Were Greek temples ori

Ioannis Liritzis and Helen Vassiliou assess the evidence that the Ancient Greeks saw the aurora borealis, and that it was a rare and special event, strongly enough associated with particular gods to build temples of unusual orientation.

Abstract

Two ancient Greek temples of Apollo at Bassae (Phigaleia, western Peloponnese, Greece), and Thermon at Aetolia, (Aetoloacarnania, western central Greece), have a north–south orientation of their main entrances. This is a rather rare alignment of temples in general and specifically of Apollo in classical Greece, where most of them have broadly an east–west orientation. Based on historical and mythological accounts, as well as astronomical orientation measurements, the northern direction orientation of these constructions may relate to the rare, albeit impressive, occurrence of aurorae borealis, the northern lights. These strong lights are attributed to god Apollo by the epithet "hyperborean", meaning to the northern lands. Attribution is supported by archaeomagnetic directional data accompanied by auroral occurrence during those times.

The orientation of buildings in the ancient world has been attributed to celestial bodies and sunrise at one of the four solar stands (two equinoxes and two solstices) by renowned scholars from the 19th to the early 20th century (Penrose 1892, Nissen 1906–10, Dinsmoor 1939). More recent researchers have continued this work (Shaw 1977, Henriksson and Blomberg 1996, Papathanassiou and Hoskin 1996, Aveni and Ammerman 2001, Liritzis and Vassiliou 2002, 2003). Although astronomical targets may have been only one among several factors that determined the orientation of such ancient buildings, arguments drawn from ancient literature support contemporary research that points to intentional orientation towards a celestial phenomenon.

Here we examine the possibility of the correlation between the orientation of two important ancient Greek temples dedicated to the god Apollo, and the aurora borealis. Both buildings have a north–south orientation, a rare alignment of temples in general and specifically of Apollo in classical Greece, where most of them have broadly an east–west orientation (figure 1). In particular, the figure shows the orientation of 14 Temples of Apollo from ancient Greece and its colonies (Nissen 1906–10 p244–7). Only the two temples dealt with in this work have a north–south orientation, followed by Thera and Metaponte, the others have an eastern (E–NE and E–SE) alignment. The N–S orientation is exceptional, although the Mother Goddess Temple at Samothrake (c. 300 BC), also has a northerly orientation (348°) (Table 1).

Here we provide evidence for the association between the temples' northern orientation and aurorae based on: Apollo's attributes representing light and his annual return from the northern lands of the "hyperboreans"; historical accounts; geomagnetic pole position derived from archaeomagnetic work, that aurorae could have been seen in Greece; and correlation of low-latitude occurrence of aurorae during spring with Ursa Major. A brief account on aurorae borealis formation is given together with reported significant occurrences in China and Europe.

Archaeological context

The temple of Epicurean Apollo (built c. 450–420 BC) is situated at an altitude of 1131 m on a narrow terrace of Mt Kotilion in the small state of Phigaleia at Bassae (Arcadia, western Peloponnese). It is a Doric, peripteral, hexastyle temple, shown in figure 2; most of the columns and the architrave are still in place because of the inaccessibility of the temple (lost until AD 1765). It is the first nearly complete temple still surviving and combines, for the first time, the three architectural styles Doric, Ionian and Corinthian. Its principal facade faces north, but there is also an eastern door (to admit the sunrise at right angles to the axis). The ancient traveller Pausanias (second century AD) visited the temple and admired it, and he reports that it was built as a thanksgiving to Apollo for deliverance from a plague in 430 BC. He regarded it as the second most important temple in the Peloponnese, after Athena's Temple in Tegea (Gruben 2000, Kokkorou-Alevra 1991, Mastrapas 1994, Dinsmoor 1975).

The northern orientation of the temple (table 2) may be connected to Ursa Major, which was known by the ancient Greeks as Helike or Helice, but may also be connected with the aurora borealis (Liritzis and Vassiliou 2003). The northern orientation may be connected to the epithet "hyperborean" given to Apollo for his shift, every winter, to northern (hyperborean) lands and his return to Delphi during the spring. This aspect could be strengthened by the scene on sculptured metopes in the front porch of the building, where he is greeted by Zeus, the local nymphs and Arkas (the hero of Arcadia), implying Apollo's return from the land of Hyperboreans (Decharme 1884, Stewart 1990).

The occurrence of the northern lights coinciding with the cessation of the plague of 430 BC may have been taken as a sign of Apollo's deliverance from this plague, probably leading local people to orient the temple towards these lights in thanksgiving. Supportive contextual evidence for aurorae given in some ancient Greek literature (Liritzis and Vassiliou 2002, Stothers 1979a, 1979b) is coupled with supportive contemporary research on aurorae and archaeomagnetic data (Keimatsu 1968, Liritzis 1988, 1990, Liritzis and Petropoulos 1987), all of which make it clear that the aurorae could be seen at these latitudes.

The Temple of Apollo Thermios, built c. 630–610 BC (figure 3), situated on the Greek mainland and surrounded by mountains, is one of the earliest peripteral buildings of Doric style, with axial colonnade, five columns at the ends and 15 columns at the sides. It is located at the northern end of the Sanctuary of Apollo Thermios, built over the remains of an apsidal building – the Megaron B. The entrance is from the south. The dating and functioning of the megaron remains uncertain, but it is considered to be of the geometric period (c. 1000 BC to 680 BC). A row of columns down the centre divided the building lengthwise; some column-drums remain in place. The walls may have been made of sun-dried brick. The entablature was of decorated wood; the frieze and acroteria of painted terracotta (Dinsmoor 1975, Lawrence 1983, Kokkorou-Alevra 1991, Mastrapas 1994, Papapostolou 1994).

The cult of Apollo, founder god of many towns in Epirus, Aetolia and Acarnania, held a special place among the deities of these regions. Literary tradition and archaeological evidence, especially the painted metopes in the case of the temple of Apollo Thermios, confirm that the cult of Apollo was under Corinthian influence from the archaic period onwards (Tzouvara-Souli 1991). During the third century BC Thermon was the meeting place of the Aetolian League, at the site of the ancient temple to Apollo, and the much earlier prehistoric settlement, and "Thermica" festivities dedicated to Apollo were held at the site every autumn.

The most prevalent theory about the etymology and meaning of the cult epithet Thermios (from the Greek word thermos, meaning warm),

ented towards aurorae?

Methodology

At both temples, orientation measurements were made with a magnetic compass/clinometer (Meridian, MG-3101). The latitude and elevation were measured by a portable GPS (Garmin GPS III). The magnetic declination correction was determined from maps of the Military Geographical Service (Athens) for 2000 and the World Magnetic Model from the British Geological Survey, NERC (kindly provided by D Barraclough). results are shown in Table 2

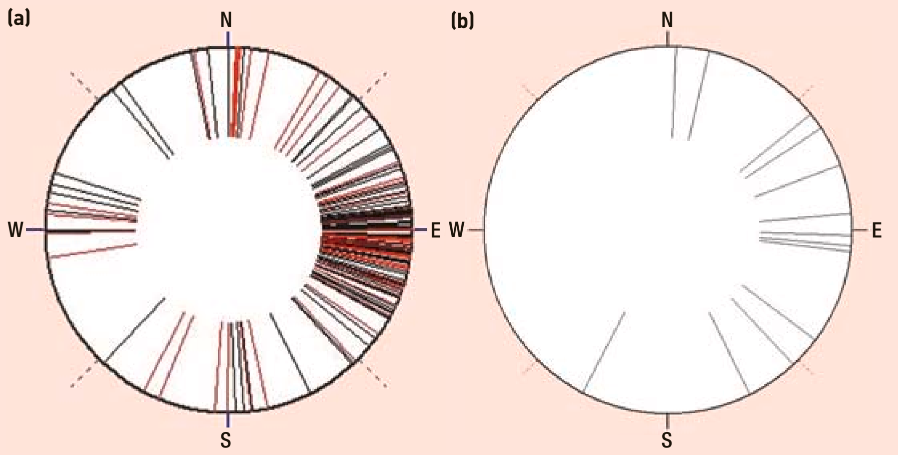
No attempt was made to check for local magnetic anomalies; geological maps show limestone locally. No refraction and extinction correction was used because AAS was high.

The astronomical declination of a horizon point and the corresponding day of the year of sunrise, where appropriate, were calculated using specially developed software (STARDEC and SUNDAY, based upon formulas from Hawkins and Rosenthal 1967, Thom 1967, Ruggles 1999 285, formulas A2.1, A5.1). Stellar attributions are based on the Smithsonian Institution's star catalogue data from 10 000 BC (see Liritzis and Vassiliou 2002), identified using in-house programs.

Azimuths were measured along side walls of the temple's layout. Due to disturbances in wall foundations as well as dipping of temples, azimuths carry a larger uncertainty. Magnetic correction from present day geomagnetic declination at the sites is +2° 36′ for Phigaleia and +2° 53′ for Aetolia.

Table 1: Temples of Apollo

Temple	Date	Location	Azimuth
Apollo Epicurean	c. 450–425 BC	Bassae, Phigaleia	2° 36′
Apollo Thermios	c. 630–610 BC	Aetolia	12° 53′
Apollo	600 BC	Thera (by Wilberg)	137°
Apollo	c. 366–320 BC	Delphoi	51°
Apollo	c. 1000 BC	Didyma, Asia Minor (v. Marees)	56° 25′
Apollo	c. 600 BC	Corinth (Penrose)	69° 10′
Apollo	350 BC	Delos (Nissen)	84° 45′
Apollo	600 BC	Syrakus (Penrose)	91° 45′
Apollo Pythius	c. 600 BC	Arta, Epirus	95°
Apollo	c. 550 BC	Selinunt (Penrose)	96° 40′
Apollo Pythius	3rd–2nd century BC	Rhodes Island	96° 48′
Apollo Lyk	c. 550 BC	Metapont (Penrose)	126° 39′
Apollo Lyk		Letoon (by v. Luschan)	153° 30′
Apollo Erethimius	c. 5th–4th century BC	Rhodes Island	242° 14′



1 (a): Azimuth distributions of Greek temples (Liritzis and Vassiliou 2002, 2003; Nissen 1906–10 in red). (b): Main azimuth distribution of 14 temples of Apollo in Greece and its colonies. The azimuth measurements were taken from the opposite side of the monuments' main entrances.

which is evident in the inscriptions found in the sanctuary, is the one associated with fire-worship. This theory is strengthened by the remains of the sacrificial offerings found during the excavations of Megaron B. Apollo Thermios was worshipped as the god of fire, and gave his name to the whole area. Elsewhere the same deity is found as Thermodon at Boeotia, Neoptolemos (Pyrrhos) at Delphi and Thermaeos at the Island of Crete, that is, ancient deities which later became heroes or other persons in mythology, e.g. the Thermidon river related to Amazons (Rhomaios 1932, Tzouvara-Souli 1991).

Ancient aurorae

Early accounts of phenomena that may be identified as auroral displays (aurorae are electrical discharge phenomena in low-density air) have been abstracted from reports of unusual celestial events in the classical literature. Aurorae were seen as precursors of terrestrial natural events and social incidents. In ancient Korea it was believed that the aurora was a kind of mysterious and divine light (Zhuwen Zhang 1983). The ancient prodigies of "sky fire" and "night suns" (and, more uncertainly, of "blood rain" and "milk rain") appear to be phenomena closely allied to each other, since they show virtually the same cyclical variation during the well-documented time interval 291–23 BC (Pliny the Elder in de Mairan 1733, Stothers 1979a,b).

Contextual arguments that support the contention that a given astronomical alignment of at least some Greek temples was in fact intentional, must be brought to bear. Indeed, an extensive catalogue of ancient aurorae, as well as quotations on temple orientation, is reported. Moreover, mathematical methods of analysing fragmentary time series of observations of aurorae and sunspot numbers have been used, at least since the fifth century BC, in various parts of the world with particular reference to Mediterranean and classical Greek literature.

Ancient reports for aurorae in Greece (e.g. in 479 BC Athens, 466 BC Athens, 372 BC all Greece, 348 BC all Greece, 343 BC near Corinth), include the following: Aristotle *Meteorologika* 371b–378a; Seneca *Quaestiones Naturales* Book I; Anaxagoras (fifth century BC) fragmentum 74 in Plutarch's *Moralia, Symposium* VIII 3, 3 722; Pliny the Elder in AD 77 in Livy's great annalistic history of Rome written between 27 BC and AD 17; while the word *selas* (meaning *aurorae)* is found in Homer's *Odyssey*, in assimilation contexts.

Aristotle's description is particularly interesting (*Meteorologica* Book I, Chapter Part 5):

"Sometimes on a clear night a number of appearances can be seen taking shape in the sky, such as 'chasms', 'trenches' and blood-

red colours. These again have the same cause. For we have shown that the upper air condenses and takes fire and that its combustion sometimes produces the appearance of a burning fire, sometimes of 'torches' or stars in motion; it is therefore to be expected that this same air in process of condensation should assume all sorts of colours. For light penetrating more feebly through a thicker medium, and the air when it permits reflection, will produce all sorts of colours, and particularly red and purple: for these colours are usually observed when fire-colour and white are superimposed and combined, as happens for instance in hot weather when the stars at their rising or setting appear red when seen through a smoky medium. The air will also produce the same effects by reflection, when the reflecting medium is such as to reproduce colour only and not shape. The cause of the brief duration of these phenomena is that the condensation lasts for a short time only. Chasms have an appearance of depth because the light breaks out from a dark blue or black background. Similar conditions often cause the fall of 'torches' when there is a greater degree of condensation: but while the process of contraction is going on a chasm appears. In general, white thrown on black produces a variety of colours, as does flame on smoke. In the day time the sun prevents their appearance, at night all other colours except red are lost because they provide no contrast with the background of darkness. These then must be assumed to be the causes of shooting stars and fires and of other such phenomena whose appearance is of brief duration."

Lucius Annaeus Seneca (4 BC–AD 54), in the first book of his treatises *Quaestiones Naturales*, quotes:

"Hear what I think about those fires which the atmosphere drives across the sky. They move obliquely at very high speeds, which is proof that they have been driven by a great force. It is obvious that they do not move on their own accord but are hurled. The fires have many different shapes," 14.1.

"It is time to consider, briefly, other atmospheric fires, of which there are various forms. At times a star flashes. At times there are glowing lights. These are sometimes stationary and sticking to one spot, sometimes whirling past. Many kinds of them are seen. There are bothyni: within a surrounding corona there is a great gap in the sky like a hole dug in a circle. There are pithiai: an enormous round mass of fire, like a barrel, either darts by or blazes in one place. There are chasmata: some area of the sky settles and, gaping in hiding – so to speak – sends out flame. The colours of all these are also very numerous: some are very bright red, some a pale and light flame, some a white light, some uniformly yellow and without outbursts or rays," Pref.17–1–3.

*"How, then, do they start? The fire is ignited by the friction of the air and propelled violently by a wind. Yet it is not always caused by wind or friction. Sometimes the fire is generated by certain favourable conditions in the atmosphere. For in the sky there are many elements, dry, hot, earthy, among which fire originates and flows down following after its own type of fuel; consequently, it moves at great speed. But why does it have various colours? Because it makes a difference what element is set ablaze and the quantity and force by which it is set on fire. Falling lights of this sort indicate wind; and, in fact, wind from the region where they started burning. You ask: 'The lights which Greeks call **sela** – how are they produced?' In many ways they say. It is possible for the force of the winds to produce them. The high temperature of the upper atmosphere can cause them. For since fire is extended far and wide there, it sometimes seizes the lower region if elements are suitably flammable,"* 14.5–15.1.

"Among these you may also include a phenomenon which we read about frequently in history: the sky seems to be on fire. Sometimes its glow is so high it appears to be actually among the stars. Sometimes it is so low that it gives the illusion of a fire some distance away. In the reign of Tiberius Caesar (AD 14–37) watchmen rushed to the aid of the colony at Ostia just as though it were ablaze, since throughout most of the night there had been a glow in the sky, dull, as of a thick smoky fire. Concerning these phenomena no-one doubts that they have the flame which they show; there is a definite substance to them," 15.5–6.

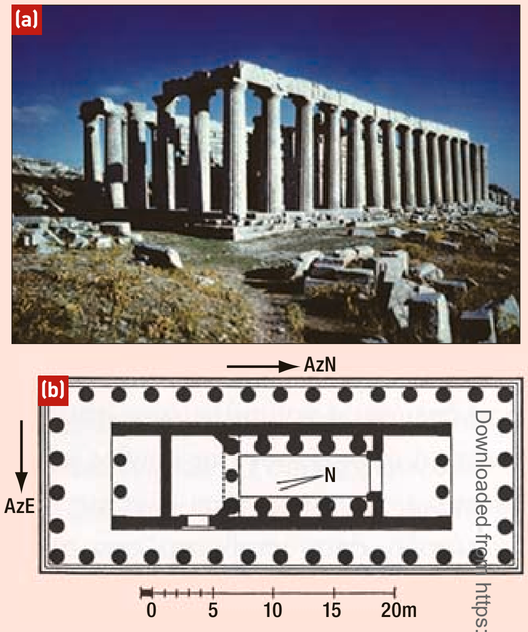
Similarly, Plutarch (AD 45–120), in his *Symposium (Table talks) Moralia* summarizes Anaxagora's (fifth century BC) sayings:

"So now I shall leave this argument of yours and cite Anaxagoras, who says that the air is moved by the sun with a quivering, vibrating motion, as is clear from the little bits and fragments always dancing in the sunlight, which some call motes (tilas). Anaxagoras says these, hissing and buzzing in the heat, by their noise make other sounds hard to hear in the daytime, but at night their dancing and their noise abate."

Here he is probably talking about wind that pulses from the Sun, moving along rays of light called *tilas* producing sound; it moves better at night (*Moralia* VIII 3, 3 722) (Liritzis 2003).

Modern reviews on ancient auroral occurrences (since the sixth century BC) from classical literature include those by Schove (1951, 1955), Stothers (1979a, b), and seventh century BC in China (Willis and Stephenson 2000, Silvermann 1998, NASA website).

The two temples

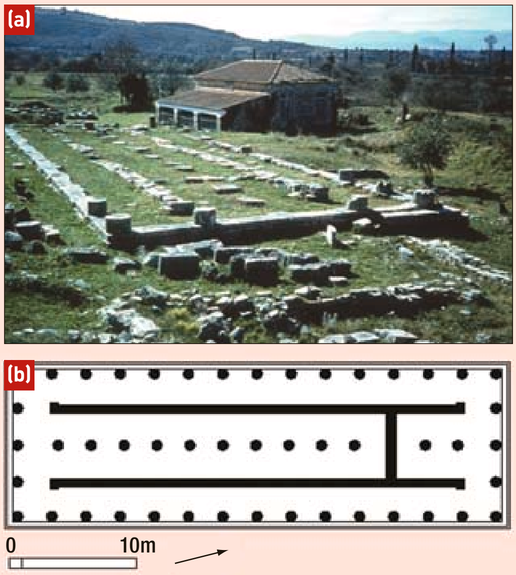


2 (a): Temple of Apollo Epicurean, at Bassae, Peloponesse. (http://www.culture.gr Odysseus copyright 1995–2001) (b): Plan of the temple. Azimuth directions along the two sides are shown with arrows. (Based on Kokkorou-Alevra 1991, Dinsmoor 1975)

Nevertheless, perceptions of the sky are culture-specific, and the present mode of explanation is pertinent to the Greek tradition. It is doubtlessly true that aurorae were caused in the past, as now, by the interaction of the solar wind with the Earth's upper atmosphere and magnetosphere. So the ancient auroral cycle can be directly equated with the ancient solar cycle, apart from a possible difference of phase. Although at northern geomagnetic latitudes the aurorae are frequent (several appearances per year), in low geomagnetic latitudes such as the northern Mediterranean rim regions, only an extremely rare aurora every few decades would have been easily seen, mainly when the geomagnetic pole inclined towards these regions. The geomagnetic poles move around geographical poles and the auroral bright oval formed round them moves accordingly. Great geomagnetic storms may cause aurorae in low latitudes, say as low as 35–39°N. In contemporary Greece aurorae have been reported by Greek and foreign scholars from the observatories in Athens and Corfu during the 1860s and the 1870s and in 1938 (Corfu), (Zoubos 1938).

Geomagnetic pole position

Archaeomagnetic inclination data support the notion that during the fifth century BC the geomagnetic pole inclined towards SE Mediterranean, i.e. including Greece (Keimatsu *et al.* 1968, Liritzis 1985). The geomagnetic pole position in the seventh and fifth centuries BC is inferred through archaeomagnetic and palaeo-



3 (a): Temple of Apollo Thermios at Thermae. (http://www.culture.gr, Odysseus, copyright 1995–2001) (b): Ground-plan of the temple. Geographical north is shown with the arrow. (Based on Dinsmoor 1975)

magnetic measurements.

Archaeomagnetic data include inclination (I) from Bulgarian kilns, giving for 600–500 BC, I = 63±4° and declination D = –2±7°, and for 500–400 BC, I = 59.6±4° and D = –4.5±1.5° (Kovacheva 1997, 1998). Transformation of I values to a common reduced latitude (London) gave for 400–300 BC I = 63±3°, and D = –10±10° (Liritzis1988, Liritzis and Xanthakis 1985). In fact a detailed time-series analysis of reduced to common latitude best global I values for the last 2000 years revealed periodicities of 1000, 500 and 260 years (Xanthakis and Liritzis 1989). This variation predicts D between 0 and –5° for 400 BC.

Evans (1992) measured I and D in sixth century BC Greek kilns, finding I ≥ 63.7° and D = –5° (=355°, west). Palaeomagnetic data include measurements from the Greek lakes Begoritis and Volvi (Papamarinopoulos 1978). Here inclination values are 63±3° for 400–300 BC, D = 0–6° for 600 BC, and D = 0° for 200 BC.

If the ancient orientation of these two temples was towards the northern lights, this must coincide approximately with the northern geomagnetic pole. The coincidence cannot be exact, because they are non-dipole sources, the local magnetic field must be taken into account, and these lights appear along a zone not as a bright point. For such an occurrence the difference (if both magnetic poles in the same side of geographical pole) or addition (if both geomagnetic poles in either side of geographical pole) between geomagnetic declinations today (Do) and those at the ancient construction date (Da), equals today's azimuth i.e.

$$Do \pm Da = Az \quad (1)$$

For Az = 0 the north geomagnetic pole positions are the same then and today.

Azimuth values for the two temples with a northern orientation are: Az_{epic} = –2±2° for 450–420 BC, and Az_{therm} = 3–12° (large uncertainty due to disturbed foundations) for 630–610 BC. Equation 1 gives for fourth and sixth–seventh centuries BC similar value of Do,a = –7±1.5° which coincides with Az within errors.

Northern orientation and aurorae

It is a happy accident of history that ancient civilization in Europe developed around low geomagnetic latitudes. For, if modern aurorae are admitted as a provisional guide to ancient ones, a small (but not negligible) number of aurorae are expected to have been easily visible in any decade down through the centuries at the low latitudes of the Mediterranean countries. In fact, at more southerly geomagnetic latitudes, only an extremely rare aurora every few decades would have been easily noticeable.

Naturally, only people at geographical latitudes within and at the boundaries of the auroral oval around the shifted geomagnetic pole would have seen these events. Thus, a comparable sky status could be shown between the fifth century BC observation of aurorae in Greece and the account of AD 937 at Loyang China (34° 46′N, 112° 26′E) (Keimatsu 1968) where the accounts says, "*the reddish veil 30 feet long appeared in the north, moved NNW to NWW, and back to NNE, like a flame. The tzu-wei-yuan and big-dipper stars could be seen through the reddish veil*". The tzu-wei-yuan is an old Chinese name for a constellation around the celestial north pole. It consists of more than 170 stars including those in Ursa Major, Ursa Minor, Draco, Cassiopeia, Cephus and others. It may be the type of aurora called a Stable Auroral Red (SAR) arc or mid-latitude red arcs, generally, that occur in mid-latitudes and have an east–west extension of thousands of kilometres and even possibly extend around the Earth. They occur most frequently near the equinoxes (around March and September).

For Epicurean Apollo the orientation to the east drawn from an additional eastern entrance to the temple, with Az = 98° 36′, corresponds to the rising Sun in early to mid-March or early October. On the other hand the northern direction relates to α, β UMa. For Thermios Apollo the northern direction points to ν UMa. No side doors are found. Therefore it seems that the period of auroral occurrence at least in Phigaleia, occurs according to the seasonal position of the Sun (early October and mid-March).

The correlation with the earlier Chinese report at Loyang between the auroral light and Big-Dipper (as well as Ursa Major, Ursa Minor and Draco), resembles with the sky status at Phigaleia and Aetolia, where the northern direction of the temples align with bright stars α Dra and α, β UMa (for Epicurean) and ν UMa (for Thermios).

Although other northern lights or zodiacal light may be suggested, the auroral incidence is most probable as only spectacular events associated with great magnetic storms could make a strong impression and attract the sort of notice that might lead to temple construction. Moreover, as mentioned above, several points lead to this inference, such as the epoch, association with stars, and the type of mid-latitude aurorae, as well as the inclination of the geomagnetic pole.

The northern orientation may be connected to the hyperborean epithet given to Apollo. The occurrence of these northern lights during a period of deliverance from the reported plague during 450–420 BC in Phigaleia might have lead local people to orient the temple towards these lights, as thanksgiving to their hyperborean god Apollo. It is worth mentioning that in both sites no topographical reasons forced the N–S orientation.

No reports refer to a cause of construction of the Thermios Apollo temple. However, taking into account the characteristic of fire in the epithet Thermios, it is possible to correlate with due caution the cult of Apollo at this place with the appearance of "fires" in the sky, and attribute to hyperborean Apollo is reasonable to relate for the same rationale to auroral lights.

Conclusion

The notion that the northern orientation of two temples of Apollo in Greece – Epicurean and Thermios – is related to aurorae borealis has a sound basis. Textual evidence, at least for Epicurean Apollo, refers to deliverance from a plague during the fifth century BC and local people built the temple as a thanksgiving to god Apollo. In addition the epithet "hyperborean" given to Apollo provides further support for the northerly orientation. The other Temple of Thermios Apollo (thermios meaning light, fire), of an earlier date, lacks textual evidence but may as well be related with the hyperborean Apollo, god of light and enlightenment. Aurorae are connected to omens during medieval time, but these impressive yet rare occurrences, as well as the god's representation of light, are strong elements in the northern orientation of these two temples. Furthermore, archaeomagnetic directional measurements for the two construction dates support an inclined geomagnetic pole towards Mediterranean, and in turn an auroral occurrence. ●

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Table 2: Astronomical orientation data with associated errors, for the two temples along different sides

Azimuth (Az), angular altitude of skyline (AAS), geographical latitude longitude, declination (δ), star attribution and date of sunrise. Magnetic declination correction was +2° 36′ for Epicurean and +2° 53′ for Thermios.

Temple	Azimuth	AAS	Lat./Long.	δ ± σ	Star	Sun
Apollo Epicurean, Bassae, Peloponnese c. 450–420 BC	N direction, from W long side = 358° (±2°), deviation of pillars 0–2°	15° (±1°)	37°25′45″ 21°54′0.4″ error = 5 m	67°17′ (±1°)	β UMa (−500) η Dra (−500) γ UMa (−500)	
	N direction, from E long side = 5°53′ (±3°)			66°14′ (±1°)		
	S direction, from E side = 187°6′ (±0.5°)			−52°37′ (±0.5°)	α Car (−500, −400) ε Car (−500, −400)	
	S direction, from E long side = 179°36′ (+0.5°)			−53°11′ (±0.5°)	α Car (−500, −400) ε Car (−500, −400)	
	S direction, from inner E wall = 180° (±0.5°)			−53°6′ (±1°)	α Car (−500, −400)	
	W direction, from S side = 276° (±0.2°)	0° (±0.2°)		4°9′ (±1°)	α Aql (−500, −400)	Sep. 4, 7, 9 or Apr. 2, 5, 7
	E direction, from S side = 98°36′ (±0.5°) (Penrose in Nissen's catalogue 1906–10, Az = 180°26′ towards S direction and Az = 270°26.6′ towards W direction)	4° (±0.2°)		−4°58′ (±0.5°)	δ Ori (−500) ε Ori (−400)	Oct. 2, 4, 6 or Mar. 7, 9, 10
Apollo Thermios Thermon, Aetoloacarnania c. 630–610 BC	N direction, from W long side = 1° (±1°) deviation of W long wall 0°–2° (± 0.5°)	10° (± 0.5°)	38°33′30″ 21°40′ error = 4 m	61°1′ (±0.5°)	ν UMa (−400)	
	N direction, from E long side = 12°53′ (± 0.5°)	10° (±0.5°)		58°56′ (±0.5°)		
	S direction, from W long side = 185°53′ (±0.5°) (Lykakis in Nissen's catalogue 1906–10, Az = 185° towards S)	9.5° (±0.5°)		−41°43′ (±0.5°)	γ Vel (−700, −600) α Psa (−700, −600) α Ara (−700) γ Cru (−700)	
	S direction, from E long side = 187°53′ (±0.5°)	9.5° (±0.5°)		−41°24′ (±0.5°)	α Psa (−700, −600) γ Vel (−700, −600)	
	W direction, from S short side = 277°53′ (±0.5°)	2° (±1°)		7°27′ (±0.5°)	α Tau (−700) β Ari (−600)	Sep. 2, 4, 6 or Apr. 6, 8, 10
	E direction, from S short side = 97°53′ (±0.5°)	34° (±0.5°)		14°55′ (±0.5°)	α And (−700) β Peg (−700)	Aug. 12, 13, 14 or Apr. 28, 29, 30

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