Mediterranean Arhaeology and Archaeometry, Vol. 13, No 1, pp.235-264

THE PHAISTOS DISK: A SOLAR CALENDAR. CONTRIBUTION TO A DECIPHERMENT

Mary Kilbourne Matossian

Department of History, University of Maryland, USA

Received: 30/9/2012
Accepted: 25/10/2012
Corresponding author: mary@matossian.net

ABSTRACT

The objective of this paper is to contribute to the decipherment of the Phaistos Disk. The present assumption is that the Disk was a solar calendar. The proposed method is used to recreate the night sky over Crete in the year 1613 B.C., beginning on September 1, and to follow the astral phenomena for a year thereafter. In addition, the figures on the Disk are interpreted by what is known about Bronze Age Cretan culture, especially agriculture.

The result was a set of plausible interpretations of most of the icons found on the Disk. The conclusion is that the Phaistos Disk Unknown Script was created primarily to serve as a guide to the timing of agricultural activities and religious rituals.

KEYWORDS: opium, bull rituals, double axe, planets, constellations, Phaistos disc, Minoan calendar

1. INTRODUCTION

In 1908 an archaeologist, Luigi Pernier, discovered the Phaistos Disk in the ruins of the first palace at Phaistos, Crete, which had been destroyed by a severe earthquake. Many have tried, but none so far have succeeded in deciphering the figures printed on it. The purpose of this article is to make a contribution to this decipherment.

In a 1976 essay, Leon Pomerance argued that the Phaistos Disk was an almanac or calendar. He identified two celestial symbols on the Disk: the eagle as the constellation Aquila, and the seven dots inside a circle as the Pleiades (Pomerance, 1976).

In 1996 Goran Henriksson and Mary Blomberg suggested that the Minoans had astronomical observatories in the peak sanctuaries of Petsophas and Graostalos (Henriksson and Blomberg, 1996).

In 2011 Henrickson and Blomberg published an article presenting evidence from Knossos that the Minoans had a solar and a lunisolar calendar. They said that the calendar began with the autumnal equinox. They identified the double axe sign with the constellation Orion (Henriksson and Blomberg, 1996).

In 1966 University of Glasgow astronomer Michael Ovenden argued that the constellations recognized by the Greeks had been invented in 2800 B.C. ± 800 years. He designated the most likely place of invention as Latitude 36 and one and a half degrees north, and Longitude 26 and one third degrees east. As to the identity of the inventors of the constellations Ovenden said: *"I would like to put forward the claims of the Minoans of the Minoans, based in Crete, who were in the Mediterranean in strength by the beginning of third millennium [B.C..]"* (Ovenden, 1966).

In 2006 astronomer Bradley E. Schaefer argued that the Greek constellations, as catalogued by Ptolemy of Alexandria in the second-century b.c.e. Almagest, originated in Mesopotamia between 1300 and 1000 B.C.. Taking the precession of the equinoxes into account, Schaefer argued that the Mesopotamian constellations would have been visible near or at Lat. 33-36 degrees (Schaefer, 2006) He did not estimate the longitude.

The palace at Phaistos was in south-central Crete at Latitude 35 degrees North and longitude 25 degrees East. This was quite close to the location specified by Michael Ovenden for the invention of the constellations. The palace commanded a view of the twin peaks of Mount Ida which lay due north.

Earlier attempted decipherments of the disc are numerous, all but a few of not scholarly value and none yet of wide academic acceptance.

The journal of Archeoastronomy (Vol II, number 3, Summer 1979) included a book review by D. H. Kelley for the book by Pomerance (1976).

Dieter (1990, 1994) made some linguistic evaluations, Dr. M. Frenkel claims that the Disc is an astronomical calculator. His views were presented at Oxford VI and SEAC 99 Conference (27-05-99).

In the words of the Author, Claire Grace Watson, *"The disk is a Minoan wave spiral (left) on which is depicted the Aegean world of Minoan Crete, including a cave, a boat, a pyramid, a star, planets, a constellation, geometry, math, and everyday life in Crete that mirrors the stars above. We reveal them on the disk just as we revealed the kind grandmother, by connecting identical pictographs with lines. This is also how the constellations are revealed. We know they are only stars, but to the people of the Aegean world, the stars and planets were the eyes of the gods watching over them"*. (see, http://www.diskoftheworld.com/)

Ridderstad (2010) talked of a lunisolar calendar, and Bernd Schomburg (2000) – *Der Jahrtausend-Kalender der Minoer* (= Minoan calendar with directions for the measurement of the year and the

millennium), of a Minoan calendar with schematic winding ideogram.

Concerning the evidence of Minoan astronomy Blomberg and Henriksson (2001) provide new trends and more results that document this.

2. DATING THE PHAISTOS DISK

The dating of the Category 7 (most severe) volcanic eruption of nearby Santorini has been confirmed by recent dendrochronological studies which concluded that a likely time of disturbance was in the range of 1627–1600 B.C.. (Friedrich, 2006; Manning, 2007). All the old palaces in Crete were destroyed by an earthquake in this period. Accordingly this, the decipherment of the Phaistos Disk was based on the median date, 1613 B.C. A second computer run of the data for 1650 B.C gave results about an hour different from the 1613 B.C. run.

3. METHODOLOGY

The computer program used here was Your Sky, prepared by John Walker, founder of Autodesk, and posted on the Internet in 2003. *Your Sky* can display the sky as it appeared at any date and time from 4713 B.C. to the distant future (the Sun, Moon, and planets are not shown for dates beyond A.D. 8000 because the technique used to calculate their positions is not valid beyond that date). This permits one to create a star map for almost any date in recorded history (http://www.fourmilab.ch/). It takes into account precession of equinoxes and gives Julian dates. I have set its virtual telescope for 35 degrees north and 25 degrees east, close to the ruins of Phaistos. The significant positions of stars and planets were 1) near the eastern or western horizon at dawn, 2) the peak (culmination) and 3) near the eastern or western horizon at sunset. I have assigned "sunrise" to appearances between 5 and 7 a.m., "sunset" to between 5 and 7 p.m. and culmination to 11 a.m. to 1 p.m.

The hypothesized interpretations of the signs on the Disk were tested in two ways. The first was to match the signs with the seasonal sequence of events in agriculture, based on the climate of Crete and the changing condition of the plants and animals found there. The second was to match the signs with contemporary events in the sky, specifically, the rise, peak (culmination) and setting of constellations and planets as shown in computer reconstructions.

When a sign on the Disk matched the date of a known agricultural or celestial event that was taken as a positive verification. Equally important was the absence of such signs at times in the year when no such events normally occurred. The associations between agricultural and celestial events were usually significant, suggesting that the motivation for creating the Phaistos Disk was the need to schedule agricultural events appropriately. For example, the cluster called “Scorpius” was associated on the Disk with a bare vine in winter and leafy vine in summer.

The migration of birds (symbol V, like a gnomon) over Crete between Europe and Africa was the kind of event that reflected important changes in temperature and precipitation. The timing of V symbols is relevant. There were no V symbols for the period August through October, when the weather was warm. There were six V symbols, suggesting heavy migration, during April through July, possibly birds moving from the heat of Africa north to Europe. There were two V symbols between November 11 and February 10, possibly indicating migration from Europe back to Africa. (Note: This would suggest a different migration timing than is true today. Recent research supports the idea that the climate during Minoan civilization was cooler and wetter due to El Nino activity, see, Grove and Rackham, 2001;. Tsonis et. al, 2010). The Thera eruption may also have contributed to climate change for

that and following a few years.

The Phaistos Disk appears to be a 360-day Minoan calendar produced by local observations. Some of its signs can be shown to be pictograms which, with the use of the computer, can be linked to celestial associates. Other signs can be interpreted with reference to Cretan agriculture and Greek myths (see Table 1)

It was common for ancient peoples to time their seasonal activities to the regular risings and settings of constellations. The ancient Greeks and Romans used changes in the rising, peak and setting of stars and planets to determine the correct timing for farm work (Hannah, 2005).

The climate of Crete today may be much the same as the climate in the Late Bronze Age. The months of June, July, and August are hot. In September the weather begins to cool and October is comfortable. The rainy season starts in late October and lasts until March or April. However, there is a week in January when the weather is fair and the winds die down. Winter is mild. Wild flowers bloom in April and there is no rain after May 10. In May the weather is ideal for sailing, clear and warm, and the sea is calm.

In one respect the climate of Crete in the seventeenth century B.C.. may have been different from the present. A study of Dead Sea levels found that rainfall was much more abundant in the Bronze Age than in the period 1200 - 400 BC. (Enzel, 2003). So the planting of crops in September, as suggested in this decipherment, seems plausible.

It seems correct to read the signs on the Disk from the center out since the maker of a spiral tends to start from the center and wind around it. There is no doubt that the signs were imprinted on the Disk from right to left, that is, clockwise. Those who have tried to interpret the Disk from the outside in (counter-clockwise) have not succeeded.(see refrences in the introduction)

4. EVIDENCE OF TIME-FACTORED CHARACTER

It is hard to recognize the Disk as a calendar because there are only 122 signs on side A and 119 signs on side B: 122 + 119 = 241. In Table 1 the two sides of the disc and the symbols with celestial analogs are shown. These are presented as separate groups. However, on both sides of the Disk there are small circles containing seven dots inside.The seven dots plus a circle were counted as 8 days each.

There are fifteen of these circles on side A: 15 x 8 = 120. There are two of these circles on side B: 2 x 8 = 16.

Adding 122 symbols + 105 dots (15 x 7 =105) for side A = 227.

Adding 119 symbols + 14 dots (2x 7 =14) for side B = 133.

Adding 227 + 133 (symbols plus dots) = 360 days.

This coincided exactly with the Egyptian calendar of 360 days, plus five intercalary days. But if the Phaistos Disk was a calendar, why was it divided into two parts, one on side A, and one on side B? The key to understanding this is that Mediterranean agriculture has two sowing seasons a year, a sowing of grain in September or October for harvest around March and a sowing of quick-maturing crops soon afterwards. If the climate was cooler and wetter in 1613 B.C. than today, two growing seasons would have been more likely.

Some important agricultural activities continued in the dry season. Cultivated olives and grapes had very deep roots to reach ground water. Other plants like the opium poppy were drought-resistant and, once sprouted, could survive without water for weeks. Consequently the two sides of the Disk portrayed two different planting seasons with continuity over the summer on Side B.

A period of five intercalary days was probably inserted at the end of Side B. There is no suggestion of a winter break like

that of our Gregorian calendar on December 31. Instead, the start date for the calendar may have been the autumnal equinox. This may have been at the end of August, as supported by the practice of the Egyptians, (Hannah, 2005). This could have been the case in Minoan Crete as well. The calendar year would have begun as the summer's worst heat was subsiding and rains may have revived plant life. Alternatively, the date could have been October 6, which has been proposed by Henriksson and Blomberg, 1996, 2011).

5. FINDINGS

Eleven of the twelve Greek zodiac constellations— Aquarius, Pisces, Aries, Taurus, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, and Cancer—are found on the Phaistos Disk according to author's description. These eleven Cretan symbols correspond to the rising, culmination or setting of the constellations from September 1, 1613 until August 26, 1614 B.C. (see Table 1).

The missing constellation of Gemini is associated on the Phaistos Disk with a wrapped hand (suggesting a time for making vows). Gemini may have been seen as al-Jauza, the Central Woman, in whom some Arabs believe today (Allouche, 2005; Baalbaki, 2003; Bagley, 1974, and Varisco, 2001) (Beit al-Jauza = Betelgeuse). The Indo-European peoples gave the name of twins to a constellation that others saw as a powerful female, the source of milk in the Milky Way. Her feet touched the western edge of the Milky Way.

Constellations which appeared in the *Almagest* but not on the Phaistos Disc were Ursa Major, Ursa Minor, and Gemini (see previous paragraph). The bright star Arcturus was mentioned in the *Almagest*, but not its constellation Bootes, the Bear herdsman, who appears according to the author's description on the Phaistos Disc. The absence of the Bears on the Disk may reflect the fact that the Bears are continuously visible in the night sky of Crete and do not rise or set.

Aquila, which appears on the Disk but not in the *Almagest*, was the eagle of Zeus in Greek mythology. In some myths, Zeus was born in Crete.

6. INTERPRETATION OF SIGNS

The Rosette. The appearance of the rosette at the center of Side A suggests opium according to the author's opinion. The rosette design was found in opium poppies in the artifacts of the cults of Inanna and Ishtar in Mesopotamia, Astarte in the Levant, and Demeter in Greece. The rosette resembles the crown of the unripe poppy seed capsule, which contains the opium. It may contain four to eighteen septa, depending on elevation of the plant. Six septa are usual in the highlands of Asia Minor, so the eight septa shown on the Disk rosette would be possible at Phaistos, which was located on a high hill.

The decipherment of Linear B writing on Minoan tablets firmly established the cultivation of opium in Minoan Crete. According to Karl Kerenyi (Kerenyi, 1976).

The clay tablets that have been deciphered testify to the fact that poppies were widely cultivated both in Crete and in Pylos in the Late Minoan period. The use of the poppy head as an ideogram in these account books leaves no room for doubt. The yield of poppies mentioned is so enormous that students long suspected that the figures referred to grain rather than poppies (Kerenyi, 1976).

There was an eight-septa rosette design on the ceiling in the palace of Knossos, Crete. At a small sanctuary in Gazi, a village near Heraklion, the figure of a female with three opium seed capsules stuck by pins in her head was unearthed. Her eyelids were shut and her mouth slightly open, suggesting she had been ingesting or smoking opium (Goodison and Morris, 1998).

The opium poppy needs a lot of sun—twelve hours a day during its 40–60 day growth cycle. Once planted in moist conditions it needs no further watering.

The rosette is sign 1 on Side A, right in the center of the Phaistos Disk, suggesting importance. It recurs as sign 13 and again as sign 76 (September 1 and 20, and January 10). On both September 1 and 20 the planets Mercury (Hermes) and Venus (Aphrodite) rose at dawn in the east. The goddess Venus was associated with opium in Mesopotamia; Hermes was mentioned in association with opium in the Greek Hymn to Demeter. Sign 76 (January 10) may indicate the end of opium processing. The rosette on Side B is number 72 (June 26). This appears to be the end of the harvest of the poppies sown in mid-April.

Hermes. Immediately after the first two rosettes on Side A, is the profile of a man with 8 marks on his cheek. The 8 mark stood for Hermes (Mercury), the messenger between the worlds of the living and the dead according to the author's opinion. The symbol represented the mating of two snakes (in myth, Zeus and Hera). The 8 sign was attached to the staff of Hermes, first called the kerykeion. Later it was called the caduceus, a staff with two wings added to the top and multiple snake windings. It was Hermes who brought Persephone back from Hades to her mother, Demeter, on earth.

Hermes was from Kyllene, otherwise known as Mekone, the "poppy town", (Merlin, 1984), Hence he is logically connected with the rosette, emblem of opium.

Furthermore, consulting the sky for the dates September 2 and 21, one sees that the planet Mercury (Hermes) rose at 7 a.m.

Opium poppy. The sign of a flower on top of a long upright stalk may be an opium poppy. It occurred on May 29, July 9, August 9, September 7, and December 7. It is unclear whether it referred to events in poppy cultivation or occasions for opium use. All poppy signs were associated with the rise or peak of Mercury except the one on July 9 which connects with Mars peak. The connection between the rosette and Venus is through opium.

The rosette = the crown of the seed container of the poppy. The Love

goddess was the patroness of the opium poppy.

Ear of Grain. Near to the rosette center of Side A is a symbol that appears to be an ear of grain (Signs 3 and 15, September 3 and 22). On September 3 the bright star Spica rose at 5 a.m. and at 4 a.m. on September 22. This star represents an ear of grain in the hand of the constellation Virgo. Signs 3 and 15 may have been be planting dates for wheat or barley when the climate was cooler and wetter. Today, the planting dates for wheat or barley are last days of October through the first days of November.

The ear of grain appeared as the star Spica peaked at 6 a.m. on November 19 and January 4. These may have been dates for harvesting and processing wheat and barley.

Olives. There were two other important crops grown on Crete: olives and grapes. The leaves of the olive tree, Olea europaea, are arranged opposite each other on the stem, which is a way of identifying the sign on the Disk.

Olive trees flower in May and are thinned two weeks after full bloom. The olive fruit needs six to eight months to mature. Olives are harvested from the beginning of November until spring.

In the Northern hemisphere, green olives are picked at the end of September to about the middle of November. Blond olives are picked from the middle of October to the end of November and black olives are collected from the middle of November to the end of January or early February.

The olive branch sign appears eleven times on the Disk. Every appearance was correlated with one of the three significant

positions of the constellation, excluding his head. The starry torso of Leo, represented by an olive branch, is a celestial analogue, including a slight leftward bend of the top of the branch.

In Greek mythology, as mentioned above, Herakles attacked the Nemean Lion with a club made of wild olive wood. The lion survived, so Herakles had to strangle him. He took the hollowed-out cranium of the dead lion to use as a helmet.

This serves to explain the association between the olive branch and the Leo constellation.

Grapevine. The cultivation of the grapevine in Crete began by 2500 B.C.E. Unlike olive trees, grapevines are deciduous and dormant in fall and winter (McGovern, 2003).

On Side B, the upright Y with leaves seem to be a grapevine sign, the vertical support for the vine. A leafy Y appeared on May 4, June 3, and June 30. A bare Y is represented September 24, October 17, and January 27. The last three signs appeared when the vine was dormant. The grapevine should be linked to Scorpius. Scorpius is associated with death, and the cutting of bunches of grapes may be analagous. Dionysos is more closely linked to the grapevine, but there is no agreed upon constellation of Dionysos. As for other constellations, like the dove, which cannot be proved to be extant in the Bronze Age, it may be that the Minoans used a number of such images since it appears their astronomy was more advanced than we previously knew. Perhaps the Minoans conceived of Scorpius as Dionysos.

The lily symbol appears on the Disk on April 29, June 10, July 17, and January 9. It is associated in the sky is Delphinos, the dolphin. The first three dates of lily signs fall into the blooming period of the Madonna lily, spring to midsummer. The fourth lily sign for January 9 was the date on which Delphinus was at its peak at 9 a.m. The same is true for 4-29 or 7-17.

Knife-blade. Sign 99 (June 19 and July 23), might be a knife blade suitable for grape harvesting. The first date might have the sacrifice of first fruits of this precious crop. It was close to the summer solstice at that time. The second knife sign might have signaled grape harvest at that time. On both dates the constellation Scorpius was at its peak. Scorpius may have been associated with death because of its fatal sting. A harvest involves the death of the crop.

October 17 was a date of unusual significance for watchers of the night sky. At 5:30 a.m. Scorpius appeared in the east. Saturn and Mars were in conjunction. There was a full moon. Next to Scorpius was Libra, the scales, symbol of balance. Next to Libra was Virgo. Due north of the scales was the constellation Corona Borealis, containing a U of seven bright stars.

According to a Greek myth, Dionysos married Ariadne, princess of Crete and gave her a gold wedding crown (the Corona Borealis).

Cancer. The inverse Y sign is that of the present as well as ancient constellation of Cancer the Crab according to my description. Without exception it coincided with the rise, setting, or peak of that constellation. The sign may have represented either a root or a thread spun by twisting fibers. Originally the crab may have represented a Y- shaped distaff, from which a spinner draws several fibers and twists them to make a thread, the first step in spinning.

Apiculture, the care of honeybees, was practiced in Crete by the Late Bronze Age. It was mentioned in Linear B inscriptions from Crete. Honey was fermented to make mead and was offered to the gods (Kerenyi, 1970).

Beekeeping was also related to celestial phenomena. The Pleiades, a group of seven stars in the constellation of Taurus, were frequently cited by Hesiod as a sign by which to time agricultural operations that may include beekeeping. The constellation

of Orion and the planet Jupiter (Zeus) were also associated with bees. Orion was born in a town called Hyrai, a form of *hyron* said to be the Cretan word for a swarm of bees or beehive. Bees in Crete were supposed to have fed Cretan Zeus as a baby.

Bee: Minoan apiculture was revealed on the Disk by the presence of a bee on March 19, April 20, and May 19. That was when the flowers were in bloom, and the bees were beginning to collect nectar. On March 19, the Pleiades rose at dawn, Orion set at 7 p.m., and Jupiter was near its peak. The bee symbols on April 20 and May 19 coincided with the rising at dawn of the constellation Orion.

Beehive. The beehive symbol appeared on the Disk on April 3 and May 7 with the rising of the Pleiades in early morning. It appeared next on June 22, June 23, and July 5, when the Pleiades were at their peak at dawn. It last appeared on August 2, when the Pleiades set at 8 a.m.. The beehive sign probably signaled the time for removing honey from the hives and cleaning them. It may have signaled the time to pour honey libations for the gods.

Jar. The jar sign appeared on Side B in two places: Symbol 67 (June 21) and Symbol 101 (August 1), in both cases preceding a beehive. The celestial analogue of the jar was the Pleiades (honeycomb associate). The June 21 date may have been a festival in which honey was collected and offered to the gods. (KERENYI 1976) When the jar appeared on August 1 Pleiades set in the west. This may have represented the start of the honey harvest.

There were no apiculture signs during the fall and winter when the bees were hibernating. This was a negative confirmation of the decipherment.

There is an icon of a woman with the long hair flying loose and a long skirt. This sign appeared to be a woman in festival dress. She appeared on February 11, on April 25, June 13, and October 20. These may have been days of women's rituals. The occurrence of this sign on February 11, followed by an unspecified eight-day period, may have marked the Cretan celebration of the beginning of spring and the opening of the first wine jars. By this time spring in the Mediterranean area was well under way. In Athens this was the time of the festival of Anthesteria, lasting three days in late February or early March. It was dedicated to Dionysos and Hermes. At this time the wine produced in the preceding year was considered ready to drink and the party season began.

Sideways V. The V turned sideways suggested a flock of migrating birds in flight according to my description. Hesiod used as a sign the appearance of migrating cranes, either going north toward Europe in the late spring, or going south to Africa in the fall, as signs for undertaking agricultural operations (Hannah, 2005). The sideways V was always correlated with the dawn, peak and evening positions of the constellation Cygnus, the Swan.

The dancing woman was also associated with the appearance of the constellation Cygnus, which the Greeks called "Bird." Cygnus immediately preceded the dancer on October 19 and February 10, and followed the dancer three days later on April 28, and again four days later on June 17.

Inverted triangle. The plain inverted triangle which appears at the center of Side B of the Disk is yet another sign of Venus: the pubis, also known as the Mound of Venus. It appeared near dawn in the east on sixteen occasions, and in the evening once, setting 8 a.m. on August 12.

Inverted triangle with dots. The inverted triangle, filled with dots, represents the female pubis full of seeds, and was also associated with Venus, who was a fertility goddess. The triangle appears only on July 20.. All five of the known planets were visible, Venus was in conjunction with the sun, and there was a new moon, another auspicious sign for fertility. This may have

been thought the best day in the year for a couple to conceive a child.

Water signs. The man who appeared on March 9 coincided with the rise of Aquarius, the water carrier, at dawn in the east. The sign for a stream of water appeared seven times between March 5 and May 27, and all were associated with significant positions of Aquarius.

Hanging fleece or sheepskin: The hanging skin probably represented a sheep, rather than some other animal, since the wool of the sheep had long-lasting value. The palace at Pylos, a Minoan settlement in Greece, controlled 10,000 sheep (Hannah, 2005) (Barker 2005: 58). The fleece sign may have signaled times for slaughtering lambs, sheering wool, breeding sheep and processing wool. They are all associated with positions of the constellation Aries.

Ram's head. The ram's head appeared just once, on April 30. This did not refer to breeding, since the breeding season of sheep is from October to early December. On April 30, the constellation Aries, the Ram rose in the east at 4:00 a.m. It may have been connected with sheep-shearing or some other act of husbandry (Barker, 2005).

Dove. Doves mated and bred all year round. They were also seen as messengers between heaven and earth since they could fly very high. The dove was a symbol of the goddess Astarte (Ishtar) in Phoenicia. There was a shrine to a dove goddess at the Palace of Knossos of Crete. Later the Greeks sacrificed doves to Aphrodite (Venus). In a Cretan wedding song of today, the bride is represented by the dove. The dove sign was associated with with rise, set at dawn or at sunrise respectively or peak position of the southern constellation Columba (dove) on October 23 and January 12. Although this constellation is a new discovery, it may have been known in the ancient times.

Bull's horn. The bull's horn represented the bull, a symbol of power and masculinity. It played an important role in Minoan religion. The bull was the most expensive sacrifice made to the gods. The bull's horn appears on the Disk on July 1, October 15, November 4, November 23, December 20, and February 8. Perhaps on these days the Minoans engaged in bull-baiting sports, such as the gymnast vaulting the back of the bull. All these signs were associated with rise, set at dawn or at sunrise respectively or peak position of the visible constellation of the bull, Taurus.

Axe: The ominous single axe, which appeared on July 15, suggested sacrifice. It seems likely that this was the date when the bull was killed.The appearance of the axe was correlated with the appearance at 7:00 a.m. of a lineup of all the five known planets. Taurus, Gemini, and Orion peaked.

Eagle. On Side A the bull's horn was followed on all four appearances by an eagle. This sign represented the constellation of Aquila, the eagle of Zeus . This visible constellation moved in coordination with that of Taurus on the opposite horizon. Both were masculine symbols. In a Cretan wedding song the eagle represents the groom.

The eagle was also associated with the hammer, sign of the storm god Zeus. Zeus carried a staff; but Thor, his Scandinavian counterpart, carried a hammer. This sign, which occurred eight times on the Disk, was always associated with with rise, set at dawn or at sunrise respectively or peak position of the planet Jupiter.

Hoof. The single hoof may represent the sure-footed goat. This sign appeared on November 16 and January 1. These two dates correspond to the setting of the constellation Capricorn, the sea goat, and its rise at dawn.

Fish: The fish sign was associated with with rise, set at dawn or at sunrise respectively or peak position of the constellation Pisces on the zodiac. These may have been auspicious days for fishing while the date December 5 is forbidden for fishing.

Dog. A dog's head appeared ten times on

the Disk. Dogs were present in Minoan Crete, probably used for hunting and possibly for herding sheep. These signs without exception were associated with with rise, set at dawn or at sunrise respectively or peak position of the constellations Canis Major and Canis Minor.

The dog's head on June 24 coincided with the rising of Sirius in Canis Major at 5 a.m. in the east.

Ship. The best time for sailing today in the Aegean is from mid-April to the end of October. There is a week in January of good weather, when the winds die down. Sailing was represented by a ship sign on the Disk.

On Side B, a ship appeared on April 18, probably the beginning of the sailing season. On Side A there was a boat on November 20, the probable end of the season, and on January 5, during the week of probable good weather.

The appearance of ships between April and November (17 May, 27 June and 5 August) may have represented scheduled voyages with export goods for Egypt and elsewhere. They were associated with positions of stars in Argo Navis, the large southern constellation in the southern sky of Crete, which included the subconstellations of Carina (keel), Puppis (poop), and Vela (sail). The ship signs on the Disk were correlated with with rise, set at dawn or at sunrise respectively or peak position of Puppis and/or Vela.The constellation Scorpius (Dionysos?) appeared at the same times as the subconstellations Puppis and Vela of Argo Navis. According to myth, Dionysos traveled by ship spreading viticulture in the eastern Mediterranean.

Warrior. The head with the high brush of hair looks like that of a warrior. It was associated with with rise, set at dawn or at sunrise respectively or peak position of the planet Mars (Ares). The Philistine soldiers in Palestine, who had a similar headdress are believed to have emigrated from Crete.

A layout of a building, perhaps the palace itself, is shown on Side A on September 6 and December 6. This sign may have designated feast days for all the personnel of the palace and their families. Both days were associated with unusual events in the sky. On September 6 the southern bright star Canopus showed faintly in the south for one night only, and the southern constellations were visible. On December 6 the constellations Scorpius (Dionysos?) and Virgo, a wedded couple since October 17, peaked at 7 a.m.

Club. The club sign on the Disk suggested Herakles, who carried a club. All five occurrences of this sign were associated with rise, set at dawn or at sunrise respectively or peak position of the constellation of Hercules.

Runner. The runner, who appeared eight times on the Disk, was associated with the positions of the constellation Bootes, which included Arcturus, the fourth brightest star in the sky. The appearance of Arcturus was mentioned by Greek and Roman authors as a signal for undertaking agricultural work. Its name meant "guardian of the bears." Bootes was imagined as chasing two bears, Ursa Major and Ursa Minor. Without exception the runner sign was associated with with rise, set at dawn or at sunrise respectively or peak position of Bootes.

Lyre. The lyre, which appeared June 1 and July 7, was associated with positions of the constellation Lyra.

Scales. The scales according to the author's opinion, which appeared October 24, were associated with the rise of Libra in the east..

Bow. The bow, which appeared on January 8, was associated with the rise of Sagittarius the archer in the east.

Pipes. Pan was a Greek god of fertility, the son of Hermes. He played his pipes to mourn the loss of a nymph he loved. The panpipes, January 24 and 28, were correlated with the setting of Virgo in the west at dawn.

Ragged piece. A difficult sign to decipher

was a ragged or torn piece of something (July 8) when Virgo set at 7 p.m. The torn piece of something may have represented the torn hymen of Virgo. At that hour Jupiter was passing out of the constellation Virgo and making conjunction with Saturn.

The man who stood amazed (?) on August 7 at 6 a.m. may represent Bootes viewing the lineup of the five planets and Gemini and Orion at peak.

Spiral. Finally one must ask why the maker of the Disk decided to design it as a spiral. Kerenyi argues that the original design of the labyrinth in the palace of Knossos was not a square but a spiral. This was probably the most sacred place in the Cretan religion. On a coin of Knossos of the fifth century b.c.e. a four-part labyrinth is depicted connected with a star in the center. This may have been a hint that the movements of the stars and planets governed the Minoan religion (Kerenyi, 1976).

Why was the spiral pattern chosen? One candidate was a mollusk called the conch, known to the Minoans both in natural form and reproductions. The origin of the name is Greek: conche, probably pronounced konkha. There are many big spiral shells in existence; the most likely candidate is *Strombus decorus raybaudii.* If the apex is removed from a conch shell and one blows through it, the shell will produce loud, weird sounds. Perhaps it was used as a foghorn or in the more solemn rituals of the Cretan religion. (Montagu, 1981) It is also possible that the Minoans ate the soft tissues of this mollusk out of season, when it contained neurotoxins, and experienced hallucinations and euphoria as a result (Glowaki, 2005).

The spiral may also represent a spiritual passage, or growth and development. The Mother Goddess in India carries a conch shell in her hand.

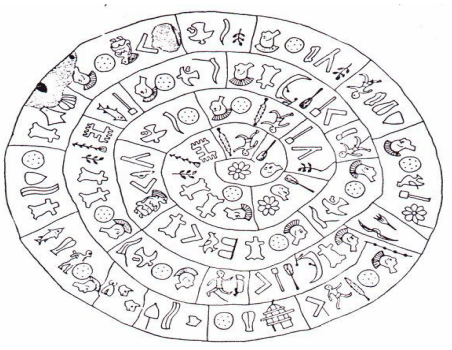
7. CONCLUSION

The evidence presented here supports the view that the Phaistos Disk may well have been a solar calendar intended to set the time for agricultural activities and religious ritiuals. The year consisted of 360 days with five intercalary days added at the end of summer. The proposed method is used to recreate the night sky over Crete in the year 1613 B.C., beginning on September 1, and to follow the astral phenomena for a year thereafter. In addition, the figures on the Disk are interpreted by what is known about Bronze Age Cretan culture, especially agriculture.

ACKNOWLEDGEMENTS

I wish to thank Michele Matossian, my daughter, for her leadership in preparing the final draft of the manuscript of my study of the Phaistos Disk.

Table 1. Symbol and constellation analogues of Phaistos disc's time (side A).



2

Symbol Number	*Dates*	*Symbol Icon*	*Symbol Name and Position of Celestial Analogue*
1	9-1	P	Rosette (Opium) -- Ve (Venus and Me (Mercury) rose in the east at 6 a.m.
2	9-2	c	Hermes – Me rose in the east at 7 a.m.
3	9-3	k	Ear of grain – Spica (in Virgo) rose in the east at 5 a.m.
4	9-4	a	Runner – Bootes set in the west at 7 p.m.
5	9-5	n	Club – Hercules set in the west at 9 p.m.
6	9-6	v	Palace – Me, Ve, J (Jupiter), S (Saturn) and the Star Canopis were visible.
7	9-7	O	Poppy – Me set in the west at 6 p.m.
8`	9-8	M	Olive branch – Leo near peak at 5:30 a.m.
9	9-9	C	Sheepskin – Aries near peak at 6 a.m.
10	9-10	C	Sheepskin – Aries at peak at 6 a.m.
11	9-11– 9-18	m	Eight day period
12	9-19	b	Warrior (Ares) – Mars rose in the east at 7 a.m.

3

13	9-20	P	Rosette – Me and Ve rose in the east at 7 a.m.
14	9-21	c	Hermes – Me rose in the east at 7 a.m.
15`	9-22	k	Ear of grain – Spica rose in the east at 5 a.m. New moon
16	9-23	M	Olive branch – Leo at peak at 6 a.m.
17	9-24	t	Grapevine, bare – Scorpius (Dionysos) rose in the east at 8 a.m.
18	9-25	x	Hammer – Jupiter (Zeus) at peak at 6 a.m.
19	9-26	a	Runner – Bootes rose in the east at 4 a.m.
20	9-27	n	Club – Hercules set in the west at 8 p.m.
21	9-28 –10-5	m	Eight day period
22	10-6	b	Hermes – Ma (Mars) rose in the east at 8 a.m.
23	10-7 – 10-14	m	Eight day period
24	10-15	A	Horn of bull – Taurus set in the west at 4 a.m.
25	10-16	I	Eagle – Aquila set in the west at 8 p.m.
26	10-17	t	Scorpius rose in the east at 7 a.m.; the five

4

			known planets were all visible; Libra, Virgo and Corona Borealis visible; new moon
27	10-18	r	Cymbal – Ve rose in the east at 7:30 a.m. All five planets visible. Me in conjunction with the new moon.
28`	10-19	s	Migrating birds – Cygnus at peak at 5 p.m.
29	10-20	g	Dancing woman – Venus rose at 6:30 a.m.; all planets and Spica visible; conjunction of the sun and moon.
30	10-21	B	Sheep – Aries rose in the east at 5 p.m.
31	10-22	s	Migrating birds – Cygnus at peak and 5 p.m.
32	10-23	J	Dove – Columba rose in the east at 9 p.m.
33	10-24	o	Scales – Libra rose in the east at 4 a.m.
34	10-25	B	Aries – near peak at 7 p.m.
35	10-26 – 11-2	m	Eight day period
36	11-3	b	Warrior – Mars rose in the east at 7:30 a.m.
37	11-4	A	Horn of bull – Taurus set in the west at 4 a.m.
38	11-5	I	Eagle – Aquila set in the west at 7 p.m.

5

39	11-6 – 11-13	m	Eight day period
40	11-14	b	Warrior – Mars rose in the east at 7 p.m.
41	11-15	a	Runner – Bootes at peak at 7 a.m.
42	11-16	E	Goat leg – Capricorn set in west at 5 a.m.
43	11-17	s	Migrating birds – Cygnus rose in the east at 7 a.m.
44	11-18	x	Hammer – Jupiter at peak at 6 a.m.
45	11-19	k	Ear of grain – Spica at peak at 6 a.m.; new moon
46	11-20	z	Ship – Vela set in the west at 6 a.m.
47	11-21	B	Sheepskin – Aries a peak at 7 p.m.
48	11-22	b	Warrior – Mars rose in the east at 7 a.m.
49	11-23	A	Horn of bull – Taurus rose in the east at 5 p.m.
50	11-24	I	Eagle – Aquila set in the west at 6 p.m.
51	11-25 – 12-2	m	Eight day period

6

52	12-3	b	Warrior – Mars rose in the east at 7:30 a.m.
53	12-3	x	Hammer – Jupiter at peak at 7 a.m.
54	12-5	K	Fish – Pisces at peak at 6 p.m.
55	12-6	v	Palace – Scorpius and Virgo at peak. Me, Ve, J, and S visible; Moon almost full.
56	12-7	O	Poppy – Me and Ve rose in east at 8 a.m.
57	12-8	M	Olive branch – Leo rose in east at 6 p.m.
58	12-9	B	Sheepskin – Aries at peak at 6 p.m.
59	12-10	B	Sheepskin – Aries at peak at 6 p.m.
60	12-11–12-18	m	Eight day period
61	12-19	b	Warrior – Mars rose in the east at 7 a.m.
62	12-20	A	Horn of bull – Taurus near peak at 7 p.m.
63	12-21	I	Eagle – Aquila rose in the east at 4 a.m.
64	12-22 –12-29	m	Eight day period. Winter solstice
65	12-30	b	Warrior – Mars rose in the east at 12:30 a.m.
66	12-31	a	Runner – Bootes rose in the east at 8 p.m.

7

67	1-1	E	Goat leg – Capricorn rose in the east at 7 a.m.
68	1-2	s	Migrating birds – Cygnus near peak at 8 a.m.
69	1-3	x	Hammer – Jupiter rose in the east at 5 a.m.
70	1-4	k	Ear of grain – Spica set in the west at 8 a.m.
71	1-5	z	Ship – Vela rose in the east at 8 p.m.
72	1-6	B	Sheepskin – Aries set in the west at 8 p.m.
73	1-7	b	Warrior – Mars set in the west at 5 a.m.
74	1-8	l	Bow – Sagittarius rose in the east at 5 a.m.
75	1-9	Q	Lily – Delphinus near peak at 8 a.m.
76	1-10	P	Rosette – Me rose, Ve near peak at 7 a.m.
77	1-11	x	Hammer – Jupiter set in the west at 5 a.m.
78	1-12	J	Dove – Columba set in the west at 9 p.m.
79	1-13— 1-20	m	Eight day period
80	1-21	b	Warrior – Mars set in the west at 4 p.m.
81	1-22	h	Pubic triangle – Ve at peak at 7 a.m.

8

82	1-23	R	Venus legs – Venus rose in the east at 5 a.m.
83	1-24	S	Pan pipes – Virgo set in the west at 8 a.m.
84`	1-25	a	Runner – Bootes rose in the east at 8 p.m.
85	1-26	M	Olive branch – Leo rose in the east at 5 p.m.
86	1-27	t	Grapevine, bare – Scorpius at peak at 5:30 a.m.
87	1-28	S	Pan pipes – Virgo set in the west at 7 a.m.
88	1-29— 2-5	m	Eight day period
89	2-6	b	Warrior – Mars at peak at 7 p.m.
90	2-7	M	Olive branch – Leo rose in the east at 5 p.m.
91	2-8	A	Horn of bull – Taurus set in the west at 8 p.m.
92	2-9	I	Eagle – Aquila at peak at 6 a.m.
93	2-10	s	Migrating birds – Cygnus at peak at 7:30 a.m.
94	2-11	g	Woman dancing – Venus at peak at 8 a.m.
95	2-12— 2-19	m	Eight day period

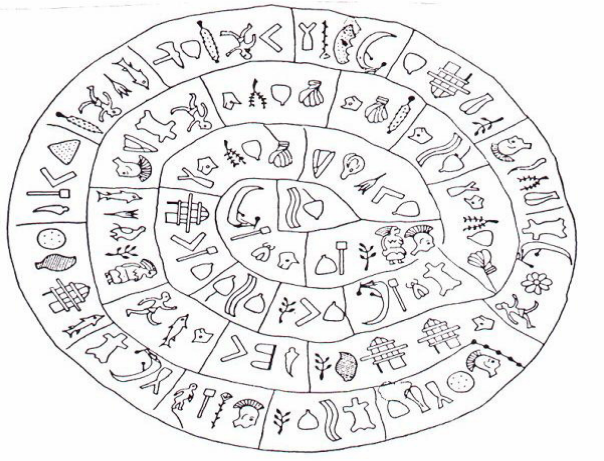
9

96	2-20	b	Warrior – Mars rose in the east at 8 a.m.
97	2-21	i	Wrapped hand – Gemini at peak at 5 p.m.
98	2-22	W	Outline of Virgo – Virgo rose in the east at 6 p.m.
99	2-23	B	Sheepskin – Aries rose in the east at 7 a.m.
100	2-24—3-3	m	Eight day period
101	3-4	h	Pubic triangle – Venus rose in the east at 5:30 a.m.
102	3-5	X	Water – Aquarius rose in the east at 5:30 a.m.
103	3-6	B	Sheepskin – Aries rose in the east at 7 a.m.
104	3-7	K	Fish – Pisces rose in the east at 6 a.m.
105	3-8	R	Venus legs -- Venus rose in the east at 6 a.m.
106	3-9	d	Carrier – Aquarius rose in the east at 4 a.m.
107	3-10—3-17	m	Eight day period
108	3-18	b	Warrior – Mars at peak at 6 p.m.
109	3-19	L	Bee – Pleiades rose in the east, Orion set in the west and Jupiter at peak at 6 p.m.

10

110	3-20	F	Dog – Canis Major set in the west at 8 p.m.
111	3-21	F	Dog – Canis Minor set in the west at 8 p.m.
112	3-22	h	Pubic triangle – Venus in the east at 7 a.m.
113	3-23	X	Water – Aquarius rose in the west at 5:30 a.m., in conjunction with Venus
114	3-24	F	Dog – Canis Minor set in the west at 8 p.m.
115	3-25—4-1	m	Eight-day period
116	4-2	R	Venus legs – Venus rose in the east at 4 a.m.
117	4-3	y	Beehive – Pleiades rose in the east at 6:30 a.m.
118	4-4	s	Migrating birds – Cygnus at peak at 6:30 a.m.
119	4-5	a	Runner – Bootes set in the west at 5 a.m.
120	4-6	n	Club – Hercules set in the west at 6:30 a.m.
121	4-7—4-14	m	Eight day period
122	4-15	b	Warrior – Mars at peak at 7 p.m.

Table 1. Symbol and constellation analogues of Phaistos disc's time (side B).



12

Symbol Number	Dates	Symbol Icon	Symbol Name and Position of Celestial Analogue
1	4-16	h	Pubic triangle – Venus at peak at 6 a.m.
2	4-17	X	Water – Aquarius at peak at 5 a.m.
3	4-18	z	Ship -- Puppis and Vela set at 7 a.m.
4	4-19	x	Hammer -- Jupiter near peak at 6 p.m.
5	4-20	L	Bee – Jupiter near peak at 6 p.m.
6	4-21	F	Dog – Canis Major and Minor set in the west at 8 a.m.
7	4-22	h	Pubic triangle – Venus in the east at 6 a.m.
8	4-23	x	Hammer – Jupiter near peak at 6 a.m.
9	4-24	M	Olive branch – Leo at peak at 5:30 a.m.
10	4-25	g	Woman dancing – Venus rose at 7 a.m.; partial solar eclipse
11	4-26	b	Warrior – Mars at peak at 6 a.m.
12	4-27	h	Pubic triangle – Venus in east at 6 a.m.

13

13	4-28	s	Birds migrating – Cygnus set in the west at 6 a.m.
14	4-29	Q	Lily – Delphinus at peak at 5 a.m.
15	4-30	G	Head of ram – Aries rose in the east at 4 a.m.
16	5-1	j	Lyre – Lyra at peak at 4 a.m.
17	5-2	i	Wrapped hand – Gemini rose in the east at 5 a.m.
18	5-3	h	Pubic triangle – Venus rose in the east at 5 a.m.
19	5-4	N	Grapevine, leafy – Scorpius rose in the east at 7 p.m.
20	5-5	F	Dog – Canis Major and Minor set in the west at 7:30 a.m.
21	5-6	w	Root – Cancer set in the west at 6 p.m.
22	5-7	y	Pleiades rose in the east at 4 a.m.
23	5-8	s	Migrating birds – Cygnus at peak at 5 a.m.
24	5-9	x	Hammer – Jupiter at peak at 6 p.m.
25	5-10	h	Pubic triangle – Venus in conjunction with Pleiades rose at 5 a.m.

14

26	5-11	h	Pubic triangle – Venus rose at 5 a.m. near new moon
27	5-12	X	Water – Aquarius set in the west at 7 p.m.
28	5-13	h	Pubic triangle – Venus rose at 5 a.m. near new moon
29	5-14	M	Olive branch – Leo in the west at 7 p.m.
30	5-15	s	Migrating birds – Cygnus at peak at 6:30 a.m.
31	5-16	h	Pubic triangle – Venus rose in the east at 5 a.m. in cojunction with the Pleiades and near new moon
32	5-17	z	Ship – Vela set in the west at 6 p.m.
33	5-18	x	Hammer – Jupiter at peak at 6 p.m.
34	5-19	L	Bee – Orion rose in the east at 5 a.m.
35	5-20	B	Sheepskin – Aries near peak at 5 a.m.
36	5-21	i	Wrapped hand – Gemini rose in the east at 5 a.m.
37	5-22	h	Pubic triangle – Venus rose in the east at 5 a.m.
38	5-23	N	Grapevine, leafy – Scorpius near peak at 6:30 p.m.

15

39	5-24	F	Dog – Canis Minor rose in the east at 6 a.m.
40	5-25	w	Root – Cancer rose in the east at 6 a.m.
41	5-26	h	Pubic triangle – Venus rose in the east at 5 a.m.
42	5-27	X	Water – Aquarius set in the west at 7 p.m.
43	5-28	F	Dog – Canis Minor rose in the east at 6 a.m.
44	5-29	O	Poppy – Mercury rose in the east at 5 a.m.
45	5-30	i	Wrapped hand – Gemini set in the west at 5 p.m.
46	5-31	F	Dog – Canis Major rose in the east at 6 a.m.
47	6-1	i	Wrapped hand – Gemini rose in the east at 5 a.m.
48	6-2	h	Pubic triangle – Venus rose in the east at 4 a.m.
49	6-3	N	Grapevine, leafy – Scorpius at peak at 6 p.m.
50	6-4	F	Dog – Canis Minor rose in the east at 6 a.m.
51	6-5	a	Runner – Bootes at peak at 8 p.m.

16

52	6-6	B	Sheepskin – Aries at peak at 6 a.m.
53	6-7	j	Lyre – Lyra set in the west at 6 p.m.
54	6-8	b	Warrior – Mars set in the west at 8 p.m.
55	6-9	K	Fish – Pisces at peak at 4 a.m.
56	6-10	Q	Lily – Delphinus set in the west at 4 a.m.
57	6-11	J	Dove – Columba rose in the east at 7 a.m.
58	6-12	M	Olive branch – Leo set in the west at 7 p.m.
59	6-13	g	Woman dancing – Venus rose in the east at 4:30 a.m.
60	6-14	a	Runner – Bootes at peak at 6 p.m.
61	6-15	K	Fish – Pisces at peak at 4 a.m.
62	6-16	F	Dog – Canis Minor rose in the east at 4 a.m.
63	6-17	s	Migrating birds – Cygnus rose in the east at 4 a.m.
64	6-18	o	Scales – Libra rose in the east at 4 a.m.
65	6-19	q	Knife – Scorpius at peak at 6 p.m.

17

66	6-20	M	Olive branch – Leo rose in the east at 6 a.m.
67	6-21	u	Jar – Pleiades at peak 7 a.m.; summer solstice, new moon
68	6-22	y	Beehive – Pleiades near peak at 5 a.m.
69	6-23	y	Beehive – Pleiades near peak at 5 a.m.
70	6-24	F	Dog – Canis Major, including Sirius, rose in the east at 5 a.m.
71	6-25	a	Runner – Bootes near peak at 8 p.m.
72	6-26	P	Rosette – Mercury and Venus in conjunction, rose in the east at 4 a.m.
73	6-27	z	Ship – Puppis rose in the east at 7 a.m.
74	6-28	B	Sheepskin – Aries near peak at 4 a.m.
75	6-29	R	Venus legs – Venus rose in the east at 4 a.m.
76	6-30	N	Scorpius at peak at 6 p.m.
77	7-1	A	Horn of bull – Taurus at peak at 7 a.m.
78	7-2	b	Warrior – Mars rose in the east at 8 a.m.
79	7-3	M	Olive branch – Leo rose in the east at 5 a.m.

18

80	7-4	R	Venus legs – Venus rose in the east at 4 a.m.
81	7-5	y	Beehive – Pleiades at peak at 6 a.m.
82	7-6	h	Pubic triangle – Venus rose in the east at 4 a.m.
83	7-7	z	Ship – Puppis rose in the east at 6 a.m.
84	7-8	T	Torn hymen – Mars in Virgo set in the west at 7 p.m.
85	7-9	O	Poppy – Mars and Venus near peak at 7 a.m.
86	7-10	w	Root – Cancer near peak at 5 a.m.
87	7-11	s	Migrating birds – Cygnus set in the west at 6 a.m.
88	7-12	a	Runner – Bootes near peak at 8 p.m.
89	7-13	n	Club – Hercules at peak at 8 p.m.
90	7-14	h	Pubic triangle – Venus rose in the east at 4 a.m.
91	7-15	p	Axe – Mars rose in the east at 7:30 a.m.; all planets visible; Venus in conjunction with the sun

19

92	7-16	K	Fish – Pisces set in the west and 6 a.m.
93	7-17	Q	Lily – Delphinus at peak at 8 p.m.
94	7-18	a	Runner – Bootes near peak at 8 p.m.
95	7-19	n	Club – Hercules at peak at 7:30 a.m.
96	7-20	V	Pubic triangle containing seeds – Venus in conjunction with the sun at 7:30 a.m., all planets visible, near new moon.
97	7-21	s	Migrating birds – Cygnus at peak at 8 p.m.
98	7-22	x	Hammer – Jupiter rose in the east at 4 a.m.
99	7-23	q	Knife – Scorpius set in west at 7 p.m. ; new moon
100	7-24– 7-31	m	Eight day period
101	8-1	u	Jar – Pleiades at peak at 6 a.m. Ve and J in conjunction with the sun
102	8-2	y	Beehive – Pleiades at peak at 6:30 a.m.
103	8-3	K	Fish – Pisces rose in the east at 8 a.m.
104	8-4	B	Sheepskin – Aries set in the west at 5 a.m.

20

105	8-5	z	Ship – Puppis rose in the east at 4 a.m.
106	8-6	w	Root – Cancer at peak at 6 a.m.
107	8-7	f	Man amazed – Bootes rose in the east at 5 a.m.; Me, Ve, J, S and Pleiades visible
108	8-8	x	Hammer – Jupiter in west at 5 a.m.
109	8-9	O	Poppy – Mercury set in the west at 6 p.m.
110	8-10	b	Warrior – Mars set in the west and 6 p.m.
111	8-11	M	Olive branch – Leo near peak at 5 a.m.
112	8-12	h	Pubic triangle – Venus set in the west at 5 p.m.
113	8-13	X	Aquarius rose in the east at 5 p.m.
114	8-14	B	Sheepskin – Aries set in the west at 7 a.m.
115	8-15	h	Pubic triangle – Venus rose in the east at 5 a.m.
116	8-16	R	Venus legs – Venus set in the west at 5 p.m.
117	8-17	w	Root – Cancer at peak at 4 p.m.
118	8-18 – 8-25	m	Eight day period
119	8-26	b	Warrior – Mars set in the west at 6 p.m.

REFERENCES

Barker, G (2005) Agriculture, pastoralism, and Mediterranean landscapes in prehistory. *In The Archaeology of Mediterranean Prehistory. Ed. Emma Burke and E. Bernard Knapp.* Oxford, Blackwell, 270-274.

Black, J and Green, A (1992) *Gods, Demons and Symbols of Ancient Mesopotamia. Austin,* University of Texas Press.

Blomberg, M., and Henriksson, G., (2001) Archaeoastronomy: New trends in the field, with methods and results from studies in Minoan Crete, *Journal of Radioanalytical and Nuclear Chemistry* 247, 609-19.

Brown, D (2000) *Mesopotamian Planetary Astronomy-Astrology.* Gronigen, Styx.

Rumpel Dieter (1990) On the internal Structure of the Diskos of Phaistos text. *Glottometrika* 12 (= Quantitative Linguistics Vol. 45), S. 131-149

Rumpel Dieter (1994) Some Quantitative Evaluations of the Disk of Phaistos Text. J*ournal of Quantitative Linguistics,* 1,156-167

Fitton, J. L. (2002) *The Minoans.* London, Cambridge University Press.

Friedrich, W, L, Kromer.B, Friedrich.M, Heinemeier.J, Pfeiffer, T and Talamo, S (2006) Santorini eruption radiocarbon dated 1627-1600. Science 312, 548.

Glowacki, M (2005) Food of the Gods or mere mortals? *Antiquity* 304: 257-268.

Goodison L and Morris C, eds. (1998) Beyond the 'Great Mother': The sacred world of the Minoans. In Ancient Goddesses: *The Myths and the Evidence, 113–132. London: British Museum Press.*

Grove, A.T. and Rackham, O. (2001) Climate in Early Historic and Prehistoric Times. *In The Nature of Mediterranean Europe: An Ecological History* (New Haven, CT: Yale University Press), 2nd ed., 150.

Hannah, R (2005) *Greek and Roman Calendars.* London, Duckworth.

Henriksson, G and Blomberg, M (1996) Evidence for Minoan astronomical observations from the peak structures on Petsophas and Graostalos. *Opuscula Atheniensia* XXI: 6. 99-114.

Henriksson, G and Blomberg, M (2011) The Evidence From Knossos On The Minoan Calendar, *Mediterranean Archaeology and Archaeometry*, Vol.11, No.1, 59-68.

Kerenyi, C, (1976) *Dionysos*. Princeton, Princeton University Press.

Manning, S. W. et al. (2006) Chronology for the Aegean Late Bronze Age, 1700-1400 BC, *Science* V. 312, 565-569.

McGovern, P (2003) Ancient Wine. Princeton, Princeton University Press.

Merlin, M. D. (1984) *On the Trail of the Ancient Opium Poppy.* Rutherford, N.J., Farleigh Dickinson Press.

Montagu, J (1981) The conch in prehistory. *World Archaeology* 12 (3), 273-279.

Ovenden, M (1966) The origin of the constellations, *The Philosophical Journal* 3: 1-18.

Pomerance, L (1976) T*he Phaistos Disk.* Goteburg, Paul Astroms.

Pomerance, L (1976) The Phaistos Disk: An Interpretation of Astronomical Symbols, Paul *Astroms forlag, Goteborg, Archaeology Series: Studies in Mediterranean Archaeology,* 78 pages.

Ridderstad, M (2010) Lunisolar Calendrical Symbolism on the Phaistos Disk Anistoriton, vol. 12 (http://www.anistor.gr/english/enback/2010_2s_Anistoriton.pdf)

Schaefer, B.E. (2006) The origin of the Greek constellations. *Scientific American* (November) 96-101.

Tsonis, A. A. et al. (2010) Climate change and the demise of Minoan civilization, *Climate of the Past* 6(4): 525-530.

Willetts, R. F. (1977) *The Civilization of Ancient Crete.* New York, Phoenix Press.