assumptions.

If you anticipate lower-accuracy alignments then the results show no significant differences between celestial and chthonic gods. This is not the same as saying there is no astronomical significance. The aggregated results (see section 7) show there is. Instead this demonstrated that the importance of astronomical alignment was not divided as to whether or not a deity was 'celestial'. This is perhaps to be expected as even chthonic deities could have celestial counterparts, the equation of what is now Virgo with Demeter Parthenos is an obvious example.

If you prefer to think that Greek temples were laid out with high accuracy then it is possible to argue for significant results for celestial deities. The azimuths and target declinations are distinctive above 2σ for accuracies of 1° and 2° . The chthonic temples are slightly more ambiguous. There is nothing special about the azimuth alignment – even at 1° they are only significant at 1.87σ – however their declination targets are significant at accuracies of 0° and 1° to greater than 2σ . As mentioned above the azimuth orientations are measurements of alignments from north and would indicate topographical clustering, the declinations in contrast reveal an interest in celestial targets.

One possible interpretation here is that chthonic temples were sited in places of particular interest - and then aligned to face a celestial target, while the celestial

temples were specifically sited with the intention of viewing the heavens. The problem with such an interpretation is that it rests on the assumption that the accuracy of celestial alignment was important to chthonic temples, despite the lack of evidence to support this.

For an accuracy of 1° the significance associated with the chthonic declination targets is 2.06σ , barely above the 2σ threshold and hardly compelling by itself. It is entirely possible this is a false positive, yet the celestial temples for an accuracy of 1° are significant to 2.52σ . The argument is therefore one about how accurate the alignments of Greek temples are. Currently this discussion has little context, but as more data is processed from other surveys it may become possible to reassess these results.

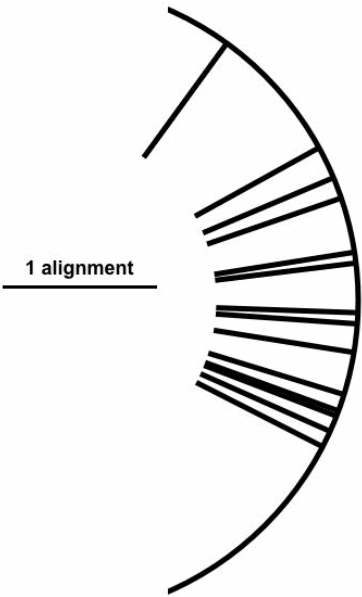
12. The Genders of Temples

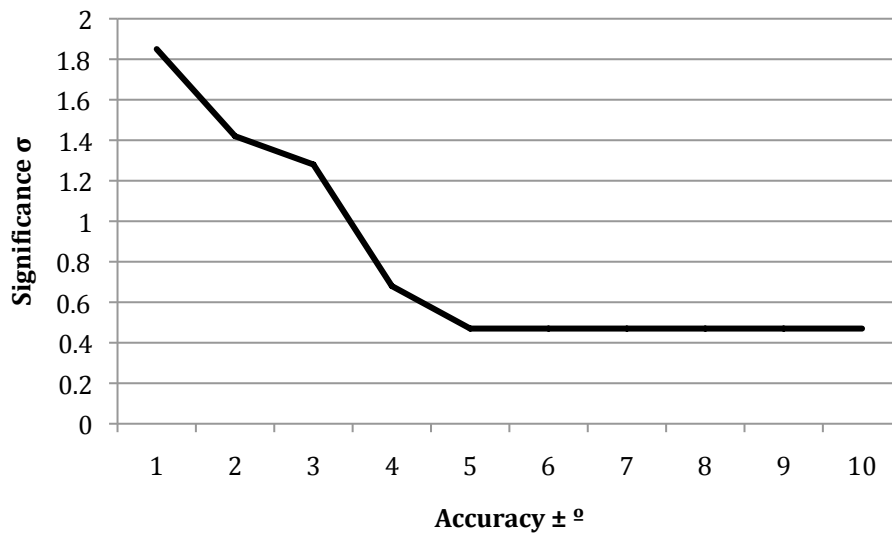
This analysis was performed on the grounds that the temples could be meaningfully divided into two groups, though no specific variations were anticipated. The value of this test was expected primarily to be a test of the analysis itself. The reason why no significant results were expected is not that gender was unimportant to the ancient Greeks. On the contrary the Greek world was highly gendered. However, the importance of gender was a permanent feature and so expressed all year round. A difference between male and female alignments would suggest the existence of masculine or feminine parts of the year, or gendered regions of the sky.

12.1 Female Temples

Azimuths

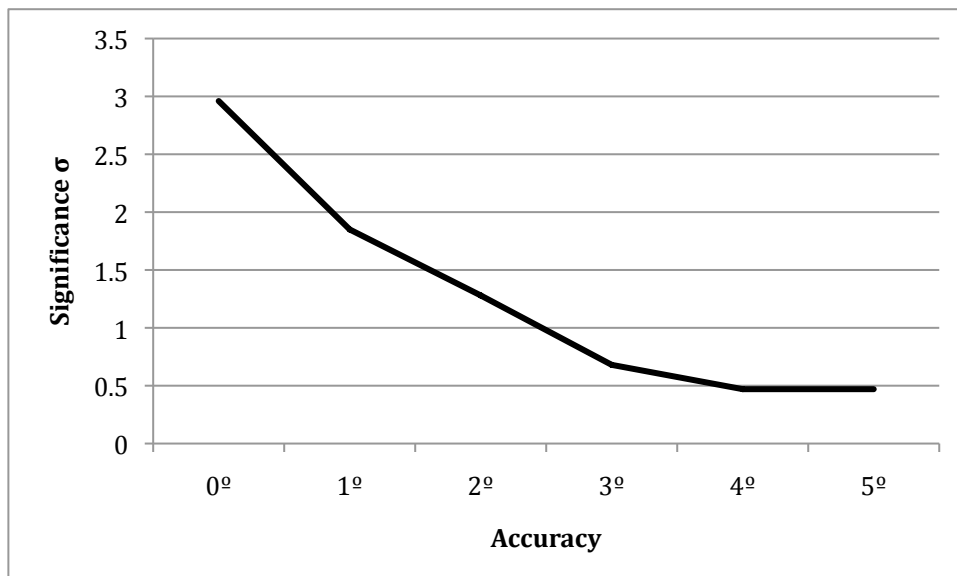
Accuracy \pm °	Number of Matches	Significance σ
1	16	1.85
2	19	1.42
3	20	1.28
4	24	0.68
5	25	0.47
6	25	0.47
7	25	0.47
8	25	0.47
9	25	0.47
10	25	0.47





Declinations

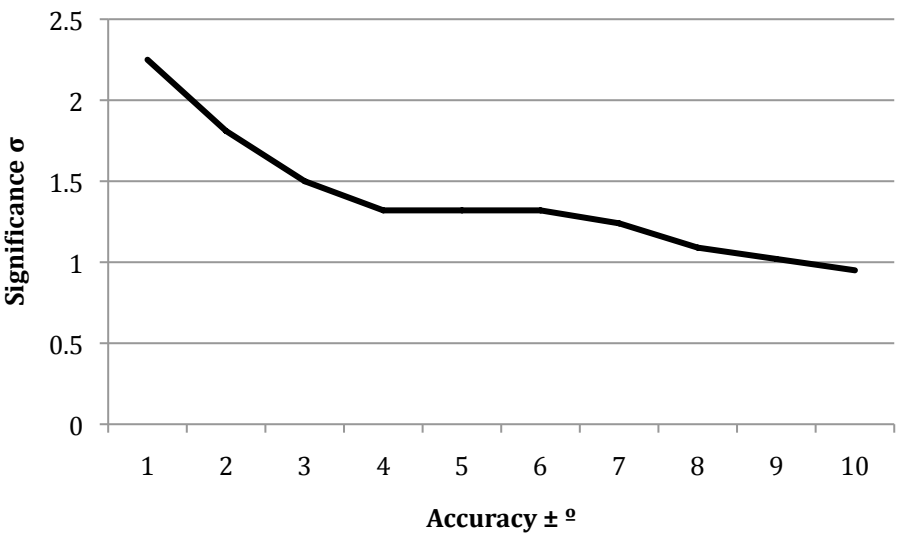
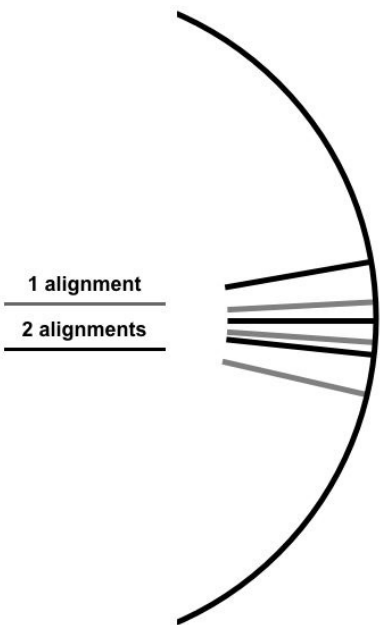
Accuracy \pm °	Number of Matches	Significance σ
0°	6	2.93
1°	14	1.59
2°	16	1.41
3°	16	1.41
4°	18	1.24
5°	19	1.16



12.2 Male temples

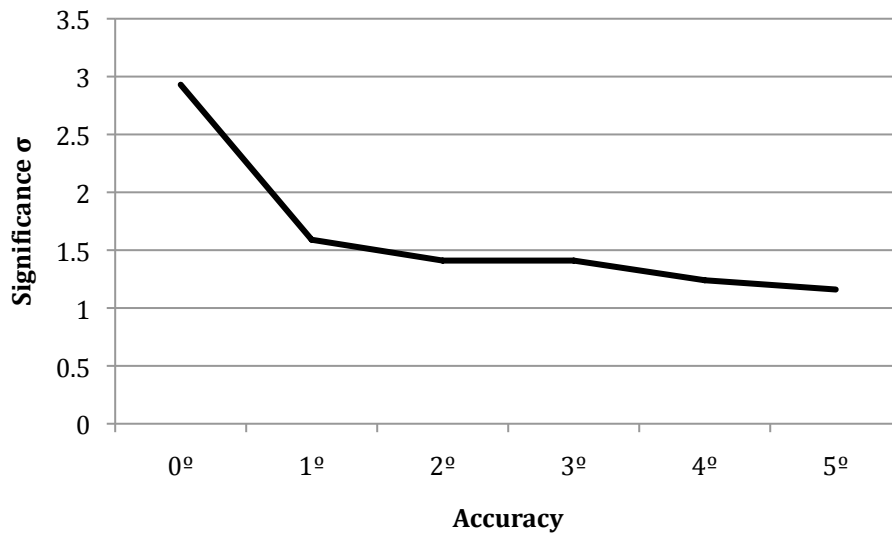
Azimuths

Accuracy \pm °	Number of Matches	Significance σ
1	9	2.25
2	12	1.81
3	15	1.5
4	17	1.32
5	17	1.32
6	17	1.32
7	18	1.24
8	20	1.09
9	21	1.02
10	22	0.95



Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	6	2.93
1	14	1.59
2	16	1.41
3	16	1.41
4	18	1.24
5	19	1.16

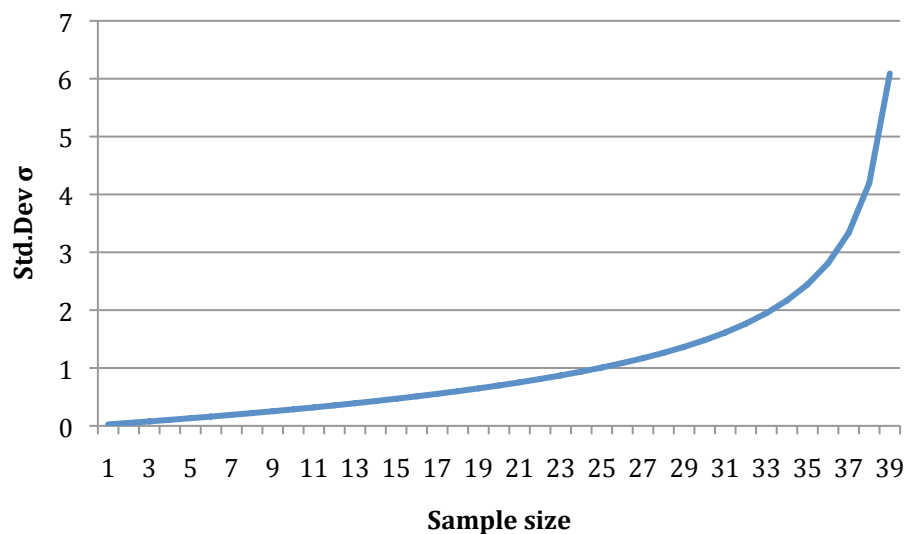


12.3 Combined Gender Analysis

The significance of the declination alignments would appear to disprove my hypothesis, but closer analysis would show this is not the case. The declination alignments are only significant at the highest levels of accuracy, and even then not to 3σ .

What is interesting about this result is the significance of a test sample as it approaches a perfect match to the comparison sample. In the case of the female temples the sample size is 15, which leaves only 26 possible matches, of which it reaches 25. This is significant to $.47\sigma$ which may seem a rather high figure. This is because the data are granular. We can add or subtract a temple from the data set but we cannot add or subtract $.35$ of a temple. The effect of the granule size is a function of the comparison set. The deviations are measured against the comparison sample which varies in size depending on the test sample. In the case of the male temples the sample size of nine means that the temples can match between zero and thirty-two temples. In comparison the sample size of fifteen for the female temples means that they can only match between zero and twenty-six temples and so the steps are

greater. Because the standard deviation is a non-linear function this is not a directly proportional relationship as the graph between shows.

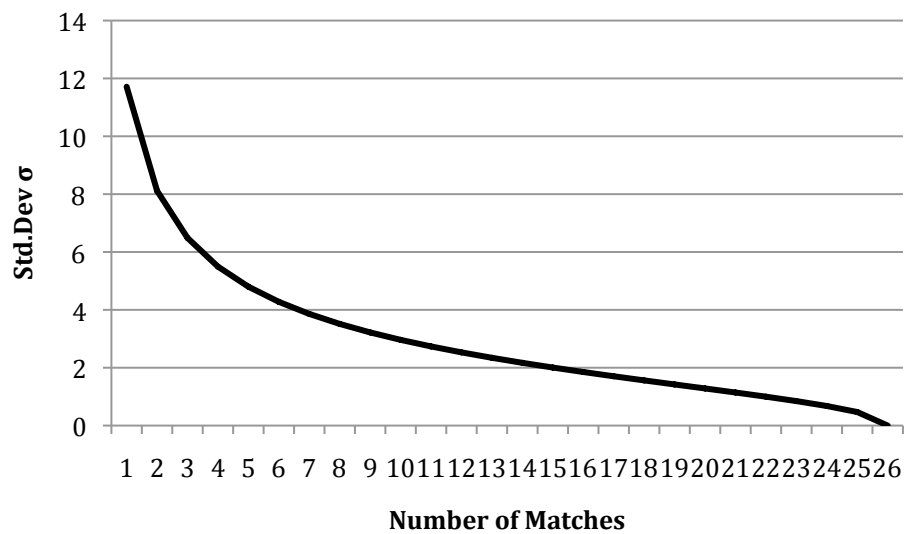


Minimum Standard Deviation of a sample

For extremely large samples the graph above would suggest that any difference between the sample set and comparison set would appear to be significant, which would be odd. The counter to this would be that any sample above 20 would exceed the comparison set, therefore it would be highly questionable to have a sample set exceeding this figure and a comparison of a few temples. The largest sample set in this analysis is the 5th century temples set in the chronological analysis (see section 10.2). The smallest non-zero deviation would be 0.7σ .

Despite this lack of flexibility the samples below twenty-one temples appear to produce readable results. In the case below the fifteen temple female gender sample has been plotted against one to twenty-six putative matches in the comparison set. This show the non-linearity of the standard deviation scale. While just two fewer matches (twenty-three) would double the sample's significance to 0.85σ , the sample only becomes significant at 2σ at fifteen matches, and would need just nine to be

significant to 3σ or greater. While the method needs to be refined for large sample sets, it would appear reasonably robust.



Value of significance in for 1-26 matches in the comparison sample

Regretfully, it would seem that the lack of known genders, and the limited number of possible genders for a Greek deity, means that there is not yet anything useful that can be said about the relationship between gender and orientation. A larger scale survey of temples with known attributions may not settle the question, as beliefs may have differed between regions.

13. Analysis of Temples by Deity

As suggested by Dinsmoor (1939) and Scully (1979, p. 44) there is a belief that temples sometimes faced the sunrise of the feast day of their god. This is not necessarily intuitive. There are good practical reasons for orientating a temple to the east. The rising sun would provide light for any activity that needed to be conducted in the temple, though the public activity would have taken place outside, in front of the temple. The morning sun would also provide heat, which would help dry out dampness which may have settled in the temple overnight. Either of these factors would make no difference if the temple were only opened on the feast day of the god, but this is unlikely to be the case, especially large urban temples.

The Greek calendar is a monthly cycle of ritual activity embedded in an annual cycle of ritual activity. There are therefore regular ritual events that in turn are supplemented by annual events and possibly biennial or quadrennial events. These festivals, rituals and processions would have been part of the process of making the world work, and would have been necessary at all Greek cities. However, not every deity had a temple. It may be the case for some deities, especially Demeter and Kore in Sicily, that their sanctuaries may have left little or no archaeological trace. An example would be the bothroi deposited at Helorus. These are ritual deposits of offerings found in association with a building north of the city. The archaeology is uncertain and the building not suitable for this analysis, but a lack of major stone building shows that ritual activity was not necessarily monumental.

At the same time a large stone temple is a building of high prestige. At the poleis of Akrai and Camarina, there was just the one temple. In the case of Camarina, there are altars associated with the agora, but the use of a building just once a year would seem to be an extravagance, and at Akrai votive offerings to other gods are found

associated with what is identifiably a temple to Aphrodite. This suggests it was highly likely that a temple would be used reasonably frequently.

If this is the case then the arguments for heat and light in the temples could argue against alignment to the feast-day of the temple's deity. If the temple is opened around the year, then it will need to be facing the rising sun in the winter months. A temple facing this direction would not be facing sunrise in the summer months, but would nonetheless be facing a sun climbing in the morning sky. In contrast a temple aligned to a summer sunrise would never see sunlight inside the building during the winter months.

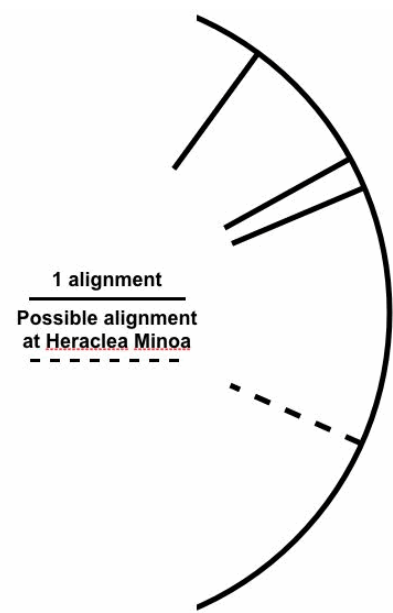
There are four deities chosen in this analysis. Aphrodite, Athena, Zeus and Aphrodite. Temples dedicated to other gods have been identified, but the minimum sample size used is three temples, to attempt to minimise the effect of random alignments which could skew small samples. In all cases the samples cover a wide range of azimuths and so it has not been possible to identify any temple as belonging to a specific god by virtue of its alignment alone.

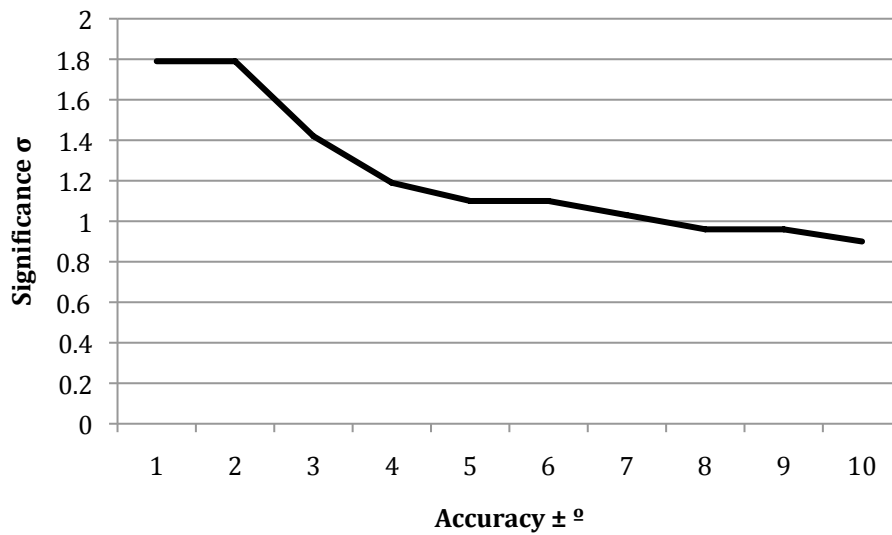
13.1 Aphrodite

The temples of Aphrodite are found at Akrai (section 6.9), Naxos (section 6.23) and Heraclea Minoa (section 6.12). The temples at Akrai and Naxos are securely identified. The temple at Heraclea Minoa is more problematic. While Diodorus identified a temple as belonging to Aphrodite, he did not say which of the two temples it was. For this analysis I have chosen the more northerly facing of the two temples at it faces within the arc of sunrise. If the more southerly facing of the two temples were chosen then the sample would appear to be more significant than shown below.

Azimuths

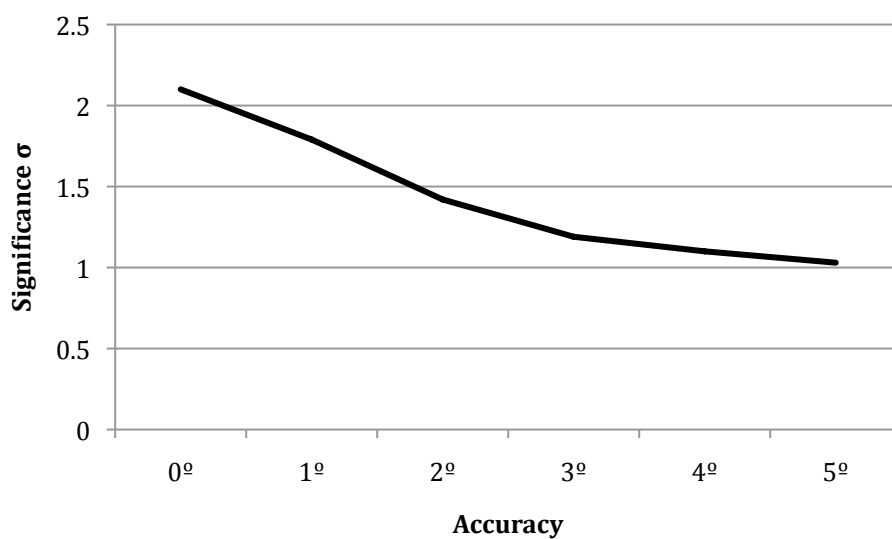
Accuracy \pm °	Number of Matches	Significance σ
1	4	1.79
2	4	1.79
3	6	1.42
4	8	1.19
5	9	1.1
6	9	1.1
7	10	1.03
8	10	0.96
9	11	0.96
10	12	0.9





Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	3	2.1
1	4	1.79
2	6	1.42
3	8	1.19
4	9	1.1
5	10	1.03



It could be tempting to argue for solstitial alignment for the Aphrodite temples. The temples at Naxos show indications of rebuild with the intention of facing the summer solstice. Similarly the temple at Heraclea Minoa faces a declination of -19°

which could indicate an alignment to the winter solstice, although this is 4.5° off the winter solstice sun. The incommensurability of the lunar and solar periods means that building the temple within a lunar month for a solar purpose could account for the misalignment. This is highly unlikely.

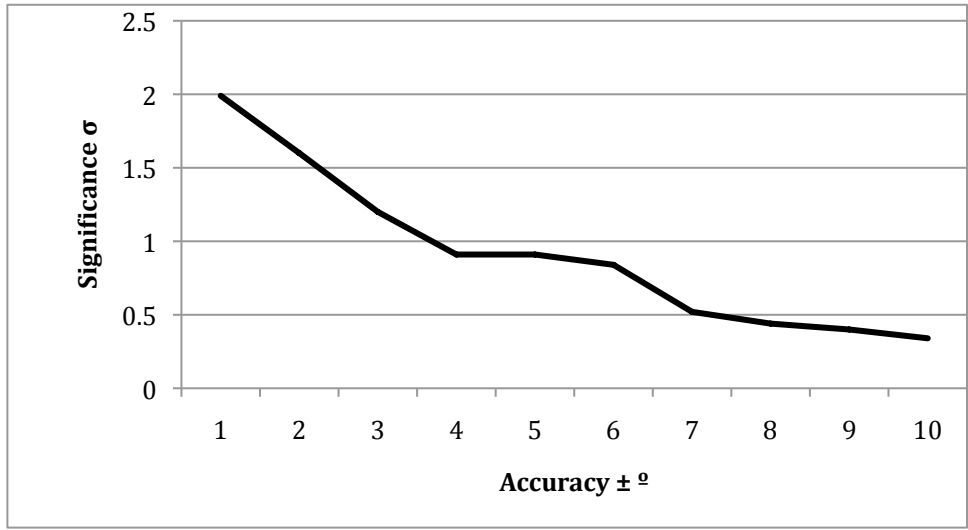
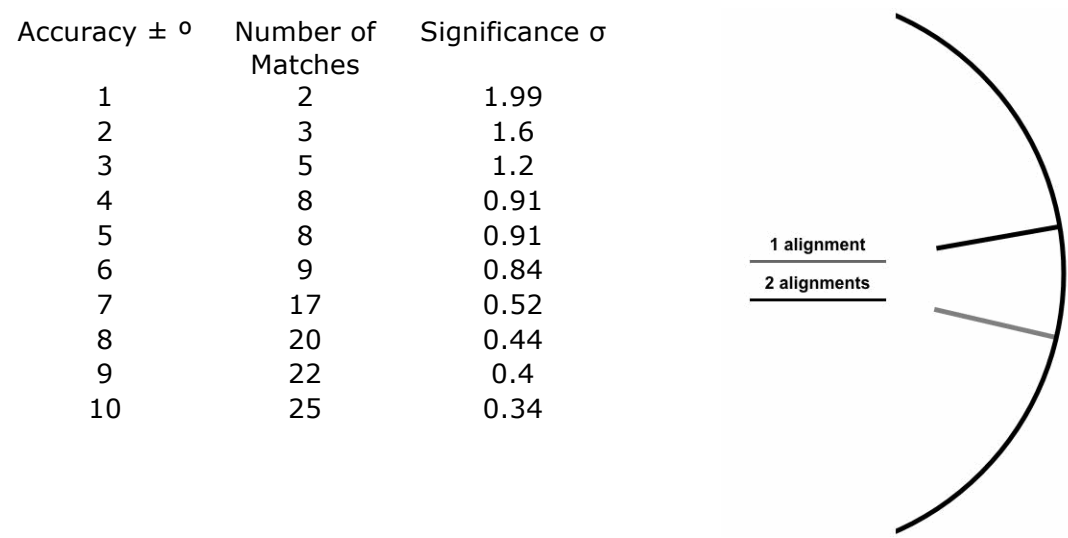
The temple at Akrai faces neither of these targets, instead pointing to a declination of 18° . Similarly this could be a solsticially aligned temple built in a year when exactly the wrong phase of the moon marked the solstice. However, while the declination graph shows possible significance at 0° accuracy, the argument depends on an astronomical accuracy of 5° , which is only significant at 1.1σ . Similarly the error in the azimuth would be 6° , which is also a 1.1σ event. To be significant to more than 2σ , there would have to be just three matching temples in the comparison sample. This would be the case if the more southerly facing of the two Heraclea Minoa temples were the temple to Aphrodite, but that would demolish any astronomical argument and suggest that any apparent significance was a false positive.

In this instance while the rebuilding of the temples at Naxos suggests a correction of alignment at that location (see section 6.23), there is no indication of an overall alignment for Aphrodite's temples. The statistical analysis shows that in the absence of clear unambiguous historical evidence for such a preference any such claims would be extremely subjective.

13.2 Zeus

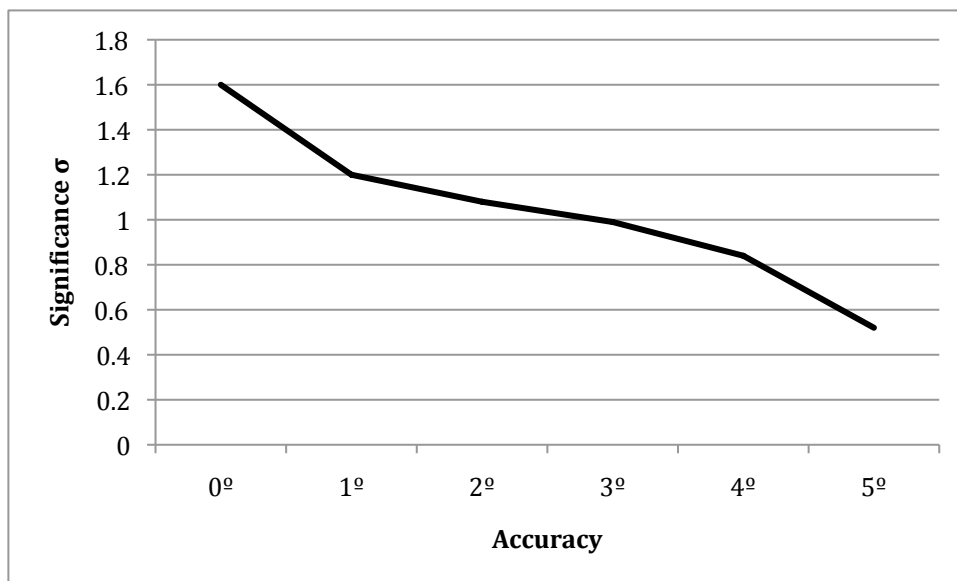
It is questionable to what extent the temples of Zeus form a coherent set. The temples are to Zeus Olympios at Akragas (section 6.2) and Syracuse (section 6.33) and to Zeus Melikhios at Selinous (section 6.29). The latter is very much a chthonic god, and so may not be expected to exhibit the same features as the more celestial aspects of Zeus. Additionally it is possible that the temple at Akragas was built with its alignment for historical, rather than religious reasons (see section 15.1). Therefore it was not considered likely that any significant pattern would emerge.

Azimuths



Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	3	1.6
1	5	1.2
2	6	1.08
3	7	0.99
4	9	0.84
5	17	0.52



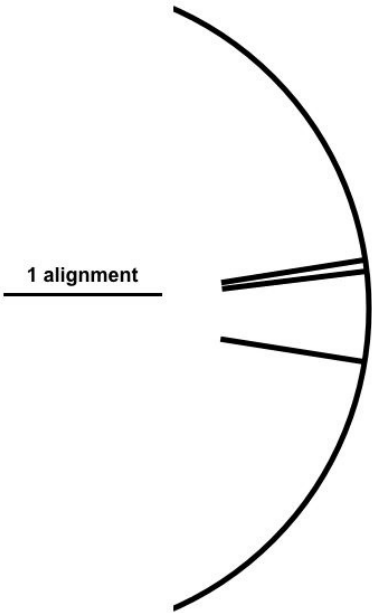
In this instance there would appear to be nothing significant about temples of Zeus as a group. Instead any explanations must be either limited to the generic – all Greek temples face a sunrise – or else local and contingent.

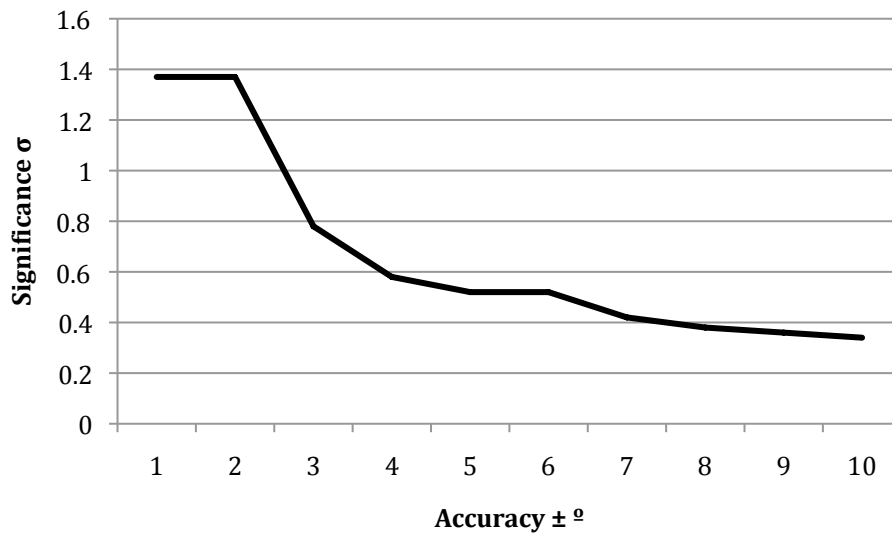
13.3 Demeter

Demeter with her daughter Kore, is one of the most prominent deities of ancient Sicily. Her role in agricultural ritual makes her an extremely important being, and her rituals, especially the Thesmophoria would have been major events in Greek civic life. The known date for the Thesmophoria, around the autumnal equinox (Brumfield, 1981, p. 79) and the tradition of the Anthesteria (Brumfield, 1981, p. 119) in the earliest days of spring would suggest that the declinations between 0° and -10° would be favoured. The aggregated results from Akragas (section 6.8), Helorus (section 6.11), and Selinous (section 6.28) flatly contradict this, with this being an extremely under-populated range compared to temples facing between 0° and +10° declination. This may show that the results of the analysis below should not be a surprise.

Azimuths

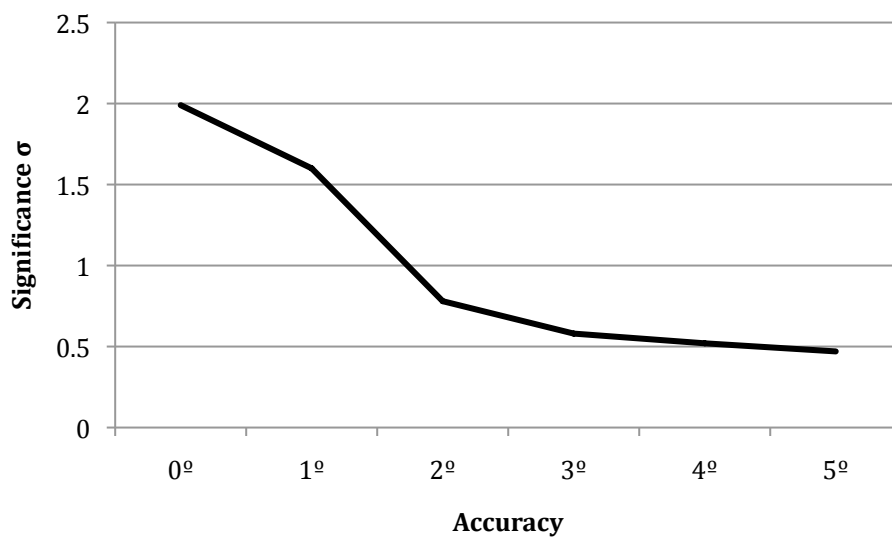
Accuracy ± °	Number of Matches	Significance σ
1	4	1.37
2	4	1.37
3	10	0.78
4	15	0.58
5	17	0.52
6	17	0.52
7	21	0.42
8	23	0.38
9	24	0.36
10	25	0.34





Declinations

Accuracy \pm °	Number of Matches	Significance σ
0	2	1.99
1	3	1.6
2	10	0.78
3	15	0.58
4	17	0.52
5	19	0.47



The temples of Demeter face +8° (Akragas), -7° (Helorus) and +6° (Selinous). If the native temple of Demeter at Segesta were added with its declination target of +6°, there would appear to be a cluster, albeit on entirely the opposite side of the

equinoxes to what I was expecting. Yet even with Segesta added to the sample the significance does not exceed 1.79σ . Despite the many sanctuaries and finds associated with Demeter and Kore, there appears to be no clear preference for an orientation that stands out over the other generic temple alignments. On this occasion the statistical analysis performs the useful, if frustrating job, of illustrating the limits of interpretation.

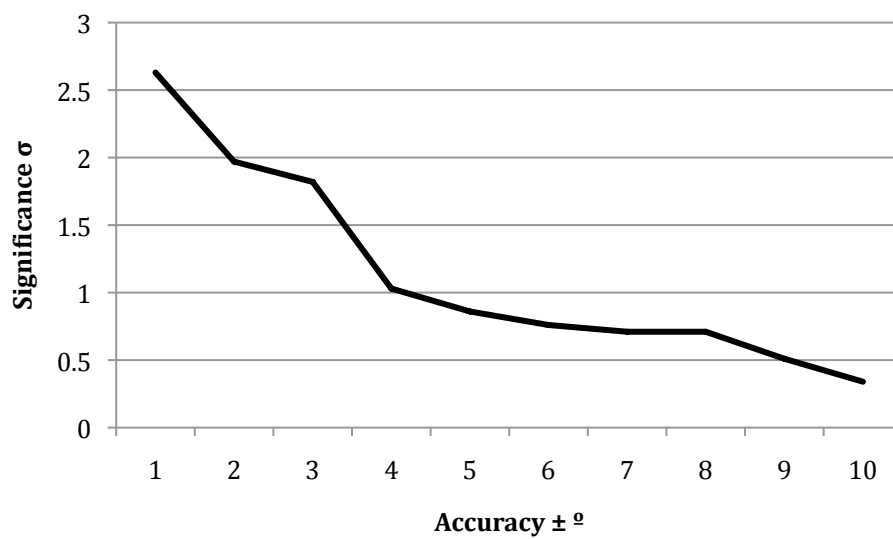
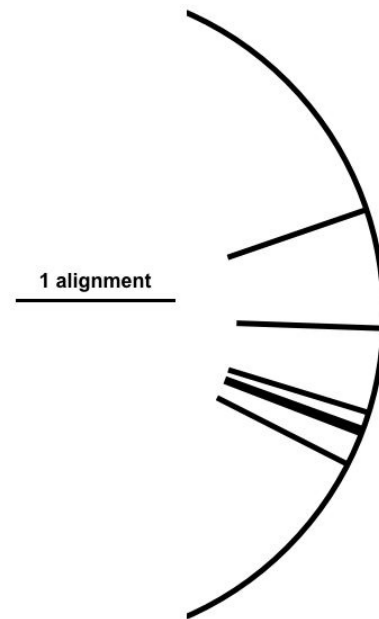
13.4 Athena

Athena could be the least likely of the four deities to have a preference for a specific astronomical alignment. She has an element of a lunar goddess (Cashford, 2003, p. 78), but the position of the moon would have swung between its extremes on a monthly basis, and the lunar cycle would not seem to specify a specific solar orientation. It is possible in particular years that an alignment to the summer solstice would also face the summer new moon, or the winter solstice sun would rise around the same place as the winter full moon, but without historical evidence there is no reason to assume this is correct.

Further there are good reasons to presume there is a topographical element to her temples. She has temples at Akragas (section 6.4), Camarina (section 6.10), Gela (section 6.13), Himera (section 6.16), and Syracuse (section 6.32). They tend to be found on acropoleis, except at Sycause though the temple is at the heart of the old city. This is to be expected, as under threat people would retreat to the acropolis. This would also be a time when it would be necessary to call on Athena and it could damage morale if the enemy was holding her temple. However as the acropolis would also be expected to be the highest land in the immediate vicinity a counter-argument could be raised that temples of Athena located on acropoleis are uniquely situated to be astronomically aligned, given their field of view.

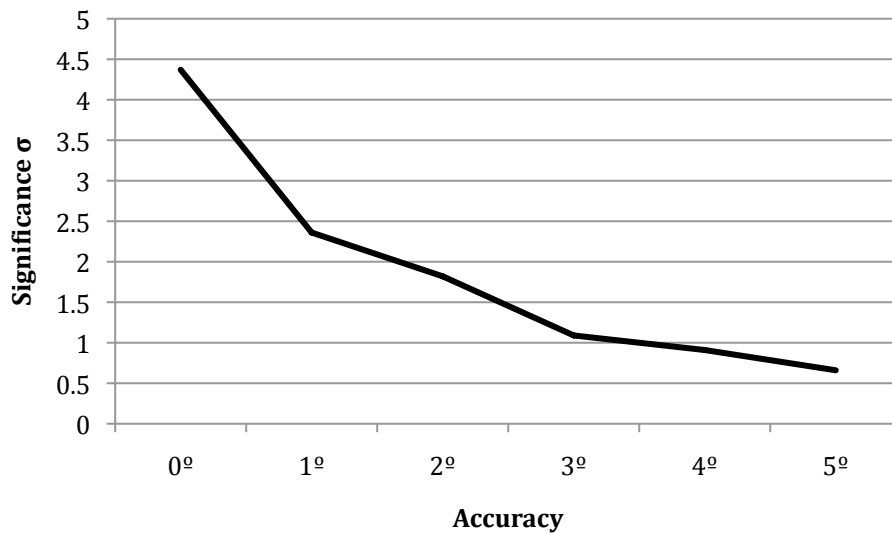
Azimuths

Accuracy \pm °	Number of Matches	Significance σ
1	5	2.63
2	8	1.97
3	9	1.82
4	18	1.03
5	21	0.86
6	23	0.76
7	24	0.71
8	24	0.71
9	28	0.51
10	31	0.34



Declinations

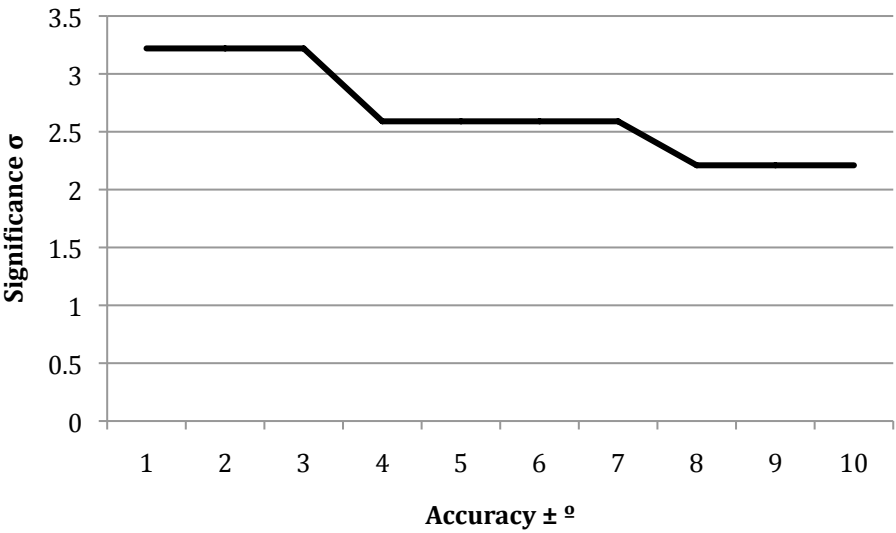
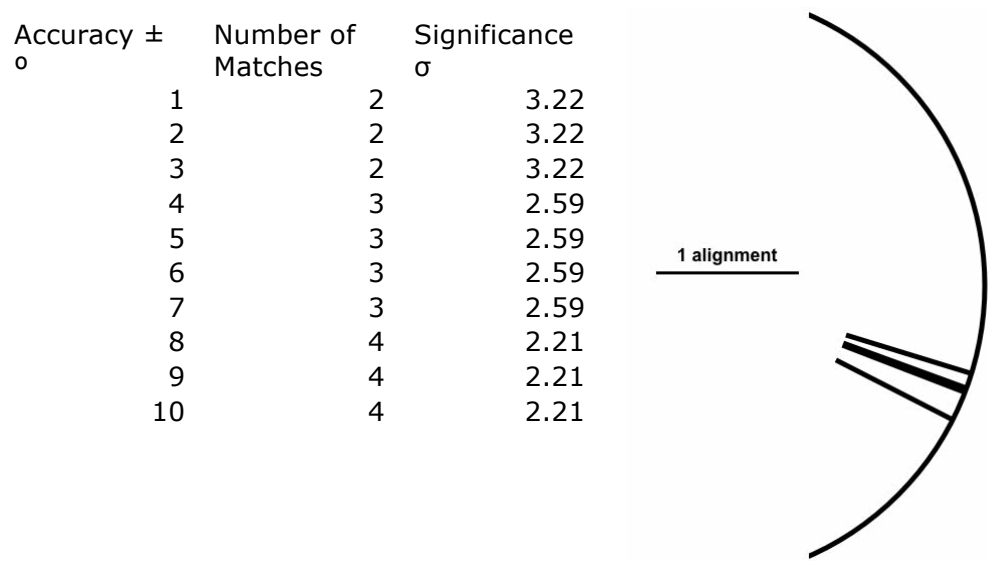
Accuracy \pm °	Number of Matches	Significance σ
0	2	4.37
1	6	2.36
2	9	1.82
3	17	1.09
4	20	0.91
5	25	0.66



The results are ambiguous. The azimuths are only significant at the highest accuracy, but the declinations are also significant to 1° error. Feasibly the temple sample could be significant if the someone were to insist that they were built with a high degree of skill and intent. The arguments above however would appear to contradict this. Why would Athena require a precise solar alignment? This problem may be resolved if it is acknowledged that this is not a homogenous sample.

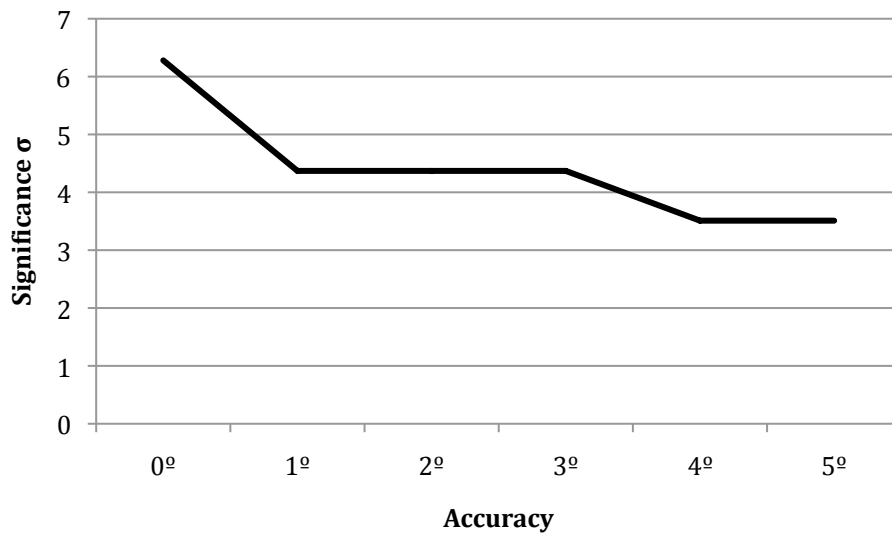
Most of the temples to Athena come from the Lindian colonies of Akragas, Gela and Camarina. Only two of the seven temples come from outside this lineage, the temples built by Gelo of Syracuse after his defeat of the Carthaginians at Himera. The temple he built at Himera is very explicitly built for the goddess for the victory being a temple of Athena Nike (see section 6.16). The temple at Syracuse is likewise intimately connected with this battle, and the historical record means that these temples can be analysed separately. With these temples removed the slightly smaller sample yields dramatically different results.

Azimuths



Declinations

Accuracy ± °	Number of Matches	Significance σ
0	1	6.28
1	2	4.37
2	2	4.37
3	2	4.37
4	3	3.51
5	3	3.51



These results are surprisingly emphatic. The azimuths are strongly significant up to an accuracy of 3° and remain significant even if we are sceptical of high-accuracy alignments. As for examination of the astronomical targets, the importance of the 0° result can be ignored as the significance exceeds 4 σ (about 1:15,000) to 3° and 3 σ to 6°. In fact, even if the declinations were only accurate to $\pm 8^\circ$ they would still be significant to 2.99 σ . The reason for this high degree of significance is that very few other temples point anywhere near to this direction. The exceptions are the most northerly temple of Heraclea Minoa, and the Naxos-X temple. What features do these temples have in common?

They all sit on the high ground. In the case of Gela the temples are aligned with the Acropolis. At Akragas the temple is on the Acropolis, but temples on the high southern ridge all avoid the south easterly alignment. At Camarina the temple is on the high ground, but in this instance the alignment is fractionally uphill, which would suggest the direction was considered important.

The temples were built by people who at the time of construction traced their ancestry back to Rhodes (see section 9.2). In the case of Akragas the temple was explicitly to Athena Lindioi, yet the foundation story traced this connection through Gela. It is therefore reasonable to consider that the colonists also considered themselves of Rhodian descent. The temples all date from the 6th and 5th centuries BC, not from the earliest periods of the colony. An exception might be Camarina, but it seems that even here the temple was built after the second foundation of the colony from Gela, some time before 450 BC (see section 6.10). This would have been a period of when the Greeks were acutely aware of the 'other'. In this instance however building the temples not only shows a Hellenic identity, but a very specific sub-identity. These temples are not generically Greek, but Rhodian.

At this point it would be impressive if I could reveal that the alignment of the temple of Athena at Lindos was also towards -18° declination. In fact this is not the case. It faces an azimuth of 32° (Dyggve, 1960, p. 135) or 37.5° or 216° (Liritzis & Vassiliou, 2003, p. 95), missing sunrise altogether in all cases. This alignment is of the later Hellenistic temple, which means that remains of an earlier temple with a closer alignment may lie in deeper layers, but it is extremely speculative to postulate that it could be 90° out of alignment. Therefore the alignment of the Sicilian temples cannot be explained by the ties to Lindos.

The analysis above shows there is something to explain, and the topography of the temples strongly suggests that something is an astronomical orientation. Yet the range around $-17^\circ \pm 4^\circ$ is not typically on the shopping list of astronomical targets in same way that archaeoastronomers look for solstices or equinoxes. The Sun would be around this declination mid-November or early February plus or minus a couple of weeks. This is consistent with a festival held in a lunar month centred around this period. This could be consistent with the Chalkeia, a festival to Athena Erigone,

goddess of the artisans (Simon, 1983, p. 38); however this requires some juggling of calendars.

Simon dates the Chalkeia to the last days of Pyanopsion in the Athenian Calendar. This is useful as this is also the month of the Thesmophoria. The timing of the month of Thesmophoria can be identified in the Rhodian calendar as there is a month Thesmophorion which is named after the festival. Cross-dating this month to the Athenian calendar is more problematic.

Trümper (Trümper, 1997, p. 178) suggests that Thesmophorion corresponds with the Athenian month of Boedromion which is the third month following the summer solstice. If this is correct then Thesmophorion could fall as early as 19 August – 17 September. This last day would be before the autumnal equinox which means the Sun would still be at a positive declination. With this correlation the last day of Thesmophorion would fall around 16 October at its latest. The Sun would still have only reached declination -9° , which would rule out the Chalkeia – if the Rhodian colonies held it in Thesmophorion. However, this correlation may not be certain.

Trümper (Trümper, 1997, p. 169) also lists Thesmophorion as the first of the Rhodian winter months. If Thesmophorion is the first month following the equinox then it can be moved later. While the equinox is a geometric concept and these temples were built before geometric astronomy it is *possible* that the heliacal rising of Spica served as an agricultural marker that was sufficiently close to the equinox (see section 15.3). This would give possible dates for the end of Thesmophorion between October 23 and November 21 in the Gregorian calendar, plus or minus a few days. The Sun in this period crosses from a declination of -12° to -20° . A further connection to the Chalkeia is found in the goddess celebrated, Athena Erigone. Erigone was, according

to one myth (Hyginus 2.4) catasterised as Virgo. The star Spica leads the rest of the constellation of Virgo over the horizon in the month following the autumnal equinox in this period. The temples of Athena would therefore be aligned to the sunrise when Erigone appeared in the pre-dawn sky looking over the rituals.

Even if the temples are aligned to the sunrise around the Chalkeia there remains the puzzle why. One tempting explanation is to look at the social contexts of the colonists. They are people who believe they come from a city with a strong connection to Athena on an island dominated by Etna, possibly one of the forges of Hephaistos. It is possible that the Chalkeia in the Lindian colonies was celebrated in a similar way to the Athenian Chalkeia in that Athena Erigone is almost a wife to Hephaistos in this festival. The festival could therefore be symbolic of a Greek identity beyond the homeland. This is problematic.

One reason is that Athena is only almost a wife. In myth she spurned Hephaistos's advances which hardly evokes a partnership between Greek and Native. Erigone also refers to death and strife. Though according to the Greek perspective the relationship with the natives in the 5th century BC was one of death and strife and so it is possible that the Chalkeia performed an annual ritual of reaffirming the divide between *them* and *us*.

A second objection would be to the gender of the goddess. Usually colonisation is portrayed as a masculine activity. The Massaliotes are said to have gained their women from the natives through diplomacy, (Pompeius Trogus ap. Justin, Hist Phil Epit, XLIII.3.4–12) the Tarentines through conquest (Strabo 6.3.2). A partnership between Athena and Hephaistos would put Athena in the subservient role in a highly patriarchal society. A strong Athena cannot be married. It could be argued

that the emphasis on Athena would demonstrate the Hellenicity of the colonists, but this is *post hoc* reasoning. It would be more likely that the Athena celebrated in the Lindian Chalkeia was Athena as goddess of artisans and Athena as a defender.

13.5 Deities reconsidered

The Athena sample would appear to support the contention that temples faced important feast days. The spread of azimuths within the range of the Lindian colonies for temples of Athena would indicate that the temples were aligned on days within lunar months rather than to specific solar targets. This would make sense, the months were the schedule of rituals, but it causes complications in analysing the alignment of other temples.

The reason it was possible to identify the Chalkeia as a potential target was that the Chalkeia sits in a space occupied by few other festivals. Events in before the solstice in June will leave the same trace as an event after the solstice in early July. Equinoctial alignments could be either autumnal or vernal. Further around the equinoxes the sun crosses a much greater range of the horizon, in the order of $\pm 10^\circ$, depending on the idiosyncrasies of the local horizon. This means traces of events will overlap each other requiring large numbers of temples in a sample. Statistically samples of three are too small to be able to distinguish these events and the lack of identifying evidence for many temples means this situation is unlikely to improve.

A possible way around this problem would be to widen the geographical scope. This would bring its own problems as it would assume a homogeneity of belief across the Greek Mediterranean and if the temples were from all time periods then there would have to be unity of belief across many centuries. Again, the Athena sample shows the importance of local identities and practices.

14. The Temples Statistically Considered

Statistical analysis of the temples has shown very effectively that there are astronomical aspects to the alignments of Greek temples that have to be explained. It has also showed that it is possible to analyse sub-samples and gain conclusions. The topographical analysis show that temple alignments can only be considered within their local landscape and that in some locations landscape can dictate the placing of temples.

What the analysis has failed to provide is a magic bullet which can pull out patterns hidden deeply in the data. This is not a fatal flaw in the technique. The questions ultimately being asked are historical and anthropological rather than statistical. The question “How are the temples used in a relationship with the sky?” will not have a numerical answer. Yet in providing cautionary results the analyses serve as a warning on the limits of interpretation of historical data. Alignments of temples remain to be analysed using the historical record, but in some cases such as the temples of Demeter the statistics show that such explanations have to demonstrate why a connection should be likely and also that such explanations must show an interaction with Greek society beyond specific annual events.

15. The Temples in Their Historical Context

It is not always possible, or even necessary to statistically evaluate the historical contexts of the temples. Indeed while questions about the distribution of their alignments may be statistical questions, many questions about their the temple are about their social and historical meaning which is qualitative rather than quantitative in nature. It also varies with time. The temples as they are presented today are exemplars of a classical ideal and inheritance. In earlier times they were strongholds of a pagan past that needed to be conquered. Earlier still they were building sites and parts of the mundane day-to-day life of the city in much the same way that modern cathedrals can be beautiful and sacred yet still accessible.

15.1 The Battle of Himera and its temples

Had Akragas or Syracuse produced the bulk of the surviving historical texts rather than Athens, it is possible that the battle of Himera would be fêted in a similar way to the battles of Thermopylae and Salamis. The battle of Himera is traditionally considered to be a victory of an allied Sicilian Greek army over a Punic force in 480 BC, the spoils of which funded the building of several temples. I would like to examine these temples in the context of the aftermath of the battle, but first it is necessary to establish when the battle was fought, and that is not so simple.

According to ancient sources the battle of Himera was fought on the same day as the battle of Thermopylae (Diod. 11.24.1) or Salamis (Herod. 7.166). This poses two distinct problems. One is that these two battles are around a month apart in time. The second is that the dating, particularly of Thermopylae is questionable as the eclipse used to date the battle by modern historians was not visible from Greece

(Smith pers. comm.).⁴⁷ The conclusion would therefore be that the historical sources are inaccurate and untrustworthy. Indeed, if we question foundation dates of colonies we should also expect to question the validity of other dates. Whatever the date of the battle it happened at least fifty years before the work of the earliest historians.

To bluntly say that the ancient historians were in error and move on is however unfair. History in this period was not merely a chronicle but also drew upon epic and drama and Feeney (2007, pp. 43-46, 51) argues that the battle of Himera could have had a very powerful dramatic purpose. The Persian war was, for mainland Greece, a matter of grave peril. It was also something of a golden age as it marked the last action of a unified Greece before the onset of the Peloponnesian War. This is a golden age that does not have a place for Sicilians. Feeney says that the dating of the battle of Himera was a way of the Sicilian Greeks staking a claim in fighting alongside the homeland. The story of the later fifth-century was that as the Greeks fought for their survival against the barbarian in the east, so too the Sicilians defended the Greeks against the barbarians in the west. Thus their absence is not a matter of regret, but in fact necessary and laudable.

Lest this be taken as rejecting the historical record entirely, there are good reasons to suppose that the battle of Himera took place close to one of these dates. Firstly, while histories were not being written at the time, Sicily had been integrated into the Greek world for decades by this period, even if we are sceptical about the Greek origins of the colonies. Not only do the Olympic records show this to be the case. Herodotus (5.42–46) suggests that the Spartan Dorieus was active in Sicily around 510 BC when

⁴⁷ Espenak shows that a partial annular eclipse might have been visible (<http://eclipse.gsfc.nasa.gov/5MCSEmap/-0499--0400/-479-10-02.gif>) but Greece was at the northern limit of visibility. The fractional of the solar disc obscured would be so small as to be unnoticeable.

he led an army against the Elymians and Phoenicians on the island (Herod. 5.42). This member of Spartan royalty is said to have received an oracle from Delphi granting sanction to build a colony in western Sicily. The failure to do so is blamed on Doreius' insistence on interfering in Italiote politics on the way to founding the colony (Herod. 5.45). If the story is accurate then his political and military ambitions, which ended in defeat in Western Sicily was probably a contributing factor to the Carthaginian invasion of the Greek region of the island.

Malkin (2003, p. 198) discusses the actions of Dorieus at great length and concludes that the tale of the oracle is an accurate reflection of late sixth-century occurrences rather than a later tale as he does not believe an unfulfilled prophecy would be a matter of later invention. I agree with Malkin that this is likely to be accurate but for different reasons. I see no reason why a failed oracle *per se* could not be invented. In this instance a failed oracle would both justify a Greek claim to disputed territories in the west, and blame Carthaginian aggression on the homeland Greeks rather than the Sicilians themselves. The Heraklid inheritance of the lands claimed for Sparta by the myth (Herod. 5.43) could also be used by Selinous which appeared to be closely associated with the demigod given the decoration of the metopes of Temple C (Martin, 1979, p. 12; Marconi C. , 1994). However, while I disagree with Malkin on this one point, his work strongly demonstrates the use of myth as a political tool in the late sixth-century and the myth of Dorieus should be seen in this context.

The vast bulk of the sample consists of temples built in the late sixth-century BC and later. If there is a construction of myths to justify connections with the homeland, this building boom would appear to be the material remains of this process. If this is the case then a myth constructed in the late sixth-century is unlikely to refer to contemporary characters. The actions of a person a century ago may be debatable, but it would be hard to blame Dorieus for Carthaginian dominance in the sixth-

century if he was elsewhere in the Mediterranean. Following increased integration with Greece the opportunities for inventions of the recent past would be limited, though fifth-century inventions regarding a more distant past would remain feasible. If Herodotus' account of Dorieus is reasonably accurate for the period around 510 BC, it would be problematic to reject a date of 480 BC as it falls just a generation after. Therefore I consider it likely that the battle of Himera was fought in the same year as the battles of Thermopylae and Salamis.

Yet while the year may be the same, the precise timing of the battle within that year remains open to question, especially given the contradictory dates given by Herodotus and Diodorus Siculus. However, the logistics of warfare would suggest that the late summer or early autumn would be the best time to fight. Much of the agricultural work has been done (Isager & Skysdgaard, 1995, pp. 161-170) yet the sea has yet to become too wild to safely cross. While the notion of the battle occurring on the very same day as one of the battles may seem unlikely, especially given the remoteness of Sicily from Greece, the battle could be expected to have occurred around the same time. Therefore it is worthwhile examining the temples and their construction in relation to the battle. The temples under consideration are:

- The temple of Athena Nike, Himera
- The Temple of Olympian Zeus, Akragas
- The Temple of Athena, Syracuse

These three temples can be dated and provenanced back to the victory over the Carthaginians. The temple of Athena Nike is the logical place to start. It was dedicated to Athena as the goddess of victory at Himera by Gelon of Syracuse who, with Theron of Akragas, led the Greek forces to victory over the Carthaginians who were led by Hamilcar. This latter point is noteworthy as Herodotus records a

Carthaginian tale that the battle took a whole day to fight and that Hamilcar spent his time looking for good omens in the sacrifices. Eventually with defeat imminent and no good omens Hamilcar himself jumped into the flames (Herod. 5.167). Whether or not this is true, and Herodotus is uncertain, the tale would suggest that the Carthaginians were not merely a defeated but crushed. This would be consistent with the victory funding the construction of so many temples, and a massive victory would also inspire a ruler eager to leave a monument to his triumph to dedicate a temple.

Here some speculation is inevitable. While the temple was dedicated after the battle, there is the question how soon after is *after*? If the battle had taken all day the very earliest a temple could be dedicated would be the day after the battle. Given the size of the battle it is likely that matters of administration would have been attended to, not least confirming the victory, delaying the foundation by another day or more. Once the decision of building a temple is made there then follows the actual process of building the temple.

The need to design, let alone build the temple rules out the building as a single neat event. In contrast the need to give thanks for a victory could be considered urgent. I shall consider the possibility that the temple was dedicated on a morning closely following the victory. The aggregate results would suggest that we should expect the temple should face within the arc of sunrise yet, as this is not a temple to a Lidian Athena, there is no a priori reason to assume that it would face a specific existing feast day. If a feast day were to be inaugurated for this temple and Greek temples faced sunrise on the feast days of their deities, it would be expected to face sunrise around the time of the victory. If the temple was built merely with an easterly intention in mind, the sunrise would be an accurate enough guide. In this instance it would still mean that the temple faced towards sunrise around the time of the battle.

For the temple of Athena Nike the orientation is 71° which faces a declination of $+15^{\circ}$. This faces sunrise on 16 August in the Gregorian calendar (see section 6.16).⁴⁸ Correlating this with events in mainland Greece is extremely difficult.

Sacks (1976) has surveyed the dates proposed for the battle of Thermopylae from July 31 by Labarbe (1959), August 29 (Dascalakis 1962:140-169, Hignett 1963:448-9 Xerxes' invasion of Greece) but finds both to be inconsistent with Herodotus and so dates the battle of Thermopylae to 19 September. He does not explicitly state that this is a Julian date (equivalent to 15 September in the Gregorian calendar) but his reference to a solar eclipse occurring on 2 October would show this is the case.

Unfortunately this eclipse was unlikely to be visible from Greece as it was only visible as a partial eclipse in this region (Mosshammer, 1981; Smith pers. comm.). The eclipse could have been missed as there is no noticeable light dimming until an eclipse is almost total. Stephenson and Clark (1978, p. 39) have argued that up to 98% of the sun could be obscured and pass unnoticed. Ginzel (1899, pp. 14, 175) is not so emphatic, but nonetheless argues that an unpredicted partial eclipse, when the sun is at it highest (the eclipse would have taken place around 13:30 local solar time for Greece) is unlikely to be seen. Contrary to this Mostert (1989) argues from a reading of Beke's 14th century work *Chronographia* that a partial eclipse could be observed during the day following a description of a horned sun around ten o'clock on August 15, 1300 (Julian calendar). The dating of the battles of Thermopylae and Salamis would seem to be an open question.

Therefore instead of correlating the temple of Athena Nike with distant events, I think it best to examine the temple in its Sicilian context. If this temple were founded

⁴⁸ 20 August in the Julian calendar.

to face sunrise in the days following the battle of Himera, we could expect the other post-Himera temples to face later dates in the year.

The temple of Olympian Zeus was built by Theron (Diodorus Siculus XI.26.2 , XIII.82.1-4) following the battle of Himera. The alignment is 80° and towards a declination of $+10^\circ$ (see section 6.2). This would be towards sunrise around 28 or 29 August.⁴⁹ As mentioned in the entry for Temple B, this would have coincided with a New Moon, the first after the battle. Himera is around 110 km from Akragas⁵⁰ which could plausibly be marched to in a week or less, or reached within a couple of days by horse. Therefore it is perfectly possible that this temple was dedicated upon the return of the victorious army.

The return to Syracuse would be somewhat longer, around 250 km by foot over central Sicily⁵¹ or a longer but almost certainly faster trip around the north shore and east coast. The Athenaion dedicated after the battle of Himera faces 92° and to a declination of -2° . This gives dates of 29 September (or 4 October in the Julian calendar). This is close to, but not exactly correspondent with, the date given by Herodotus for the battle of Salamis according to Sacks (1976, p. 232). It would also follow the date given for the eclipse which, while not visible from Syracuse, would

⁴⁹ 1 or 2 September in the Julian calendar.

⁵⁰ From Google Maps:

<http://maps.google.com/maps?f=d&saddr=37.970599,13.824631&daddr=agrigento&hl=en&geocode=&mra=dme&mrcr=0&mrs=0&sz=17&dirflg=w&sll=37.969762,13.821841&sspn=0.004423,0.006909&ie=UTF8&ll=37.971246,13.82336&spn=0.002212,0.003455&t=h&z=18>

⁵¹ From Google Maps:

<http://maps.google.com/maps?f=d&saddr=Unknown+road&daddr=37.779399,14.436035+to:syracuse&hl=en&geocode=FbRiQwIdEvLSAA%3B%3B&mra=dme&mrcr=0&mrs=1&sz=7&via=1&dirflg=w&sll=38.822591,16.380615&sspn=4.475868,7.075195&ie=UTF8&ll=38.873929,16.149902&spn=4.472642,7.075195&t=h&z=7>

have marked the New Moon. 4 October would feasibly be the night of the first sighting of the New Moon.

The dates given by the temples are consistent with a returning victor laying out the alignment of a temple in the immediate aftermath of the battle of Himera. In this instance it would also suggest that while the matter of orientation, the alignment to the east, was important - the actual position of east was sufficiently vague that anywhere where the Sun rose could be considered east, rather than an adherence to a cardinal direction. Of interest is the correlation of two of the foundations with New Moons, and the temple of Athena Nike at Himera can be explained by its dedication following the battle without great violence to the notion that temples would typically be laid out at the start of a month. As a note of caution this is based on a sample of two and had the temples been laid out to coincide with a Full Moon then it would be possible to argue for a correlation there too. The evidence of the post-Himera temples would be that, in contrast to the Lindian Athena temples (see section 9.2) there is no attempt at high-precision astronomy.

15.2 The case of Hekate

Another case that defies statistical explanation is the Hekataion on the Gaggera hill to the west of Selinous. It is the sole Greek Sicilian temple in the sample which does not face to the east for any description of east. It forms a relatively minor part of the Demeter Malophoros complex and without further information it could be dismissed as being too unusual to fit in with the wider plan. On the contrary I shall argue that this alignment is intentional and is indicative of the area's existence as a continuation of native ritual practice.

The sanctuary of Demeter Malophoros at Selinous sits in a distinctive part of the landscape which has clearly been the focus of ritual since before the foundation of the temple in the late sixth-century BC due to offerings of figurines in earlier strata (Gabrici 1927:52). This may involve a more literal reading of the flight of Daedalus than I would like, but it does strongly indicate continuity of worship and settlement which is also hinted at by Dominguez (2006, p. 232).

As well as being a native site, it also appears to be a distinctive site in terms of design. The temples on the Gaggera hill are not included in Spawforth's (2006) recent book *The Complete Greek Temples* despite being temples thought to be built by Greeks. The reason for the omission is the book is a compilation of *colonnaded* temples. The temples on the Acropolis and Marinella hills are colonnaded, and so appear in the book. The temples in the sanctuary of Demeter Malophoros are not colonnaded and so are different both in location and architecture. While the temples on the acropolis and Marinella hill are part of the same overall grid plan, the temples of the Gaggera hill sit in their own region with their own orientations, despite being closer to the Acropolis.

The sanctuary is on the opposite side of the river Selinous from the Acropolis. The river valley is verdant in the summer though the river itself skulks low in the bottom of the valley. Following rains the river would form a much more formidable barrier between the city and the sanctuary. The sanctuary is found a little walk along from the sea on the right bank of the river where the hillside pulls away from the river. Unlike the temples on the Marinella hill there seems little inter-visibility with the acropolis. Far from being on top of the hill, the sanctuary is built into the side of the hill. Whilst the colonnaded temples are beneath the heavens, the impression of the Demeter sanctuary is that it looks more towards the earth. This is likely to be intentional.

Demeter herself could be seen as either a chthonic or celestial god. She is connected with the fertility of the earth, which certainly would appear to be a strong connection with the underworld, yet she is also associated with Parthenos the constellation now known as Virgo. The epithet of Demeter here, Malophoros, in contrast is almost certainly chthonic meaning something equivalent to apple, fruit or pomegranate-bearer (Markale, 1999, p. 215). In this last form she would be connected with the myth of Persephone eating a pomegranate seed to ensure her return to the earth.

De Polignac (1995, p. 113) sees the sanctuary as an 'archetype' of a periurban sanctuary. The division of the sanctuary from the city by the river marks a firm division between the city and the sanctuary that is emphatically outside the city. He also uses the sanctuary of Demeter at Bitalemi, outside Gela as another example of intentional division from the city which he argues allows both connection with and exclusion from the community. It is certainly a provocative idea, but it relies upon an opposition between Greek and Indigène. He comments that Malophoros "...was a Demeter suspected of 'Sicilianism'" (De Polignac, 1995, p. 111). While I can accept the origins of the cult may have been recognised as native I find his reconstruction of ritual activities both thought-provoking and speculative. He paints a picture of a site for Greek festivals conducted by largely native women. In this instance it is far from certain that the ethnicity of the settlers was strongly divided along gender grounds. Further, when the temples were set in stone there would have been generations of settlers on site. Certainly genealogies would have been important to people, but the later stone forms of the temples would have been built for the use of the later inhabitants rather than the first colonists of a century or more earlier.

Further while Malophoros may be a Sicilian deity, her companion on the site Zeus Melikhios is extremely well known to homeland Greeks. In his form as Melikhios,

Zeus is not a sky god, but rather a chthonic god. He is known in this context as being associated with Demeter; Melikhios or kindly Zeus revealed the location of her daughter in the underworld (Cosmopoulos, 2004, p. 221). This may be a hellenised form of a native deity, but in name he seems to be as Greek as the gods in the homeland. The architecture of the sanctuary is also, surprisingly, an exemplar of Greek architecture. Ito (2002, p. 60) notes that the sanctuary is one of the earliest example of the use of axuality in Greek planning. This combined with the early grid plan of the city raises a question; what is native and what is Greek?

De Polignac sees the sanctuary at of Demeter at Selinous as evidence of a bipolar identity for Greek Sicilian cities, having both native and Greek faces. This may be the case, but it may also be a case of over-interpretation. He sees the sanctuary as being deliberately aligned to face the city on the Manuzza hill. In contrast I see a temple orientated to be built into the local slope. Both interpretations may be correct, the temple could have been built at that site because it was where building into the slope would have allowed the axis of the sanctuary to face the city. However, any other orientation could be rationalised in a *post hoc* manner. Nonetheless his argument that the sanctuary is in opposition to something is powerful and could be explored further.

The final temple, the Hekataion, is the biggest puzzle of all. It is the one temple in the sample which faces west. Indeed it could be the mascot for de Polignac's argument of opposition being extremely opposite to the other temples. Even the temple alignment is problematic. It is quoted as facing 338° and a declination of 47° degrees. This is highly debatable. The reason I have recorded these figures is that this is the orientation of the long side of the temple from the back to the front. Yet there is no opening to the front. Instead there is an entrance in the left wall at the far end of the wall from the back. It is as if the axis of alignment is bent 90° anti-clockwise just

before leaving the temple. This challenges some basic assumptions about the meaning of a temple alignment.

In the case of the other temples it is assumed there is a meaningful axis which runs through the cella, out through the pronaos into the landscape and vice versa. Hence this axis connects what lies within the temple with the landscape or sky beyond. The most obvious example is that, if the doors are open, the light of the sun can penetrate into the cella. In the case of the Hekataion this cannot be the case. What would be visible from the back of the temple would be the front of the temple being lit by the fading embers of the setting sun, whilst the back of the temple would remain in perpetual gloom. This may be connected to the mythological nature of Hekate.

Hekate is a lunar goddess. She is possibly an anachronism according to Marquardt (Marquardt, 1981, p. 245) who makes a great deal of her association with the Titans rather than the Olympian gods as being symbolic of her primacy. Her origins are found in Anatolia according to Gimbutas (Gimbutas, 1982, pp. 196-200) and Burkert (Burkert, 1977, p. 171), the latter basing his opinion on the etymology of the name. She takes an important part in the Homeric Hymn to Demeter, being the one goddess who helps Demeter in her search for her daughter, Nagy's translation of the *Hymn to Demeter* describes Hekate as 'the one with splendid headband' (*HH Demeter* 438). This is a reference to the appearance of the crescent moon in its thinnest early or late phases.

The hymn provides fertile ground for those looking for further lunar metaphors. In line 440 of the hymn, Hekate becomes Persephone's 'substitute queen' (Nagy, 2000). Baring and Cashford (1991, pp. 364-390) also comment at length on the lunar origin of the myth. Cashford (2003, p. 244) adds that Persephone translates as 'she who

shines in the dark', and that Hekate as a tripartite goddess would exist in three phases, waxing, waning and dark (Cashford, 2003, p. 129). This would associate Persephone with the visible phases of the moon and Hekate as the period around the New Moon.

Further, the hymn refers to Hekate as living in a cave (line 25). This is an interesting parallel with the poor illumination of the Hekataion. Despite being a goddess of the dark illumination is a problem and on lines 52 and 61-62 Hekate and Demeter are described as holding torches ablaze in the search for Persephone. De Polignac (1995, p. 112) notes the many lamps found in the sanctuary recorded by Dewailly (1992, p. 153), but attributes these to nocturnal rituals. This is possible, but given the dark nature of the Hekataion, it could also be tied to early mythology. In this case the sanctuary would be emphatically chthonic and closely tied to the tale of the abduction of Persephone. Yet this could also simply be the result of an architectural accident. Without further evidence this is all speculation and little can be said beyond that Hekate would appear to be another Greek import.

There is fortunately further evidence, but not from a Greek or Near Eastern source. The Hekataion does have another possible parallel. The Tempio di Diana at Cefalù is a close match for the Hekataion. The temple shares a similar plan to the Hekataion in that there is no clear axis of alignment through the entrance. As at the Hekataion the entrance is, viewed from the back of the temple, at the far end on the left. An exit to the right would not have been practical as, even more so than the temple at Selinous, it is built into the side of a hill. Like the Hekataion the temple is not facing towards sunrise. In fact it faces due north as close as can be measured, meaning that the entrance itself faces 270°. This measurement has been confirmed by examining the temple via Google Earth at the location N38°01'19,32" and E14°01'30.36". This was necessary as Aveni and Romano (2000, p. S54) record a radically different azimuth of

84° facing a declination of +21°. Given the strong correlation between their results and my own elsewhere this has been a matter of some concern. I therefore propose that they have measured another building instead, or possibly the Byzantine fortifications.

The Tempio di Diana was published by Marconi (1929b) whose work mainly describes the architecture. He dates the temple to the fifth-century BC on the basis of brickwork in the doorways (1929b, p. 289), but also mentions the may date as late as the start of the fourth-century. The building as a whole may yet date from the sixth-century (1929b, p. 291), over possibly older levels from the ninth or eighth-centuries, which would be the basis for Aveni and Romano's date. Given the remains of the doorway are listed as fifth-century, this is the date I have adopted, though as it temple is not in the heart of this survey, the possible error on the date would be of little consequence.

A temple of Diana may not immediately seem to be a good correlate for a temple of Hekate. Whether or not this attribution is defensible is hard to say. Marconi (1929b, p. 295) finds no evidence in the archaeology to support an attribution to Diana, and instead draws parallels with the rupestral temple of Demeter at Akragas. This would be more suitable given the context of the Selinous sample. Yet even if the temple is to Diana, the different names may be closer to a difference in epithets rather than a fundamental difference between the deities. Cashford (2003, p. 127) uses examples from the Iliad and Odyssey to show that in early Greece Hekate and Artemis were dual aspects of the moon a view shared by Gimbutas (1982, p. 197). This would therefore appear to be a suitable correlate for the Hekataion - except this is not a Greek temple. Cefalù is traditionally interpreted as a Sikel site, not a colony.

The similarities in alignment despite the differing underlying topography suggest that the directionality of the temples is important. Both have their exits facing west on the north side of the temple. Yet while this faces downhill in the case of the Tempio di Diana at Cefalù, it is facing uphill at Selinous, which would suggest that precise observation of the sky was not the primary concern. If it was we would expect to see the Hekataion higher up the hill, or even with the exit out facing downhill. It would appear that the Hekataion can only be understood in its wider context. This means examining the connections between the ritual and the agricultural year.

15.3 The Greek Calendar

It is a common opening for any history of astronomy that it must be the oldest science as people would need to have a calendar in order to plant crops and perform other agricultural activities. This shows that gardening is probably not a popular hobby amongst astronomers. Any attempt to grow crops by adhering to a calendar will fail after the bout of unseasonal weather. While the agricultural year is cyclical in the long term, the procession of one year to another can vary greatly with long winters, droughts or heatwaves. The most successful farmers would be those who can adapt their schedules to whatever the current conditions are. As Hannah (Hannah, 2005, pp. 5-7) recognises calendars are necessary but for social functions, one of which may be agriculture. This does not mean there is a need for accuracy.

An example is the case of the Mursi, a modern people living by the Omo in southwestern Ethiopia, the calendar seems to be a perpetual argument where no one is willing to say with certainty which month it is, let alone which day it might be (Turton & Ruggles, 1978; Ruggles & Turton, 2005). Nonetheless the agriculture, based on sorghum, requires precise timing in terms of planting in relation to the

flooding of the Omo. The fact that they can do this shows that accuracy in a calendar may be desirable, but it is not a *sine qua non* of agriculture.

This is relevant to discussion of the Greek calendar as the uncertainty of the calendar is under-appreciated. It is common to see Greek months equated with Gregorian or Julian months as though there was a simple correlation. This requires an anachronistic application of Hellenistic and later astronomy into the archaic period, and also ignores the fact that uncertainty and inaccuracy were built into the Greek calendar.

The Greek calendar was lunisolar (Thomson, 1943, p. 52; Hannah, 2005, p. 12), which means that a solar year was divided into subdivisions of synodic lunar months, the period between one new moon. This is the cause of the uncertainty. The synodic period is around twenty-nine and a half days. This means that twelve months pass in three hundred and fifty four days. Given there are three hundred sixty-five and a quarter days in the year, a twelve-month year would consistently end eleven days too soon (see Hannah 2005:14-15). If the year consistently lasted thirteen months then the year would last too long. The existence of seasonal events, such as the Thesmophoria, show that there were methods to calibrate the lunar year against the tropical year. However no contemporary historical records exist to say what it was.

The question of calibration is a contested, if slow-burning battleground which has smouldered for the best part of a century. Pritchett (Pritchett, 2001) recently published a rejoinder to Meritt's work on the Athenian Calendar, much of which argued against Meritt's 1961 book *The Athenian Year* and his paper 'Athenian Calendar Problems' in *The Transactions and Proceedings of the American Philological Association* from 1964. Pritchett argues convincingly against Meritt's

claims that the Athenian calendar worked on a regular cycle of alternating months of twenty-nine and thirty-days with intercalary months inserted into the year on predictable basis. The fact that he has done so almost half a century later would indicate that the field is not a popular one with classicists. It also demonstrates the sheer paucity of discussion of the archaic calendar. Apart from Hannah (Hannah, 2005, pp. 16-41) the early Greek calendar is not tackled in the secondary literature and Hannah's own work is, by necessity, reliant on much later sources. If I hope to place the use of temples in their religious context I must attempt to deduce some features of the early Greek calendar.

I do not believe that much discussion of Greek astronomy would be helpful in reconstructing the archaic calendar. While there is plenty of rigorous work done on the Metonic cycle, the astronomy of Eudoxos and, later, Hipparchos in generating high-precision models of the world I do not find them relevant. None of these individuals was alive in the late sixth-century when the major phase of temple construction was under way. Despite this some later works are of use.

In particular the *Phaenomena* by Aratos of Soli is a useful guide to the Greek sky. It should be used with caution, it is feasible that some of the constellations described are later inventions, or possibly described slightly differently from his place in the eastern Mediterranean than a Sicilian would have chosen to depict them. It is also important to remember that Aratos was working for the Hellenistic king Antigonos Gonatas (Kidd, 1997, p. 4) (Kidd 1997:4). The work was to glorify him and so while Kidd (1997, pp. 8, 13) notes its relationship to the Hesiodic genre and says that the poem was limited to estimating the time of year or time of night, it could well be a lot more comprehensive than the typical range of constellations used by the average Greek. So long as a few key stars or constellations are visible it is not necessary to know the positions of all stars to estimate the time. At the same time the astronomy

of Aratos must have been recognisable in form to the people the poem was written to impress.

Aratos uses the observation of the rising and setting of stars and in doing so follows a tradition from the around the seventh-century described by Hesiod who also uses risings and settings to describe times of year, if from a somewhat smaller range of constellations. Hesiod also described the lunar month giving the correct days for performing certain tasks. Unfortunately Hesiod does not give exactly details of how it was known that it was time for a new month. Aratos (733-735) uses the first sighting of the New Moon to signal the new month. Given the correlation of Aratos' method of observing the stars with Hesiod, it is plausible that here too he is in concordance with astronomical practice in Hesiod's time. If this is the case then the length of the month becomes a very simple task to determine.

Because the moon shines with reflected light, the actual new moon is impossible to see with the naked eye, being the time when none of it is lit. Amateur astronomers consider observing the new moon within its first twenty-four hours as impossible and within the first thirty-six as an achievement. In this case the first sighting of the new moon would be as a silver fingernail low in the western sky around sunset. This is significant as Bolling (1902) has compared statements by Varro with an analysis of the *Iliad* and *Odyssey* to show the Greek day started with sunset. Thus the act of watching the new day begin would also be an opportunity to observe if it was also the start of a new month. Yet it may not be that simple.

Observing a new moon can be difficult at the best of times, given the age of the moon in the lunar cycle. This can be made impossible by the presence of clouds. Persistent cloud is entirely likely in winter months and so would raise the question of how the

starts of these months were determined. Rigid adherence to astronomical observation would not be an option if a city were planning to hold a festival late in the month. The cycle of twenty-nine or thirty days would be well-known and could be estimated in the absence of observation. I contend that the observation would only be of importance after at least one missed observation as a calibrating factor. Given the political power which can be wielded in the absence of any authority from nature, it would seem reasonable to assume that people would step in to say what they thought should occur. Archaeological evidence for this can be found in Athens with inscriptions giving two dates, one by the civic calendar and one 'ton theoi' or by the goddess (McCluskey, 2000, p. 18). If the start of months can be regulated by astronomical observation then can the start of years be calibrated the same way too?

The Works and Days of Hesiod is not an example of this, though it does provide the means for calibrating a lunisolar calendar. Hesiod's text is not a calendar but an agricultural manual. In it he provides a variety of signs for various agricultural activities, some astronomical and some biological. It is the lack of calendrical references that made that text so useful, as each city had its own calendar with its own political and religious connotations. By omitting these Hesiod produced a guide which could be applied anywhere in the earliest period of the Greek colonies. Therefore it would seem reasonable to look for an event that could be observed to indicate when the year is to start.

Traditionally the events used are the solstice and the equinox. Thomson (1943, p. 53) states that the calendars of various cities started with the solstices or the equinoxes. Hannah (2005, p. 43) states that the Athenian calendar started with the first new moon after the summer solstice. At least one of these statements is anachronistic. Certainly it seems likely that many calendars started in the autumn, but I question

the plausibility of an archaic calendar starting after the equinox. The reason is that at the day of equinox spectacular astronomical events conspicuously fail to happen.

First it would be helpful to clarify what it is we mean by 'equinox'. Ruggles (1997) has provided a variety of definitions such as night and day of equal length, or the sun rising due east and setting due west, or the crossing of the celestial equator by the sun, and found them to be features associated with Greek mathematical astronomy and cautions against their use in contexts outside of Greek culture. Generally the equinox could make sense as being the point midway between the solstices, but this too is problematic. Ptolemy (*Almagest* III.1) and Diodorus Siculus (XII.36.2) credit Meton with observing the solstice in 432 BC. If this is the case then while the length of the year would be roughly known, it would have been unlikely that the equinox was being observed. More plausible solutions would be to observe the solstice and count on three months, or else observe a stellar event and start the year following that.

I would also discount the solstice as an observational point for a year that starts with the equinox as this too could be an anachronism. In modern times the solstice is the time when the Sun reaches its most extreme northerly or southerly declination. As such it can be timed to the second and can certainly be said to happen on a specific day. In contrast the name is derived from *sol sistere* for 'the Sun to stand still'. This is a period of perhaps two weeks or more where, unless you observe very closely, the Sun appears to rise and set in the same position. This vagueness of time would suit a calendar that starts with the solstice extremely well because there would probably be a new moon which occurred during the solstice period. For this reason I would argue that Hannah's definition of the start of the Athenian year is too precise. However this uncertainty of time would make it an odd choice for measuring the equinox from. If the equinox is an uncertain point in time it would make more sense to measure it

from a more certain point rather than an equally uncertain date. Therefore I would suggest that it is fruitful to examine what happens at the start of a year for a colony that measures its years from the autumn. The answer lies, I believe, with Demeter.

The cult of Demeter or Demeter and Kore is found across Sicily (Hinz, 1988), to the extent that this is likely to be a native cult which has been Hellenised. This would be consistent with the apparent hellenisation of the lunar cult at Selinous in the Malophoros complex (see section 6.28). There is also a long and widespread tradition of Demeter festivals in the Greek homeland (Brumfield, 1981; Pratt, 2000) which would indicate that any native festivals to a fertility goddess would be prime targets for syncretism. Demeter also provided the Greeks with one festival in particular of great importance, the Thesmophoria.

The Thesmophoria was a feminine festival to Demeter held shortly before the autumn ploughing. While there was no single harvest festival in Greece, the Thesmophoria was effectively the mark of the end of one agricultural year and the start of the next. In addition evidence from Sicilian calendars makes clear that Thesmophorion or Malaphorios, was the start of the year (Trümper, 1997, p. 169). The connection between the social activity of the New Year and the agricultural imperatives driven by Nature, which was uninterested in political activity, mean that this festival would have had to be held at the right time, and so evidence of calibration would be important.

The morning sky in this period is one of the richest collections of seasonal constellations in the heavens. The dominant constellations are Boötes, the Ploughman, and Parthenos, the modern constellation of Virgo, which Aratos (135-6) records as being close together. Virgo herself gets a large number of lines for the

description, describing her as Dike. Aratus tells the tale of her departure from the earth during the age of Bronze. Hesiod (WD 901-902) discusses the origin of Dike in the same lines as Eunomia and the Horae and Eirene. The connection of Dike as justice with Eunomia as order and Eirene as peace is obvious, but the Horae would seem to be out of place. This would not be the case if the departure of Dike was seen as a calendrical event marking the end of the year, making her the last to leave men on an annual basis. Spica would have heliacally set around 1 September in the Julian calendar (26 August Gregorian) in the late sixth-century BC. Whether or not this was a keenly-observed event is debatable. Fantuzzi and Hunter (2004, p. 241)(2004:241) argue that Aratus may have misread Hesiod turning someone who watched from heaven into a star. In this case watching for the heliacal setting of Spica would be anachronistic.

However, there is circumstantial evidence that this was a calendrically significant region of the sky as Aratus describes two specific stars associated with Virgo: Spica (Aratos 97) and another star Protrygeter (138-140) that Kidd (1997, p. 83) translates as the 'Vintager'. Ridpath (1988, pp. 2-3) states that Aratus names just six individual stars, of which one, Procyon forms its own constellation (Aratus 450, 595, 690). The other stars are Arcturus (Aratus 95, 405-7, 609, 745), Capella (Aratus 157, 718) and Sirius (Aratus 332-337, 342, 352, 503, 595, 603, 676). The value of a star as opposed to a constellation as a calendrical marker is that the appearance of a star is an event, rather than a process which could take days or weeks, as for a constellation.

Spica rises around 25 September 25 (20 September in the Gregorian calendar), give or take a few days. Protrygeter would have risen around 8-11 September (September 1-3 in the Gregorian calendar). If the presence of the wheatsheaf of Demeter in the form of Spica in the sky was necessary for the Thesmophoria then the disappearance of Spica in the evening or the rising of Protrygeter could be a suitable calibration

point for the New Year. If the year started with the first New Moon after one of these events then the Thesmophoria would either be held under the first shining of Spica or, in rare cases, it may have been rising during the festival. It would have been pleasing if the time between the Stenia, a preparatory festival for the Thesmophoria (Parke, 1977, p. 88), and the Thesmophoria itself was similar to the time between the risings of Protrygeter and Spica. Sadly this is not the case as the Stenia was held just two days before the Thesmophoria (Mikalson, 1975, p. 71).

In terms of archaeological correlates there appear to be none of note. Orsi (1906, p. 547=730) records the ruins of a site dedicated to Antiphemus in the sanctuary of Bitalemi, which was sacred to Demeter and Kore. This attribution is based on offerings, including figurines of a woman with children. The Antiphemus in question is almost certainly the proposed oikist of Gela. Thucydides (VII.152.2) tells us that the priests claimed to have been descended from him and that this was specifically a right of the descendants of Antiphemus. The site was probably active from the earliest times with at least one building on site dated back to the start of the sixth-century BC (Holloway, 1971, p. 79).

Orlandini (1968-69) records many pig bones both at Bitalemi and Helorus, where whole vessels can also be found in deposits. Kron (1992, pp. 643-644) records whole pots as being deposited in the sanctuary, which is different from the usual collection of pot sherds. Bookidis et al. (1999, pp. 43-44) show that pigs, especially as piglets, are a common feature of the Thesmophorion, so this would appear to be a panhellenic tradition performed in a specifically Sicilian way. This should be little surprise. Scheidel (1995, p. 216 n41) regards the offerings such as weaving weights as symbolic of women's work. The relatively few agricultural tools such as Kron's (1992, p. 638) record of the hoes deposited are seen as indicative of women working vegetable beds (Scheidel, 1996, p. 9 n3). Scheidel discounts the ploughshares found

as purely symbolic, but they would suggest that the event was associated with ploughing. It could be seen as being connected with the return of Arcturus, who signalled the start of ploughing, but this is pure speculation.

Most confusing of all is the proposal by Evans (2002) that altars may have had no part in the worship of Demeter at Eleusis, which would raise the question of whether they were required anywhere else. She argues (2002, pp. 249-250) that there would be no single form of the ritual. This would seem likely for a festival dominated by women, who would have rarely travelled to see how other women performed the same festival. If many of the women were also ethnically native then this would further increase the likelihood of the Thesmophoria, as practised in Sicily, of being an event with local variation. This sceptical approach to the sources is reflected in more recent work on the Thesmophoria. Pratt (2000, pp. 56-57) states that the unknown authorship of the *Homeric Hymn to Demeter* means that little can be inferred as to the role of women in the Demeter cult. A male author would have had a very different view of a feminine cult than a female author. This frustrating ambiguity of evidence is typical of the protohistoric period and so beyond the fact that the Thesmophoria happened in the autumn and that it involved lamps and pigs, there is little we can conclusively say about the event.

The strongest evidence to support the possibility of a stellar marker for the Thesmophoria, besides the implausibility of the equinox being observed, is a similar marker proposed for the festival of Apollo Delphinios. It has been argued by Salt and Boutsikas (2005) that the relatively faint stars of Delphinus could have acted as a marker for the festival to Apollo Delphinios. The heliacal rising of the stars in the constellation correlates with the two known Delphinios events at Athens and Olous, but not with the event at Delphi during Bysios which is one month after the expected date. The argument of Salt and Boutsikas (2005) rests upon the local horizon delaying

the heliacal rising of Delphinus by one lunar month. If a similar horizon effect could be found and correlated with the year in Sicily then this would lend more weight to the notion of a stellar signal for the Thesmophoria. As it happens there is no such horizon, which is consistent with the lack of unusual dates for Thesmophorion months in Sicily, but does seem somewhat of an argument from silence.

16. What do the temples indicate about Sikeliote cosmology?

Frustratingly little.

There are some positive findings that emerge from the evidence. There is definitely a preference for orientations to the east. This is found in both the Sicilian and Greek data sets and would therefore suggest that the idea of explicit orientation is a factor in the practice of Greek religion. The stronger result for the Sicilian sample set requires some explanation and this can be found by extending notions already used to explain Sicilian architecture. In particular it is noted that the temples of the colonies are built to a slightly larger scale than their counterparts in the homeland. This is particularly seen in Temple E at Selinous and the Temple B at Akragas. If these are temples built to impress how could we expect these people to adopt orientation?

In the Greek homeland there is a preference, but this is not uniform. There are well-known examples of temples that simply do not fit any pre-conceived ideas of how a temple should be laid out. The most famous example is the temple of Apollo at Bassae. This faces north, with its back resolutely turned to the Sun. Why should the homeland Greeks be less assiduous in orientating their temples?

One reason would be historical inertia. The east-facing colonnaded temple is a classical ideal. The Doric order is identified first in the seventh-century BC at Thermon (Watkin, 2005, pp. 25-31), ironically another temple which does not face

east (Liritzis & Vassiliou, 2006). It may not have fully formed in style until the building of the temple of Artemis at Garitsa, Corfu (Watkin, 2005, p. 26). The use of religious sites would however have long preceded the architectural form of the building and may even, as in the case of Thermon, had pre-Hellenic antecedents. Temples built in Greece were not built onto a pristine landscape, but one that already had centuries of meanings embedded within it reaching back into the Bronze Age. While the buildings may be classical, the social context of a Greek temple would be a lot deeper. In contrast if the Sicilian colonies were founded by Greeks in what were – for them if not the natives – new territories then the new sites would not have the historical baggage of the homeland cities. Each temple would be erected in light of the religious practice since the foundation of the city. There would therefore be comparatively little reason to not face east.

We can also firmly discount some ideas about the cosmology of the temples. For example it is highly unlikely that temples faced the feast day of their deity. The discussion of the Greek calendar strongly suggests that if this were so then we should expect to find that temples of Demeter pointed to significant points on the horizon. While there are some temples which do face in the right direction such as Selinous and Akragas, the presence of other temples such as those at Helorus which do not face in the right direction would seem to negate this argument. The statistical analysis shows that there is nothing distinctive about the orientations of temples of Demeter that could not be explained by chance. In the absence of any evidence we have no reason to accept this proposal.

Further the analysis of temples built after the battle of Himera shows that there is a plausible low-precision method for explaining the orientations. These temples face east, if east is simply defined as the direction of sunrise on the day they are likely to have been laid out. The cluster of temple alignments towards east could be explained

by the approximate nature of the alignment, or temples being laid out in spring before the work of the summer began or in autumn once the economic surplus is known. This would account for the astronomical features of the samples without requiring the invention of undocumented rituals or procedures.

The only counter-evidence to this is the analysis of the temples to Athena at the Lindian colonies. The distinctiveness of these samples is large, in excess of 3σ or 4σ if the declination targets are examined. Even allowing for 3° error, the results are significant to 4.37σ or in excess of 1:80,000. This surely would suggest some evidence of a highly significant and precise form of astronomy in the temples? At this point it is helpful to consult Schaefer's argument on the value of statistics. He has made the somewhat surreal claim that, "Working scientists know that half of all 3-sigma claims turn out to be wrong." (Schaefer, 2006a, p. 29) That statement means that one hundred to one chances crop up fifty per cent of the time. The question therefore is how significant is significant?

I would reject Schaefer's 3σ minimum for many of these tests. The reason is that Schaefer is referring to astronomical data. In each of the sample tests the data are not purely astronomical. The samples are also selected on historical and cultural grounds. Nonetheless Schaefer's statement does cause problems for the claims at the Lindian colonies, when you examine why Schaefer believes half of 3-sigma claims are false. He refers to the number of trials where the best result is taken and the rest ignored. Effectively large swathes of data that do not fit the claim are ignored. Reluctantly, I believe that the same may be true of the analysis of the Lindian colonies, when we examine the comparable tests.

The number of attested deities is limited, but apart from the temples with the Lindian colonies there are no similar samples that show a distinctive range of alignments. In the other cases it may be the sample size is simply small, but nevertheless within the limits of the test this is a negative result. Therefore it would be quite reasonable to conclude that the negative results are being ignored for the one positive result that turned up, and that with so many tests at least one good result should be expected by chance.

Other relevant tests are the local topographic analyses. In the case of Akragas it is mildly significant (see section 8.1), but Gela is less so (see section 8.6). Camarina has just the one temple and so it is too small a sample size to consider. Yet when the cities are collated into one sample they become more distinctive as a unit. This does indicate they share more with each other than they do with the Sicilian sample set as a whole. This, along with the ethnographic information that, at least at Akragas, there was a conscious attempt to connect with Greeks in the homeland, is suggestive of a possible inherited cosmology at the sites. The spanner in the works is that the cosmology was not inherited from Lindos where the temple of Athena faces to the north-east.

In this case I think the explicit statement of what a post-positivist interdisciplinary method would entail is useful. Ultimately which interpretation requires more invention as a whole? Chance or Intention? Chance requires dismissing the historical record and the statistical analysis. Intention on the other hand requires either inventing a new hitherto unknown temple beneath the Hellenistic temple on Lindos or rejecting an obvious test of the hypothesis as it gives an inconvenient result. Neither seems an attractive option, so I shall choose a third.

I think that the similarity of alignments in temples of Athena at Gela, Akragas and Camarina is indicative of a perception of a shared origin among the three cities. Whether or not that origin is real and can be traced back to Rhodes is unknown, but it would seem to have been believed in the fifth-century BC. To determine if this interpretation is correct it is necessary to examine the wider social context of colonisation.

17. The social context of Greek colonisation

I have already laid out the traditional approaches to Greek colonisation, but now I would like to adopt another perspective. Just as I have treated the historical texts as being products of their time when examining the temples, I shall now apply this approach to other evidence used in the study of colonisation. The source material is vast in quantity, so I shall limit myself to examining the evidence in three fields, the historical record, the burial evidence and the economic activity of the colonies. This approach is taken with the intent to provide a provocative counterpoint to both the orthodox and post-colonial positions. The explicit difference I wish to make is between the traditional classical method of examining Greek colonisation and a method which, for want of a better term, I shall call post-positivist as it avoids the application of an overly positivist view of the past (see section 5.2). In particular it means that if we have just one historical source for an event from centuries after an event we are not compelled to accept it because it is the only source. This difference is most keenly felt when we critically examine the historical evidence for the foundations of the colonies.

17.1 Ties of trade and blood

If ancient Greek historians are to be believed then there are two common factors which drove colonisation. One is the happy accident, such as the hapless sailor who is blown off course, half-way across the Mediterranean and discovers that the Iberians are willing to trade plenty of luxuries at cheap prices. The other is that the Greek cities themselves were suffering acute but brief bouts of political conflict which drove out citizens in spurts from the homeland. These motivations have settled into discussions of the difference between *apoikia*, homes from home and *emporia* sites set up purely to trade with natives (Boardman, 1999, pp. 162-164), but both are based on the assumption that the historians were correct when they talked

about movements of people settling, and this is a modern division which may not have been recognised in the ancient world.

Proving this should no longer be a problem. Archaeogenetics is now a common feature of archaeological investigations into colonisation. It is not simply capable of detecting common origins of people, but also of identifying hybrid origins. An example of this would be the work by Wang et al. (2008) 'Geographic Patterns of Genome Admixture in Latin American Mestizos'. This study compared differences autosomal genes with differences in X-chromosomes. The autosomal genes are inherited from either parent, but X-chromosomes are more likely to be passed along the maternal lineage. The result allowed the investigators to examine what would happen in a situation where an influx of foreign males took possession of the native women at the expense of the native men, which is a model proposed both for Latin America and ancient Sicily (Buchner, 1979, p. 135). This model was confirmed by Wang's study in Latin America and so a similar study in the Mediterranean could be expected to produce similar results.

Unfortunately there are key differences between modern and ancient colonisations which have only been accounted for with mixed success in Old World genetic studies. New World studies can work with a historically attested invasion from a known source at a known time. The concept of the mestizo as an inheritor of two distinct genetic heritages is sound. In contrast the Mediterranean in general and Sicily in particular have been crossed on a regular basis by various populations since before historical records began and frequently after. Sicilians inherit from Carthaginians, Romans, Normans, Moors and later Italians as well as the Greeks and whoever the indigenous inhabitants were, if such a concept is meaningful.

An attempt at tracking the genetic markers of invaders has been made. Cavalli-Sforza (Cavalli-Sforza, 2001, pp. 119-120) has argued that not only has Greek colonisation left a trace that can explain his fourth principal component of genetic variation in Europe 'simply'. I disagree. My first and perhaps weakest objection is that his map of genetic variation is only very loosely correlated with Greek colonisation. Regions such as Tuscany and the Levant show stronger signs of Greek genetic influence than southern France, where the Greeks were known to set up colonies. It could be that the Greek influence on southern France has been overstated, and that the strong showing of Greek genes in the Levant and Tuscany shows that there was more interbreeding between peoples than might have been expected. This second point would however dramatically undermine his assumption that the genetic map can be correlated to culturally distinctive people in the present or the past.

A more serious matter is that the coast of northeastern Spain, settled by the Greeks, looks less Greek than the interior of Spain, left to the natives. This cluster and a similar one in Lapland would be better explained as random variation in the population. This leads to my second objection.

Cavalli-Sforza argues the results are statistically significant, but significant of what? Europe has a busy and well-known history in terms of population movement. If there are random variations in genes then it should be possible by pure chance to match almost any cluster with a known historical event. In the case of the Greek cluster there are two possible sources. One would be a colonisation in the first millennium AD. The second would be the control of southern Italy in the mid-first millennium AD by the Byzantines under Justinian. This would explain the genetic gradient through Sicily and the strong presence in the Levant combined with the weaker presence in the west. My own explanation is another example of *post hoc*

reasoning. So far there are no explicit rules for what a genetic survey should reveal when we examine evidence of historical population movements. These will be developed as models grow more sophisticated and more data are gathered. At present though, there is no genetic evidence of a mass movement of Greeks from archaeogenetics. Still, this is not the same as saying there evidence is against Greek population movement. Future studies will be extremely welcome as the foundation stories of the colonies often describe some form of gender difference in the foundation.

The story of the oikist, the founder who made a site a home, is a common feature of Greek colonies. He explains why a city is here and why it came into being. The oikist himself need not have existed in historical time. For example the citizens of Sinope on the Black Sea considered Autolykus as their oikist (Strabo XII.3.11). It would be an enthusiastic person who stated such a claim was a reflection of a genuine reality. However, as Drews writes (1976, pp. 23-24), the claim could be a reflection of a genuine belief in the period when it was written. The mythical nature of the oikist would be no problem at all as the founder would have received sacrifices and blessings from the later inhabitants of the city.

In Sicily the most commonly cited reference is Thucydides who records the foundations of cities on the island. It is from Thucydides (6.3.2) that we learn that Syracuse was founded by Archias of Corinth, who drove the Sikels out from the island of Ortygia. This was a year after the foundation of Naxos by Thukles who founded the first colony on the island. Five years later Thucydides (6.3.3) records the foundations of Leontini by Thucles and Catania by Evander before describing the foundations of Megara Hybalea, Gela, Zancle and other cities, each with a year.

The reception of these dates is curious. Dunbabin (1948) accepts them without qualification. Boardman (1999, p. 161) states that the evidence of ancient historians is set out in other works and that he therefore has no need to retread this ground. He too accepts the dates without discussion in his book. De Angelis (2004, pp. 11-12) discusses the matter of chronology in more detail, giving information about Ephoros's dating of Naxos from the Trojan War and why it produces such an early date for the colony. He then goes on to Thucydides' date and the scholarship based on that before quoting dates like 734/3 BC for the foundation of Syracuse. De Angelis seems satisfied with Thucydides' accuracy on the basis of pot sherds dating to the mid-eighth century as confirming a foundation date 735/4 BC for Naxos. After this De Angelis (2004, p. 13) cites Thucydides as a reliable authority indicating that Syracuse was founded by Archias. Boardman (1999, p. 172) is slightly more circumspect referring to the foundation story, if not the actual date, as tradition.

Thucydides was writing in the Greek homeland at the end of the fifth-century and the start of the fourth. It is perhaps reasonable to question how accurate he could be on subjects hundreds of years earlier and hundreds of miles away. How did he get his information? This is not a new puzzle. The answer has been known for over a century. Mahaffy (1881, p. 177) said: "As Thucydides was really not inspired, he must have drawn these things from some authority; and the researches of the Germans have made out with tolerable clearness that his source was here the work of Antiochus of Syracuse." Mahaffy goes on to demonstrate that the dates of Eusebius' register for the first fifty Olympiads and Antiochus' dates are unlikely to be reliable. Naxos is a year older than Syracuse because that is the smallest precedence that Antiochus can give to a rival of his own city.

The reliance of Thucydides on Antiochus and approximation by generations is a recurring theme in Sicilian chronology. Van Compernelle (1959) made it the subject

of his doctoral thesis. Miller (1970) likewise has examined the dates of the Sicilian colonies with reference to Thucydides and Ephoros. It is simply that while these dates require offspring to be produced with startling regularity, this is not enough to make the sources unreliable for some historians. One reason for this could be that the exact dates do not matter. Few grand schemes will collapse if it can be shown that Megara Hyblaea predated Syracuse by a couple of years, if that is the sole difference. What would matter would be if it could be shown that the details of who left and where they departed to were wrong.

A second example an oikist tale would be that of the foundation of Massalia in southern France which sits in the foundations of the modern city of Marseilles. The city was founded, according to Plutarch in the *Life of Solon* (2.7) by a man named Protis. This could be the earliest case of nominative determinism recorded, or it could be that the oikist Protis or First was a later invention of the city. The traditional foundation date for the city is 600 BC (Timaios *FGrHist* 566; Domínguez, 2006, p. 165), comfortably post-dating many Sicilian sites. Yet it would seem that the details of the foundation did not survive into the historical record and instead we are left with an approximation.

Given that neither the dates nor the founders names seem reliable, it is puzzling that these stories are used as if they accurately reflect eighth-century history. This is even more baffling when it is clear that classicists who have studied the construction and uses of myths are keenly aware of its unreliability. Finley (1964; 1965) has written two papers on the subject of the relationship between myth and history. 'Myth, Memory and History' includes a powerful warning against literal readings of archaic history:

"The plain fact is that the classical Greeks knew little about their history before 650 B.C. (or even 550 B.C.), and that what they thought they knew

was a jumble of fact and fiction, some miscellaneous facts and much fiction about the essentials and about most of the details. One need only consider Thucydides' introduction, which I have already mentioned, in which he justified his own effort by offering in twenty-one chapters (a dozen pages) a most remarkable interpretation of early Greek history."

(Finley, 1965, p. 289)

In the article 'The Trojan War' Finley (1964) compares traditions surrounding the *Song of Roland*, the *Nibelungenlied* and the *Battle of Kosovo* as examples of how traditions can become invented. In the *Song of Roland* in the eighth-century AD an embarrassing but insignificant ambush on the rear of Charlemagne's army at the hands of Christian Basques became a heroic stand against a horde of four hundred thousand Saracens (Finley, 1964, p. 2). He gives similar examples of other misinterpretations and embellishments before returning to the theme of the Trojan War to confirm how little is reliably known about the event. He accepts that archaeology shows that something happened there, and that it can give an approximate date, but it cannot give the details that some historians would wish for. For those who would use Homer's *Iliad* as a source as it is the only surviving record, he offers no comfort. "True, we have nowhere else to turn at present, but that is a pity, not an argument." (Finley, 1964, p. 9)

Rather than seeing Thucydides as a historian of the eighth-century I would suggest seeing him as someone who wrote what fifth-century Greeks thought about the centuries beforehand. In this case we should question why people would tell these tales about their city's past and why these stories should be important.

Usually the tales of foundation contain three elements, the oikist, the city he came from and the reason why he came to found a new city. Identifying the oikist as *someone* is almost certainly a narrative requirement. Even if the name is as uninspired as Protis, the oikist has to be a specific person. He also needs a home and the use of a

home will define a colony's relationship with its metropolis. We may not know if Archias left Corinth in the eighth-century BC to found a city in Sicily. What we do know is that by the fifth-century BC Corinth and Syracuse recognised a mutual bond which brought them closer to each other than to other cities. Just as Syracuse could look to Corinth for cultural and economic links in the homeland, so too could Corinthians connect with Syracuse when they looked to exploit the wealth of Sicily.

Further the foundation tales usually give a colony a place in the wider Greek world. Not only are colonies founded from places, they are also usually founded with regard to a divine command. Plutarch (*Mor.* 772e-773b) states that Archias has a part in accidentally tearing apart boy he wanted as a lover to pieces in a fracas in Corinth. The father was distraught but found that the Corinthians were unwilling to give him justice. Frustrated he cursed them and threw himself off the cliffs from the temple of Poseidon at Isthmia to his death. This is said to have caused a drought, and a deputation was sent from Corinth to Delphi to find out how the drought could be broken. The oracle's response was that there had to be punishment for the death of the boy, and so Archias resolved not to return to Corinth but instead found a colony.

The role of Delphi in the foundation of colonies is frequent. Cyrene was founded by Battus of Thera after a visit to Delphi. This was an annoyance to Battus as he had arrived in Delphi looking for a cure for his stammer (Herod. IV.155-159). By 426 BC the role of the oracle had become more perfunctory. Thucydides (3.92) describes the Spartans deciding to set up a colony Heraclea Trachea and making a trip to Delphi to confirm the site would be suitable for colonisation in a manner similar to the way a modern house-buyer would get a surveyor's report. In both cases the common feature is that the foundation act does not simply place a colony within a physical landscape, but also within a ritual landscape. The existence of the city becomes divinely sanctioned. Foundation may make the city exist, but it is the gods who make

a city Greek. Therefore any city with pretensions to being Greek in the sixth and fifth-centuries would be expected to have a foundation oracle regardless of whether or not this was actually the case.

Historical tales could also explain other local peculiarities. Naxos was considered the first colony in Sicily and even travellers to and from other colonies on the island would stop at Naxos before travelling around the island shore or crossing the sea towards Italy and onto Greece (Thuc. VI.3.1). This is explained as Naxos being the first place on the island in time, but this location in time could be dependent on its geographical location. Dunbabin (1948, p. 8) refers to the presence of a sea current recorded by Columba (*Porti Della Sicilia Antica*, 321) which would have carried ships to Naxos. Another possible explanation would be due to navigation. Ships passing Cape Spartivento travelling west would see Etna looming on the horizon. A reconstruction of the route using Google Earth shows that a course set for Etna from this point would take them straight to Naxos. Similarly a course with Etna astern would give a route back to Cape Spartivento. By being physically the first place ships would make landfall in Sicily, so too it would make sense if this became historically the first place on Sicily.

It would seem that the historical records are therefore of limited use when examining the earliest phase of colonisation. While this is not evidence against colonisation occurring, the citation of Thucydides should not be seen as reliable evidence for the colonisation process.

17.2 Silent witnesses

While we may not have oikists and dates, we should at least have Greeks, and these should be able to be found in eighth-century contexts. Yet the state of evidence is

best summed up in the title of Shepherd's 2005 paper in the *Oxford Journal of Archaeology*: 'Dead Men Tell No Tales.' though her approach is in direct opposite to mine and her conclusions likewise in direction opposition. The key point where I disagree with her is after she describes the foundation myth of Syracuse: "These passages give us more detail than we have for many colonial foundations and contain information which may have implications for determining the precise nature of the early stages of Greek colonies, particularly those in the West." (Shepherd, 2005, p. 115) If we do not accept these passages as historically accurate then how can we interpret them?

A burial is not always planned according to the wishes of the deceased. Instead the burial is organised by the surviving family who will in the act of burying the body be making social and political statements to their peers. A direct correlation between burial and ethnicity cannot be assumed. At the same time ethnic identity is, largely, inherited, if there is a public display then it has to be plausible to the audience, so the burial cannot be entirely divorced from deceased's identity either. The data from burials are thus real but obscure.

Shepherd's work also makes it clear that the data are not only socially fuzzy, but are also blurred in time. The burials of the sixth-century BC are not the same as the burials of the eighth-century BC, yet at the same time continuity of settlement means there are no discrete points or ruptures allowing the classification of burials into neat categories. Nonetheless Shepherd (1995, pp. 51-82)(1995:51-82) has managed to marshal the data to produce a description of the evolution of funerary practice over time.

Her most important conclusion about the graves is that they appear to be Greek. They have Greek goods, though Shepherd (2005, p. 117) cautions in cases such as Morgantina that this may be an attempt to display Greek connections for social prestige rather than a reflection of native ethnicity. More fruitful are her discussions of burial position. Burials in the Greek colonies are usually in an extended dorsal position. In contrast contracted burials, where the body is flexed and placed on its side are extremely rare in Greek Sicily, but are found in the burials of the natives (Kurtz & Boardman, 1971, p. 308; Shepherd, 2005, p. 120). There certainly appears to be a difference and there are grounds for dividing these burials between native and Greek, but this latter 'Greek' label is problematic. Hodos (2000, p. 43) following Bradley (1997, p. 35) argues that archaeology cannot always identify ethnic groups and that difference may only appear significant because of the literary sources which may be misinterpreted or unreliable. In the case of burial positions, Shepherd (2005, p. 120) cautions that the flexed burial was standard practice in Archaic Corinth, if not Syracuse. The difference between the coastal and interior sites may be real, if another historical source was significantly different to Thucydides, how difficult would it be to reinterpret the burials at Syracuse as being ethnically distinct from the homeland?

Shepherd (2005, pp. 118-120) also contrasts the use of multiple burials in sarcophagi by natives and its relative absence by Greeks. She provides further evidence of showing this may be an indicator of ethnic identity by noting that the use of multiple burials declines after the first century of foundation. This would be consistent with increasing 'Hellenisation' of the native population. Yet it remains difficult to say who, precisely, was 'Hellenising', especially if we do not have a shared concept of what 'Hellenising' is.

Megara Hyblaea is the most striking example. This was supposedly colonised from Megara, according to Thucydides (VI.3.4). The burial evidence is extraordinarily different. Shepherd (1995, pp. 56-60) does not record any burials similar to the mother city until 650 BC. After this the proportion of Megara-style burials grows steadily until they make up fifty per-cent of the burials by 600 BC. If burial evidence is evidence of ethnic identity then we should ask "Where were the Megarians when they founded their city?" Megara Hyblaeon burials may have been Greek, but this would seem, rather like the temple data, to be generically Greek rather than specifically from a Greek city. Shepherd (2005:119) records a similar discontinuity of burial practice at Selinous, the daughter colony of Megara Hyblaea. It raises the question of how many people would leave a mother city to found a daughter colony.

It would appear that burial evidence is extremely flexible and that Hodos (2000, p. 43) is right to caution against a literal reading of ethnicity from the archaeological remains. Papadopoulos (1999) is more explicit in rejecting what he calls 'the tyranny of text', following Lightfoot (1995) in identifying three problems in archaeology. Two are the assumption that historical records from the fifth-century are accurate histories of earlier periods, and the primacy of historical texts when interpreting the past. This echoes my concerns above that if history is used as the method of interpreting the archaeological record then there is no integrated research project. Papadopoulos adds the additional criticism that the research goals of history and archaeology are different. In light of this it could be possible, if you were insistent, that the presence of Greek material culture in the burials of Sicily is evidence only of the presence of Greek material culture in Sicily and not of Greeks themselves. It does beg the question of how, if Greeks are not present, could the Greek material be present in Sicily? This would suggest that the economic activity of the Greeks is central to understanding the colonisation process.

17.3 Trade and Exchange

Boardman (1999, p. 162) is cautious, saying that an increase in population is unnecessary to explain the colonies. Instead he highlights the importance of trade in opening markets in the west. Boardman (1999, p. 163) states that the earliest pottery is indicative of the original founders of the state. As evidence of this he presents the excellent example of Pithekoussai. Historical sources (Livy 8.22.6, Strabo V.4.9) identify Pithekoussai as being a colony from Euboea. This is the basis of the identification of the site. Ridgway (1992, p. 140) says that had these texts not survived that such an identification would not be possible. Further Boardman (1999, pp. 165-166) identifies Pithekoussai as the first Greek foundation, before describing Cumae, where he cites pottery evidence of an earlier Greek presence than Pithekoussai (Ridgway, 1973). This is interpreted as trade rather than settlement for no obvious archaeological reason. This places a great burden on the historical record. The fact that Strabo and Livy were able to identify the Euboeans as the first settlers of Pithekoussai deserves some closer examination.

The evidence of trade in the Sicilian colonies reveals two common presences in the earliest levels of all Greek Sicilian sites. Euboean pottery is common and Corinthian pottery ubiquitous. This is true to the extent that colonies such as Megara Hyblaea have Corinthian pottery in their earliest Greek strata. Boardman (1999, pp. 163-164) recognises that the ubiquity of Corinthian pottery is a problem, and decides that Corinthian pottery is not diagnostic of ethnic identity, except possibly at Syracuse, where the prominence of Corinthian ware over Euboean and Athenian pottery (Boardman, 1999, p. 173) fits the historical record. Euboean pottery appears to be regarded as diagnostic at sites where an Euboean foundation is historically attested, and as evidence of trade where there is no historical attestation. East Greek wares are evidence of trade and not participation in colonisation (Boardman, 1999, p. 174).

My concern is not that Boardman has no argument, but rather that archaeological excavations that are interpreted or designed to fit historical accounts do not independently corroborate historical accounts. The assumption that the history is correct is already built into the research method. Should a new inscription be found identifying Syracuse as being founded by Argos there would be absolutely no problem interpreting the archaeological evidence as fully supporting this, regardless of the great damage it would do to the historical record. An archaeological record which is so malleable is in effect of little help. This has been amply demonstrated by Osborne (1996) who shows how selective historical readings are when used to support claims of a Euboean settlement of Pithekoussai.

The above studies would suggest that it is possible to write a history of Greek colonisation without having to resort to any notion of Greeks colonising Sicily. I do not believe this would be desirable or accurate. Nonetheless I do believe the examples above show that detailed archaeological interpretations that are used to corroborate the historical texts are unsound, being pre-loaded with assumptions drawn from those same texts. If an archaeological approach is to have anything useful to say about the context of the Greeks in Sicily, it must primarily be archaeological before it is integrated with the historical record to produce a bigger picture. There are, I believe some defensible positions which do support the notion of Greek colonisation.

Firstly, Greeks were active in the Western Mediterranean. This is attested by the extensive pottery remains found across Sicily and Italy. There were presumably native goods traded in return and if these could be found in the homeland one could launch a counter-argument that Sicilians were active in Greece. However Sicily and Italy were just one part of a wider phase of a diverse range of practices labelled as 'Greek colonisation' which is seen in the Black Sea, Cyprus, along the coast of Asia

and north Africa. It is a simpler solution to conclude that the Greeks were driving the trade in all these locations.

There is a change in building practice and burial practice in the colonies. The fact that native buildings can be identified in Syracuse after the supposed defeat of the natives does mean that something identifiably non-native was active in Syracuse. It may not have been specifically Corinthian, or at least no more visibly Corinthian than the other Greek colonies of the east coast, but it was clearly different. This would be at least evidence of a new hybrid culture.

While there is no evidence of close ties to mother cities, there is evidence of connections being made with the Greek homeland. Shepherd (1995, p. 75) discusses Kilian-Dirlmeier's (1985) analysis of eighth and seventh-century dedications at Olympia and other Greek sites. Kilian-Dirlmeier shows there is a consistent and disproportionate interest in Delphi from the western cities. From the sixth-century BC this begins to manifest itself in large-scale monumental architecture and this continues into the fifth-century. This coincides with the biggest surge of temple building in the west. This strongly implies the construction of an intentionally Hellenic identity in this period, but the earlier offerings show that this was not an innovation but a development from earlier times.

Hall (2004) argues that even the assumption of a Greek identity on the part of the first settlers of colonies is possibly anachronistic and may have only developed as the colonisation process showed the settlers of the Greek cities that they had more in common with the other 'Greeks' rather than the Sikels in Sicily. He uses evidence from Homer such as the *Odyssey* (11.495-96) that shows that Hellas and Argos are considered two different places, the former being land in southern Thessaly. In light

of this it is perhaps better to see Hellenic identity not as the essence of all Greeks but something that was developed as a social process over the course of centuries as the influence of Persia and Carthage grew in the Mediterranean.

The evidence of the temple alignments is consistent with this interpretation of Greek identity. There is certainly evidence of a Greek identity in the broadest sense, and also of civic identities in the temple results, however the lack of strong evidence for inheritance of practices along genealogical lines, or of standard alignments for specific deities, is reflective of a group of people who were building their identities at the same time as they were building their temples.

It would have been convenient if the historical development of the temples had shown some element of development as identity and religious ideas grew through the centuries, but the size of the sample is simply too small to draw any conclusions. There is room for a further panhellenic study, if temples can be securely dated and attributed. There is also the possibility of extending the temporal scope of the study into the Roman and Late Antique periods of the Mediterranean.

However, the sample has proven suitable for the task set. It has shown a shared identity at a comparable scale to the other archaeological evidence. It now remains to integrate the various strands of evidence into one narrative.

18. Conclusions: What would a post-positivist model of colonisation look like?

The temptation in writing a history is to veer towards teleology. We know that there were Greeks in the Sicilian cities by the fifth-century BC because contemporary historians record them. Thucydides explains the Greek origins of the colonies in order to place their role in the Peloponnesian War into context. If our goal is the study of the origins of the colonisation itself in the eighth-century then we cannot depend upon the historical evidence. Scepticism regarding the historical record is common when discussing Greece in general (e.g. Osborne 1996b). At the same time wholesale rejection of history in favour of archaeology risks giving another field undue primacy in the study. Therefore what follows is an attempt to produce a multidisciplinary account of colonisation. I believe the citations show that of itself it is not a radical construction of the past. What may be different is the way the evidence is put together.

18.1 The foundations and Early Phase

The archaeological record of Sicilian settlement shows a marked change in the eighth-century. The earliest possible contacts may have occurred in the first half of the eighth-century, Leighton (1999, pp. 224-225) cites the presence of Middle Geometric pottery in native tombs at Villasmundo which could date from as early as the ninth-century, but he cautions against using this as a certain marker of the date, due to the possible existence of the artefacts as antiques. This may show evidence of early contact prior to colonisation, but the bulk of evidence dates to the second half of the century. Why should this be so?

This was the period of synoecism. At Corinth synoecism can be dated to the mid-eighth-century by the latest due to the finds of geometric wares in the graves of the north cemetery (Shear, 1930). Legon (2004, p. 463) dates the synoecism of Megara to the same period based upon Plutarch (*Quaest. Graec.* 17) . An assumption made explicit by Roebuck (1972, p. 97) is that the latest date for synoecism can be defined by the Thucydidean dates of the foundations of their colonies. This relies upon Thucydides being accurate in his dating, which is debateable.

Despite the questions regarding the reliability of the historical dates, there are a couple of reasons for thinking this may yet be broadly correct in date, when we think of what the state of Greece was during the period of synoecism. Camp (1979) argues there is evidence of a drought in Greece some time in the eighth-century, and this view is supported by Cawkwell (1992) who discounts the existence of a population explosion. Changing economic circumstances could create the conditions to promote synoecism when, inevitably, a series of poor years put pressure on the economy. Regions closest to a 'tipping point' could be driven to reorganise, but a drought does not explain synoecism in all circumstances; Rhodes was extremely late in doing so. However, nucleation of settlement changes the social and economic environment. Arcadia, relatively remote from coastal trade, would have been under very different influences to maritime regions, which may explain the relative lack of large urban centres.

Drought and political upheaval would not create a surplus of population, but certainly would mean that some people did not fit into the new regimes. Others may have sought to keep their lives out of the hands of politically strong group of citizens. Therefore the conditions would exist for informal settlement of other lands. De Angelis (2004, p. 44) estimates the initial settlement at Megara Hyblaea would

have been in the low three figures, on the basis of the number of houses excavated. It is therefore tempting to see the newly organising states in the homeland intentionally bundling off an awkward minority in the interests of local civic harmony. There must be a minimum viable size for a colony and there appears to be little evidence of Greeks sending out parties that were too small to form a viable colony.

The problem with that reasoning is that had tiny parties of Greeks set out to settle new lands, what archaeological or historical evidence could they be expected to leave behind? A failed settlement would leave no striking domestic architecture, no major depositions of Greek pottery and no elaborate burials. It may have even been eradicated by hostile natives or slavers. At best the settlers would move to the protection of a larger Greek settlement. Therefore micro-settlements would be expected to leave no particular archaeological traces. Being missing by the fifth-century, they would not be expected to be found in the historical record either. The discovery of Greek farmsteads in hitherto undocumented areas would support a micro-settlement model, but this will need extensive landscape survey and some luck to bear evidence.

Evidence leans towards both sexes being present in the colonies. The historical record is of men founding colonies. However if the historical record were considered accurate in its portrayal of the relevant frequency of sexes, then the human race would have probably died out. Women generally are of little interest to ancient sources, except where they relate to male activities. Holloway's (2000, pp. 51-52) evidence of infant burials could be evidence of early family units, but would these units necessarily include Greek females? Native women could have been married to secure land. If this was the case though it would seem that they either hellenised

rapidly, or Greek women were imported as suitable brides in the seventh-century. On balance a mixed-sex founding population seems most likely.

Such a model suggests that people were highly mobile in the eighth-century. This is especially plausible if polis identities were still in the process of forming. Therefore while the settlers may have been from Corinth, Megara and similar places, there seems little reason to assume that they were solely from these places. The pottery evidence shows that it cannot be used as an ethnic marker. Gela, said to be founded by Rhodians and Cretans in the early seventh-century by Thucydides may be an early record of heterogeneous settlement.

Settlement of the interior at Akrai, Casmenae and Camarina is problematic in this model. Akrai appears to be the latest in a series of settlements on its plateau. The proposal by Domínguez (2006: 284-5) that Akrai was not a formally independent polis would be consistent with the notion of spread of settlement rather than formal colonisation. This would also explain the poor historical records for Helorus, Casmenae and Syracusan Camarina.

18.2 The Creation of a Shared Identity and the Middle Phase

The mobility of people should not be expected to stop with the foundation of distant settlements. Indeed, the relatively small size of the Sicilian settlements and the presence of larger markets in the homeland would suggest that for the Sicilians it would be better for them to take the initiative in driving trade, rather than the homeland Greeks. This would have put the Sicilian Greeks in regular contact with a wide variety of Greek culture. Yet around 650 BC the nature of the Greek Sicilian cities changes.

It is now that treasuries start to be built at Olympia. This starts with Gela, a comparatively recent foundation in 688 BC which built its treasury near the end of the seventh-century (Gardiner, 1925, pp. 222-223). Other Greek cities, mainly those from the west follow. This was a provocative act. Raschke (1988, p. 23) refers to it a competition, as much as the athletic events. Orlandini (1968, p. 21) records the earliest Geloan temple being built around this time (see section 6.13). The Temples Nord, Sud and Sud-Est (see sections 6.19. 6.21 and 6.22), are built in Megara Hyblaea around this time.

In Megara Hyblaea, the first burials of a Megaran type are seen. Around this period Megara Nisea is said to have founded numerous colonies in the Black Sea; Legon (2004, p. 465) counts at least four in the seventh-century. Megara Nisea seems to have been a major economy in this period, if its connections can be substantiated. The origins of Megara Hyblaea may therefore be irrelevant to its connection to Megara Nisea. It may be that it was economically advantageous to be adopted by Megara Nisea to access markets. This would be particularly attractive in the case of Megara Nisea as the city would later boast that the only two non-Megarians granted citizenship were Herakles and Alexander (Plut. *Mor.* 826c).

This kind of negotiated relationship could invent the concept of the *apoikia* as an intentional act. This would suggest that the second-phase colonies, such as Selinous and Akragas, could represent conscious decisions to settle cities as opposed to unorganised settlement. Half-remembered tales of expulsions or hardships could also explain why the oikist of a city founded the settlement as an act of penance. This may make the tale of Archias founding Corinth to account for his role more understandable; Dunbabin (1948, p. 15) who was baffled as to why the Greeks would recall lurid allegations or crimes when talking of their civic founders.

With the advent of creation of links between settlements, the concept of the deliberate foundation of new settlements becomes plausible. Selinous is founded in this period, by Megara Hyblaea with an oikist from Megara Nisea, according to Thucydides (6.4.4.). If this is the case then this could be seen as a deliberate act by the two colonies as a reflection of the foundation of Megara Hyblaea by Megara Nisea. Polybius (9.27) records a similar borrowing of founders from Rhodes by Gela. By the time of HeracleaMinoa's foundation (Herod. 5.46.2) the concept of founding a settlement with the intention of forming a polis must have been well-developed. It is reasonable to assume that even if the earlier settlements were not intentional foundations; by this time they would have been conceived of as such.

Monumental temple building accelerated across Sicily in the sixth-century. In Syracuse the Apollonion and Olympieion were built. Selinous seems to have had monumental temples around fifty years after its foundation. Himera may have had its first temple slightly sooner after its foundation. Early temples were also built in Gela and Naxos in the second half of the sixth-century. This coincides with a wider spate of temple building across Greek territories around this time. Osborne (2009, pp. 248-257) argues that this is a matter of identity. He states that the Greek colonies wished to emphasise the difference between Greek and native settlement, while the development of architectural styles in the Greek homeland was about differentiating one form of Greek from another.

However, Plommer's (1967, p. 369) statement: 'Sicilian buildings merely embody the chaotic flotsam of various external schools' should be challenged. These temples could be described as exhibiting 'a lack of taste' (Dunbabin, 1948, p. 245). Yet if the western settlements were drawing in immigrants from across the Greek world then surely such a hybrid form of architecture should be expected. The chronology of the

building of the temples shows that these buildings could not have been lagging in fashion behind the Greek homeland, as the homeland had precious few temples when this phase of building started. If the Greek Sicilian temples are to be described as chaotic, it is therefore symptomatic of the nature of colonisation of the land, rather than a flaw on the part of the settlers. In the Sicilian context we would therefore expect to find Greek temples, but not necessarily temples tied to specific Greek locations. The alignment evidence suggests, with the possible exception of the Geloan cities that this is the case.

18.3 Profit from War and the Late Phase

Another phase of building can be added to the end of the middle phase. It is difficult to separate the temples into discrete archaeological categories and so this is a historical rather than archaeological division. There continues to be a programme of temple building through the early and mid fifth-century BC, especially following 480 BC. This is due, in part to the defeat of the Carthaginians, who provided booty which paid for the building of temples. Added to this is the problem of the Peloponnesian War, which developed through most of the fifth-century (Shipley, 1993, p. 16).

The war was probably good for business in Sicily. The position of the island far from the Aegean meant it was not a natural target for Athenian aggression. The development of political ties with Dorian cities, especially Corinth, also meant that there was access to markets in the Peloponnese. The Gulf of Corinth would provide a northern route into Corinth which would be on the far side of the Peloponnese for the Athenian Navy, and would tactically speaking, be a very bad place for a navy. Even with superior ships, seamen and numbers, a strong Athenian force could risk being trapped in the gulf by a small Peloponnesian force. Later the Sicilian

expedition would show that away from their ships, the Athenian navy was very vulnerable.

The rich hinterlands of Selinous and Akragas would have provided the trade to pay for the later, fifth-century temples. The biggest puzzle is why Syracuse, a city so wealthy it drew the ill-fated Sicilian expedition from Athens, did not build so many temples in a similar fashion. A common justification for the building of the Selinuntine and Agrigentine temples is that the cities were in competition with each other. Any such explanation would still raise the question why Syracuse did not feel the need to compete in the same way.

This is where the historical record may offer more than the archaeological record. The early fifth-century in Syracuse is an era of tyrants. First Gelo and Hiero took control of the city. Their own efforts seem geared towards control over other cities (Herod. VII.156) and later towards promoting themselves in the panhellenic sanctuaries personally, rather than explicitly as rulers of Syracuse (Harrell, 2002). The tyranny came to an end in 466 BC with the overthrow of Thrasybulus (Diod. XI.68.6), when the city adopted what may have been a form of democracy (Arist. *Politics* 1316a).

If this was the case then the lack of monuments becomes even more puzzling. In democratic Athens illustrates that notional equality did not kill the practice of euergetism. The absence of tyrants should have opened up Syracuse to competition for public favour. A check against this was the practice of petalism (Diod. XI.87), which was a public vote exiling anyone who was considered too powerful for a period of five years. The duration of petalism was short, but Robinson (Robinson, 2000, p. 197) argues that its use shows that the democracy was powerful enough to

govern the aristocracy. In such an environment any conspicuous public benefactor may have found himself the victim of 'tall-poppy syndrome', which could explain why the strongest city in Sicily had so few temples.

18.4 What does a post-positivist model offer?

The outline above is an example of what a wider view of Greek colonisation would look like. The explanation uses both archaeology and history, but neither arbitrarily nor equally. The early phase is largely archaeologically led in its evidence. Similarly the last phase is historically led. The archaeological evidence varies little in reliability or precision, whilst the historical record becomes vastly more reliable in its later stages in comparison to its earliest phase. Where the value of the histories is most debatable is in the middle phase. At what point do the vague memories and tales of earlier generations emerge from the fog of time and become reliable facts?

The difficulty is that there is unlikely to be a specific point. This would be a process. From the above I would suggest that the foundation of Gela, the last of the primary colonies, occurred around the time when homeland Greece was becoming more aware of the western Greeks as living in recognisably Greek communities. It is hard to say if this marked the last of the *ad hoc* settlements to nucleate into a city, or the first deliberate foundation. By the middle of the seventh-century it is clear that the west and in particular Sicily is integrated into the Hellenic world as recognised by the homeland Greeks. The history may still not be entirely reliable. This is the period of the great law reforms in homeland Greece that are notoriously scant in evidence in comparison to later periods. Nonetheless it would be around this that it could be said that the texts at least reveal the shadows of the events.

By the time of the fifth-century it is clear that the wealth and potential aid that Sicily could offer made it a very attractive partner. It is highly likely that the histories of this period at least reflect the Greek, and mainly Athenian, perceptions of their Sicilian cousins at this time, and so should be considered with the appropriate accuracy. How far back in time the record can be considered accurate is a matter of personal judgement. The post-positivist approach should at least make such judgements as biases clear, enabling other scholars to accept or reject them.

19. Conclusions: What does a study of Sikeliotē Cosmology reveal?

Young, Ioannidis and Al-Ubaydli (2008) have argued that current scientific publishing practices distort the reporting of results. They state that a variation of the ‘Winner’s Curse’ is found in academic publishing whereby spectacular claims are encouraged at the expense of reliable claims. This echoes in some ways Hoskin’s warning referred to above (see section 4) that there is the danger of building astronomical significance into a study before the first site has even been surveyed. Therefore I would argue the results of greatest value in this thesis are not the positive results, but rather the negative and ambiguous results. If every sample, or even most samples had been found to be significant, then the reader could rightly ask if the word ‘significant’ was meaningful. The ability to identify non-significant results therefore gives me confidence that the results that are significant are worthwhile discussion points rather than exercises in extreme numerology.

19.1 Temples exhibit solar alignments

The most striking result is that, in Sicily, there is clear evidence of a preference for an easterly orientation of temples. This is a fact in the Hoskin sense. Whether or not this is a cosmological, or purely a practical feature can be debated, but the significance of the orientation to 6.4σ far exceeds the barriers to significance for purely random and acultural astronomical data. This may not be significant enough for the reader’s personal taste, but if this is the case then the reader also has the challenge of explaining why natural sciences are too lax in accepting significance. A more fruitful line of disputation would be to argue that the sample set itself is loaded. High significance can be found in almost anything after the event, if the observer is

sufficiently discriminating. However, I think the data selection – which was purely all measurable temples, and the simplicity of the criteria – do the temples face east as in an azimuth of $90^{\circ} \pm 90^{\circ}$, mean that such an objection would be difficult to sustain. What this first result does not do, however, is establish that the result is due to cosmological, rather than practical concerns. Nor does it suggest the temples were aligned to the east. They could be aligned with their long side facing to the north. Evidence on this question comes from the second general test.

The second test, whether or not the temples faced within the arc of sunrise, was more emphatic despite more temples falling outside this region, being significant to 13.3σ . The calculation of the improbability of such a result by traditional odds is virtually meaningless. Instead the calculation in terms of standard deviation show that even if several temples were mis-measured, the result would still hold. The preference for the arc of sunrise, rather than vaguer easterly orientation would also support the notion of there being some form of astronomical significance to the alignment. This would support Aveni and Romano's (2000) broad conclusions, and contradict statements by Herbert (1984), Boutsikas (2007) and Retallack (2008) that the scatter of some temple orientations away from sunrises means there was no particular pattern of alignment for temples. I believe the work above advances on the work by Aveni and Romano (2000), by presenting a case that identifies that any discussion of what a meaningful pattern of alignments is must offer some definition of 'meaningful'. I also believe that this method is widely applicable in many different contexts, and a variation of this method has already been applied to Roman urban plans (Magli, 2008).

What the above survey does not support is a universal law of Greek temple alignment. This is not the case in Sicily, and less so in the Greek homeland. Rather than failing as a single explanation the value of such as model means that temples

which do not align with the Sun require specific explanations. The failure of a temple to align with any sunrise would indicate they are almost certainly aligned or placed in the landscape with a definite (probably non-astronomical) intent. Thus far from dismissing Retallack's survey of palaeosols, identifying aberrant temples could in fact highlight particular examples where geological and geomorphological factors were decisive in placing a sanctuary. This could lead to a more rounded cosmological model where local vegetation and skyline visibility are not in conflict.

One such example is the Hekataion at Selinous. Following this survey, the westerly alignment is now a striking problem, and would suggest that the sanctuary as a whole needs to be reinterpreted with a local geological survey, as would the temple of Diana at Cefalù. If the likely local vegetation can be derived from the palaeosols, then this could give further insight into the seasonality of the complex. Yet this all becomes a more important issue than before because of the failure of the temple to fit any existing astronomical model.

19.2 Temples provide evidence of positional horizon astronomy in social contexts

The specific sub-sample tests are, on the whole, unexciting. The bulk of the tests test hypotheses which no one has seriously proposed, such as that the alignment of a temple may be influenced by the gender of the deity it is dedicated to, and then suggests that these are not worth further examination. It is difficult to get the average scholar interested in such a result, but it is these negative tests that give the positive tests meaning.

In some cases the meaning is fairly clear. The analyses of Akragas and Selinous may show significant patterns of orientation, whilst Megara Hyblaea does not, but this will not be a huge surprise to anyone who has visited these sites. Akragas has many folds in its local topography and the temples are aligned to respect this. Similarly the alignments of the temples at Selinous are clearly associated with its street grid, whilst Megara Hyblaea is an extremely flat landscape and so a temple has no compelling local imperative to face one way or another. These results however do act as a test of the novel method I have employed in analysing sub-samples of the Sicilian data set.

Further, in the case of sites like Akragas, the adherence to local topography reveals there was interest in pointing a temple at a distant horizon, where possible, rather than straight into the rising landscape nearer the temple. This would strongly suggest that horizon astronomy was important in some way either in the building of Greek temples or in the religious practices there. A possible reason for this is that a temple is where the divine world and human world interact. For comparison Jaaniste (2006, pp. 190-191) argues that it is within 20° of the horizon that the Moon can be placed within context of terrestrial markers. Higher than this and it is merely 'in the sky'. A similar effect could be observed with the Sun, which appears to touch the horizon at sunrise and sunset, but is otherwise in the sky, without even the benefit of visible constellations to enable it to be placed. A Sun on the horizon can therefore be meaningfully said to occupy a place in connection with the earth. The more distant the horizon, the more accurately its position can be marked and shared with a group of people.

It would seem that the results from Akragas, Selinous and the azimuth results from Himera which are all locally distinctive would provide evidence for what would otherwise merely be an assumption, the positional horizon astronomy was important in ancient Sicily. It was known that the appearance or disappearance of stars was

important in archaic astronomy, but not necessarily the location of the sun. This is correlates by the inscriptional evidence from *IC III.4.11* translated by Isager and Skydsgaard (1995:163) as “Patron set this up for Zeus Eopsios. Winter solstice. Should anyone wish to know: off ‘The little pig’ and the stele the sun turns.” The little pig in this inscription being a outcrop of rock which, in line with the stele, marked the most southerly rising of the sun.

The evidence from town-planning shows that high-accuracy astronomy could have been practised, if the Greeks had desired. This is certain following, the alignment of many temples at Selinous to within a degree of the city grid. The fact that these observations appear to be made within an urban context is therefore interesting. This would suggest that the observations were communal. It was not enough to see a specific star rise, or else see the Sun rise over a specific point. This was something that had to be demonstrated. This makes astronomy in the archaic period a social, rather than scientific, practice.

19.3 Religious behaviour may be calibrated by stellar observation

The element of astronomy as social practice is also evident in the use of calendars by the Greek Sicilians. Following the dating of Greek months by Trümpy (1997), it is apparent that the inaccuracy of the Greek calendar is under-estimated in the study of Greek ritual. Examination of Hesiod (Salt & Boutsikas, 2005) and Homer (Hannah, 1994) shows that the heliacal risings and settings of stars could play an important part in the scheduling of agricultural and ritual events. The correlation of the months Thesmophorion and Malaphorios with the risings of the stars Arcturus, Spica and Vindemiatrix provides a method of astronomy which is known to have existed in archaic times to calibrate the lunisolar year against the seasons. In contrast the usual

explanation of observation of solstitial or equinoctial solar risings relies upon an anachronistic form of astronomy. Additionally the limited numbers of named stars, as opposed to constellations strongly suggests interest in accurately marking this period of the year.

However the evidence from the Sicilian colonies does not strongly prove this claim. The similar mechanism proposed of the timing of Delphinios at Olous and Bysios at Delphi (Salt & Boutsikas 2005) is consistent with this model, but as mentioned above, the local landscape does not permit the idea to be tested beyond simple correlations. The proposition would benefit from more correlations being found between stars and festivals. It is tempting to suggest that a correlation be sought between Artemis festivals, goats and the rising of Capella and the Kids. However, Artemis has festivals around the year, as well as the Spring, and many festivals in Greece may have used a goat in sacrifice. The correlation between stellar events and festivals is consistent with the Sicilian evidence, but more research is required.

19.4 Some temples may be aligned to the date of their foundation

Another intriguing hypothesis which may benefit from more data which may be found elsewhere in the Greek world is the notion that Greek temples were aligned with the sunrise on the day of their foundation. This is the basis of Penrose's work from the nineteenth-century and may yet prove to be a plausible explanation for some temple alignments. Unlike the other hypotheses I have offered no statistical analysis of the proposition that temples built following the victory over the Carthaginians were aligned to the day of their foundation. This is because I cannot think of any propositions of probability which would not a priori build a positive or negative result into the outcome.

The implications of this finding offers the hope of being able to date the foundation of a temple, in a manner similar to that suggested by Penrose. However, I am not optimistic this is the case. The evidence from the survey, particularly the analysis of Retallack's data, shows that alignment is just one of several concerns. Clearly alignment is not the most important factor in the architecture of a temple which does not face sunrise. For these temples we can assume that their alignment is random therefore for every temple which faces out of alignment there is probably another temple which is equally unhindered by astronomical pressures, which fortuitously faces the expected direction anyway. This means that equally it cannot be assumed it is a major factor in temples which do face sunrise. Therefore I believe it is only possible to date a temple by astronomical means if you already have a very clear and unambiguous date obtained by other means.

What the alignments of the post-Himera temples may suggest is that more can be learned about the process of dedicating and constructing a temple. In the case of the temples built away from Himera, the temple orientations are consistent with sunrise on the day of a New Moon. This could indicate major construction projects were started with the new month, possibly to sequester funds before other claims on the treasury were made. A re-assessment of Dinsmoor's (1939) work on the Parthenon, along with further studies with temples from other regions, with foundation dates known to within a year, are required.

19.5 Religious continuity between settlements may have existed in later colonies

If the historical record is to be believed religious continuity should be expected between all the colonies and their parent cities. The act of founding a new colony

was a religious act (Malkin 1987). Therefore the lack of positive results for this proposition requires some explanation. The answer, as I have shown above, is that many historical and archaeological conflicts can be eliminated if one rejects the accuracy of the historical record for the earliest phases of archaic settlement in Sicily. If this is the case then the results of the genealogical analyses become far more explicable. They occur when the historical record and the concept of founding poleis both exist, making the historical texts a more accurate record of the settlement of the time.

No distinctive patterns of alignments were found in the Megaran and Corinthian genealogies. These are the foundations about which I have expressed most scepticism above. If these are adopted colonies rather than deliberate foundations, the lack of distinctive features can be explained by these cities adopting generic Greek alignments, which they shared with their own daughter colonies. In contrast the Lindian colonies do seem to share common alignments, especially when the analysis is specifically of the Athena temples. The foundation of Gela falls in the intermediate phase when the historical record may or may not be accurate, but the later settlement of Akragas and the re-settlement of Camarina both fall in the period after the concept of apoikia being daughter settlements of homeland poleis was established. It is possible that the difference between the results for the Lindian cities and those of the other cities is due to their identities being expressed at a later time in the Hellenisation of Sicily. However there are grounds for rejecting the Lindian results as being significant, not least because the temple of Athena at Lindos does not remotely fit this pattern.

Liritzis and Vassiliou (2003:93) have measured this temple as facing 216° or 37.5° . This is not even 90° out of alignment with the temples of Athena in the Lindian colonies of Sicily, and so is unmistakably a very different alignment. Liritzis and

Vassiliou argue for an alignment to the south-west towards the setting of delta Centauri over a distant peak. From the association of the constellation Centarus to the centaur Chiron, tutor of Asklepios, god of healing, they conclude that the temple was intentionally aligned to face this stellar event, making Athena Lindia the patron of a healing sanctuary. I have difficulty accepting this explanation on two grounds.

One is that Athena had many responsibilities. Athena did give the blood of a gorgon to Asklepios to boost his powers of healing (Apollodorus III.10.3), but she is not a deity as well associated with the myth of Asklepios as, for example, Apollo or Asklepios himself. In her role as a goddess of health she is more likely to be Athena Hygieia (for example see Plutarch's *Life of Pericles* 13.8). Asklepieia are well known elsewhere, so if the link to Asklepios via Chiron via Centaurus was important, the connection seems eccentric. The second reason is that Liritzis and Vassilou's alignment works from the front of the temple to the back, through the rear wall. Elsewhere they adopt back-to-front alignments passing out through the doors, as I use in this survey. In their other work (Liritzis and Vassiliou 2006) they routinely swap between the two alignments with no prior justification. This is a questionable practice, particularly as a temple of Athena with a known connection to Asklepios and Hygieia at Tegea does appear to face east (Norman, 1986, p. 430). I cannot disprove the conclusions of Liritzis and Vassiliou but I would suggest that, with a sky full of stars, planets and other bodies, any temple could be found to face something significant if you are willing to take a sufficiently generous view of what 'significant' is.

Having said this about Liritzis and Vassiliou's work, I should therefore ask the same question of my own. Surely if I am willing to throw sufficient tests at a sample set, sooner or later something significant will turn up. I can point to significances between 2σ and 3σ , but the chance of something like this occurring by chance is only

between 1:20 and 1:100. At the lower end of the scale there are enough tests used to suggest that something should have arisen by chance. If you accept higher-accuracy alignments the results may look more significant, but 'temples of Athena in Lindian colonies' is a much more specific *post hoc* sample to test than 'temples facing east'. A case could be made that the sample is loaded in significance by eliminating everything insignificant from it.

Against this negative assessment, I would also add that the temple at Camarina points uphill, which supports the notion of an intentional alignment. Yet even this may not be enough, as the slope is gentle and the temple is almost at the crest of the hill. It barely points uphill. In light of this I prefer to leave unanswered the question of whether cultural continuity can be seen being expressed in temple.

19.6 Archaic astronomy is approximate astronomy

The common theme in the findings above is that astronomy in the archaic period seems to be approximate and flexible rather than precise and rigid. It is its contested nature that most strongly shows that it is a social practice and therefore helpful in examining how the Greeks conceived their world. Later Greek astronomy can be studied as a precursor to scientific astronomy, but astronomy, like any other social activity in the Greek world, was not static but changed with the times it was employed in. Herodotus (II.4) laments that the Greek calendar was inaccurate compared to the superior Egyptian calendar. This did not matter as it was sufficient for Greek needs, and one of those needs may have included the ability to manipulate the calendar for political purposes.

The most blatant example of this can be found in Thucydides (V.54). Argos was set to fight Epidauros, but any attack would draw in Epidauros's allies, who were waiting

by the borders of their own territories. As a result the Argives decided they should not start a battle they could not win. This situation continued until the last few days before Karneios, a holy month, when the Spartans withdrew. Battle was forbidden in Karneios. The Argive solution was elegant. They simply resolved to not have Karneios and declared each day to be three days before the start of the month. While Epidauros' allies were observing the festival, the Argives were free to plunder their victims. Typical politics would not be so dramatic, but Aristophanes (*Clouds* 749-757) states that in Athens monetary interest is calculated by the month. Being able to delay months could therefore be advantageous. In light of the irregular months any astronomical features in temples would have to be flexible too, and so only general patterns of orientation should be expected, except where the temples can be pinned to specific dates in an absolute chronology.

Further, the temples would seem to indicate that hybrid nature of Greek cultures was present even in the earliest stages of the formation of a Greek identity in Sicily. With the possible exception of the Lindian colonies, the building, display and use of the temples seems to have been conducted with reference to a 'Greek' ideal, rather than to any specific form. Ironically the scholars who bemoaned the character of Greek Sicilian art and architecture as being a poor derivative of the Greek homeland may have got it exactly wrong. The style of the colonies may have been the only style which can truly be called 'Greek' as opposed to Athenian or Corinthian.

19.7 Religion as a bridge to the Greek past

Your viewpoint of how the Greek colonisation of Sicily occurred will depend in part upon where you are standing and in what direction you look. The historical record, existing as a narrative, is the history of a shared concept without physical form or location. In contrast the archaeological record, particularly the debris of economic

activity, always exists within a specifically local context. To understand Greek activity in Sicily, a bridge between the mental and physical world needs to be built.

A few sentences before he described religion as the opiate of the people Marx laid out a case for why it might be such a bridge:

“The basis of irreligious criticism is: Man makes religion, religion does not make man... But man is no abstract being encamped outside the world. Man is the world of man, the state, society. This state, this society, produces religion, an inverted world-consciousness, because they are an inverted world. Religion is the general theory of that world, its encyclopaedic compendium, its logic in a popular form, its spiritualistic point d'honneur, its enthusiasm, its moral sanction, its solemn complement, its universal source of consolation and justification. It is the fantastic realisation of the human essence because the human essence has no true reality.”

Marx Contribution to the Critique of Hegel's Philosophy of Right
(1844:43)

Religion in the Greek world must have served a variety of purposes. Its complexity defies simple definition, but that is not an insurmountable problem. It was part of an organising principle of human activity in the cities of ancient Sicily. It was not the sole organising principle, but unlike economic, topographical or biological factors it was purely social and, with respect to nature, arbitrary. Herodotus (VIII.144) also highlights the importance of religion when he lists blood, speech, sanctuaries and sacrifices as the things Greeks have in common. Speech does not directly survive from the past, just some fragments in written form much of which is in a highly stylised manner. I have shown that I doubt that blood will be accessible until new genetic models are developed. This leaves the sanctuaries and sacrifices.

The sanctuaries are well known and have been extensively surveyed. I believe that the study above shows that the sacrifices may not be perfectly reconstructed, but

nonetheless the archaeological record can reveal some details about ritual practice. This and further work, whether it is framed as cognitive archaeology, neuroarchaeology or neurohistory, will contribute to the ongoing discussion between archaeologists and historians. Integrating evidence from both approaches through their (ultimately religious) worldview can provide the means to connect history, often recorded at the scale of whole societies, with archaeology which currently concentrates on much smaller groups of people or even individuals.

Osborne (2003:616) has lamented that ancient historians and archaeologists frequently talk past, rather than to, each other. I would hope that the effort to thoughtfully fuse the two methods in tackling the one problem would show what a conversation between Classics and Archaeology could look like.

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