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Original article

New evidence from archaeoastronomy on Apollo oracles and Apollo-Asclepius related cult

Ioannis Liritzis[a,b,c,*], Evgenia Bousoulegka[c], Anne Nyquist[d], Belen Castro[c], Fahad Mutlaq Alotaibi[e], Androniki Drivaliari[f]

[a] Collaborative Innovation Center on Yellow River Civilization of Henan Province & Key Research Institute of Yellow River Civilization and Sustainable Development, Henan University, Henan, China
[b] King Saud University, Riyadh, Saudi Arabia
[c] University of the Aegean, Dept of Mediterranean Studies, Lab of Archaeometry, 1 Demokratias Str, Rhodes 85132, Greece
[d] Institute of Archaeology, Conservation and History, Faculty of Humanities, University of Oslo, Postbox 1008, Blindern, 0315 Oslo, Norway
[e] Dept of History, King Saud University, Riyadh, Saudi Arabia
[f] University of the Aegean, Department of Mediterranean Studies, Lab of Environmental Archaeology, 1 Demokratias Str, Rhodes 85132, Greece

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ABSTRACT

Apollonian temples with oracular function related to the cult of Apollo's son Asclepius, as well as, Asclepius temples, (both) appear to align with the heliacal rising of the constellation of the Crow (raven) by the sunrise of the Autumn Equinox. Some show to align with Ophiuchus, too. Both constellations are related with the mythological circle of the deities as a dual entity. This astronomical phenomenon is supported by myth, archaeological finds, historical texts, artistic representations and astronomical academic tradition. The seventeen temples-altars chosen for survey cover a major chronological and geographical area. Ten temples are of Apollo and seven are of Asclepius: the Pythios Apollon in Gortyna and associated Lebena Asclepius temple (Crete), the Apollo Maleatas and associated Altar within the Asclepeiion of Epidaurus, and the Asclepius temple of Epidaurus (Peloponnese, mainland Greece), Apollo Deiradiotes and an Asclepius temple close to the town of Argos (Peloponnese, mainland Greece), the temple and oracle of Apollo Clarios and Apollo Temple at Notion (Ionian coast, Asia Minor, Turkey), the Temple of Apollon Lairbenos (Phrygia, Asia Minor, Turkey), the Asclepius Temple, Apollo Kyparissios and an Antonine Apollo temple at the island of Kos, and Asclepius Temple with Apollo Oikos at Messene (southern Peloponnese). Most of the Asclepius Temples (healing centers) are associated with temples (some oracular), altars or worship houses of Apollo. In our analytical work, Apollo and Asclepius function as complementary dualities who corroborate on religious prophecy and healing. On cult sites associated with ceremonial healing and curative practice, the alignment of the temples show the use of star markers in architectural planning: astronomical signs associated with myths of the actual gods, prevail. Through present study, we have shown that intangible and tangible cultural heritage are connected. The astronomical orientation of the temples is studied for their azimuth, angular altitude of the horizon and celestial declination, through applied remote sensing techniques, making use of Google Earth maps and associated astronomical tools.

1. Introduction

The research on ancient temples, which are constructed based on both an astronomical orientation and astronomical horizon markers, has been a matter of interest within much research, and significant results have been made available in academic literature. Archaeoastronomical research around the world has shown that in planning ancient urban sites and building structures, traditional historic and prehistoric cultures have incorporated astronomical alignments of calendrical or sacred ritual importance with vast influence and social impact [1,2]. Alignments to the solstices, the equinoxes, and to the major standstills of the moon and bright stars, constellations and planets have been demonstrated or suggested, while it has been shown to have been important for some societies [3–5]. The ancient learned Greeks used the first and last visible risings and settings of particular stars at dawn and dusk as 'event markers', in order to signal the appropriate time for pivotal activities, especially in the agricultural sphere, such as ploughing, sowing and harvesting, but cult ceremonies, too [6–8].

* Corresponding author. University of the Aegean, Dept of Mediterranean Studies, Lab of Archaeometry, 1 Demokratias Str, 85132 Rhodes, Greece.
E-mail address: liritzis@rhodes.aegean.gr (I. Liritzis).

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Fig. 1. Sites of Apollo and Asclepius Temples studied.

Astronomy, landscape and symbolism in field studies concerning orientation has been reported for ancient temples in the World; in particular, for Apollo Temples (either as oracles or place of cult) in Greece and ancient Hellenic world in the wider eastern Mediterranean region, the intentional orientation has been proposed and documented [3,6,9–15].

Ancient writers refer to the connection between astronomy, geometry and philosophy in choosing the right places to build their institutions and dwelling sites, excepting those temples which are assigned a special place apart by the law or else by some utterance of the Pythian oracle in Delphi (Aristotle, Strabo) (see e-supplement).

Following up our earlier work of the astronomical relationship between the main Apollonian oracles and cult Temples in mainland Greece and Asia Minor [13,15], our new research moved on to other less renowned temples and oracles dedicated to the curing cult of Apollo, that is Apollonian temples with oracular function related to the cult of Apollo's son Asclepius, god of medicine and healing. In general, the Apollo temples had a variant role in some places; consultation on cases and outbreaks of plague, but also delegation of curing of several other diseases to Asclepius after a preliminary oracular response (Claros) or an exacting of a punishment in the form of disease (Apollo Lairbenos).

The measurements were made by means of remote sensing of Google Earth via appropriate astronomical software. The studied temples are: Apollo Maleatas and the Asclipeiion at Epidaurus, Apollo Oikos and Asclepius Temple at Messene (both at Peloponnese), the Asclepieion and two Apollo temples (Kos), the Apollo temple at Claros (Asia Minor), the Apollo Pythios and Lebena and Asclepius temple (Gortyna, Crete), the Apollo Lairbenos temple (Phrygia, Asia Minor), Apollo Deiradiotos and the Asclepius temple (Argos, Peloponnese) (Fig. 1). These ones are the most well excavated and archaeologically well documented. Similar cases in colonies are another study in progress.

Before presenting our results, a brief report on the deities and associated mythology is necessary, to place the project within the frame of intangible cultural heritage, connected however, as we show, to tangible (the temples) cultural heritage with due hermeneutics.

2. Apollo, Asclepius and the mythology of raven

Apollo and Asclepius are father and son. Their relationship to the raven is linked with the myth of Asclepius' birth. The versions differ as to Asclepius' birthplace and origin; Homer (ca. 800 BC) (Illiad II, 729–731; IV, 192–194, 219; XI, 517–518), Hesiod (ca. 700–600 BC) and Strabo (ca. BC 64–AD 24) (Strab. IX.437, XIV.647) give Thessaly, the poet Isyllos that of Epidaurus (3rd–4th century BC). The parents are still Apollo and Koronis ([16]: 14). Pausanias (2nd century AD) believed that Epidaurus was the birthplace, since other Asclepius-sanctuaries were built on the Epidaurean model (Paus. II, 26.3–5, 6–9).

According to Greek mythology when the Raven or crow (Apollo's messenger and secret bird in Greek mythology) informs the god that his beloved princess Koronis (name that in Greek is also been related with the raven) has a mortal lover, Ischys. Then, Apollo enraged for the bad news and also because the bird did nothing to stop this happening, flung a curse on it, scorching the raven's feathers. That is why, the legend goes, all ravens are black. Apollo then sent his sister Artemis to kill Koronis. Before Koronis' body was burned, the unborn child, Asclepius, was cut out of her womb and given to the centaur Chiron to raise. This happens in Thessaly [17]. Another legend associated with *Corvus* is that a crow stopped on his way to fetch water for Apollo, to eat figs. Instead of telling the truth to Apollo, he lied and said that a snake, Hydra, kept him from the water, while holding a snake in his talons as proof. Apollo, saw through the fraud, and angrily flung the crow (Corvus), cup (Crater), and snake (Hydra) into the sky. He further punished the wayward bird by ensuring it would forever be thirsty, both in real life and in the heavens, where the Cup is just out of reach [18]. These three become the known asterisms – hydra, crater and corvus – close each other to the sky (see e-supplement).

Asclepius grew up to be a famous healer soon becomes a renowned physician to the point to become able to resurrect the dead and is represented by the constellation *Ophiuchus*, the serpent-bearer (Hyginus, *Astronomica* 2.14, 2.40 Latin Mythography 2nd century AD) and his symbol a rod with serpent-entwined (see e-supplement). Asclepius skills of resurrection enrage Zeus since mortals should not achieve immortality, a privilege reserved to the gods. He accordingly kills Asclepius with a thunderbolt. After his death, Asclepius passes through an apotheosis becomes divine, as well, and so he is venerated in temples and sanctuaries related to healing procedures. Asclepius having half mortal nature does not allow him to be worshiped in the absence or mentorship of his mighty father Apollo. Asclepieia were institutions, where, physicians and priests were curing their patients, trying to systematize medicine and teaching other people the art of healing. It was also the temple of the gods who in one-way or another were concerned. He was also the patron god, and reputed ancestor, of the *Asclepiades*, the ancient guild of doctors.

Asclepius, further, was the patron god, and reputed ancestor, of the *Asclepiades*, the ancient guild of doctors ([19]: 375; [20]: 269; [21]: 72; [22]: 303–338).

Apollo had until classical times been the healing god par excellence, but this aspect of his powers was effaced during the 7th or 6th century BC ([23]: 18–19). Thus, Apollo as a healer was before (and above) Asclepius.

3. The archaeology of the studied temples

3.1. Apollo Maleatas and Asclepius at Epidaurus (Peloponnese)

Dedications at Maleatas Temple of Apollo include votive bronze double axes, bronze swords, and clay animal figurines. There is evidence for cult activity in the Geometric period and also certainly of a double sanctuary belonging to both Apollo and his son Asclepius. Apollo has here the surname Maleatas a local deity from the name of the Argolid king Maleas whose granddaughter Koronis is Asclepius' mother. Apollo was first worshiped as healing deity

since the temple of Maleatas is older than the Asclipieion (sanctuary of Asclepius). Even after the huge sanctuary to Asclepius was built the temple of Apollo never ceased to work. Both sanctuaries evolved alongside. Supported archaeological evidence exists ([24]: 7–8; [25,26]).

The Apollo Maleatas temple is excavated and there are bronzes and ceramics from the 7th and 6th century, which testifies his cult from at least the 7th century BC ([24]: 3, 9–10, 62; [27]: 382). On the eastern side of the Temple, a Classical period sanctuary of Apollo was build. In the healing stelae of the Asclepieion, Asclepius is praised alongside Apollo Maleatas up until the 3rd century AD ([24]: 78). This may imply that Maleatas was the origin, although it does not exclude an additional Asclepean relation with Pythian Apollo of the sanctuary, obviously due to some connection to the Delphic Pythios Apollo. At least as early as 400 BC, Leto and Artemis were worshipped with Pythian Apollo below the mountain ([23]: 47; IG IV2 I, 40).

The earliest archaeological traces of the Asclepius cult are dated to the middle of the 6th c. BC ([24]: 10), and in a building near the temple, there are (epigraphical) dedications to Apollo and Asclepius dated to the end of the 6th and the beginning of the 5th c. BC. This building had one or two rooms of cult, and at least one were of Apollo. The rest of the building was the area's first *abaton* (dreams, prescriptions, cures) ([28]: 383, 390). However, as late as the beginning of the 5th c. BC, Asclepius only had an altar and an *abaton* within Apollo's domain below the mountain ([24]: 3).

Regarding the connection of Apollo and Asclepius and their roles, any pilgrim who addresses Asclepius in Epidauros, would first make an offering to Apollo on Mount Kynortion. An inscription of the 4th cent. BC, found within the Apollo sanctuary, informs that all visitors to Asclepius should do offers to Apollo before appealing to Asclepius for healing ([24]: 3, 9). Existing inscriptions confirm that both deities were functioning for therapeutical reasons. ([24]: 3, 72, 78; [27]: 366).

3.2. Apollo at Gortyna and Ascepius at Lebena (Crete)

Gortyna in Messara, Crete, is one of the oldest of all Apollonian oracular temples maybe even older than Delphi itself. The archaeological finds indeed confirm an early date for the practice of the sanctuary at Gortyna. The temple was excavated towards the end of the 19th century, and inscriptions give a *terminus ante quem* to the second half of the 7th cent. BC for the Temple of Pythian Apollo ([29]: 57, 113–116). However, the *cella* clad with metal plates, can be grouped chronologically with even more ancient buildings, like those of Orchomenos and Mycenae in Late Helladic times. It recalls constructions of the Homeric age, and it is evident that it is quite older than the 7th century BC ([29]: 25, 111–112) (Fig. 2).

It operated earlier that the Asclepius cult by at least three centuries. Although Gortyna had an oracle of its own, the city contacted the oracle of Claros when plague hit the area ([29]: 57). The Asclepius sanctuary is at nearby Lebena, with the temple not earlier than the 4th century BC. No healing abilities are specifically recorded for Pythian Apollo but Apollo and Asclepius shared a responsibility over judiciary and legal matters ([30]: 63–64). Apollo and Asclepius of Gortyna seem to have functioned as a divine pair/couple with a shared responsibility of justice and order, resembling in this sense Apollo Lairbenos. In connection with cures at the Asklepieion at Lebena, Apollo was thanked ([31]: 169).

3.3. Apollo Lairbenos (Phrygia, Asia Minor) (see e-supplement)

The inscriptions and numismatic evidence are between 30 BC and 300 AD, and the monumental construction of the sanctuary takes place between the end of the 1st and the beginning of the 2nd century AD ([32]: 4). Lairbenos is a youthful Anatolian god, often represented on horseback, with a cape and the double-headed axe ([32]: 3). This god was subsequently identified with Helios Apollo and considered as a prophet and a physician ([33]: 356) by the Hellenized populations.

The Apollon Lairbenos sanctuary is related to Meter Leto, Asklepios, Hygeia and Mên ([34]: 78–79, note 5). The healing nature of the site seems to have started off already with the realtion to the cult of the Phrygian lunar deity Mên, a deity associated by the Greeks with Asklepios, Apollo and healing ([33]: 356–357).

The numismatic evidence from Hierapolis shows the double-headed axe of Apollo Lairbenos with Asclepius' snake encircled around it. These coins link Apollon Lairbenos to the healing cult of Asklepios ([34]: 78–79, note 5). Besides, connected with the Apollo temple was "a sacred precinct where one could not go in an impure condition without suffering divine retribution which often appeared as a physical ailment" ([35]: 67).

On atonement inscriptions of Apollo Lairbenos, the dedicator confessed the sin committed. The consultations resulted in a punishment, often in the form of a disease afflicted on them. The sinner declares to have atoned and to have been healed, praises the god and reminds others to keep his example in mind ([32]: 12, 20).

Based on these inscriptions, it seems reasonable to assume a division of roles between Apollo and Asclepius, where Apollon exacted a punishment, while Asclepius (possibly also Hygeia and/or Mên) cured the sinners after atonement. The temple at its current state is of 100 AD.

3.4. Apollo at Claros

There is a rich store at Apollonian Claros of legendary references, which date from the 7th c. BC at the latest. The temple at Claros was the site of an oracle, probably from the archaic period ([36]: 117, 126), but excavations show that at the end of the 4th century BC, work had begun on constructing the temple, with notable reconstructions during the 1st c. AD ([36]: 129, 134).

The oracle gave advice, at times quite specific and detailed. It clearly dealt with other matters than health and physical well-being. But it is evident that the Apollo sanctuary had an authority when it came to the delegation of healing to Asclepieia elsewhere and when it came to dealing with major diseases. Epigraphical evidence reveals that Apollo was the warder-off-of-evils, the great banisher (and bringer) of pestilence. He held a special authority when it came to handling outbreaks of plague, and in fact, Asclepius alone, it seems, could not cure this affliction ([37]: 64–65). Other cases of disease were healed by Asclepius ([36]: 147, 150–157; [38]: 94–98).

So, although the written sources do not clearly indicate Claros as a place of worship of Asclepius, Apollo Clarius quite clearly had a close relation to Asclepius the healer and/or to healing in general. An indirect trace of medical activity is a group of medical and surgical instruments found near Kolophon in 1911 ([39]: 114–118). Claros excavations show that at the end of the 4th century BC, work had begun on constructing the Apollo temple which was to remain in general plan the building down to the end of its history ([36]: 129, 134). The fact that this change happens in the 4th century, the century of the growth of the Asclepius cult, may strengthen our case that there is a cooperating healing cult/strong connection also here between Apollo and Asclepius (as already supported by other signs/proof of strong connection).

The Apollo oracle of Claros calls Asclepius his beloved/favourite son in an inscription of the Asklepiastes at Kolophon. The inscription/decree of this fraternity of Asclepius-devotees was found on the Acropolis of Notion (Kolophon South). This means (most probably) that there is a close and cordial connection a cooperation

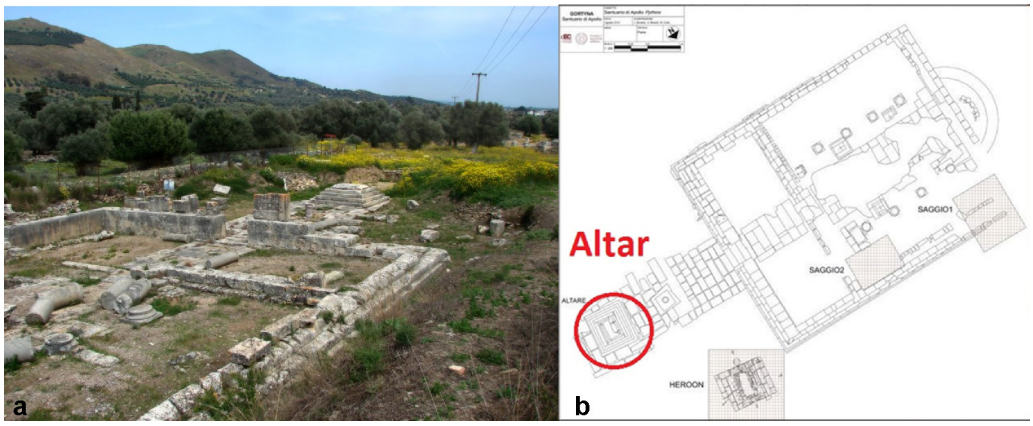

Fig. 2. Gortyna, (a) foundations of the Temple of Apollo, and (b) an altar in front of the entrance. Orientation measurements were taken along the parallel sidewalls due east (and west) from Google earth.
From [69,70].

between Apollo at Claros and Asclepius at Kolophon (Notion) ([19]: 375; [40]: 195–196).

3.5. Apollo Deiradiotes, Argos

There are two sanctuaries of Apollo in Argos, the temple of Apollo Lykeios ([41]: 97–98; Pausanias: 2.23.4) and the official cult of Apollo Pythaeus (Deiradiotes) ([42]: 360; [41]: 93).

The Deiradiotis sanctuary dates to the period between the 9th or 8th c. BC until between the 3rd and 4th c. AD ([42]: 360).

When Pythian Apollo was brought into Argos by Dorians, a location for his cult was chosen at the sanctuary of the Mycenaean acropolis (Larisa) ([41]: 101). An inscription proves that the Deiradiotes cult, like the one in Delphi had an *omphalus*, a symbol of the 'navel' of the earth (ΓΑΣ ὀμφαλός /earth omphalus) ([42]: 360).

The placing of Asclepius in connection with the Apollo Deiradiotes sanctuary is highly uncertain. It is nevertheless possible that Asclepius had his place in the courtyard building in the Apollo sanctuary in that building or nearby in the Apollo sanctuary. In the square cistern (a type not found before the end of the 4th c. BC) that lay under the court of the courtyard building, a statuette of Asclepius was discovered ([43]: 23). Furthermore, the type of oracle used in a cistern of the sanctuary, where an object gave an answer by sinking or floating, is archaeologically proven to be the same as in Epidaurus ([41]: 94–96), the best known example of a joint sanctuary of Apollo and Asclepius. It is possible to propose that Asclepius was introduced at the sanctuary in the 4th century BC, based on the find of the statuette in the cistern of the courtroom building of the Apollo Deiradiotes sanctuary, and there may have been a division of tasks of healing.

3.6. Apollo and Asclepius at Kos

The sanctuary of Asclepius was established in the cypress-grove already sacred to Apollo Kyparissios (Apollo of the cypress-grove), and in the 5th c. BC, there was an altar and possibly a small temple of Apollon Kyparissios ([23]: 47; [44]: 249; [45]: XI, 75; [46]). During the 4th century BC, Asclepius appropriated the shrine, firstly with an altar. An epigram, probably of the 4th century BC, refers to *Paianos* of the grove, who may be either Apollo or Asclepius, in a time of transition ([47]: 179; IC 43; [48]: 691–695). In Homer, *Paian* was the name of the physician of the gods (Homer Il. 5.401; Od. 4.232). Surgical instruments were found in the Koan Asclepieion, either connected with dedications (ritual use) or with medical activity (practical use) ([47]: 121; [49]: 167). Both Asclepius and Apollo were thanked for cures ([23]: 47; [31]: 169; [44]: 249; [50]: 216) and a joint cult of Asclepius and Apollo Kyparissios is attested in a *lex sacrae* from the 4th or early 3rd century BC ([51]: 12).

Both Asclepius and Apollo were thanked for cures ([31]: 169; [44]: 249; [23]: 47; [31]: 169; [50]: 216) and a joint cult of Asclepius and Apollo Kyparissios is attested in a *lex sacrae* from the 4th or early 3rd century BC ([51]: 12). So far, a temple to Apollo is attested only epigraphically. On the middle terrace, the level of temple B and C, there was a hydrotherapeutical medical center. The site had thermal baths and a complicated piping system which provided the location with a constant supply of pure water from springs. The Asclepius temple A of the upper terrace was dated to the 2nd century BC, the earlier Asclepius temple Bto ca. 350 BC and the Roman (Antonine) Apollo temple C to ca. 200 AD ([45]: 3–13, 34–39, 42–48, 75; [52]: 98, 209, fig. 414; [50]: 216).

3.7. Messene

The Asclepieion here is occupied by the imposing temple and its large altar. The sanctuary initially of the 6th–7th century BC and many offerings were found in the sanctuary aptly implying Asclepius as a healer and that the rite of incubation could be performed. During Hellenistic and later times, no dedications appropriate to healing were found that suggests Asclepius was a civic deity [53].

Later, in 369 BC, Messene was re-founded by Thebans. The temple was incorporated in the new city, then later renovated and extended during the Hellenistic era (4th or 3rd century BC). In Messene, there is another version of the Asklepios birth myth. The tradition for Messene, is that Arsinoe is Asklepius' mother, instead of Koronis (Pausanias, Description of Greece 4.3.2: "For they say that the sons of Asclepius who went to Troy were Messenians, Asklepius being the son of Arsinoe, daughter of Leucippus. . .") [54,55]. The Apollo Oikos was a building west of the Asclepius temple with an Apollo statue and evidence of the nine Muses [53].

4. Methodology and measurements

4.1. The temples and methodology

Seventeen monuments are studied, ten Apollo and seven accompanying Asclepius temples (Fig. 1). We have followed our published procedure of applied remote sensing techniques making use of the Google Earth maps [15,56].

Errors in Google earth compass tools computations with regards to in situ readings for azimuth and angular altitude is ± 1–2° (see also [15]). Results are given in Table 1.

Table 1
Apollo and Asclepius Temples (Epidauros–Gortyna/Lebena). The Earth's axis rotates slowly westward about the poles of the ecliptic, completing one circuit in about 26,000 years. This effect, known as precession, causes the coordinates of stationary celestial objects to change continuously, but slowly. Therefore, equatorial coordinates (including declination) are inherently relative to the year of their observation, and astronomers specify them with reference to a particular year.

	Epidauros							
Location	Epidauros, Peloponnese (Greece)							
	Apollo Maleatas (700 BC)/Altar of Apollo Maleata (380 BC)				Asclepius (380 BC)			
Geographical latitude	37°35′57.94″/37°35′57.77″				37°35′57.94″			
Geographical longitude	23°05′07.63″/23°05′08.39″				23°05′07.63″			
Azimuth	91° ± 2[a]/104 ± 22[a]		271° ± 2[b]/283° ± 2[b]		80° ± 1[a]		259° ± 1[b]	
Altitude	424 m/425 m				325 m			
AAS	8° 20 8° ± 2[a] 8° ± 2[a]/8° ± 2[a]		1° ± 2[b]/1° ± 2[b]		7° ± 1[a]		2° ± 1[b]	
Apparent declination, δ[e]	+4° ± 2[a]/−6 ± 2[a]		+1° ± 2[b]/+11° ± 2[b]		+12° ± 1[a]		−7° ± 1[b]	
Sunrise/sunset	17 September[a]/12 October[a]	5 April[a]/11 March[a]	24 September[b,c]/31 August	29 Mar[b]/22 April[b]	27 August[a]	27 April[a]	16 October[b]	6 March[b]
Constellation	(Hydra)[a]/Corvus[a]	(Pegasus)[a] Ophiuchus[d]/(Aspis)[a]	Ophiuchus[b,c]/(Virgo)[b]	−[b]/−[b]	(Sextant)[a]	(Pegasus)[a]	Ophiuchus[b]	(Cetus)[b]
	Gortyna/Lebena							
Location	Crete (Greece)							
	Pythios Apollo (650 BC)				Asclepius (400 BC)			
Geographical latitude	35°03′33.88″				34° 55′55.85″			
Geographical longitude	24°56′59.78″				24°55′26.83″			
Azimuth	98° ± 1[a]		278° ± 1[b]		95° ± 2[a]		275 ± 2°[b]	
Altitude	159 m				34 m			
AAS	0° ± 1		2° ± 1[b]		2° ± 1[a]		2° ± 1[b]	
Apparent declination, δ[e]	−7° ± [a]		+7° ± 1[b]		−3° ± 1[a]		+5° ± 1[b]	
Sunrise/sunset	17 October[a]	10 March[a]	11 September[b]	16 April[b]	7 October[a]	7 March[a]	14 September[b]	8 April[b]
Constellation	Corvus[a]	(Pisces)[a]	(Virgo)[b]	(Taurus)[b]	Corvus[a]	(Pegasus)[a]	(Virgo)[b]	(Taurus)[b]

[a] Sunrise.
[b] Sunset.
[c] Autumnal equinox 28 September 380 BC, most conspicuous target.
[d] At 21.36 pm.
[e] Declination (astronomical).

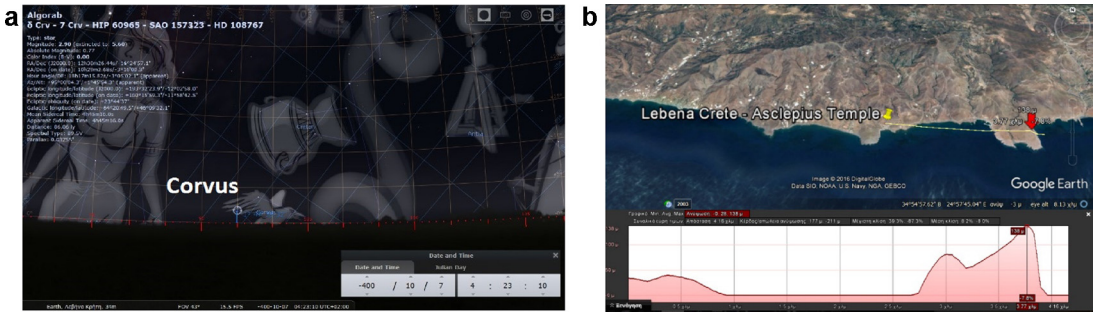

Fig. 3. Crete. Labena Asclepius temple, (a) Heliacal rising of crow 7th October 400 BC at 4 h 23′ am, (b) alignment to the east and topography with horizon altitude ~1.5°.

The measurements of orientation have been conducted by means of remote sensing for its geographical position (φ, λ), azimuth (Az) and angular altitude of skyline (AAS), guided strictly by the relevant published excavation reports. For the geographical coordinates and AAS, Google Earth and its different applications for altitude calculation and compass tools were applied. In Google Earth images, the alignment along the foundation walls is drawn traced towards the eastern facades and western direction as well, extrapolated to the furthest horizon point. The foundations from Google maps provide satisfactory image, though occasionally blurred. On the other hand, the compass tool is applied for the calculation of the Az of the monuments.

Using the application for slope calculation one can see the relief of the landscape in front of the temple and following the straight line the highest point of the horizon is computed, while this application also provides the slope percentage and altitude, which allows the calculation of the AAS. Several lines were drawn to find the average Az. Some representative estimations and images are given in Figs. 3–6 for Lebena, Gortyna, Claros, Epidaurus (more images see e-supplement).

Using azimuth and slope calculations with the appropriate astronomical software i.e. stellarium 12 and starry night, respective skyscapes were produced. The orientations of temples have been used to produce celestial declinations using the command-driven DOS program GETDEC created by Prof. Clive Ruggles http://www. le.ac.uk/archaeology/rug/aa/progs/decpak.html, which makes corrections for atmospheric refraction and extinction, and in our case of remote sensing measurement without needing magnetic correction (as the magnetic compass does) (Tables 1–4). This means that each celestial declination obtained is specific to the particular horizon and location and time, due to precession [13,15].

4.2. Measurements

Azimuths, Az (max errors ± 2°), AAS (errors ± 2°) and celestial declinations for Apollo temples in the eastern direction vary between 60° and 109°, 0° and 12°, and −27° and +24°, respectively; and for Asclepius 80° to 111°, 1° to 9° and +12° to −16°, respectively. Sunset declinations varied between −21° and +31° for Apollo and +25° and −2° for Asclepius Temples.

The 5° width of *Corvus* star configuration in the sky consists of the five brightest stars. The orientation marks the horizon point intersected by the celestial declination, the azimuth and angular altitude of horizon. Within an error of 1–2° in Az and AAS, the calculated declination coincides with the brightest gamma and delta stars of Corvus.

The characteristic eastern alignment to *Corvus* is of uttermost importance, as it echoes the mythological traits of both deities and

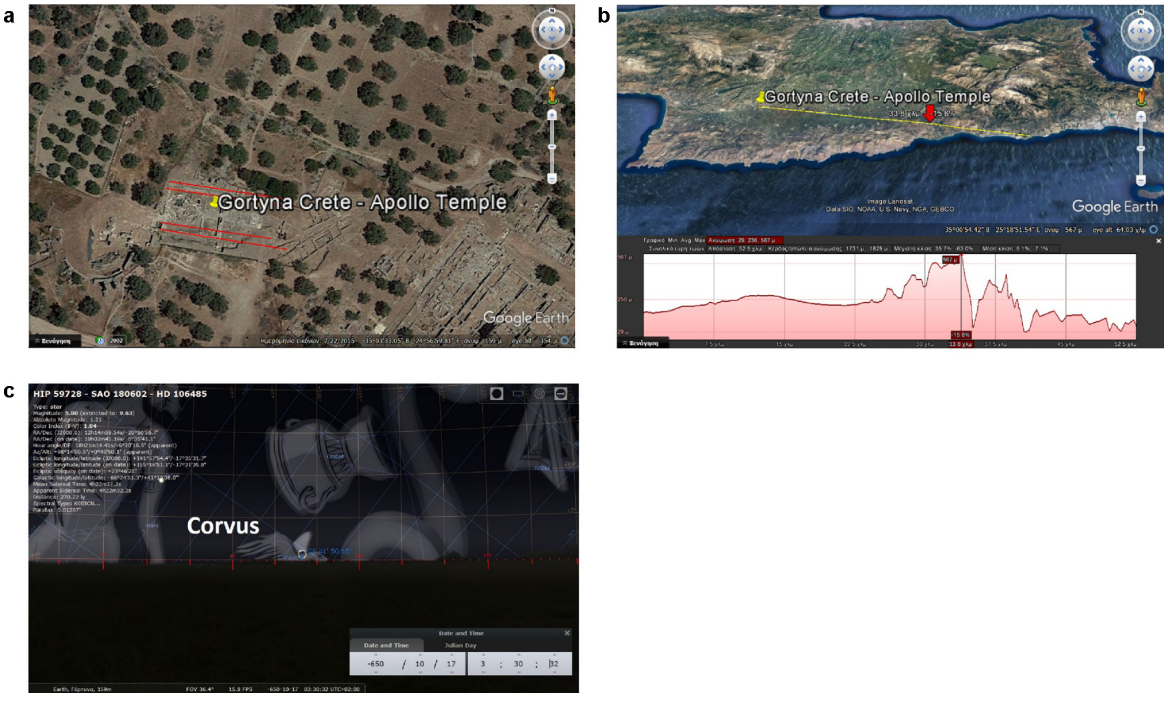

Fig. 4. Crete. (a) Gortyna Pythian Apollo and related alignments, (b) orientation due east and topography-horizon, (c) heliacal rising of craw 17 Oct 650 BC at 3 h 30′ am at near flat horizon.

Table 2
Apollo and Asclepius Temples (Argos–Messene).

Location	Argos							
	Argos, Peloponnese (Greece)[e]							
	Apollo Deiradiotis (650 BC)				Asclepius (200 BC)/Asclepius (400 BC)[c]			
Geographical latitude	37°38′31.03″				37°37′51.86″			
Geographical longitude	22°43′13.56″				22°43′12.31″			
Azimuth	95° ± 1[a]		275° ± 1[b]		111° ± 2 [a]/94° ± 1[a]		291° ± 2[b]/274° ± 1[b]	
Altitude	76 m				17 m/78 m			
AAS	1° ± 1[a]		5° ± 1[b]		1° ± 1[a]/1° ± 1[a]		14° ± 1[b]/14° ± 1[b]	
Apparent declination	−3° ± 1[a]		+7° ± 1[b]		−16° ± 1[a]/−2° ± 1[a]		+25° ± 1[b]/+25° ± 1[b]	
Sunrise[a]/sunset[b]	9 October[a]	19 March[a]	15 April[b]	12 September[b]	10 November[a]/4 October[a]	8 February[a]/19 March[a]	27 June[b]/27 June[b]	5 July[b]/–[b]
Constellation	Corvus[a]	(Pegasus)[a]	–[b]	–[b]	–[b]/Corvus[a]	Ophiuchus[a]/(Pegasus)[a]	(Leon)[b]/(Leon)[b]	(Leon) [b]/–[b]
	Messene							
Location	Messene, Peloponnese (Greece)[d]							
	Apollo (350 BC)				Asclepius (350 BC)[d]			
Geographical latitude	37°10′32.00″				37°10′32.13″			
Geographical longitude	21°55′12.23″				21°55′13.75″			
Azimuth	109° ± 1[a]		288° ± 1[b]		109° ± 1[a]		289° ± 1[b]	
Altitude	322 m				322 m			
AAS	7° ± 1[a]		5° ± 1[b]		9° ± 1[a]		4° ± 1[b]	
Apparent declination	−10° ± 1[a]		17 ± 1[b]		−9° ± 1[a]		+17° ± 1[b]	
Sunrise[a]/sunset[b]	24 October[a]	27 February[a]	10 August[b]	15 May[b]	20 October[a]	2 March[a]	10 August[b]	14 May[b]
Constellation	Corvus[a]	(Aquarius) Ophiuchus[a]	(Virgo)[b]	(Gemini)[b]	Corvus[a]	(Aquarius) Ophiuchus[a]	(Virgo)[b]	(Gemini)[b]

[a] Sunrise.
[b] Sunset.
[c] Roux (1957: 476 (fig. 1), 483, 486) argues that the peristyle courtyard building is the Asklepieion (square cistern).
[d] Archaic period (7th–6th BC): first phase of the sanctuary (according to [53]). The Messene town was built on the basis of the Hippodamean planning system with a regular NE grid. Asclepieion and Apollo Oikos differ both however orientated intentionally due east.
[e] Corvus' heliacal rising is for Apollo and heliacal setting for Asclepius 200 BC, latter's heliacal rising is Ophiuchus.

Table 3
Apollo Temples (Claros and Lairbenos).

Location	Claros				Lairbenos				Notion			
	Ionian coast, Asia Minor, (Turkey)				Phrygia, Asia Minor, (Turkey)				Ionia, Asia Minor, (Turkey)			
	Apollo (650 BC)				Apollo (100 AD)				Apollo (400 BC)			
Geographical latitude	38°00′18.10″				38°12′52.98″				37°59′33.68″			
Geographical longitude	27°11′35.13″				29°16′50.53″				27°11′43.00″			
Azimuth	108° ± 1[a]		287 ± 1[b]		107° ± 2[a]		287° ± 2[b]		93° ± 2[a]		273° ± 2[b]	
Altitude	6 m				627 m				61 m			
AAS	12° ± 0.5[a]		8° ± 1[b]		4° ± 1[a]		0° ± 1[b]		2° ± 2[a]		4° ± 2[b]	
Apparent declination	−6° ± 0.5[a]		+19° ± 1[b]		−11° ± 1[a]		+13° ± 1[b]		−1° ± 2[a]		+4° ± 2[b]	
Sunrise/sunset	16 October[a]	12 March[a] before the sunrise (Pisces)	7 August[b]	22May[b]	24 October[a]	24 February[a]	24 August[b]	26 April[b]	30 September[a,c]	23 March[a]	17 September[b]	5 April[b]
Constellation	Corvus[a]	(Aquila)[a]	(Virgo)[b]	–[b]	Corvus[a]	(Aquarius) Ophiuchus[1]	(Virgo)[b]	[b]	Corvus[a]	(Pegasus) Ophiuchus[a]	Ophiuchus[b]	(Orion)[b]

[a] Sunrise.
[b] Sunset.
[c] Autumnal equinox 400 BC.

Table 4
Apollo Temple and Asclepius Temple (Kos).

Location	KOS							
	Kos (Greece)							
	Apollo (300 BC)[g]/Apollo (200 AD)[c]				Asclepius (200 BC)/Asclepius (300 BC)[d] – Apollo Kyparissios			
Geographical latitude	36°46′40.95″/36°52′32.44″				36°52′30.96″/36°52′33.00″			
Geographical longitude	27°08′15.17″/27°15′26.02″				27°15′24.24″/27°15′24.66″			
Azimuth[h]	60° ± 2[a]/130° ± 1[a]		240° ± 2[b]/310° ± 1[b]		109° ± 2[a]/111 ± 2[a]		289° ± 2[b]/290° ± 2[b]	
Altitude	14 m/95 m				104 m/95 m			
AAS[i]	1° ± 1[a]/5 ± 1[a]		4° ± 1[b]/0° ± 1[b]		3° ± 1 [a]/4° ± 2[a]		0° ± 1[b]/0° ± 2[b]	
Apparent declination	+24° ± 1[a]/–27 ± 1[a]		–21° ± 1[b]/+31° ± 1[b]		–13° ± 1[a]/–14° ± 2[a]		+15° ± 1[b]/+16° ± 2[b]	
Sunrise/sunset	21 June[a,e]/21 December[a,f]	1 July[a]/–[a]	28 November[b]/22 June[b]	21 January[b]/–[b]	1 November[a]/4 November[a]	17 February[a]/15 February[a]	16 August[b]/14 August[b]	5 May[b]/9 May[b]
Constellation	(Auriga)[a]/Scorpion[a]	(Gemini)[a]/–	[b]/(Leon)[b]	(Aquarius)[b]–	Corvus[a]/Corvus[a]	(Aspis)[a] Ophiuchus[a]/Ophiuchus[a]	(Virgo)[b]/(Virgo)[b] Ophiuchus[b]	(Orion)[b]/(Orion)[b]

[a] Sunrise.
[b] Sunset.
[c] The Roman Temple C of Apollo (Antonine) ([45]: 42–48, 75; [52]: 98, 209, fig. 414).
[d] The first temple of Asklepios, Temple B (Ionic style), ([45]: 34–39, 75), also an Altar and possibly a small temple of Apollon Kyparissios 5th century BC.
[e] Summer Solstice:27 June 300 BC.
[f] Winter Solstice: 23 December 200 BC.
[g] Apollo Temple at Kardamaena (Alasarna) in Kos [46].
[h] Measurements calculated through the Google Earth Compass Tool and Google Compass Application. http://www.googlecompass.com and http://googlecompass.com/MagneticVariationAdjustment.htm Barcelona Field Studies Centre 2013. See also http://www.ngdc.noaa.gov/geomag-web/.
[i] AAS by remote sensing was computed by trigonometry applying the distance and height given by the slope application of Google Earth. The measurements were averages of many to achieve the most accurate error calculation. It is quite accurate in areas with higher analysis and clear geographical situation, and less accurate in areas with lower analysis, thus and a higher estimated error.

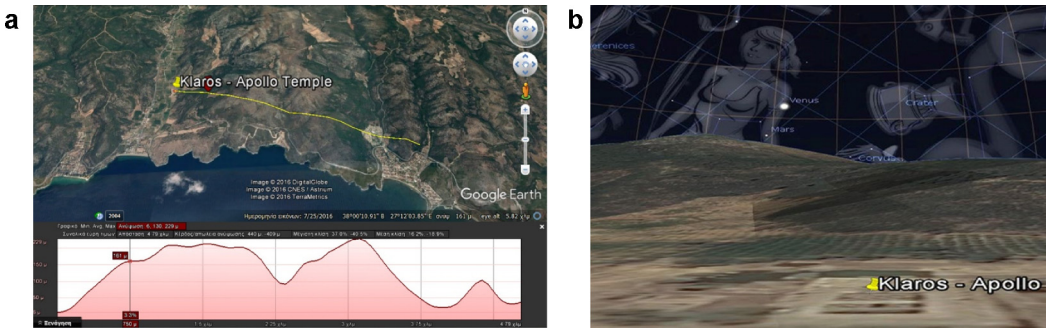

Fig. 5. Claros Apollo temple, (a) topography alignment and horizon altitude, (b) heliacal rising of Corvus 16th October 650 BC at 12° altitude, 4 h 20 am, in natural landscape from Google earth.

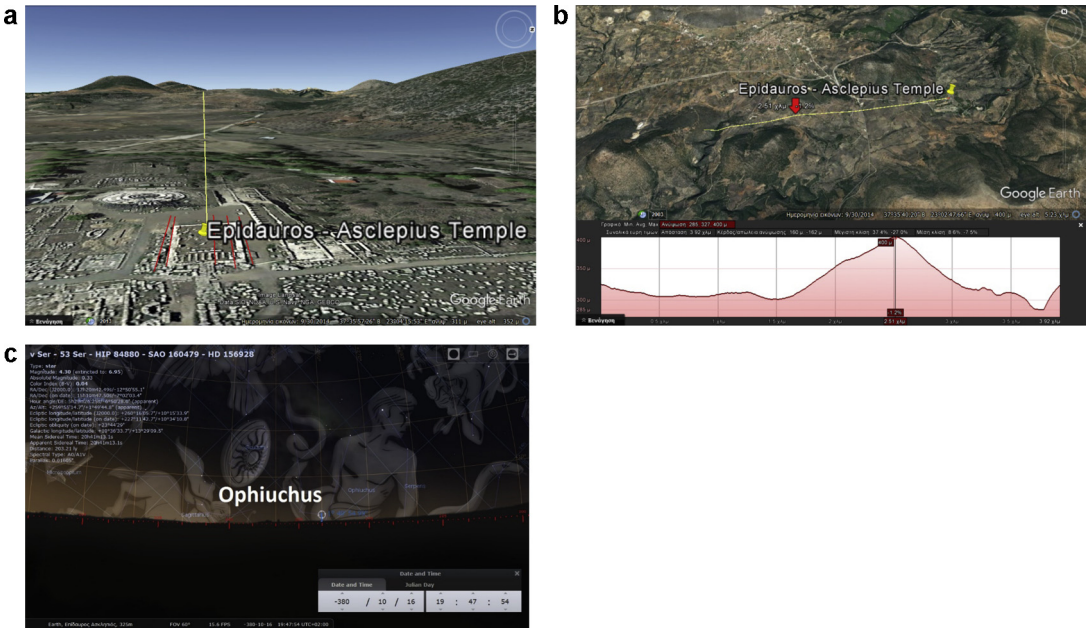

Fig. 6. Epidaurus, Asclepius Temple, (a) ground plan and alignment towards west, entering the temple from east, (b) topography alignment and western horizon altitude, (c) heliacal set of Ophiuchus on 16 Oct 380 BC at 7 h 48′ pm.

their particular properties. Thus, the temples, towards the eastern side of Apollo Maleatas (the altar) at Epidaurus, Gortyna in Crete, Deiradiotes at Argos, at Messene, Claros, Lairbenos and Notion at Asia Minor (Tables 1–3), all align to the eastern heliacal rising of *corvus* at or near autumnal equinox. An exception is the Antonine Apollo temple C of Kos, C 200 AD in the winter solstice and Scorpion (pointing to its brightest star Antares or Alpha Scorpii on average +1.1 m), with a coin with Antonine's head, the scorpion and a star as evidence (in contrast to the other Apollo Temple at Alasarna, today Kardamaena, in Kos 300 BC which gives a summer solstice) (Table 4). Maleatas at Epidaurus aligns with *Ophiuchus* (serpens and serpent-bearer wide constellation) during autumnal equinox 5th of April (Table 1). Therefore, the orientation of structures was related to astronomical observations, either solar or stellar or both. The constellations rising and setting in the declinations around equinoxes signify the apparent concurrence of corvus and Ophiuchus but in autumn.

On the western direction of the temples, no relevant constellation is observed, but, nevertheless, *Ophiuchus* has an heliacal rising also for the Maleatas Apollo near autumnal equinox 24th of September 380 BC (28th September is the equinox), on 27th of February for Messene, for Lairbenos at 24th of February, for Notion near Claros/Colophon on 23rd March and for sunset on 17th September. The February/March period correspond to Bysios Delphic month (the 7th day of this month Apollo was born in Delos), when priestess delivered oracles at Delphi with the return of Apollo from the northern lands (hyperborean) [13]. The exact timing varied between February and March due to the lunar calendar and the need to have intercalary months. The rest of calendar dates fall in or close to the autumnal equinox. On the other hand, Asclepius sacred temples in an eastern direction align with *corvus* during autumnal equinox in Lebena Crete 7th of October, Messene 20th October, Argos 4th October and Kos in 1–4 November and Ophiuchus for 15–17 February for the two temples. While during sunset, the Asclepius-related constellation *Ophiuchus*, the hydra or snake, is met in three cases; at Kos 200 BC Temple on 14th August, Epidaurus 16th October a few days after the autumnal equinox (28th Sept.), and in Messene 2nd of March. In spite of reconstructions or replacement with new structures, the new temples were built either adjacent to or on top of the old foundations, always dedicated to the same deity and preserving the memory of *Corvus* and *Ophiuchus* (Figs. 3–6). The white circle top of vertical (blue) segments in skyscape images marks the intersection of azimuth Az, the angular altitude AAS of horizon and star declination, δ (δ is a point on the celestial sphere in the equatorial coordinate system).

The four brightest stars in *Corvus* – Delta (3.1 m), Gamma (2.5pm), Epsilon (3.02 m, the nostril) and Beta (2.60–66 m) Corvi – form an asterism known as the Sail, or the Spica's Spanker,

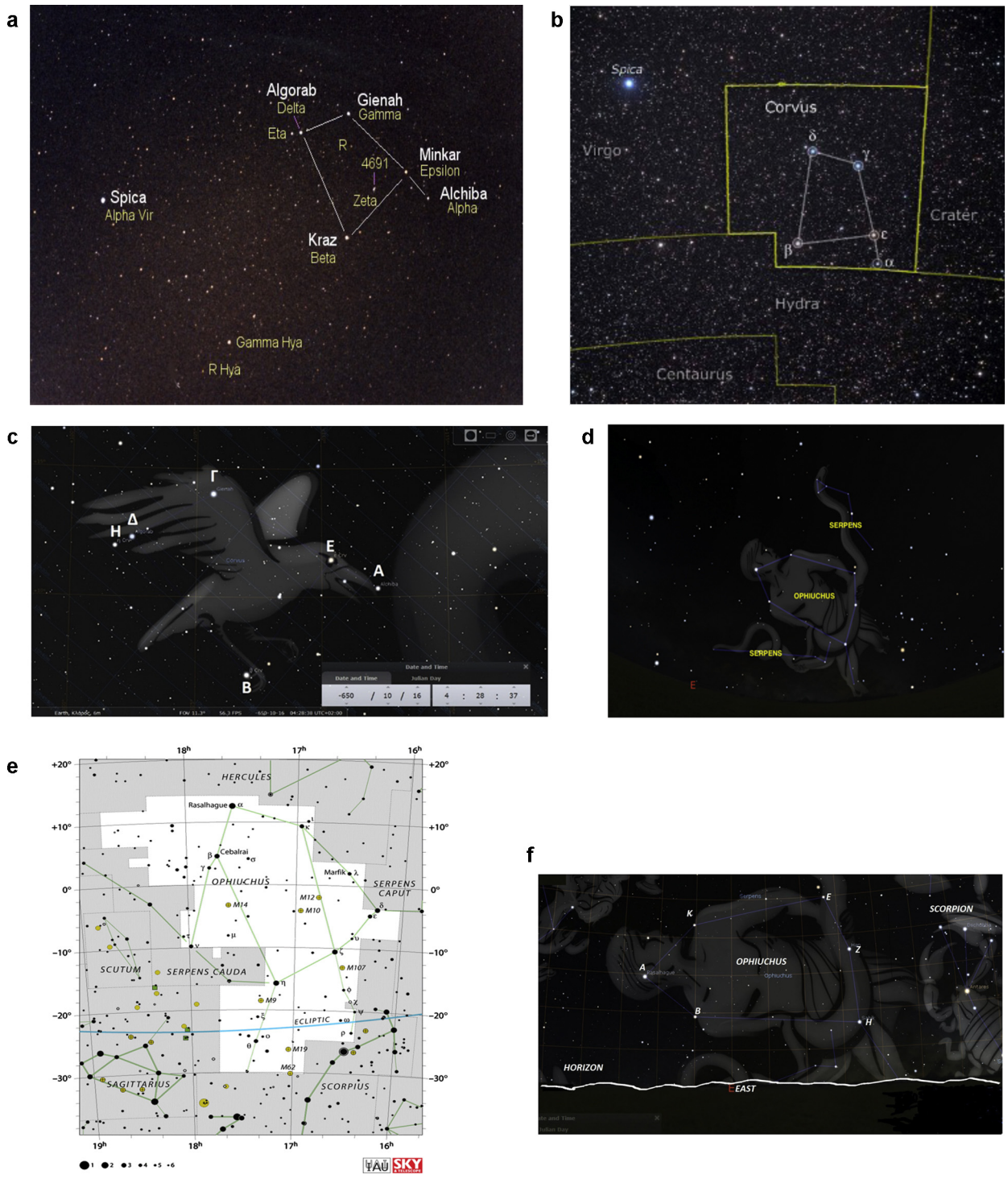

Fig. 7. (a) (left and right): corvi stars configuration and names and neighbor asterisms, (b) schematic representation with stars based on stellarium. The geometrical star setting varies due to precession; (d) Ophiuchus and serpens star configuration and related image; (e) Ophiuchus and serpens, neighbor asterisms, star names and magnitudes; (f) Ophiuchus stars rising for September 18th 700 BC 9.30 pm, Argos, Greece.

because the stars Gamma and Delta Corvi point the way to Spica (Alpha Virginis, 0.95 m), the brightest star in the constellation Virgo, left side of Corvus (Fig. 7a). Spica might have been used as a supportive identification of rising Corvus especially in a murky atmosphere. For ancient Greeks, the brightest stars in the night sky were said to be of first magnitude ($m = 1$), whereas the faintest were of sixth magnitude ($m = 6$), which is the limit of human visual perception based on apparent brightness. This is the modern magnitude system, which measures the brightness, not the apparent size, of stars. Using a logarithmic scale defined such that each step of one magnitude changes the brightness by a factor of the fifth root of 100, or approximately 2.512, it is possible for a star to be brighter than "first class", so Arcturus or Vega are magnitude 0, and Sirius is magnitude −1.46. Objects appearing farther to the left of 1 (including negative numbers) are brighter, while objects appearing higher than 1 are dimmer. Thus, zero appears in the middle, with the brightest objects on the far left, and the dimmest objects on the far right.

Stars γ and δ (and η) mark the left and right wings respectively, of Corvus, and ε, α are the head and nostril, ζ (5.21 m) the neck, and β the breast (Note: astronomical software differ, somehow, in art representation of zoomorphic images, stellarium attributes γ, δ to left wing, while starry night rightly to both wings, Fig. 7a–c). On the rising first appear stars γ, δ following an E-S oblique orbit. However, at their first appearance on a flat horizon due to their extinction the higher than 6 magnitude makes them invisible. Before dawn initially within few minutes above flat horizon δ, γ are seen, and, gradually within half an hour at most and as a whole around 5° above flat horizon, all Corvi are seen by naked eye because their extinction is less than magnitude 4. This constellation extends in a width of around 10°. In fact, the apparent magnitude of a star due to the extinction is given by: $m = m_o + k{\cdot}x$, where, m and m_o are final and initial magnitude, x = air mass and k = coefficient depends on various parameters such as star spectral type, regional topography, etc.

Ophiuchus is a large constellation located around the celestial equator. Its name is from the Greek *Ophioukhos* ("serpent-bearer"), and it is commonly represented as a man grasping the snake that is represented by the constellation Serpens. *Ophiuchus* was one of the 48 constellations listed by the 2nd century astronomer Ptolemy, and it remains one of the 88 modern constellations (formerly referred to as Serpentarius) and has bordering constellations of Hercules, Libra, Scorpius, Sagitterius and Aquila. It has 62 stars with 6 stars α, η, ζ, δ, β, λ of magnitude 2–3.8 the main ones. In Ophiuchus, the star α Oph (Rasalhague, 2.08 m) is the brightest ("the head"), δ 2.73 m, and η Ophiuchi, known as Sabik ("the preceding one"), at magnitude 2.43, ζ zeta oph of 2.54 m, β Ophiuchi, Cebalrai ("dog of the shepherd", 2.76 m) and λ Ophiuchi, or Marfik ("the elbow") of 3.82 m (Fig. 7d, e).

During sunrise first stars appear are brightest stars α, κ, δ (horizontal body image); while during sunset first stars that become invisible are η, ζ, δ, and follow α, β, κ (vertical image). It covers a large sky area about 20-30° and 25° altitude, head up. Calculated declination and Az points to the middle of the constellation from α to ζ or from β to κ for sunrise and sunset, respectively. The setting of stars that form the image depends on the observation coordinates; for Greece and Asia Minor supposed body is almost horizontal in sunrise and vertical in sunset (Fig. 7d, e). Accompanied by Scorpion with bright Antares (+0.6 to 1.6 m) on the right, it fixes the identification in case of a murky atmosphere.

5. Discussion

The revealed raven (crow) in astronomical orientation for these Apollo Temples, and raven and Ophiuchus for Asclepius temples, is intriguing. Clearly the raven/crow is Apollo's messenger; either the bird itself or Apollo himself taking its shape to pass "incognito". Why is the raven, and not the Lyra and Cygnus found elsewhere [13,15], related to these oracular temples. In this article we suggest that the explanation may be that Corvus (raven) and Ophiuchus belong to the Asclepean and apollonian mythological circle. This may have to do with the winter function of these sanctuaries.

Following the Lyra and Cygnus myth, Apollo is not present during winter because he has left for the hyperboreans [13], therefore he cannot be summoned for omen giving. Hence, the main oracles like in Delphi, do not function during wintertime and in case of need by people during the wintertime a solution could be to invoke on him through a messenger, to provide an oracle and get the healing from Asclepius. Winter is a time that often requires healing, and Apollo and Asclepius are family related (father and son) and therapists, representing service and aversion (see e.g. [57]). For the former, it is accepted that diseases are some kind of divine punishment and omens were expected for aversion and/or rectification. In this sense, the Apollonian oracles dedicated to healing procedures were orientated towards the Crow as the messenger of the god that caused the divine birth of Asclepius.

So far, it is not possible to link these temples to autumn/winter activity. It seems that no particular season is determined for operating activity, but our findings indicate a shift in practice at autumn equinox. The orientation itself may indicate an intensified period for healing procedures in autumn. Note that at Patara, in Lycia, there was a seasonal winter oracle of Apollo (Herodotus *Histories* 1.182; Vergil's *Aeneid* 4.143–44).

As with Apollo (order) and Dionysios (chaos), Apollo and Asclepius is a divine pair of opposites. Asclepius was begotten in darkness when the new moon had just appeared, by the "Crow Maiden", as Koronis the dark beauty. This explains Asclepius' dark side, and according to Epidauran tradition, Asclepius is an aspect of Apollo who embodied a form of healing light, which shone from within darkness. Apollo and Asclepius as a complementary duality thus offered treatment through prophecy and healing ([58]: 92–93; [59]: 66–67, note 117; [60]: 84).

The determination of the connection between celestial bodies and cults in temples was a long process in the Greek religion since prehistoric times. The salvation, therapy, aversion (apotropaic), prediction (oracle) involved the forecasting of earthly and human events through the observation and interpretation of the fixed stars, the Sun, the Moon, and the planets, which developed a type of divination. Devotees believe that an understanding of the influence of the planets and stars on earthly affairs would allow them to both predict and affect the destinies of individuals, groups, and nations.

Archaeoastronomy has shown that ancient believers created such a link between sky and celestial objects human affairs. First and foremost, the issues of prophecy seem to be interconnected to the duality of Apollo and his son Asclepius.

According to Jane Ellen Harrison [57]: "It is clear then that Greek religion contained two diverse, even opposite, factors: on the one hand the element of service (θεραπεία) on the other the element of aversion (ἀποτροπή)". In our thesis, the service (θεραπεία, curable diseases) echoes Asclepius and his father Apollo, as gods of medicine and healing, while aversion recalls, in general, an oracle by Apollo. Apollo's reputation as a healer god himself is known (e.g. Claros Apollo issued many oracles that had to do with purification and the warding off of the plague) ([36]: 150–157; [38]: 94–98; [37]: 64–65). Though so far epigraphic evidence of the latter in most studied Apollo Temples, is lacking, the image of Apollo Alexikakos (ancient Greek: Αλεξίκακος, the averter off of evil) provides a clue of the role of this god in the twinned configuration Asclepius–Apollo in our examined sites.

To the average ancient Greek, the word 'θεραπεία' (therapy) covered a large, perhaps the largest, area of its religion's conception. It was a word related to the religion based on a rational, but still quite cheerful mutual confidence between believers and deities [61,62].

So far, no serious attempt had been made in research to examine Greek ritual involving both Asclepius and Apollo through science. The preliminary step to any scientific understanding of Greek religion (and its tradition) is a thorough study to demystify its ritual. This habit of viewing Greek religion exclusively through the medium of Greek literature without receiving the message of its allegorical meaning, in turn properly scientifically proven, has brought with it an initial and fundamental error in method. Beneath this splendid surface of mythology lies a stratum of religious conceptions, but practical functions too, ignored or suppressed or symbolically covered by ancient writers [63]. In the present article, we investigated the abstraction of medical treatment onto a divine and metaphysical level; the work of priesthood physicians

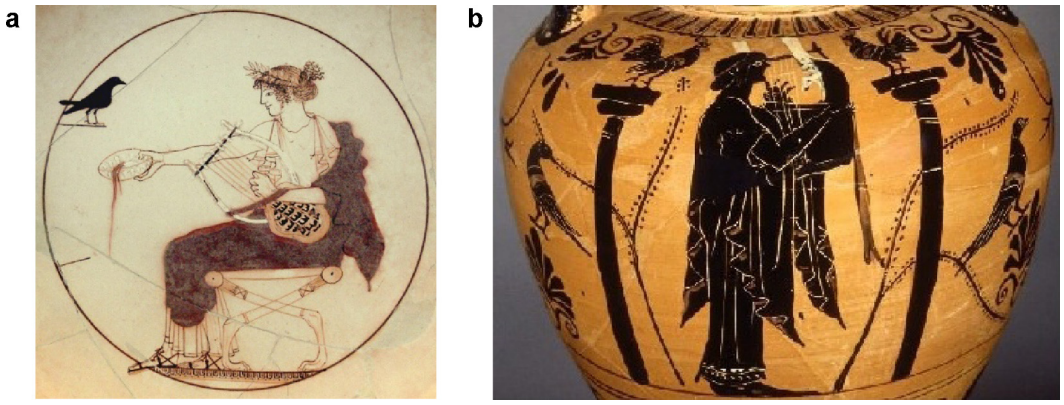

Fig. 8. a: Apollo offering a libation to the raven (kylix from Delphi Museum); b: Apollo as a prophet playing lyra (a raven looking forward and another looking backwards) (Museum of Delphi).

on the human body is made divine and miraculous, through Asclepius, supervised by his father Apollo as oracle, physician and averter off of evil.

Archaeoastronomy gives proof of a planned alignment/orientation of temples towards star constellations referring to specific myths. The constellation, thus the myth, should appear at a specific time of the year. The concept of the orientation was part of the architectural planning and considered a necessary condition for ritual success at the healing sanctuaries. In this sense, archaeoastronomy indicates that the practice of the temples is connected to myths, and for the temples studied here, the myth indicates a cooperation in healing practice between Apollo and Asclepius. Through archaeological finds of medical equipment and through logic experience, we know that the healing that took place at these sanctuaries was conducted by physicians or priestly personnel. Archaeoastronomy demonstrates the human practice in antiquity, of abstracting human proficiency and knowledge onto a divine level, attributing the gods with the healing of humans.

Apollo is a peculiar god in that he covers an extraordinary range of capacities and skills necessary to meet the needs of ancients. Apollo as a healer god, derives from the Mycenaean god Paean, healer of the gods (Linear B transliteration) (Homer *Illiad* V 401–402 and 899–900; The Knossos tablets V 52.2; [61]: 74, 145; [62]: 212) (see e-supplement).

Apollo and Asclepius seem to have been functioning as a cooperating cultic pair at these sanctuaries. Apollonian Temples close or related to Asclepius' sanctuaries may have worked as the "diagnosis" centers through the omens that the patients receive, or as holy places where offerings were an indispensable precondition for healing.

The tendency of Apollo being the original healing god went up until the 6th century BC (at least for the temples of Kos, Epidaurus and Gortyna). This seems to be the time when Asclepius was introduced, initially with altars. Asclepius then gradually takes over the healing functions up until the 4th century BC, when his temples generally are introduced. Apollo remains as the supervising power, and the only one who can heal serious/fatal diseases like plague either by invocation or apotropaic libations [64,65].

Another question regards the possible transmittance of cultic practices. The labrys (the double-headed axe) is a symbol of divine authority (see e-supplement). These axes are frequent on the numismatic material of Lairbenos and are also found as an offering in the Apollo Maleatas sanctuary. Its shape resembles the Orion constellation, a winter star configuration, and Henriksson and Blomberg [66] have proposed a new Minoan interpretation for the constellation of Orion. This symbolic item of a ritual tradition and the healer god Paean of Mycenaean origin, are fused in Apollo, and thus may imply a provenance in Minoan cult. A possible transmittence and keeping of this cultic tradition up through the centuries in areas of Greek culture, is possible [67].

At Notion (Asia Minor) and Kos, only, the recorded Orion at sunset in April and May is not considered as strong indication of intentional orientation favoring the autumnal asterism of Ophiuchus, as around autumnal equinox is the period that the temples seem to start functioning and is related to *Corvus* as discussed. An exception is the Antonine temple C of Apollo C 200 AD in the winter solstice and Scorpion (pointing to its brightest star Antares or Alpha Scorpii +1.1 m), with evidence of coin with Antonine's head, the Scorpion and a star as evidence (in contrast to the other Apollo Temple at Alasarna, today Kardamaena, in Kos 300 BC which gives a summer solstice).

Scorpion has not been found frequently in orientation studies, but it has been assigning religious and symbolic meaning. In ancient Egypt, Antares represented the Scorpion goddess Serket (and was the symbol of Isis in the pyramidal ceremonies), in Mesopotamia she is the goddess Ishhara, as well as the Hindu and the Aztecs, who make scorpion a favourite asterism attributed to deities [3]. *Ophiuchus* also is not met in orientations, but given the known Greek and Egyptian mythological issues, its association to Asclepius and Ihmotep (both healers) is anticipated. In a Roman temple in Rhodes and in a Mycenaean sacred cultic building, Scorpion has been quoted [68]. Scorpion with the bright star Antares, accompanies Ophiuchus in the skyscape.

At any rate, reiterating, the orientation of the temples of Apollo and Asclepius related to *Corvus, Ophiuchus* and functioning on a complementary manner, in lieu of same deities in temples of other sites with a quite different purpose, is striking.

5.1. The involvement of the mythology of raven

How did the Raven achieve a place between the stars? Some myths or legends present the raven as the messenger of Apollo. Either the bird was charged with this role, either the god himself took its shape, in order to inconspicuously follow some scene of interest. One of those myths explains how the Raven was sent by Apollo to bring him water (water essential element in oracular procedure). The bird was distracted and stopped in its way to eat some figs. When he realized that he had the god waiting, he hurried back and explained that the snake Hydra had kept him from the water, holding a snake in his claws as a proof. Apollo noticed this to be a lie and flung the crow, the cup and the snake (ophis, hydra) into the sky. These three constellations *corvus* (raven), *crater* and *ophiuchus* are related and always represented as a group in the autumnal sky. However, in order to further punish the bird and secure that the crow would always be thirsty, the constellation of the Crater is out of reach for the Raven. The relationship between

Apollo and Coronis (the crow) is supported in art involving libation, prophecy and music (Fig. 8) (see e-supplement), and is as already mentioned connected with the birth of Asclepius by Coronis, the "Crow Maiden".

6. Conclusion

In this thesis, the service echoes Asclepius and his father Apollo (as gods of medicine and healing), while aversion recalls, in general, an oracle by Apollo. Apollo's reputation as a healer god is followed up by his son Asclepius in Asclepieia at Epidaurus, Kos, Argos and Messene to mention a few important ones.

The investigation of astronomical orientations for these temples proves beyond coincidence that there is a relationship between skyscape and the sanctuaries in question. These temples thus appear to be intentionally oriented towards the heliacal rising or setting of Corvus and Ophiuchus. These astronomical orientation practices follow the mythology of the deities and their sacred personified stars.

Beneath the splendid surface of mythology lies a stratum of religious conceptions connected with practical life. The architectural planning of temples was considered a necessary condition for ritual success at the healing sanctuaries in question. An orientation towards the constellation of the myth of the birth of Asclepius, indicates a cooperation in healing practice with his father Apollo.

Apollonian temples close or related to Asclepius' sanctuaries may have worked as the "diagnosis" centers through the omens that the patients received, or as holy places where offerings to Apollo, not only to Asklepius, were an indispensable precondition for healing.

The tendency of Apollo being the original healing god went up until the 6th century BC (at least for the temples of Kos, Epidaurus and Gortyna). This seems to be the time when Asclepius was introduced, initially with altars. Asclepius then gradually takes over the healing functions up until the 4th century BC, when his temples generally are introduced. Apollo remains as the supervising power, and the only one who can heal serious/fatal diseases like plague (either by invocation or apotropaic libations).

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.culher.2017.02.011.

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