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The Zagora Cryptograph

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Abstract

A unique lead seal from the well-known eighth century B.C. settlement of Zagora on the island of Andros dramatically confirms and expands our knowledge of the town planning identified at the site and constituting the earliest example of an orthogonal grid plan in the Greek world.

The seal in question is decorated with a symbolic design that constitutes a rare representation of the Dioskouroi as part of the constellation Gemini. This design appears to have acted as a cryptograph enciphering the basic mathematical and astronomical principles behind the planning of Zagora. Besides offering us new insights into early Greek settlement planning, the cryptograph seems to reveal an advanced practical competence in mathematics and celestial observation, which was hitherto unsuspected for such an early period.

The Zagora cryptograph also suggests that astronomy and mathematics played a crucial role in the strengthening of the ruling élite's power at Zagora in the framework of the rising city-state or polis. *The tight interweaving of astronomical, mathematical, architectural and social considerations in the planning of Zagora is an entirely new discovery for Greece, whose implications are far-reaching.*

Keywords: *orthogonal grid plan, Golden Section, sacred universe or* cosmos, *Dioskouroi, constellation Gemini.*

Introduction

This paper attempts an analysis and interpretation of the design of a seal discovered at Zagora on Andros. In particular, it is proposed that the elaborate scene incised on the seal is actually a cryptograph comprehensively recording the main mathematical principles behind the spatial planning of Zagora and hinting strongly at the involvement of celestial observation in generating proportions, as well as the placement and orientation of buildings and streets.

Zagora is located on the west coast of the island of Andros, in the Cyclades. It is a high promontory, with a large settlement dating from the second half of the eighth century B.C. (Cambitoglou *et al.* 1971; 1981;

1988). The settlement presents an urban organisation and a clear distinction between a plateau – the living space of the local élite, where the sanctuary was also located – and the slopes, where the rest of the population lived.

The plateau of Zagora was planned on the basis of a mathematically sophisticated orthogonal grid for the benefit of an élite group of noble families headed by a paramount ruler. The grid dates from *ca.* 760-750 B.C. and is, in fact, the earliest known example of urban planning from the Greek world.

Fig. 1: *Plan of sector D/H on the plateau of Zagora. The houses belonging to the first architectural phase are indicated in black.*

Zagora appears to have constituted an early stage in the rise of the Greek city-state or *polis* and is thus of obvious importance in the investigation of the pre-classical era (Coucouzeli 2004; 2007).

The paper is arranged in three sections. In a first section, I briefly present the town planning of Zagora, and more particularly the grid plan and the main mathematical principles underlying it, so as to serve as an essential background to the analysis of the seal. In a second section, an iconographical analysis of the Zagora seal is undertaken; the first part of the analysis focuses on the relationship of the cryptograph with the grid plan, the second upon the astronomical information encapsulated in it. Finally, in a third section, I discuss the results of the analysis in two subsections, which explore in turn the meaning of the cryptograph and its overall significance.

The town planning of Zagora

The grid plan

The grid plan on the plateau of Zagora becomes apparent if one isolates the houses that belong to the first architectural phase (coloured in black on Fig. 1). All these houses, together with the outline of the temple, form part of an orthogonal grid plan shown in an idealised form on Fig. 2.

The grid exhibits a typical division of the land into three parts: private, public and sacred. Thus, it accommodates: a number of house plots of equal length with a roofed-, an unroofed- and sometimes also a semi-roofed area; public passageways; an open public area; and the temple. The house plots are distributed into four different groups (Groups 1-4) on the basis of four axes (AA'-DD') and we are dealing,

most likely, with a number of noble families belonging to four large kinship groups, such as clans. The nobles seem to have recognised a paramount ruler, a "first-among-equals", who would have lived in unit H19 and would have occupied the largest plot of all, near the sanctuary.

Special attention should be drawn to the fact that two house plots in the SE quarter of the grid are deviated by about 5° westwards from their ideal position, the point of deviation being the SW corner of the temple. This odd feature will be explained later.

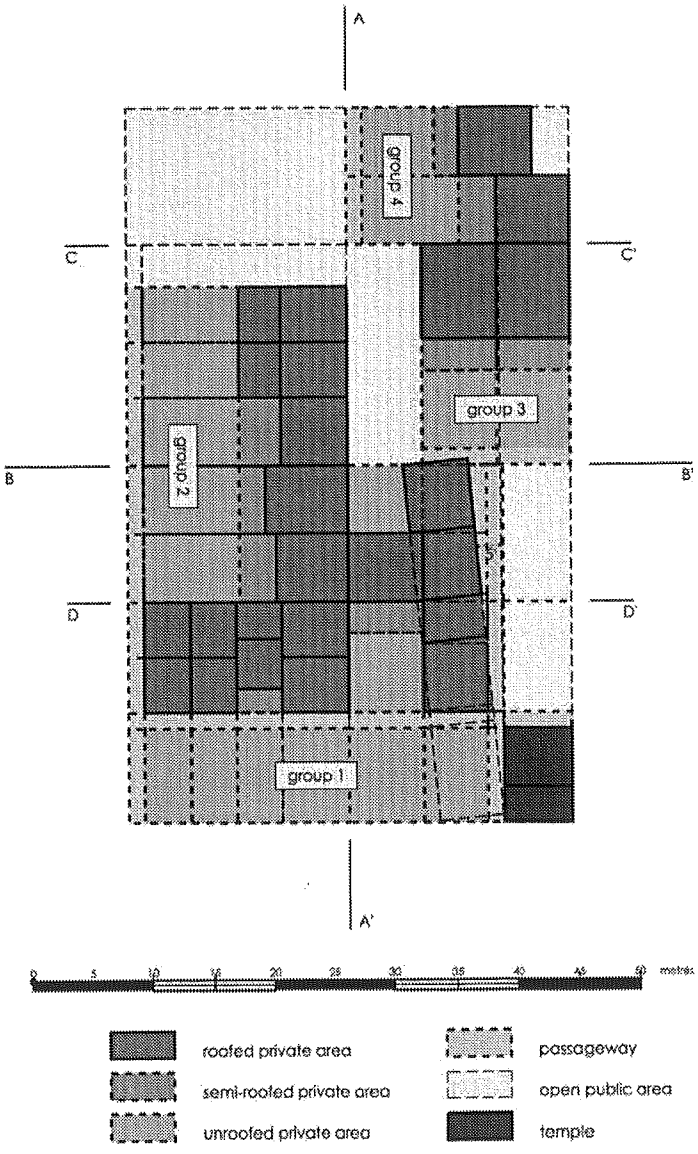

Fig. 2: *Idealised plan of the grid on the Zagora plateau showing the division of the land into private, public and sacred space.*

The mathematics of the grid plan

The Zagora grid plan shows a great mathematical complexity. Its main lines form part of a system of proportions based on the celebrated 'Golden Section' (Fig. 3). This is the division of a line segment so that the ratio of the whole segment to the extreme part is equal to the ratio of the extreme part to the mean part (Fig. 4), i.e. equal to $\frac{\sqrt{5}+1}{2} = 1.618\ldots$ (*ad infinitum*), generally symbolised by the Greek letter Φ (Phi). This proportion has the most remarkable arithmetical, algebraic and geometrical properties (Ghyka 1931; 1952; 1977, 3-19; Huntley 1970; Runion 1990; Walser 2001) and seems to go back to the Pythagoreans (Ghyka 1931; Burkert 1972, 452). Euclid called it 'division of a line into extreme and mean ratio', while Plato called it simply '*ἡ τομή*', 'the section' *par excellence*, and he considered it as the most perfect of all proportions and as the basic component of the mathematically structured and harmoniously ordered universe, the *cosmos* (Hambidge 1920, 152; Burkert 1972, 452-453; Ghyka 1977, 3-4). The ancient Greeks used this proportion (*analogia*) to give balance and beauty to the design of their art and architecture, as did later the artists of the Middle Ages and the Renaissance, who called it 'Divine Proportion' or 'Golden Section' (Hambidge 1920, 152-154; Funck-Hellet 1949; 1950; Ghyka 1952; 1977, 4, 16, 124-154; Wittkower 1988, 147-153; Martin 1994, 283-284, 291).

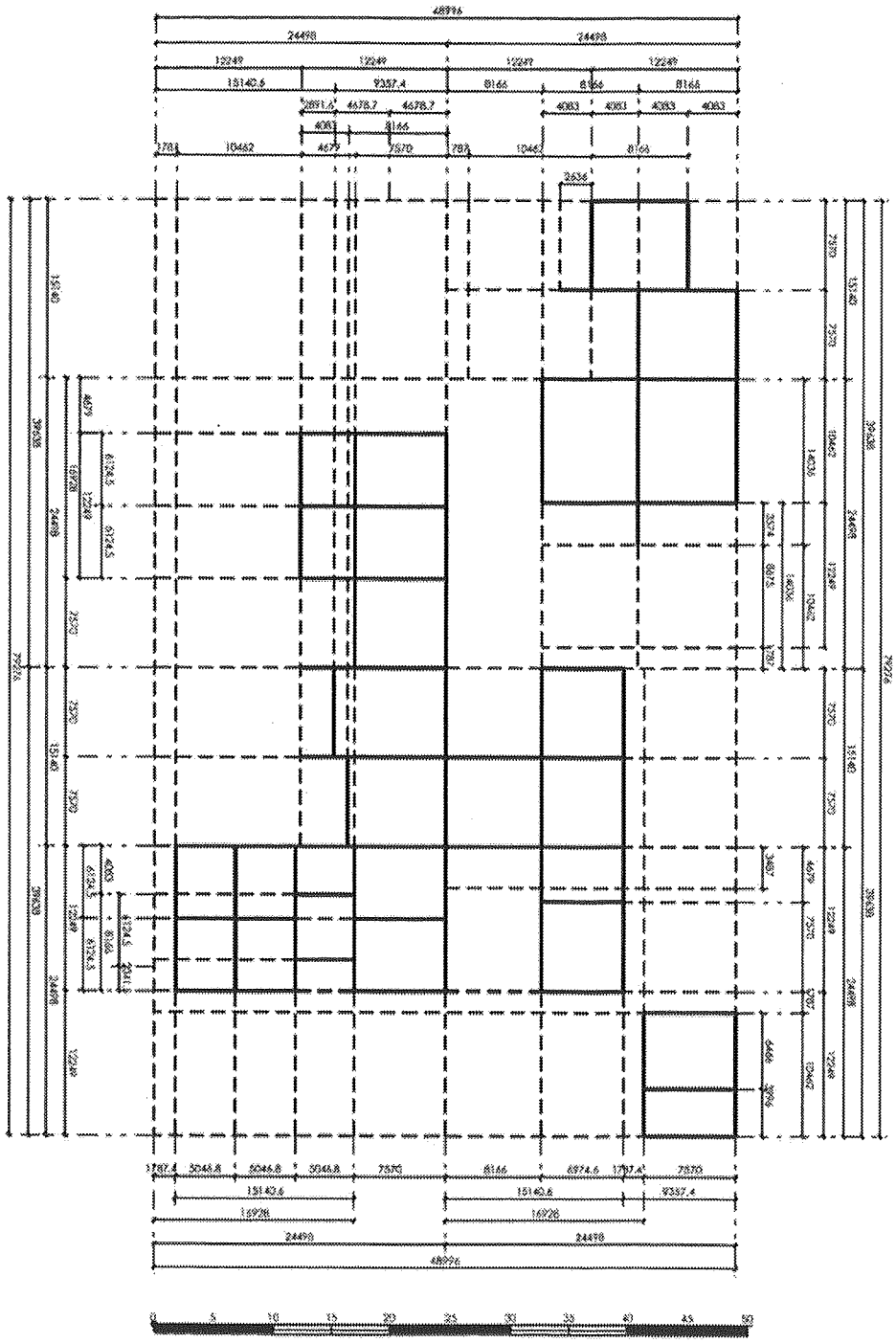

Fig. 3: *Idealised plan of the grid on the Zagora plateau with dimensions expressed as part of a system of proportions based on the Golden Section*

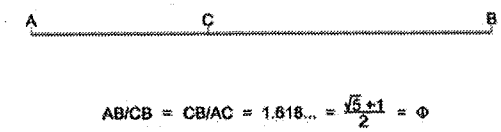

Fig. 4: *The division of a line segment according to the Golden Section*

Zagora provides us with the earliest tangible evidence of the use of the Golden Section in ancient Greece.

The large rectangle of the grid is a 'golden' or a Φ rectangle, i.e. a rectangle whose shorter side is related to the longer side as in the ratio 1: 1.618 or 1: Φ, believed to be the most aesthetically pleasing of all rectangles (Fig. 5A). The large golden rectangle is subdivided by the grid's two main axes (AA′ and BB′) into four smaller golden rectangles (Fig. 5B) (the grid was actually implemented on the ground on the basis of these four rectangles, rather than all in one piece, which inevitably introduced some slight distortions – Fig. 6). Each of the four golden rectangles is in turn subdivided by the two other axes of the grid (CC′-DD′) into a square and an even smaller golden rectangle (Fig. 5C). The repetition of this last operation produces even smaller squares and golden rectangles in a geometrical progression, which eventually leads to the well-known 'golden spiral' (Hambidge 1920, 17-18; 1926, 3-5, 10, 31; Funck-Hellet 1950, 16; Ghyka 1952, 37-39; 1977, 10) (Fig. 5D).

The end result is a well-balanced, unified plan, in which the whole and its parts are correlated through the interplay of harmoniously ordered or rhythmically repeated geometrical proportions. As such, the grid plan of Zagora foreshadows the Pythagoreo-Platonic mathematical theories (Burkert 1972), as well as the ancient Greek notions of 'symmetry' and 'eurhythmy' handed down to us by Vitruvius (*De architectura*, I, ii, 3-4; Ghyka 1977, X-XI, 5, 12-13, 125 ff.; Wittkower 1988, 97, 128).

Analysis of the Cryptograph

The cryptograph and the grid plan

The Zagora cryptograph is a small lead seal (Fig. 7), which was discovered immediately in front of the temple and dates from *ca.*750-700 B.C., being therefore contemporary with the settlement (Cambitoglou *et al.* 1981, 91 no. 291, fig. 50; 1988, 233 inv. 1238 and plate 281a-c.). The seal is about 1.3 cm^2 and it must be the base of a standing figurine now lost. All that is preserved from the figurine are the stumps of its feet on the top surface of the seal.

The bottom surface of the seal is decorated with an incised abstract scene (Fig. 8), which represents, within a square frame, two geometrical human-shaped figures standing frontally on either side of a small object upon a ground of parallel lines. Between their shoulders there is a kind of arch with a pointer at its centre. This design can now be identified as a cryptograph recording and explaining in a ciphered manner the basic planning principles in operation at Zagora.

Indeed, if one superimposes the abstract scene on

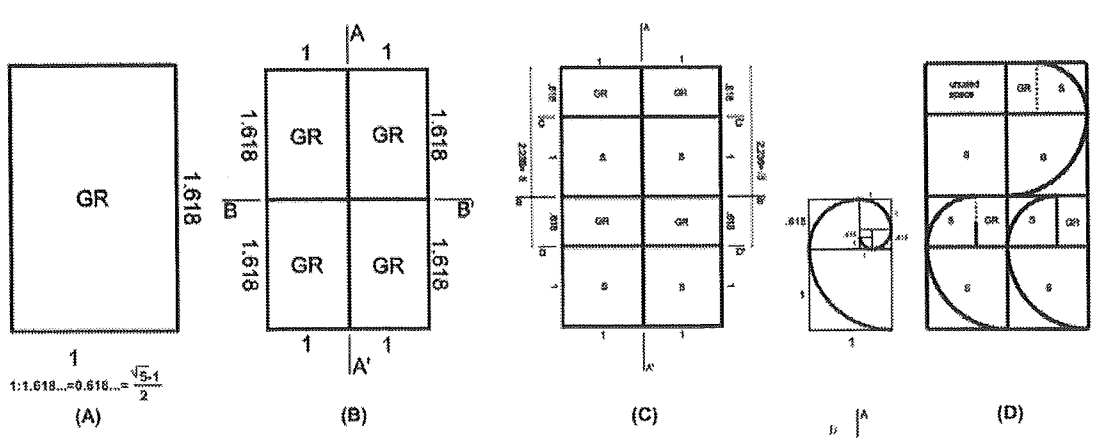

Fig. 5: *The main mathematical principles occurring in the grid plan of Zagora*

Fig. 6: *The distortions caused by the implementation of the grid on the ground*

the actual plan of the Zagora plateau (Fig. 9) and on the idealised grid plan (Fig. 10), one realises that the scene and the grid are closely interlocked and that they were conceived as part of a unified whole. More particularly, one finds that (a) the upper part of the scene 'conceals' behind it the grid plan itself: the left and right edges of the scene's square frame coincide respectively with the north and south sides of the grid's golden rectangle; the upper end of the arch's pointer 'touches' the east side of the grid's rectangle; the left foot of the right-hand figure and the vertical upright of the object between the figures 'lie' on the west side of the grid's rectangle; while the remaining outlines of the two figures as well as of the arch and of the object between them identify with the main axes of subdivision of the grid's rectangle or with important wall lines within the grid; and that (b) the series of parallel lines in the lower part of the scene represent the E-W lines of the western half of the grid, i.e. west of axis AA′ (the oblique line no. 11 on the cryptograph does not correspond to any grid line and its significance will become apparent later; line no. 10 on the cryptograph would represent grid line no. 11, apparently because grid line no. 10 has been accounted for by the left leg of the right-hand figure). On Fig. 9 one also notices that the tip of the head of the right-hand figure and the lower end of the arch's pointer align with the temple's doorways; moreover, the tip of the head and the left shoulder of the left-hand figure, as well as the slanted upright of the object between the figures mark the position of walls or rooms that were built during a second architectural phase, as part of the expansion of the houses within the framework of the grid.

Fig. 7: *The Zagora lead seal. Archaeological Museum of Andros (photo by the author with the kind permission of the Greek Archaeological Service).*

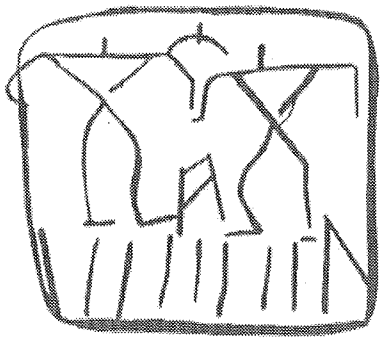

Fig. 8: *The Zagora cryptograph.*

Given the tight interweaving of the cryptograph and the grid plan, one can produce an idealised linear drawing of the former on the basis of the latter (Fig. 11).

The astronomical information of the cryptograph

A close observation of Fig. 11 reveals that, apart from recording the main mathematical principles behind the Zagora grid plan, the cryptograph, in its idealised form, is also apparently replete with astronomical information.

Indeed, if one considers the triangles formed by the shadows cast from a gnomon by the Sun and the Moon on the most significant days of the year at Zagora (lat. 37° 46′ 20″ N or 37.76° N, long. 24° 52′) ca. 760-750 B.C. (obliquity of the ecliptic: about 23.78°, i.e. 23.78636° at 759 B.C. and 23.78518° at 749 B.C.) (Fig. 12), one realises that the idealised cryptograph records (Fig. 13): a) the angles representing the maximum (meridian) altitudes of the Sun at the equinoxes and the solstices; b) the angles of the maximum (meridian) altitudes of the Moon at the northern and southern major lunar standstills; c) their complementary angles; and d) the angles opposite them, at the upper part of the gnomon.

In addition, the cryptograph records the angle of about 5.15°, by which the plane of the Moon's orbit around the Earth tilts from the plane of the ecliptic. This angle appears as the inclination of the shoulder line of the right-hand figure with respect to the shoulder line of the left-hand figure and therefore accounts for the orientation of the deviated plots in the SE quarter of the grid mentioned above.

The angle of the maximum altitude of the Sun over Zagora at the equinoxes (52.24°) and its complementary angle (127.76°) are found if one considers the arch between the two figures and completes the circle to which it belongs – in fact, this circle appears to have been drawn faintly on the cryptograph (cf. Fig. 7) –, the centre of the circle lying at the point where the lower side of the 5.15° angle crosses the E-W midline (axis BB′) of the grid (cf. Fig. 2): the two angles in question are formed in the upper half of the circle by the intersection of the left arm of the left-hand figure with the extended lower side of the 5.15° angle, i.e. shoulder line of the right-hand figure.

On Fig. 14 one can see more clearly all the astronomical angles 'stated' on the idealised cryptograph.

Discussion

The meaning of the Zagora cryptograph

There seem to be two levels of meaning or symbolism in the Zagora cryptograph, a sacred and a secular one.

First level of symbolism: On a first, sacred level of symbolism, the cryptograph seems to represent the Dioskouroi, Castor and Polydeuces or Pollux, forming part of the constellation Gemini ('The Heavenly Twins') as a result of their legendary catasterism (Pseudo-Eratosthenes, *Catasterismi,10;*

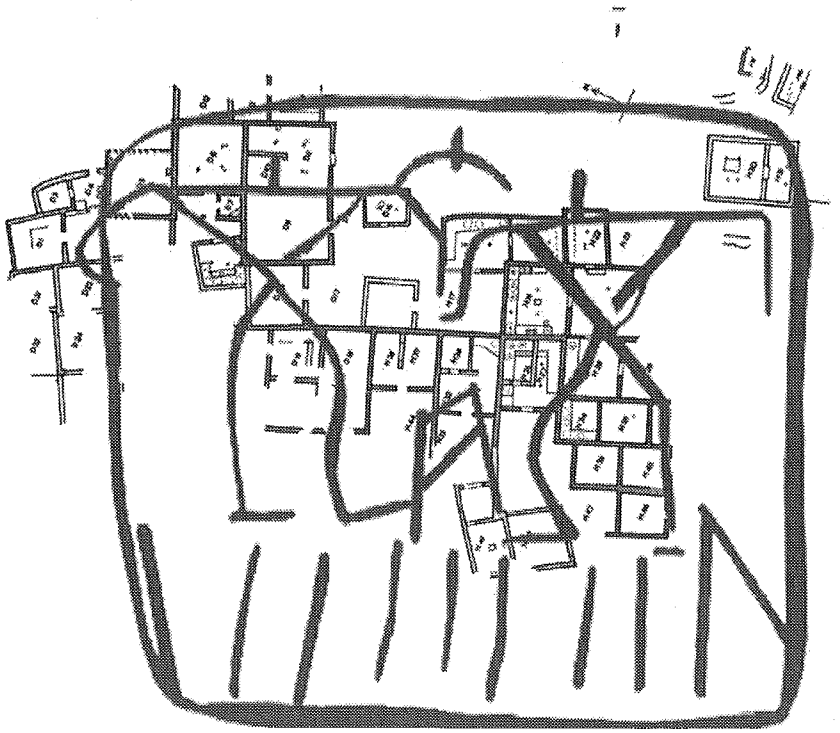

Fig. 9: *The Zagora cryptograph superimposed on the actual plan of the plateau.*

Hyginus, *De Astronomia*, 2.22).* This is supported by the following observations.

I) There are numerous similarities between the stick figures of Pollux and Castor in the constellation Gemini (Fig. 15) and the two figures on the cryptograph. One notes, in particular, the difference in height between the legs of the figures, as well as the leaning pose of the right-hand figure on the cryptograph and the shape of its left leg, which are strikingly similar to those of Pollux in the constellation; on the seal impression of the Zagora cryptograph the two figures would have been inverted and they would have thus identified easily with Pollux and Castor of the constellation.

II) The Geminids, i.e. the annual shower of meteors, which streak all over the sky and appear to radiate from the constellation Gemini reaching peak intensity on 13 December (Figs. 16-17), could be symbolised by the series of parallel lines in the lower part of the cryptograph.

III) There are obvious parallels between the Zagora cryptograph and the iconography of the Dioskouroi in ancient Greek and Roman art. Indeed, beginning in the sixth century B.C., the divine twins are often represented standing frontally next to each other, sometimes holding hands, in absolute symmetry, having on the central axis of the composition between their shoulders: a moon crescent, a star (or stars), a disc, a bust of the Sun or the Moon, either alone or in various combinations, or even the Sun (Helios) on his chariot; and between their legs: an object, such as an altar, an offering table, an

* This interpretation has been kindly suggested to me by Professor Xenophon Moussas, who also provided me with the illustrations on figs. 15-17 and 20.

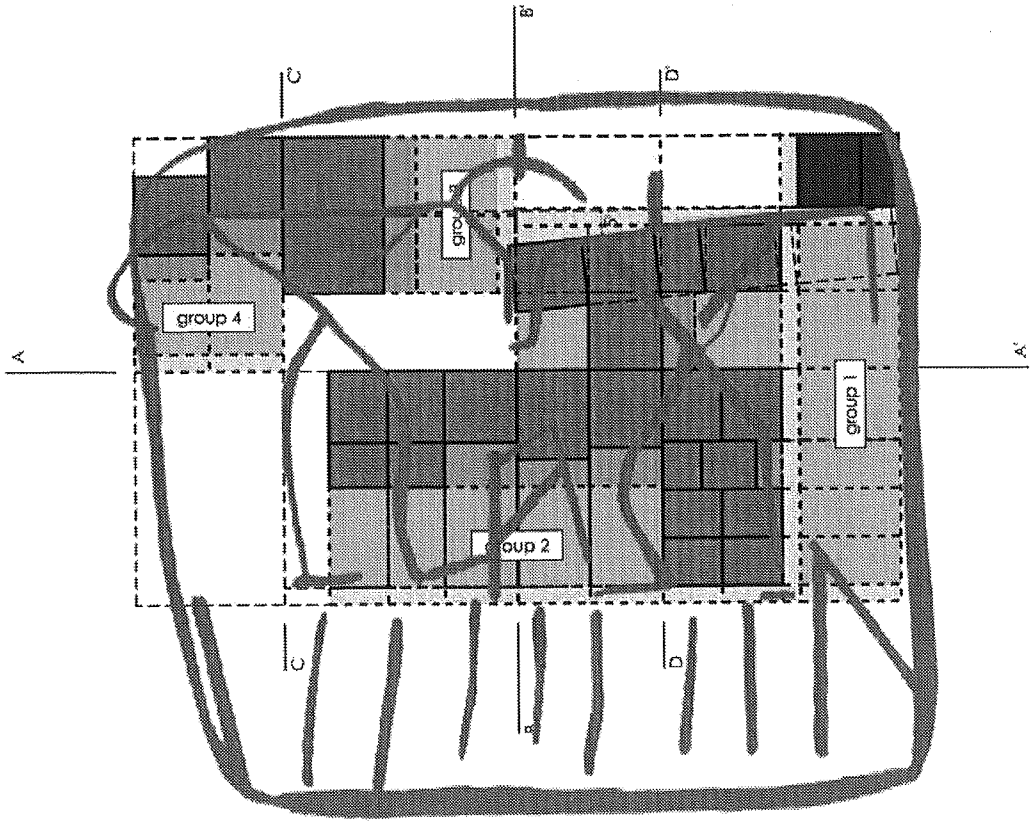

Fig. 10: *The Zagora cryptograph superimposed on the ideal grid plan of the plateau.*

amphora (or two amphorae), *dokana* or a combination of these etc. (Chapoutier 1936, *passim;* Aravantinos 1994; Köhne 1998) (Fig. 18). The *dokana* (Fig. 19) are the characteristic attribute of the Dioskouroi in Sparta, their birthplace, where the twins were venerated intensely as gods, their cult going back to nearly the end of the eighth century B.C. (Tod and Wace 1906, 113-116; Waites 1919; Guarducci 1984; Burkert 1985, 213; Pipili 1987, 54-58; Sanders 1993; Steinhauer 1993; Köhne 1998, 46-51). The meaning of the *dokana* has been much debated. According to Plutarch, they were the oldest aniconic images of the Dioskouroi in Sparta and they were composed of two parallel vertical balks connected at the top and in the middle by two horizontal cross-beams (cf. fig. 19A); the character of communion and indivisibility of this votive object symbolised the fraternal love of the two gods (Plutarch, *De Fraterno Amore*, 478A).

The Dioskouroi are frequently represented on either side of a celestial symbol, because they are themselves stellar and cosmic divinities. According to a very old tradition that goes back at least to the seventh century B.C. (*Homeric Hymns*, XXXIII; Alcaeus, Frag. 34), the Dioskouroi appeared to sailors in times of danger in the form of two stars or of the so-called St Elmo's fire, i.e. the electric discharge from the masts of ships during thunderstorms; this was regarded as the "epiphany" of the Dioskouroi in their qualification as *soteres* or saviours of all sea-going travelers (Köhne 1998, 26-28).

As saviour gods, the Dioskouroi also re-established the cosmic order and this is connected with the cosmic character of the two deities. In mytholo-

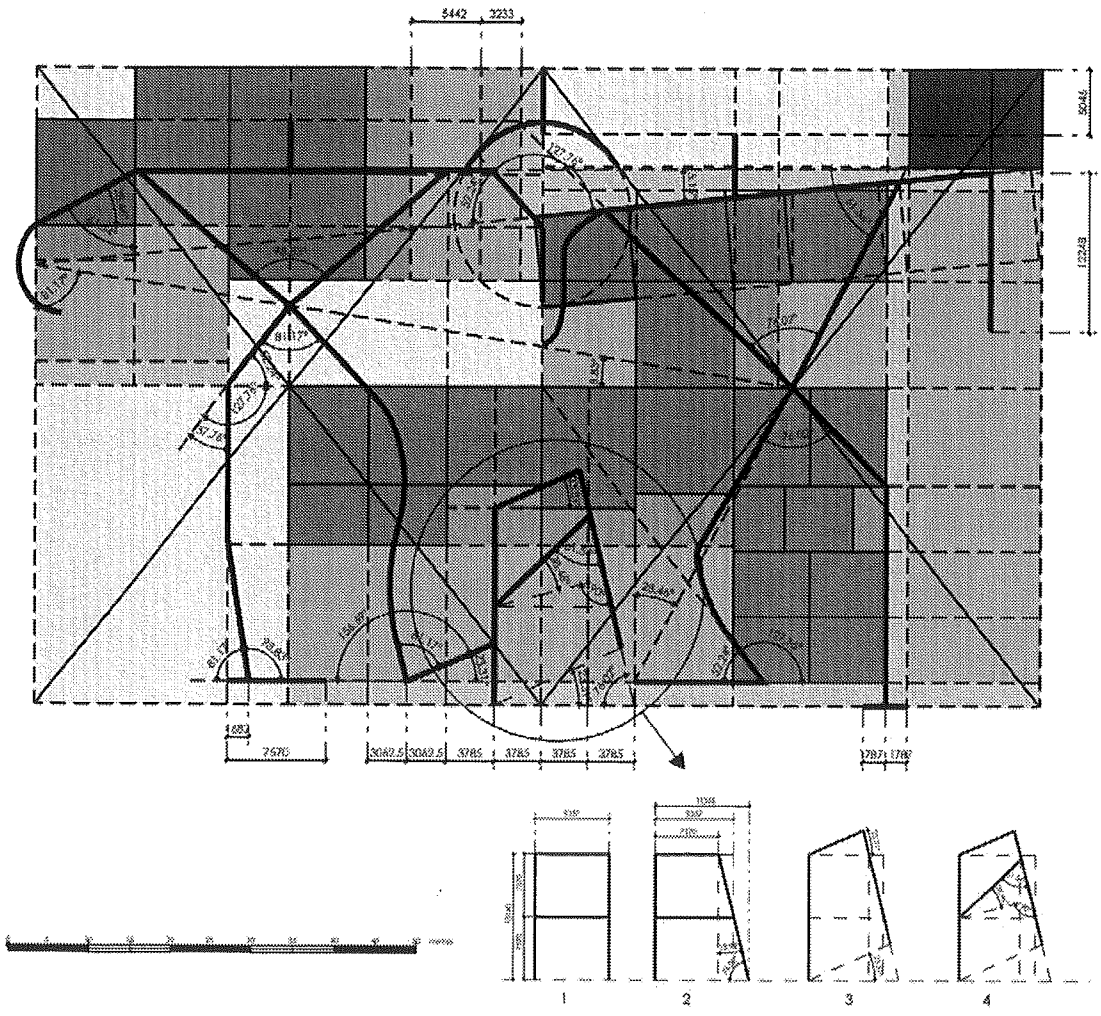

Fig. 11: *Idealised linear drawing of the upper part of the cryptograph on the basis of the ideal grid plan showing significant astronomical angles obtained at the latitude of Zagora ca. 760-750 B.C. Inset: the different stages of distortion of the object between the two figures.*

gy Castor and Pollux shared their immortality by spending alternate days between the radiant, 'golden homes of heaven' (Olympos) and the dark hollows of the earth (Hades), between life and death, or by living half of the year in heaven and the other half beneath the earth (Homer, *Odyssey*, 11.301, 302 f.; Pindar, *Pythian Odes*, 11. 61-64; *Nemean Odes*, 10. 55-57, 85-88; Burkert 1985, 212-213; Gantz 1993, 323-328). This legend received a cosmological interpretation, attributed to the Pythagoreans. The latter dedicated to the Dioskouroi the geometrical shapes of the semicircles (Damascius, *Quaestiones de primis principiis*, 261) and, according to a view, they must have been the first of a series of thinkers to identify the divine twins with the two celestial hemispheres (Chapoutier 1936, 307) – either with the day and night hemispheres or with the hemispheres divided by the equinox (since it is at the equinox that the Sun crosses from one hemisphere to the other), given also that the constellation Gemini is only visible for half of the year, being part of the winter sky. Thus, the Dioskouroi were considered to

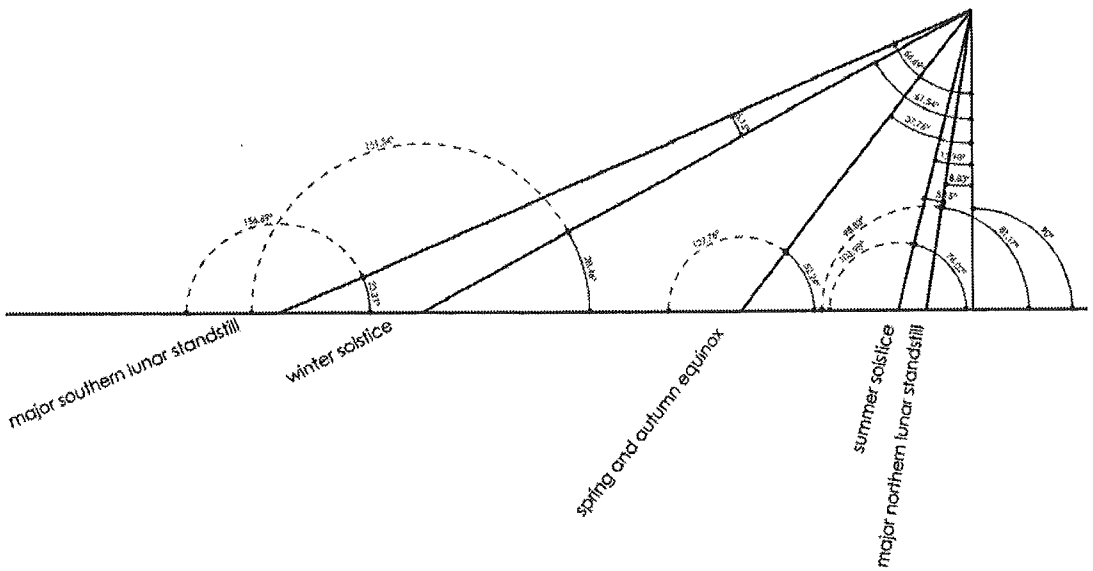

Fig. 12: *The triangles created by the shadows cast from a gnomon by the Sun and the Moon at their maximum altitudes on significant days of the year at the latitude of Zagora ca. 760-750 B.C.*

symbolise the dichotomy of the universe or *cosmos* and, at the same time, its integrity and harmonic unity (Iamblichus, *De vita pythagorica*, 155; Chapoutier 1936, 307-308; LIMC 1986, 610, 629-633 with further references). Accordingly, the sacred image of the Dioskouroi, the *dokana*, must have stood as a symbol of the harmony of the universe: the two uprights would have represented the heavenly twins as pillars ensuring the stability of the *cosmos* (LIMC 1986, 631), while the cross-beams would have symbolised their unity and like-mindedness (*homonoia*) and, by extension, the concord in the *cosmos*, as opposed to the anarchy of the chaos. It is interesting to note in this respect that the *dokana* appear to have been constructed ideally as golden rectangles (Fig. 19).

As the symbol of the 'dual' (day/night) aspect of the sky, Castor and Pollux have also been associated in Roman art with the Sun and the Moon. Sometimes the association is so close, that the Dioskouroi wear on their caps or *piloi* the images of the Sun and the Moon or they take the place of the two luminaries indistinctly or even they are disguised as Sun and Moon by a superposition of schemes that creates a synthesis of the two equivalent couples of figures: Pollux, the immortal son of Zeus, is identified with the Sun, while Castor, the mortal son of Tyndareus, is identified with the Moon (LIMC 1986, 631, 633).

Returning to the Zagora cryptograph, the stellar and cosmic character of the Dioskouroi, and their symbolic dualism would explain well: the fact that each one of the two figures is inscribed strictly within one half of the grid; the antithetical positioning of the figures on either side of an arch that forms part of a circle cut into two halves by the E-W central axis of the grid and containing the equinoctial angles –an obvious celestial symbol; and the profusion of the Sun and Moon angles recorded in and around the two figures – especially the angles found at the apices of their torsos would allow us to recognize in the left-hand figure Castor disguised as Moon and in the right-hand figure Pollux appearing as the Sun. Thus, the Dioskouroi would be represented on the cryptograph as guardians of the day- and the night hemisphere, of Heaven and of Hades, or as guardians of the two celestial hemispheres divided by the equinox (for a parallel of this latter kind of Dioskourean symbolism in Roman art, see LIMC 1986, 625 no.

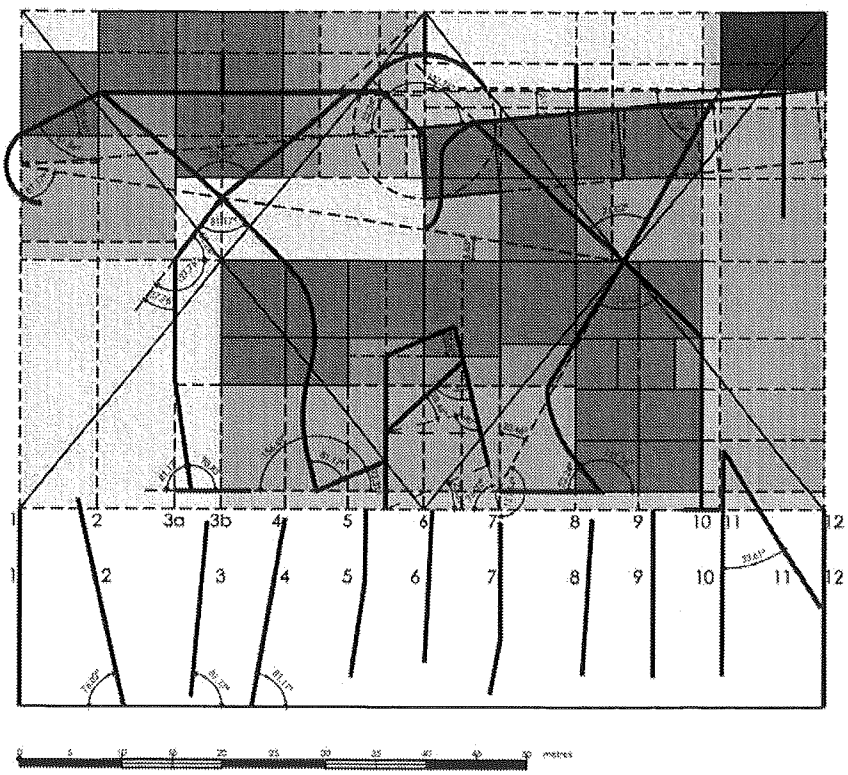

Fig. 13: *Idealised linear drawing of the cryptograph on the basis of the ideal grid plan showing significant astronomical angles obtained at the latitude of Zagora ca. 760-750 B.C.*

136, 631) and, at the same time, as personifications of the Sun and the Moon. As for the object between their legs, it could readily represent a pair of *dokana*. Indeed, it is remarkably similar to the *dokana* of the shape described by Plutarch (Fig. 19A) and, moreover, it appears to have been designed ideally as a golden rectangle, before it was intentionally distorted (Fig. 11-inset) apparently for reasons that will be explained below. Significantly, too, this object is reminiscent of the alternative configuration of the constellation Gemini as two nearly parallel sticks joined at the top by a horizontal line (Fig. 20), which itself strongly recalls the Π-shaped *dokana* represented in art (Fig. 19B).

IV) Although (Pseudo-) Eratoshenes (*Catasterismi*, 10) identified the figures in the constellation Gemini only with the Spartan Dioskouroi, i.e. Castor and Polydeuces, Hyginus (*De Astronomia*, 2.22) and Ptolemy (*Tetrabiblos*, I. 9) associated them also with Apollo and Heracles, respectively (Condos 1997, 111-113). Thus, the Heavenly Twins are depicted carrying the characteristic attributes of Apollo and Heracles, i.e. a bow and/or an arrow and a lyre, and a club, respectively, on a series of zodiacal representations, as for instance on the star maps based on (Pseudo-) Eratosthenes' and Hyginus' works (Condos 1997, 214); on the zodiacal coins of Alexandria under Antoninus Pius (Gundel 1992, 154, 279 no. 254. 3); on a Roman zodiacal disc (Gundel 1992, 226 no. 62); on ninth century European zodiacal manuscripts following the Roman tradition of illustration (Gundel 1992, 328, no. 460.2); and on European celestial atlases dating from the sixteenth to eighteenth centuries and actually marking the Twins as "Apollo or Castor" and "Heracles or Pollux".

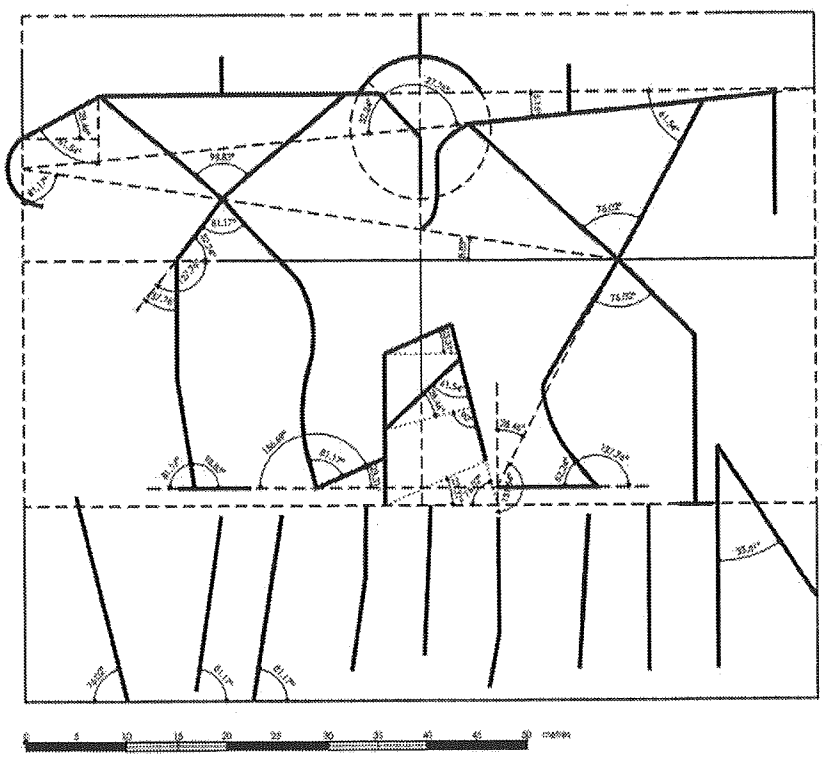

Fig. 14: *The idealised cryptograph, isolated from the grid plan, showing the astronomical angles recorded.*

All this is not surprising, given that Castor and Polydeuces were renowned, apart from their athletic qualities (Theocritus, *Idylls*, 22. 24, 27-134; Gantz 1993, 323-328), which recall those of Heracles, for their love of horses, music and poetry (Theocritus, Idylls, 22. 24, 135-211; Manilius, *Astronomica*, 4.152-155; Gantz 1993, 323), which is also a distinctive trait of Apollo. Furthermore, the complex and variable character of the Dioskouroi and their capacity to be associated or assimilated with other divine figures are well-known (Chapoutier 1936, *passim*; Guarducci 1984, 133-134; Aravantinos 1994; Köhne 1998).

On the Zagora seal, the left-hand figure would represent Castor/Apollo, while the right-hand figure would depict Pollux/Heracles: the arch between them could represent Apollo's bow-and-arrow (since it appears to be carried on the shoulder of this figure and does not touch the shoulder of the other figure), while in the lower part of the cryptograph the oblique line no. 11 could represent Heracles' main attribute, the club; it may even be that the twelve lines in the lower part of the cryptograph also stand as a symbol of the Twelve Labors of Heracles.

The interpretation of the right-hand figure as Pollux/Heracles is corroborated by a drinking vase, a kantharos, discovered within the temple of Zagora. The vase bears the inscription 'ΗΡΑΚΛΕΟΣ' ('of Heracles') (Cambitoglou *et al.* 1981, 89 no. 285, figs. 47-48; 1988, 222 inv. 1276+1277+2047 and plate 257a-c) and suggests that the temple was dedicated to the great Greek hero. The other vase with an inscription found in the building may, for its part, give an indication of the worship of Pollux: its incised retrograde graffito 'ΙΛΟΠ'(?) may actually represent the unfinished name of Polydeuces, rather than an abbreviation of Athena's epithet "Polias', as hitherto interpreted (Cambitoglou 1972, 266-267; Cambitoglou *et al.* 1981, 84 and 89 no. 284, figs. 45-46; 1988, 222). In this way, Pollux/Heracles

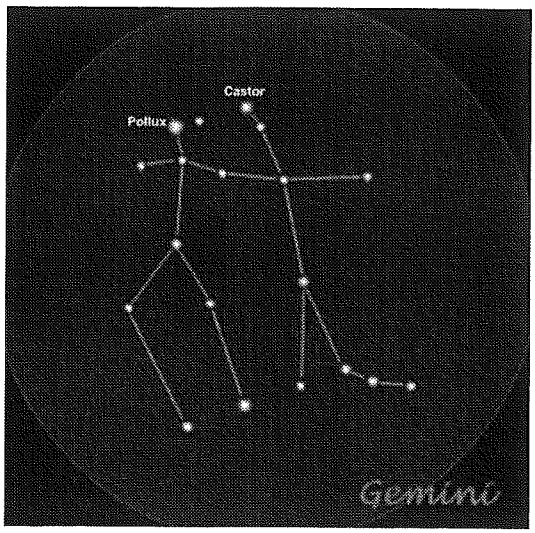

Fig. 15: *The constellation Gemini.*

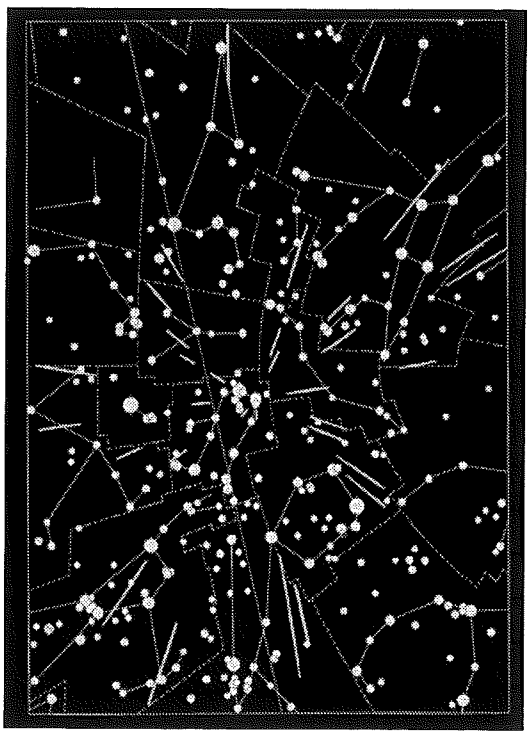

Fig. 16: *The Geminid Meteor Shower radiating from the constellation Gemini.*

would be depicted on the cryptograph as if he was carrying on his shoulder the temple of Zagora, in which he would have been venerated, perhaps jointly with Castor/Apollo. One could point out in this respect that in the temple of Apollo at Eretria Heracles was worshipped together with the god (Jeffery 1961, 85), while in the temple of Apollo at Delos two images of the Dioskouroi were dedicated (LIMC 1986, 570 no. 21). Also, on Spartan coins dating from the third century B.C. the symbols of the Dioskouroi are combined with the club of Heracles on the obverse and the head of the hero on the reverse (Palagia 2006, 206). And it may not be insignificant that Heracles and the Dioskouroi are cited together as the receivers of the libations recommended by Pythagoras before dining (Iamblichus, *De vita pythagorica*, 155-156).

The identification of the Twins Castor and Pollux with the Sun and the Moon, as well as with Heracles and Apollo is further supported by the following three observations. Firstly, in much of his mythology Heracles is presented as a Sun-hero, the human double of the Sun-god, Helios: his Twelve Labours occupy a Sun-Year and in his adventure with the cattle of Geryon, already known by Hesiod (*Theogony*, 287-294, 327, 979-983), he travels far to the west, to the island of the setting Sun (Erytheia) after borrowing Helios' golden boat-cup, in which the Sun-god crosses the Oceanus every night from west to east to rise again in the morning; in addition, Heracles' heroic-chthonic cult had solar aspects, since it involved sunset sacrifices aimed at emphasizing death and ensuring resurrection (Harrison 1912, 368-376; Burkert 1979, 83-84; 1992, 124). Secondly, the Babylonians – from whom the Greeks probably borrowed the constellation Gemini (Allen 1963, 222-237) – commemorated within the constellation of the "Great Twins", as they called it, the close friendship of their legendary heroes Gilgamesh and Enkidu, and they often depicted the Twins respectively as the Sun and the Moon, one rising as the other sets. Gilgamesh engaged in twelve adventures, which are closely paralleled to the labours of Heracles (Burkert 1979, 93-94; 1992, 119-127) and are considered to be a reflection of the solar journey; as a Sun-hero, Gilgamesh travels to the beyond 'along the route of the

Fig. 17: *The Geminid Meteor Shower reaching its peak on 13 December*

Sun' seeking immortality for himself and his dead friend Enkidu, but he does not succeed, because he must perish at sunset, sojourn in the underworld and repeat the cycle again at sunrise (Allen 1963, 224-225). Thirdly, the struggle of Gilgamesh for immortality is reminiscent both of Heracles' traveling to the Garden of the Hesperides, considered as the garden of immortality (Burkert 1992, 124), and of Pollux's plea to Zeus for his dead brother's resurrection to life and immortality (Pindar, *Nemean Odes*, 10. 75-90).

Second level of symbolism: On a second, more 'mundane' level of symbolism, the cryptograph seems to depict the two Dioskouroi as the town-planners, mathematicians and astronomers of Zagora.

In the lower part of the scene, the rain of meteors falling from the constellation Gemini would, by a superposition of schemes, represent at the same time the E-W lines of the (western half of the) grid. Thus,„Castor and Pollux would appear to be standing at the eastern end of their grid plan, on either side of its E-W midline (axis BB′) against the eastern horizon of Zagora, as if one was looking at them from the west towards the east.

The arch between them could, according to this

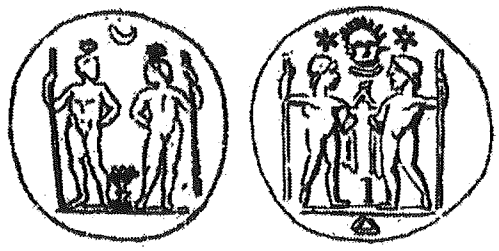

Fig. 18: *Gems showing the Dioskouroi (A) on either side of a moon crescent and a table of offerings (Chapoutier 1936, 66 no. 58); (B) on either side of a bust of the Sun (Chapoutier 1936, fig. 46).*

second scheme, be the symbol of the rising disc of the Sun at the eastern horizon of Zagora at the equinoxes; the pointer in its middle may be a reference to an actual pointer used at the eastern horizon to mark the position of the Sun's sunrise at the equinoxes. Another, more 'scientific' reading of the arch could be that it represents an astronomical instrument for measuring altitudes of celestial objects, such as the meridian quadrant described by Ptolemy (Fig. 21), which was used for finding the maximum declination of the sun and comprised an angular scale engraved on a block of stone and a bar casting a shadow across it (Ptolemy, *Almagest*, I, 12; see also Thurston 1994, 27; Evans 1998, 34-35, 59-60, 205-207).

Finally, the *dokana* between the legs of the Dioskouroi could represent, in this second layer of symbolism, the actual tool that the town-planners would have used to accurately draw their plan in different scales by reducing or enlarging it – in other words, a pantograph, a mechanical linkage based on the simple principle of the parallelogram in Euclidean geometry. This would then be the earliest example of a pantograph, the next known ones dating from the Renaissance (Scheiner 1631; Hambly 1988; Goebel 2003) (Fig. 22). The pantograph would have also enabled the tracing of the cryptograph on the tiny lead tablet by scaling down from what must have been a larger-scale prototype, incised on a wooden, clay or metal tablet, which would have been better adapted to recording the cal-

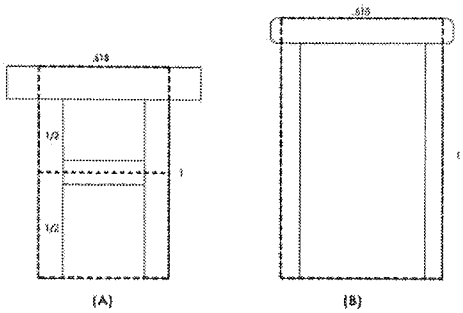

Fig. 19: *Two types of dokana, sacred symbol of the Dioskouroi, constructed on the basis of golden rectangles. (A) After Guarducci 1984, pl. VII; (B) After Aravantinos 1994, fig. 4.*

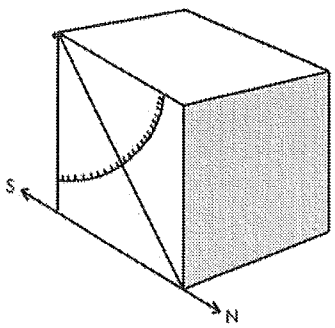

Fig. 21: *Meridian quadrant described by Ptolemy (after Thurston 1994, fig. 1.9).*

culations used in laying out the site and from which it would have been copied by an expert in miniature work.** The *dokana* would have been intentionally distorted, precisely in order to convey the image of a pantograph – in fact, of a pantograph set up ideally at a scale of 1: 2 – and, at the same time, so as to incorporate in their design significant astronomical angles obtained locally (Fig. 11-inset); it is interesting to note that the second stage of this distortion (Fig. 11-inset, 3) implies an awareness of the so-called Thales' theorem (Fig. 23). A similar type of double-layered symbolism of the *dokana* appears on a coin from Sagalassos (Fig. 24), where on the axis of symmetry, between two altars symbolizing the Dioskouroi, the *dokana* are represented forming simultaneously the letter A of

**I am grateful to Professor Anthony Snodgrass for this suggestion.

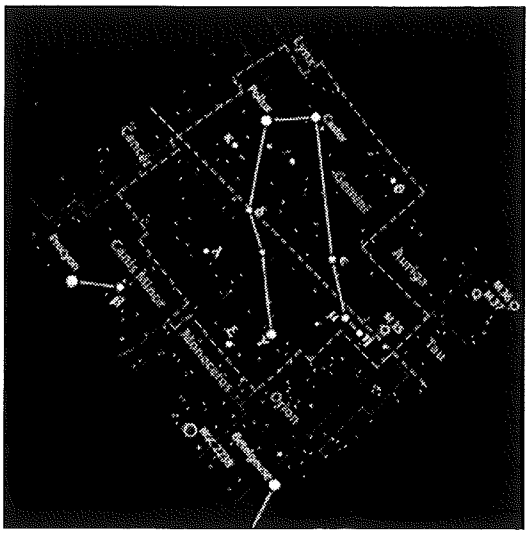

Fig. 20: *The alternative configuration of the constellation Gemini*

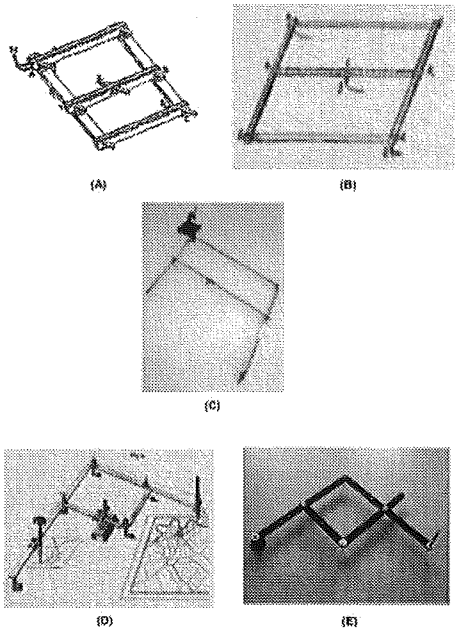

Fig. 22: *Various types of pantographs. (A) Wooden pantograph designed by the astronomer and mathematician Christoph Scheiner in 1603 (after Scheiner 1631); (B)-(D) Copper pantographs dating from the seventeenth-nineteenth centuries (Goebel 2003); (E) A twentieth-century plastic pantograph (photo by the author).*

the inscription; curiously, this shape also recalls a pantograph (Fig. 22D-E).

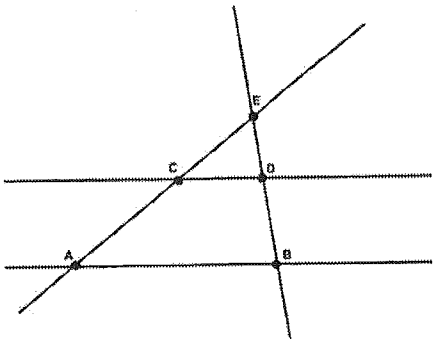

Fig. 23: Thales' theorem. Line AB is parallel to line CD, if and only if triangle AEB is similar to triangle CED, if and only if ED/EB=EC/EA.

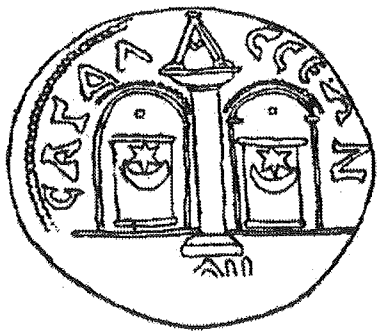

Fig. 24: Coin from Sagalassos with the symbols of the Dioskouroi (Chapoutier 1936, fig. 54).

The significance of the Zagora cryptograph

The Zagora cryptograph is, in many ways, a unique document.

In addition to providing us with the first preserved representation of the Dioskouroi in Greek art, it attempts to translate the arrangement of the stars in the constellation Gemini into an image, which, to date, is the only known occurrence in Greek and Roman art. We are clearly dealing with a symbolic, non-narrative scene, acting more like a cult image or an emblem, which through the frontal and hieratic representation of the Dioskouroi as the mirror-image of the constellation Gemini standing symmetrically on either side of their sacred attributes seeks to highlight the stellar and cosmic character of the twin divinities, rather than their heroic and purely mythological personality. This powerful sacred symbol must have been used by the local élite and/or the priests for stamping or sealing various official documents, whether religious or profane, messages, clay jars containing oil or wine etc. (cf. the Hellenistic amphora stamps bearing the symbol of the *dokana* next to the name of the Dioskouroi – LIMC 1986, 580 no. 156).

At the same time, the Zagora cryptograph is the only archaeological object known so far from the Greek world to record a town plan, even though in a coded manner. Moreover, it offers us new insights into early Greek settlement planning, suggesting that the orthogonal grid plan of Zagora was permeated not only with mathematical but also with astronomical knowledge. This truly unexpected terrestrial and celestial interaction appears to have been executed with quite an extraordinary precision both in the cryptograph (and in its putative larger-scale version) and 'in the field'.

Even more importantly, the cryptograph seems to provide us with the earliest evidence of the use of mathematics and astronomy in the Greek world. It seems to imply a long tradition of accurate observation and practice in these fields of interest at the time of Homer and Hesiod, and nearly two centuries before the first known Greek astronomers and mathematicians, Thales and Pythagoras. This tradition, whilst not necessarily being guided by formal theory of any sort, would have constituted the groundwork on which later Greek science was slowly built.

Mathematics and astronomy would have served at Zagora both as tools for practical tasks and as carriers of meanings. The grid underlying the residential quarters of the élite, with its harmonic order and its celestial information, must have been considered to echo and reveal that cosmic order, of which the nobles and especially the paramount ruler would have purported to be the exclusive interpreters and custodians. Living within the realm of a grid that symbolised the perfection and harmony of the sacred universe or *cosmos* and was endowed with divine beauty – thereby foreshadowing the Pythagorean symbolism, perhaps even the mathe-

matical correspondence between the microcosm of Man and the macrocosm of God, such as described later by Plato in his *Timaeus* (Olerud 1951; Martin 1976; Ghyka 1977, 111-114) – the Zagora nobles would have patently appeared as the necessary mediators between the gods and the common people, so as to ensure the order and harmony of society, and promote internal unity and concord (*homonoia*) in the political community as an answer to stasis or political anarchy (Ferguson 1958, 118 ff.; 1989, 41-42). Moreover, a grid that encapsulated the image of the constellation Gemini perhaps suggests that Castor/Apollo and Pollux/Heracles were used in the framework of a ruler ideology: for instance, the noble families in Zagora may have traced their ancestry from the Dioskouroi and Heracles, as did the leading families in Sparta, thereby also holding the hereditary priesthood of a cult to these probable heroic protectors of their town (cf. Cartledge and Spawforth 1989, 162-163, 195; Sanders 1993, 221; Steinhauer 1993, 227; cf. also the ideological use of thè Dioskouroi in Imperial Rome as tutelary gods of the city and role models for the emperors – Poulsen 1991; LIMC 1986, 632-633). By such means, the Zagora élite would have sought to legitimize and consolidate its power in the context of an emerging city-state or *polis* (Coucouzeli 2004; 2007).

There appears to have been, therefore, a strict connection between practical astronomy and mathematics, architecture and the political sphere at Zagora in the second half of the eighth century B.C.

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