A Minoan Calendar of Bronze Age Time

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See also

Sacred Number and the Origins of Civilization,

The Unfolding of History through the Mystery of Number

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Abstract

A perforated vessel (#2646) exists in the Heraklion Museum, Crete, found at Knossos and thought of the Late Palace Period. Consisting of painted pottery punctuated by circles of similar holes, this paper demonstrates how the vessel could have been used to predict eclipses based upon the rational relationship of the synod of Saturn to the lunar month and year. Thirty eight eclipse seasons can be seen, the seven fold iconography of Chronos (=Cronos) as the seven-day week which divides into various celestial periods and hence is a good reason for choosing the week the West now observes. The paper also discusses how the disk may reflect the cultural transormation between Chronos and his son Zeus, born on Crete within Greek mythology.

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INTRODUCTION

Most of what we know about ancient time calculation is derived from (a) monuments such as stone circles and alignments in the landscape, (b) the calendars that have passed into our age through later writings and lastly (c) time-keeping practices still used today. But a humbly presented "perforated vessel" in the Heraklion Museum records, within its "perforations", a numerical system of time recording that concurs with the most inexplicable unit of time still in use today: the week.

The Disk of Chronos

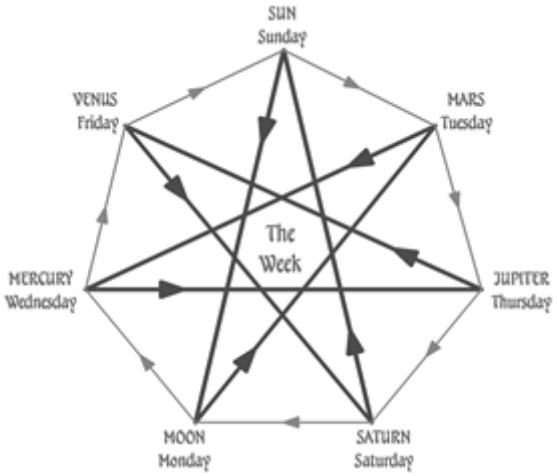
Item 2646: A "Perforated Utensil" possibly for use with incense,

New Palace Period:

"Advanced and Final Phase of the Palace of Knossos"

Gallery V, The Heraklion Museum

The week is traditionally associated with the planet Saturn, but why the ancients do not tell us. The convention of using a seven day week is thought to derive from Mesopotamia, possibly during the later Chaldean period in which astrology and astronomy dominated the court of Nebuchadnezzar. The chain of transmission for its subsequent use as the European then Global standard week, is possibly through the Semitic religions that used it and the logic runs that the Jews came to use it after their captivity in Babylon.



Planetary Diagram found at Pompeii where the inner lines yield the Order of the Days in a Week. The outer order is of decreasing maximum angular speed clockwise starting from the Moon

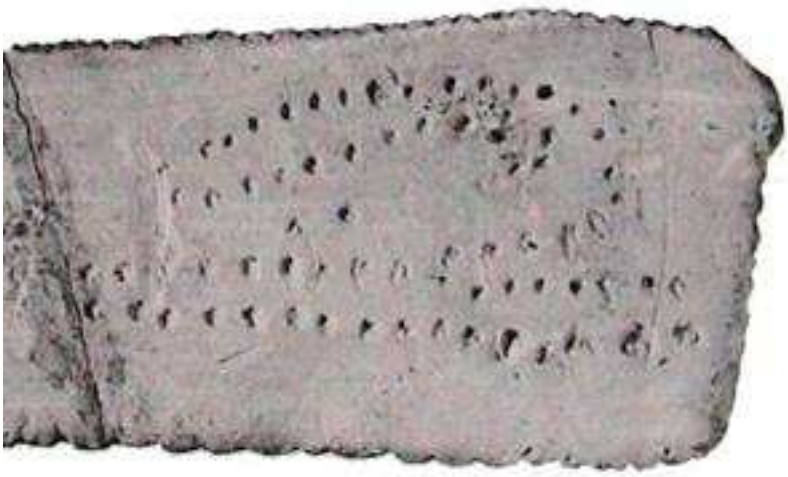
However there is also an existing argument for its origins through Greece and then Rome. This involves the absorption of eastern thought by the invading

armies of Alexander the Great. The difference between the Greek and Semitic versions can be seen in a diagram surviving from Pompeii, showing two important features.
The Greco-Roman system assigns planetary names to the days and this is how we use the seven day week today since Monday is the Moon's day, Saturday that of Saturn, Sunday of the Sun and so on. Most of Europe used such planetary assignments, whilst the Semitic religions used a numbering system, almost certainly because of their rejection of polytheism.

The above logics of how a seven day week came into modern day usage are based upon "diffusionist" ideas that propose most of the innovations leading to the modern world diffused from the neolithic revolution in Mesopotamia and Central Asia. However, the preservation of Minoan civilisation on Crete can, through the above "perforated vessel", indicate that this system of using seven days was already in use, at least in Crete. It has become more likely therefore that the classical Greek and Roman worlds inherited their week from Crete, since so much else in their mythology points back there as foundational.
It is also likely that a system of thought, connected to astronomy, led to the use of a calendar associated with Saturn or Kronos (equated to Chronos, the King of Time) that was based upon the seven day week. After all, Greek myths place Chronos as the predecessor of Zeus, who was himself born on Crete and who represents the other visible and giant planet, Jupiter, who became chief amongst the gods for Greece and Rome.

2. COUNTING AND THE CALENDAR

The evolution of sky observation into a calendar is perhaps as simple as counting itself. Alexander Marshak in The Roots of Civilisation illustrates many examples of stone age markings, often on bones, that appear to be keeping a tally of the Moon's phases. The counts typically run over two lunar months, probably because the month is itself 29 and one half days long: a double count gives a whole number of 59 days and is quite accurate. Since the processes of the sky are essentially circular, returning to the same condition to rejoin the beginning of the cycle then the natural tendency, when the medium will allow it, is to draw the cycle as a circle of marks.



Above: One of Marshak's Lunar Counting Bones
Below: His schematic version of the Count

Such counting is a measurement from which a number emerges associated naturally with the celestial cycle in question. It marks the achievement of knowledge but not necessarily the ability to use it. To synchronise life to a celestial cycle, beyond observation in the sky, requires that the new knowledge be translated into a model on Earth.

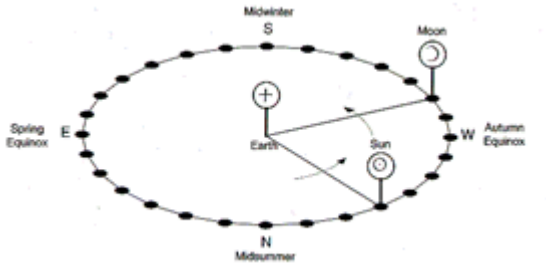
Now we know that from Megalithic times and into the bronze age, many large models of calendric knowledge were being built throughout Europe. Many of these were directly observational, such as stone circles and their alignments with solsticial sunrise, sunset, and lunar maximum. These seem to form a continuity with the bone count measurements, yet they also form an operational calendar. Something new then became possible, a calendrically based building that could contain observances connecting to the gods of celestial time phenomena.

The creation of numerical rings would then allow a further possibility: that a numerical ring could simulate celestial phenomena and, to a degree, become detached from the sky as an abstract system more akin to a clock. If and when a series of celestial cycles were found to be interrelated, these would have allowed the creation of an orrery or planetarium which outputs the condition of

a number of different celestial phenomena through the relatively simple activity of counting smaller time periods.

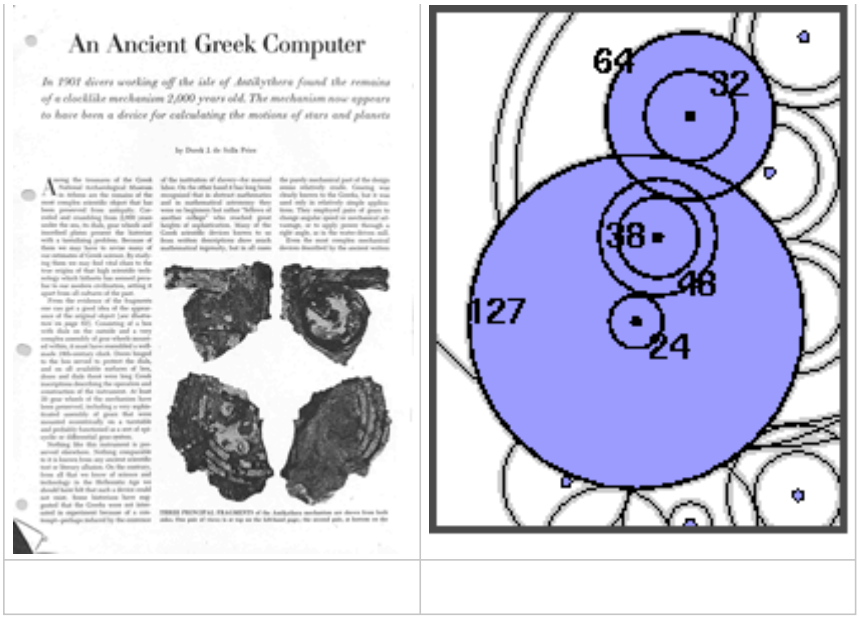
Our clocks today have evolved from such roots by employing gear wheels as numerical rings and the activity of counting is automated in the form of a spring-driven escapement, that produced a regular advancement of the gears, according to the numerosity of these cogs, rotating in circles. Thus, a clock or an orrery is based upon the relative counting of cogs cut into wheels but is essentially no different to what can be achieved by the manual movement of markers in rings of holes, moved in time with a regular celestial cycle with the day being the simplest choice.

If the ancients wanted to create an orrery, their best option was to use a ring of holes and indeed this has been suggested as one of the uses for the circles of post holes, most notably the Aubrey Circle of 56-holes around Stonehenge. Fred Hoyle showed how the Aubrey Circle could be driven as an orrery to accurately track the Sun, Moon and eclipse nodes around the ecliptic stars, using a procedure further refined by Robin Heath.



Above: Robin Heath's version of a 28 hole Sun, Moon and lunar node simulaton

In fact a bronze device using gears has been found from no later than 80 BCE, near Crete. It is a planetarium designed to simulate multiple celestial periods, called the "Antikythera Clock", and it used advanced mathematical knowledge of "continuing fractions" (reported in June 1959 Scientific American, p.60-7, see first page below.) It remains an anomaly that undermines the consensus view that clock mechanisms were a product of our industrial revolution.



Below: Numbered gears in the Antikythera planetarium mechanism

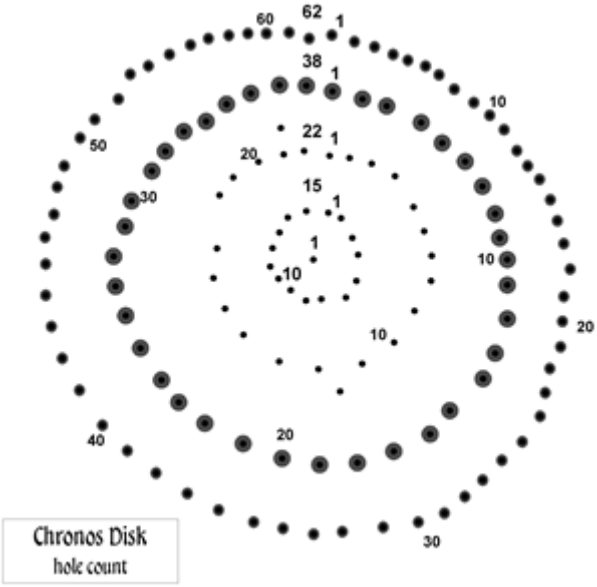
The main point here is that the use of numbers to model the movements of celestial objects, relative to each other, should not be seen as unlikely back in the bronze age or even within the later Neolithic period that encompasses the Megalithic. There are objects displaying the capacity and desire of those peoples to do just this. A counting device only requires the identification of a time period that divides well into one or more, larger time periods, as a whole number of counts. It will be shown that the day and week are just perfect for this purpose – a fact since forgotten in its applications but retained as our seven day week.

3. THE CHRONOS DISK'S FABRICATION

Each culture will use the media to hand to make its constructions. In the Mediterranean spun pottery was such a medium. We also know from the Nebra Disk, that portable summaries of the sky knowledge found in stone circles were in existence. Representations of the range between summer and winter sunrises and sunsets, lunar maxima and minima relative to the sun, the circumpolar stars and Pleiades star cluster can be read within the Nebra Disk.

The Nebra Disk from Saxony-Anhalt district of Germany

In the case of countable rings, it therefore seems logical for the Minoans to have used the already circular nature of spun pots and, in the case of the Chronos Disk, to have then perforated one in the pattern shown below.



Schematic of the Holes in the Disk

One is immediately struck by the irregularity of their efforts to place the holes, as a circular pattern and with an even distribution. Compared to excellently crafted other works in clay, the poor quality of the perforations suggests a number of likely facts.

This object was not intended for show but for inner temple use. It perhaps took a standard type of plate or cylinder design, already made by local potters, and adapted it to be the basis for a calendric device. The holes had to be placed when the clay was newly spun and it is evident from the bunching of the holes that the count sometimes got both ahead of itself and behind, relative to regular spacing and the total count required.

The holes could quite easily have been placed more accurately into a circle, as the spun circular ridges on the object are, by using a constant support whilst rotating the piece. However, the erratic holes indicate that the punching through of the clay was done off the wheel and that this made their placing difficult.

The hole-maker did not attempt to use geometrical knowledge, as his or her Egyptian counterparts would have, to make the holes evenly distributed. This indicates that the disk was made without such knowledge being available or without it being applied. In the latter case, the holes would deepen the interpretation that the evenness of the holes didn't matter, firstly because only numbers and not celestial angles are important, and secondly, as already suggested, the object was not for display outside the temple precincts. This would not meet our expectations for the Minoans, especially regarding such an important object as a sacred calendar, but the origins of the disk could also be that it was a prototype that somehow survived, discarded as less important during the destruction of the palace complex. Thus the poor quality of the hole placement cannot definitely count against the significance of the surviving disk.

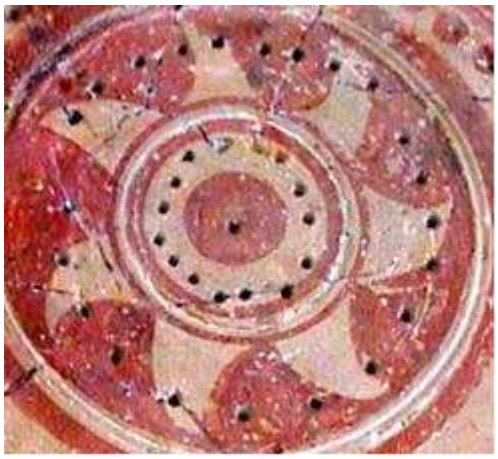
Above: Decoration following the hole placements in the eclipse ring

The decoration was evidently painted after the hole making since, where necessary, it follows the irregular placements of the holes, both as circular blobs around the holes and the scalloped effect surrounding what turns out to be the eclipse season ring holes.

4. ITS SYMBOLISM AND PRECISION

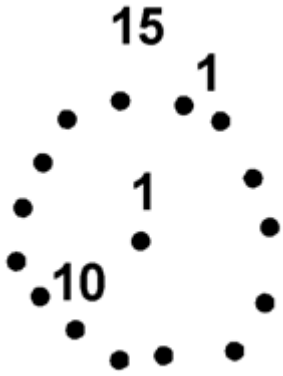
As stated therefore, the imprecision of the perforations in the Chronos Disk do not prevent its use for counting around its rings. We know that the rings expand their number of perforations in a series 1:15:22:38:62. There appear to be two

further intentional holes, one above and one below the 22-ring, that could be used to make a 24-ring or could have another use, if intended.



The seven-rayed sun at the centre of the disk

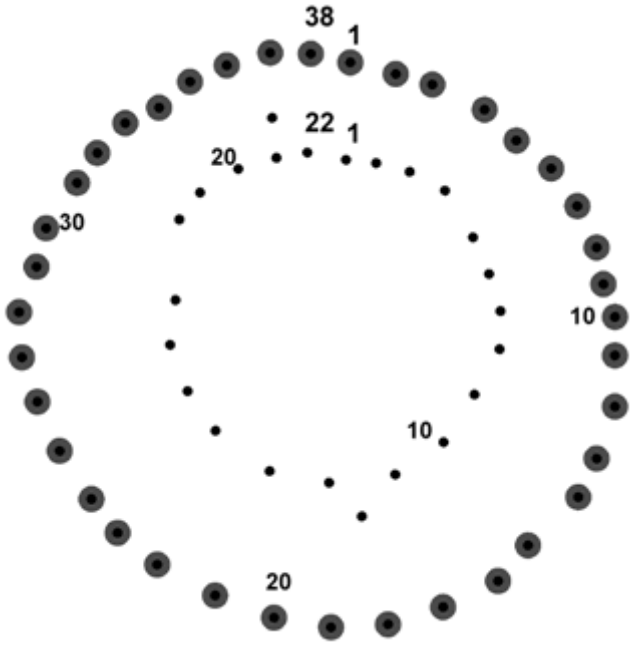
The decoration also carries number symbolism, in the form of flame-like rays around a central disk that itself could therefore be mistaken for the Sun. However, seven is not traditionally associated with the Sun but rather with Saturn. There is confusion in Sumerian between the word for Sun and Saturn such that both can be called Shamash in differing contexts. Whilst today we would tend to put the Sun at the centre of such a disk associated with the Mediterranean, it is quite abnormal to call the central painted motif solar.
If time emanates from Chronos a.k.a. Saturn, and if a 7 day week forms part of the calendar, as we shall show, then the disk's decoration is correlating with the number rings of its perforation. Also we have here a symbol that should be associated, if found in other objects from related cultures, to improve their interpretation.



The 15:16 count relationship between the lunar year and Saturn is possible at the disk's centre

A prime component of ancient time was the lunar year. The Semitic peoples are still observing it to define the dates of their religious festivals, Jews and Muslims alike. Today, we use the solar year of 365 days plus just under a quarter day, and this is found to be at odds with the lunar year. However, if

Saturn's period of 378 days is divided by 16, we discover that there are 15 units of 23 and 7/8 days in the lunar year of 354.36 days.
It is this 15:16 relationship of lunar year to Saturn, a musical semitone, that leads to the truth behind this "perforated vessel", because the first ring of holes numbers 15. This implies that, somehow, someone is counting the number of periods involved. The period 23 7/8th day is, in fact, exactly 4/5th lunar months and it is this that provides a possible harmonization between the Moon and Saturn that is not possible between the Moon and the solar year. The required key unit is 1/8th of a day or 3 out of our 24 hours, and we know from the Pompeii diagram and Chaldean records that 24 hours of a day were counted and given planetary rulers within a repeating planetary sequence.

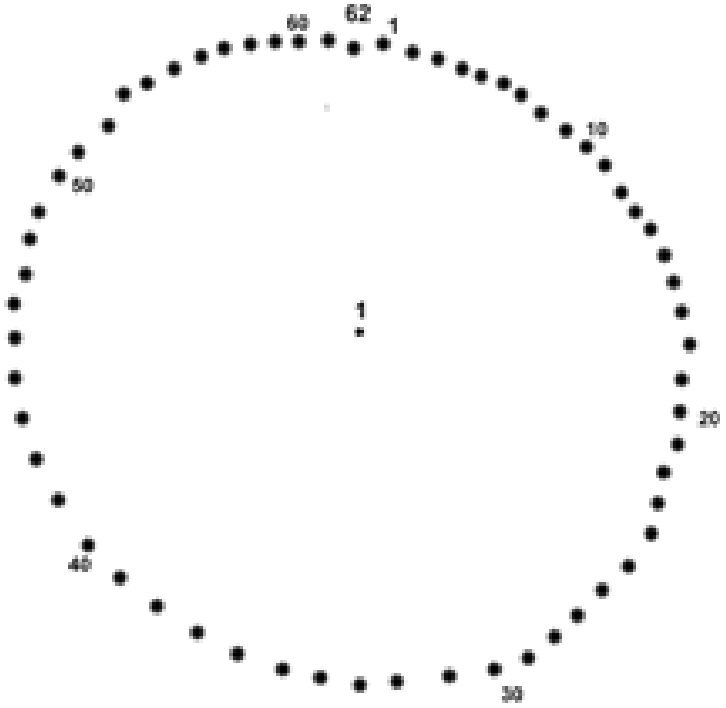


The pair of rings used to track the progress of the Eclipse Seasons

The next ring of perforations has 22 holes and we are now interested in the possibility that the disk was a counting device for more than one celestial cycle. Outside this ring is a ring of 38 holes and this number is the next big clue because it is two times 19 and nineteen is an important number for two Moon cycles. Nineteen periods make up both the Saros periods of 19 eclipse years (over which similar eclipses repeat), and the Metonic period of 19 solar years, over which Sun, Moon and stars return to a similar orientation with respect to each other.
It is the eclipse year that naturally divides into two to yield the number 38. This doubling occurs because there are two lunar nodes that give rise to eclipses at lunar conjunctions and oppositions to the Sun. Each of these lunar nodes gives rise to an eclipse season where within seventeen days, if the Sun and Moon are conjunct or opposite relative to Earth, an Eclipse of some sort will ensue. The eclipse year is 346 and 3/5th days long and hence eclipse seasons are 173 and

3/10th days long. Dividing the latter by the 22 holes in the second ring, we obtain a unit of time of 7 and 7/8th days. Note that this unit is again based upon 1/8th of a day.

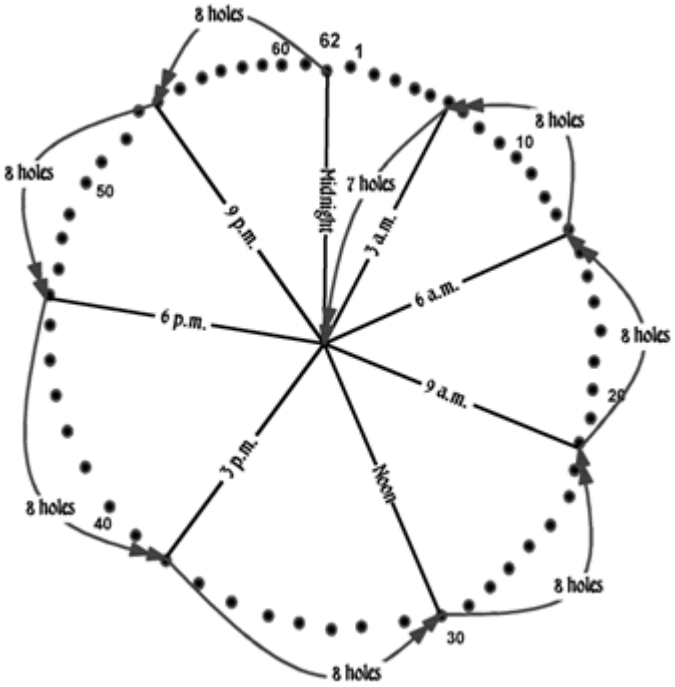
This new unit, that underlies the periodicity of eclipse seasons, is exactly one third of the 23 and 7/8th day unit that, as stated above, harmonises the lunar year to the Saturn synod in a 15:16 proportion.



How the central hole can be added to the outer ring to make 63 days, one sixth of a Saturn synod

But we still don't have a way to count these necessary periods in order to trigger movements of counters placed in these rings of holes. However, the next clue soon emerges when 7 and 7/8th days is written as a fraction because it is 63/8th days long. Could this be connected with the outer ring of the vessel which has 62 holes, not 63?

One hole can be found in the centre of the vessel and we should remember that this is a cultic, i.e. symbolic, object. As mentioned, what looks like a solar disk in the centre is surrounded by seven flames signifying Saturn, and therefore the central portion of the vessel is decorated to represent Saturn. The 63rd hole, in the centre, could be a special festival day that marks a division of the Saturnian year or synodic period of 378 days.



The counting in the 62+1 hole ring can be read like a 24 hour clockface to yield the 7 7/8th day periods accurately

The outer track of holes can simply count days. If the period sought were 8 days, then 64 holes or days would give 8 periods, but the sought after period is 1/8th of a day less than eight full days. By including the inner hole, the outer ring can count 63 whole days which, after one round would contain eight periods of the required length. Such a use of the central hole symbolises the end of one-sixth of the Saturn synod, a day special in this Saturn calendar.

After eight days, i.e. 8 holes, the count should have lost 1/8th of a day and by counting in an anticlockwise fashion, the time of day of this "falling behind" can be tracked exactly as if reading a 24 hour clock face. The diagram shows how after starting the count, the period of 7 7/8th days looked for will end very close to where the marker now stands. The marker will deviate from perfection in this regard but will generally always be showing in which three hour period the end of the 7 7/8th day period will end. This means there would be no need to show this explicitly in the decoration since it could be read accurately enough. It also means that, theoretically, this ring can, with the central hole, measure the required periodicity within three hours without any further techniques or technology.

It is also noteworthy that the same hole could be employed to signify the 16 time divisions relative to the 15 or the ring that surrounds it. Given that the central hole and 15-ring is surrounded with seven rays that imply the week of seven days, then the whole disk very much points to Saturn at its centre, incorporating the central hole in that symbolism and counting.

The two holes outside the 22 ring can be used to count to 3

However, to drive the 15 hole ring requires an additional way of counting to three. This would enable the 63/8th day periods to derive the required period of 23 7/8th of a day, upon which a marker on the 15 hole ring could be advanced. The only available system for doing that would employ the two additional holes above and below the 22 hole ring. It is important in counting with markers that the operator should not lose track of the situation, and in fact two holes are best suited to counting to three by a sequence such as, (count 1) a marker in hole 1, then (count 2) marker moved to hole two, then (count 3) marker removed from the disk. With such counting there is no ambiguity as to the next operation given the present state of the count.

5. ZEUS VERSUS CHRONOS (i.e. JUPITER VERSUS SATURN)

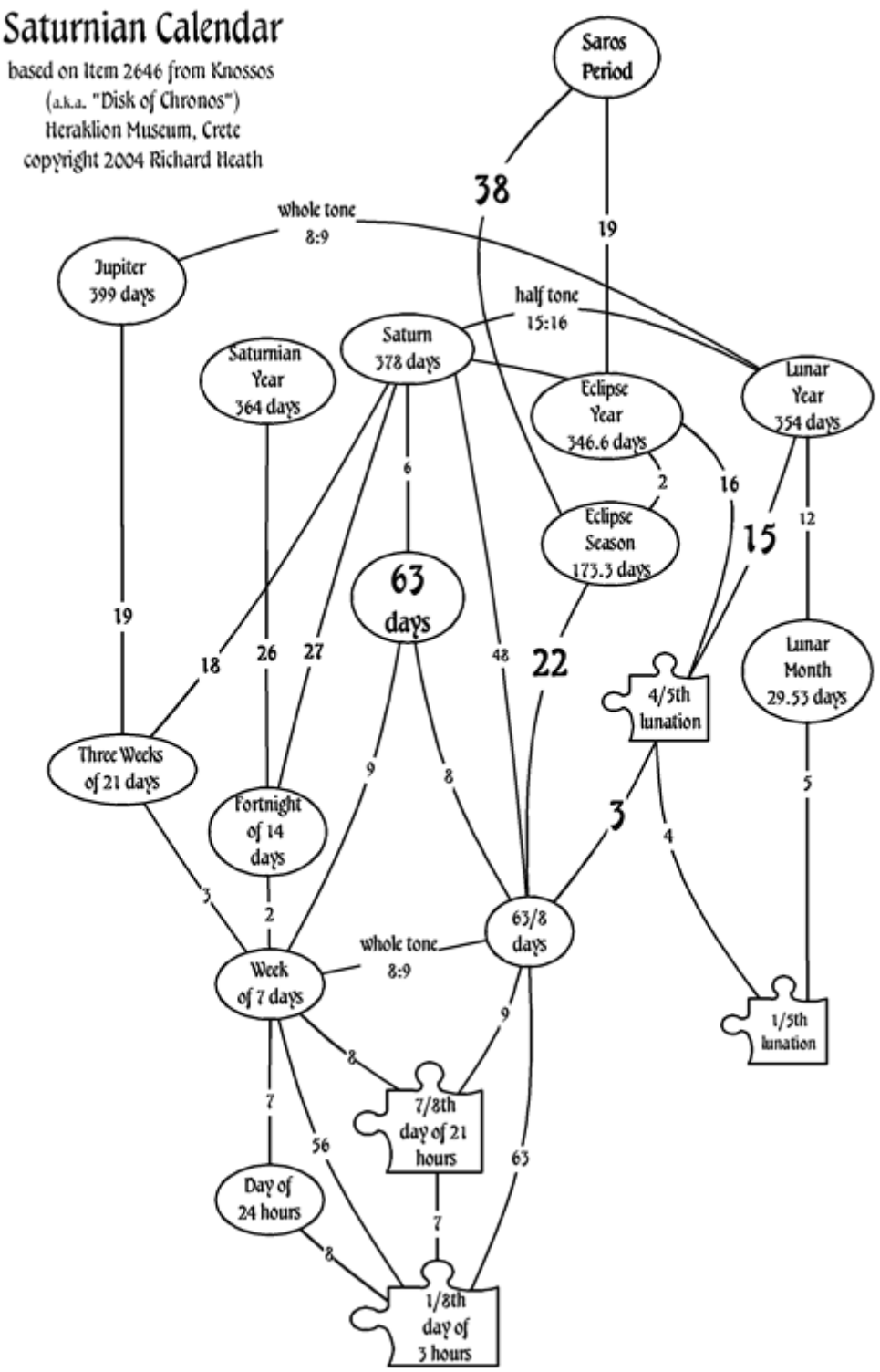
These two gods, as planets, have the synodic periods of 378 and 399 whole days – the time taken for their loop opposed the sun, to repeat in the night sky. The amazing thing is that both these numbers of days divide by seven! In fact Chronos and Zeus as planets are in the relationship of 18 to 19 units of three weeks (21 days).

The key observation here is that there are six periods of 63 days in the Saturn synodic period. Also, 63 days is three times three weeks, the period that relates Saturn to Jupiter as an 18:19 proportion. It is also worthy of note that the required period of 7 and 7/8th days is in the ratio 8:9 with the week of just 7 days, that is a perfect musical whole tone.

There is no way within this disk to show any of these further and very interesting relations. And yet it can be seen that the disk provides an excellent

basis for tracking more that just the lunar year, eclipses and Saturn synod. Also, the counting regime is based upon the simplest of all techniques, counting days, naturally organised in a seven day week. This seems most fortunate to have occurred in nature.
In the mythology of Zeus, Chronos is accused of swallowing his own children and perhaps we can see in this a reference to a system of time that if followed effectively denies (swallows) all the other celestial cycles that could be taken into account, having struck upon such a simple system of time. Zeus is saved from such a fate by his mother and is then brought up in a Cretan cave, hidden from his father who by implication might hear his cries. This implies that the drama is one entirely played out in Crete.

This calendar, implicit in the Disk of Chronos, evidently fell out of use and was replaced, probably with those for which there are historical records. It therefore seems likely that the overthrow of Chronos by Zeus was related to calendrical practices and Chronos related to some fixed religious regime associated with the older Saturnian calendar. Since the calendar is simpler than it "should be", that is, because time periods should not match so simply days to Saturn, the Moon and eclipses, then it could be seen that no further development was possible so long as such a calendar and such a god of time dominated the religious precincts of the bronze age, at least in Crete.
The fact that Jupiter fits into the scheme in an 18:19 relationship with Saturn and that Jupiter has an whole tone 8:9 relationship to the lunar year whilst Saturn only a semi-tone of 15:16, indicates that Jupiter's overthrowing of his father was written in the sky, just as his banishment to a small island might be an allusion to the semi-tone relative to a whole tone to the Moon. A diagram of a fuller "matrix" of numeric relationships is shown below.



The Matrix of Numerical Relations operating within the Disk of Chronos (large font) and some of the other time periods that also relate within this Saturn calendar. Note: Larger time periods are above lesser, and the numbers by the connections multiply one period to give the period at the other, higher end.

CONCLUSIONS

The disk discussed here is a lost calendar that is simple and effective. It corresponds with mythological information about the main characters, Saturn, Jupiter and the Moon and gives a better understanding of why the week of seven days should have come into usage when today it has no clear astronomical foundation. The week was developed, it would seem, from a Saturnian calendar and that is why tradition asserts that fact but with no causal explanation as to

why or how.

The likelihood of a perforated vessel conforming to this opportunity (of counting the main parts the Saturnian calendar) by accident must be slight. In fact the vessel has little else to suggest its utility to those who made it. It came from a sacred complex or "palace" of Knossos and this disk strongly refers to the structure of time which was a prime concern of ancient cultures.
The object considered here, deserving of a better name, shows evidence of being the oldest preserved calendar object. I suggest The Disk of Chronos. It is the most complex yet harmonious interpretation of time in any calendar, ancient or modern!
The bronze age civilisation of Crete can be read into such a calendar as that of Chronos the predecessor of Zeus. The birth of Zeus can be seen as a mythological statement of how the Olympians emerged from roots reaching back to the Minoan period and that the bronze age was when Saturn as Chronos was considered the king of time.

Appendix: The Accuracy of the Proposed Calendar Disk

1. If the basic time period of 63/7 is being counted, then the Saturn Synod of 378.09 days is achieved as 6 times 8 times 63 divided by 8 as 378 days yielding an accuracy to the Saturn synod of 99.976%
2. The Lunar Year of 12 lunations is then tracked as 15 times 3 times 73 divided by 8 equalling 354.375 days versus 354.367 days giving an accuracy of 99.998%
3. The period between Eclipse Seasons is tracked as 22 times 63 divided by 8 or 173.25 days versus an actual period of 173.31 days giving an accuracy of 99.965%
4. The eclipse season is plus or minus 17 days and 17 days corresponds to two holes of the 22 holes used for counting its periodicity. This means that the eclipse season can be expected in the area of fulfilment of the counting in the 22 hole ring, plus or minus two holes of the end of the count. If a lunar eclipse should occur with the marker outside this range, then the 22 hole marker could simply be moved to the nearest in-range hole, making the system self-correcting on the basis of simple observation.
5. As stated in the text, the 63 hole count automatically gives an implicit reading of how many 1/8th days should be removed from the whole day, advancing the time of day at which the count is actually progressing. This

does not effect the actual movement of the day marker, but indicates to high precision of a few hours, the exact moment referred to by all the markers in their different track rings.

6. Three periods of 7 7/8th days equal 4/5th of a lunar month to the very high accuracy of 99.998%, repeating the result in 2 above.

We have to ask “Would this type of accuracy be useful?” and the answer appears to be that it was. The simplicity means that once established, the level of skill required to track time focussed on the chosen time periods, would have been on a par with skills expected in the bronze age.

The probability of the Disk correlating with this calendar by accident, by the selection effect of choosing to find a calendar there, seems low considering

- the iconography of seven rays being linked with Saturn,
- the status of the Saturnian calendar found here as being unknown,
- its very simplicity of operation and accuracy in operation and
- the mysterious origins of our seven day week.

Such a probability (of accidental correspondance to time periods) should be calculated rather than being assumed to be high, that is before dismissing it as accidental or interpreted falsely.