

# MENSURATION OF SOLAR AND LUNAR CYCLES IN THE EUROPEAN BRONZE AGE: EVIDENCE FROM ARTEFACTS

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Skyscapes, Cosmology and Archaeology Module  
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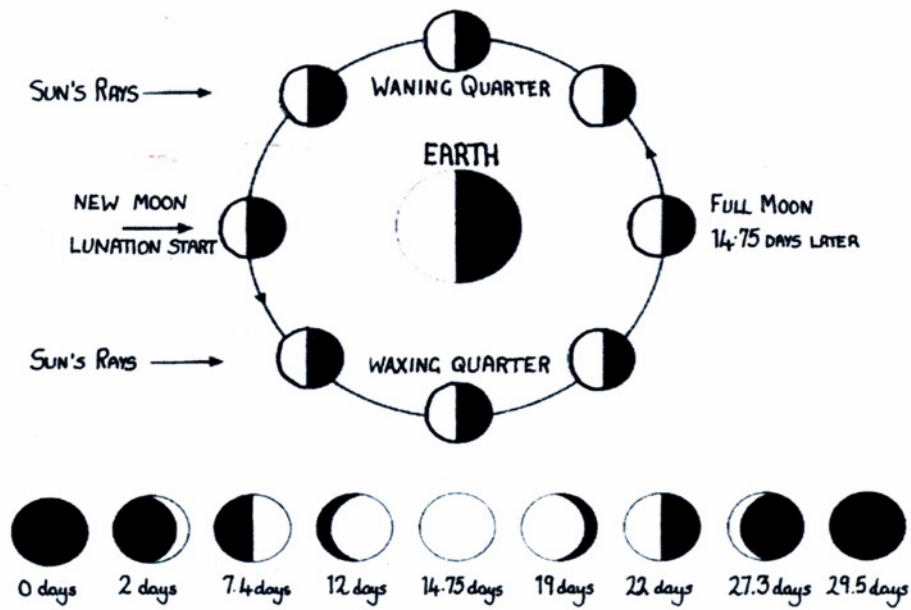


The Nebra Disc c 1600 BCE 32 cm diameter Found at Mittleberg, Germany, 1999.  
The oldest European representation of the night sky (see Crowhurst 2017)

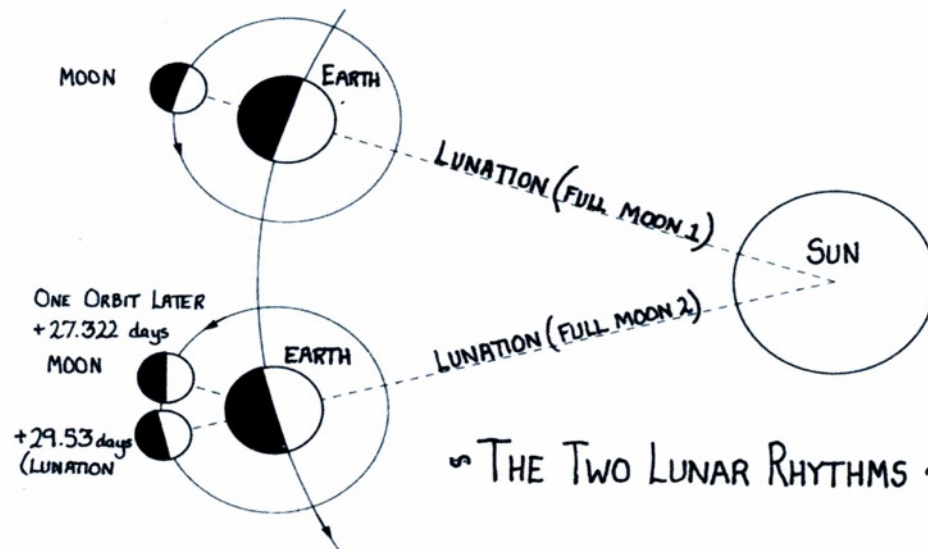
# 39 dots: what do they mean?

| Planet             | Period in Days | Multiple of 39 |
|--------------------|----------------|----------------|
| Venus              | 584            | 15             |
| Mars               | 780            | 20             |
| Mercury            | 116            | 3              |
| Human<br>Gestation | 273            | 7              |
| Moon (sidereal)    | 27.3           | 7/10           |

(These are only speculations and possibilities made by Howard Crowhurst in his book on the Nebra Disc...)



## ~THE LUNATION CYCLE~



## ~THE TWO LUNAR RHYTHMS~

# Summary of some key cycles

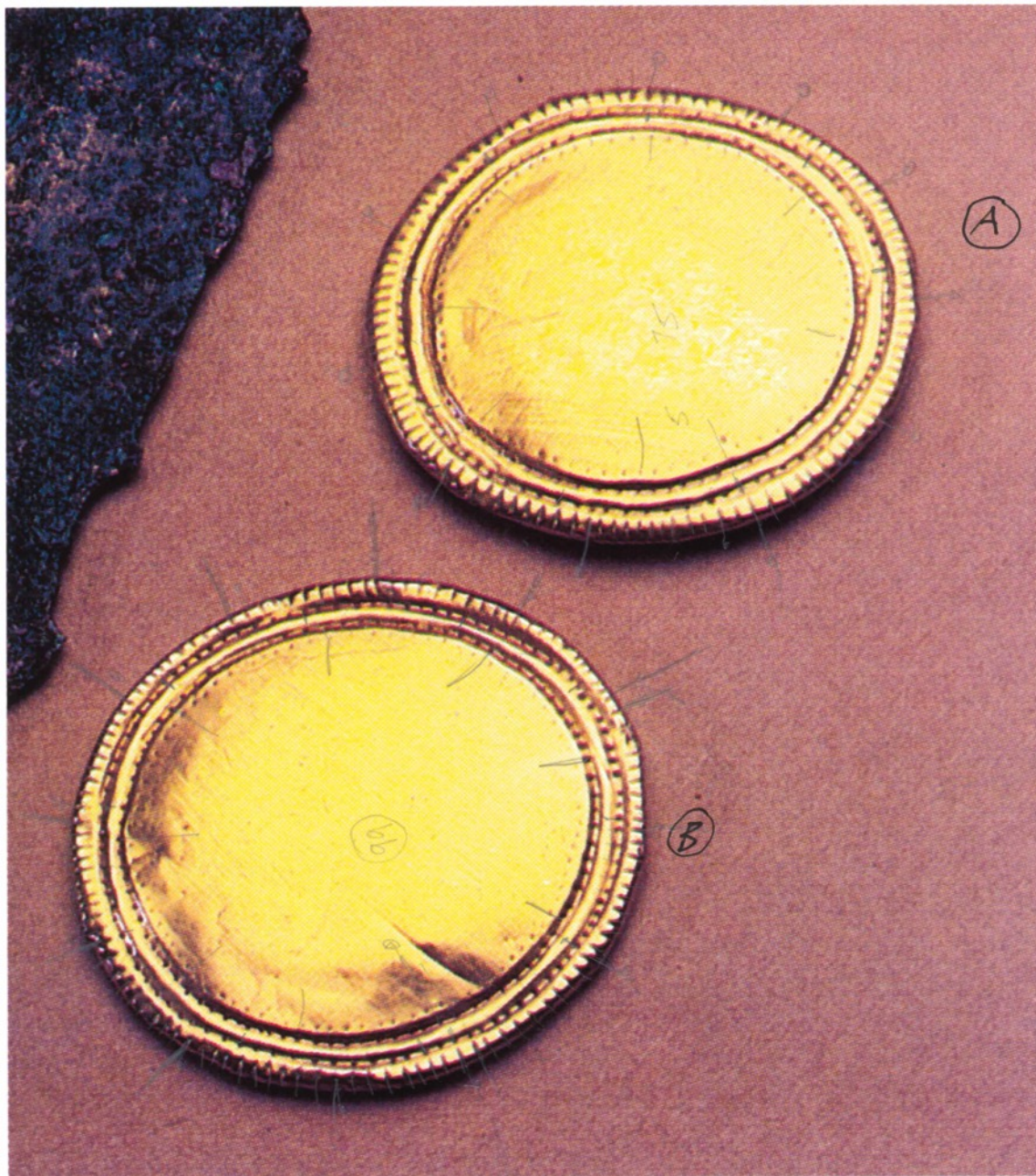
- Synodic Lunar month 29.53 days full moon to full moon
- Synodic lunar year 354.3 days ( $12 \times 29.5$ )
- Sidereal Lunar month 27.322 days, return to same fixed star
- Luni-solar month 28 days: practical compromise
- Luni-solar year 364 (+1) ( $13 \times 28$ )
- Solar year 365.242 days ( $365 - 354 = 11$  days)
- Alexander Thom's finding of a 16 fold division of the solar year. 'Epochs' or 'Sunths'\* ( $10 \times 23$  days and  $3 \times 22$  days = 365 days; smallest time unit 11 days)
- Metonic Cycle: It takes 19 solar years or 6939.6 (6940) days for the solar year (365.242) and the synodic lunar cycle (235 lunations of 29.53 days) to become congruent, so that the sun and moon return to same position within 2 hours. A kind of long term celestial 'marriage'. This cycle was first described by the 5<sup>th</sup> Century BCE Greek astronomer Meton.

\* Sunth is the term adopted by Anthony Thorley to describe these time periods as they are totally derived from solar cycle data with no reference to the moon or its cycles.

# Western European Bronze Age

- Chalcolithic (Copper age) 2500 -2200 BCE  
Copper introduced
- Initial Early Bronze Age 2200 – 2000 BCE  
Bronze and Gold introduced
- Mature Middle Bronze Age 2000 – 1500 BCE
- Later Bronze Age 1500 -700 BCE

( After Woodward and Hunter 2015)



Barnhill Gold Disks ? buttons, 30 mm diameter; found together in burial Cist at Barnhill, Angus, Scotland 1875  
Photo from 'Symbols of Power' 1985

# Barnhill Buttons numbers

## Disk A

- 112 nicks  $\times 3 = 336$
- Luni-solar ( $12 \times 28 = 336$  days)

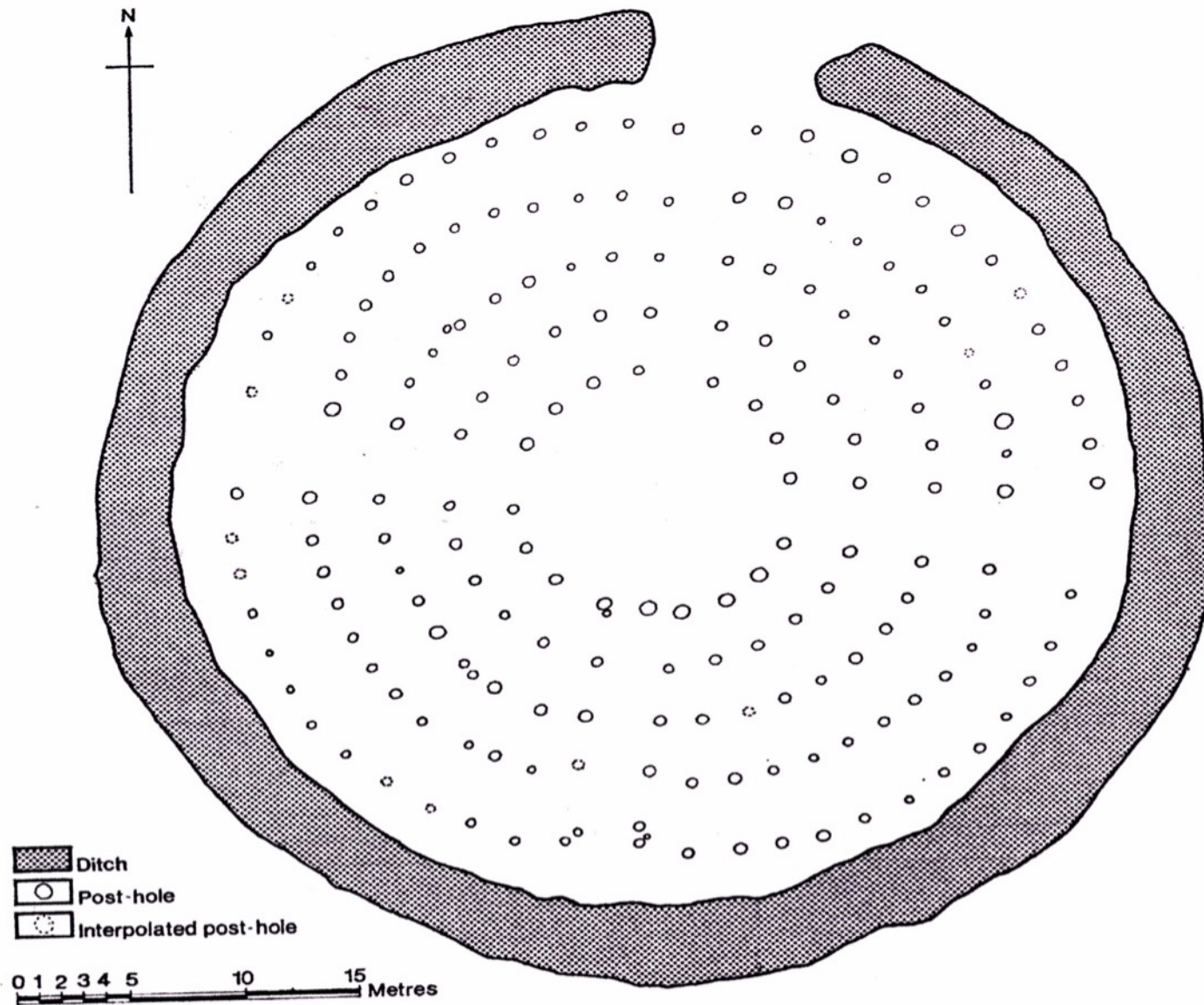
## Disc B

- 118 nicks  $\times 3 = 354$
- Synodic Lunar year (354 days)

These two buttons/disks, found together, carry between them solar and lunar information



Kirk Andrews Gold Disk, 50 mm diameter; found on Isle of Man in 1768, ? C 1800 BCE  
Photo from 'Symbols of Power' 1985



Plan of Mount Pleasant Timber Circle, Dorchester, Dorset, UK. C. 2000 BCE  
From Mount Pleasant Dorset, Excavations 1970-71 C J Wainwright, Soc. of Antiquaries 1979

# Kirk Andrews Disk numbers

## Inner Circle

- 118 dots  $3 \times 118 = 354$  (So 118 is 4 months of 29.5 days; part of a Synodic Lunar Year)

## Middle Circle

- 148 dots (5 months of a Synodic Lunar Year)
- $5 \times 29.5 = 147.5$  days (close to 148)

## Outer Circle

- 168 dots (6 months of 28 days; half of a luni-solar year of 364 days)



# INSIGNIA OF DIGNITY: Gold at Stonehenge

Special Exhibition to mark the  
bicentennial of the discovery of  
Britain's richest Bronze Age burial

Saturday 25  
and Sunday 26  
October 2008

## Exhibition Guide

WILTSHIRE HERITAGE MUSEUM 

41 Long Street, Devizes, Wiltshire, SN10 1NS

01380 727369

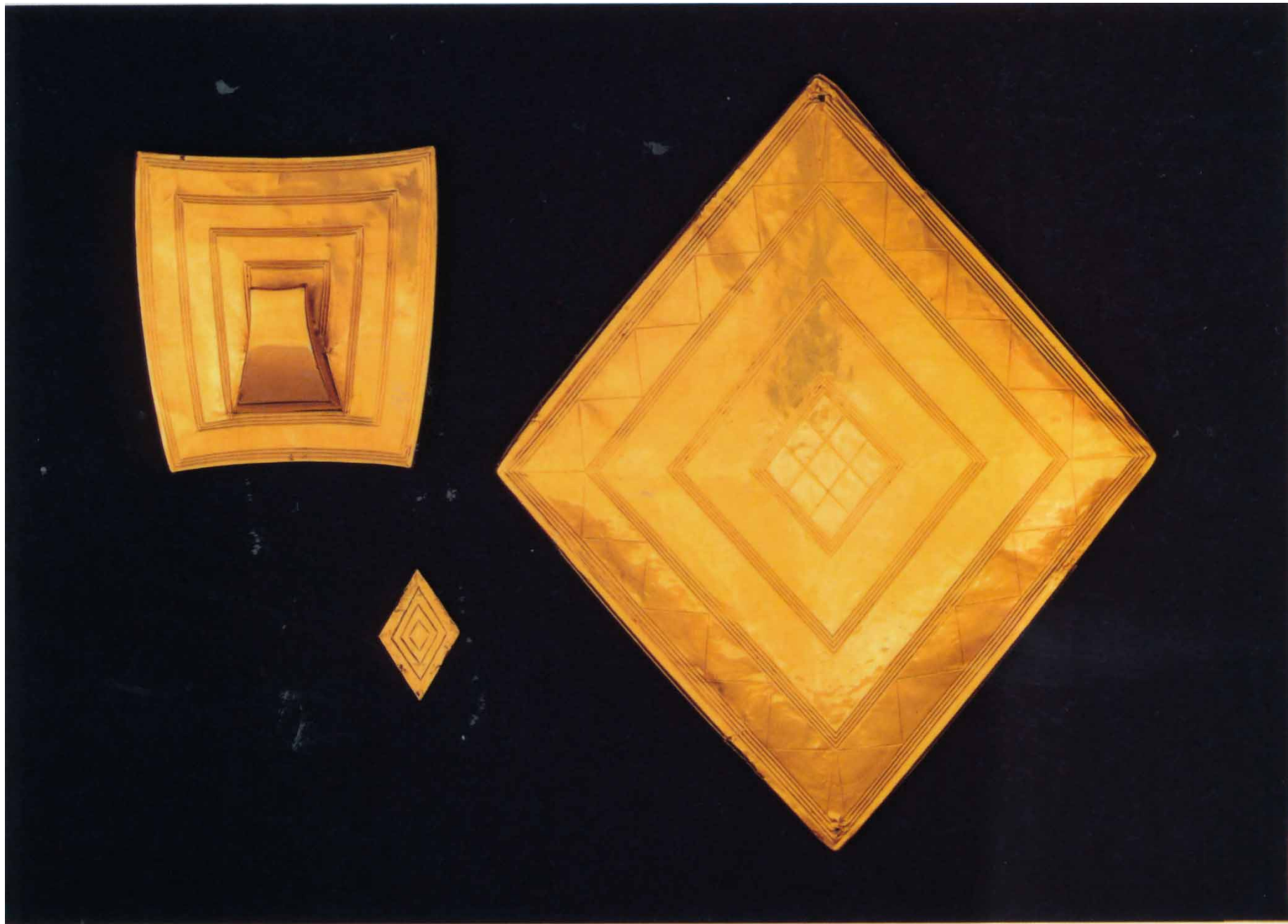
[wanhs@wiltshireheritage.org.uk](mailto:wanhs@wiltshireheritage.org.uk)

[www.wiltshireheritage.org.uk](http://www.wiltshireheritage.org.uk)

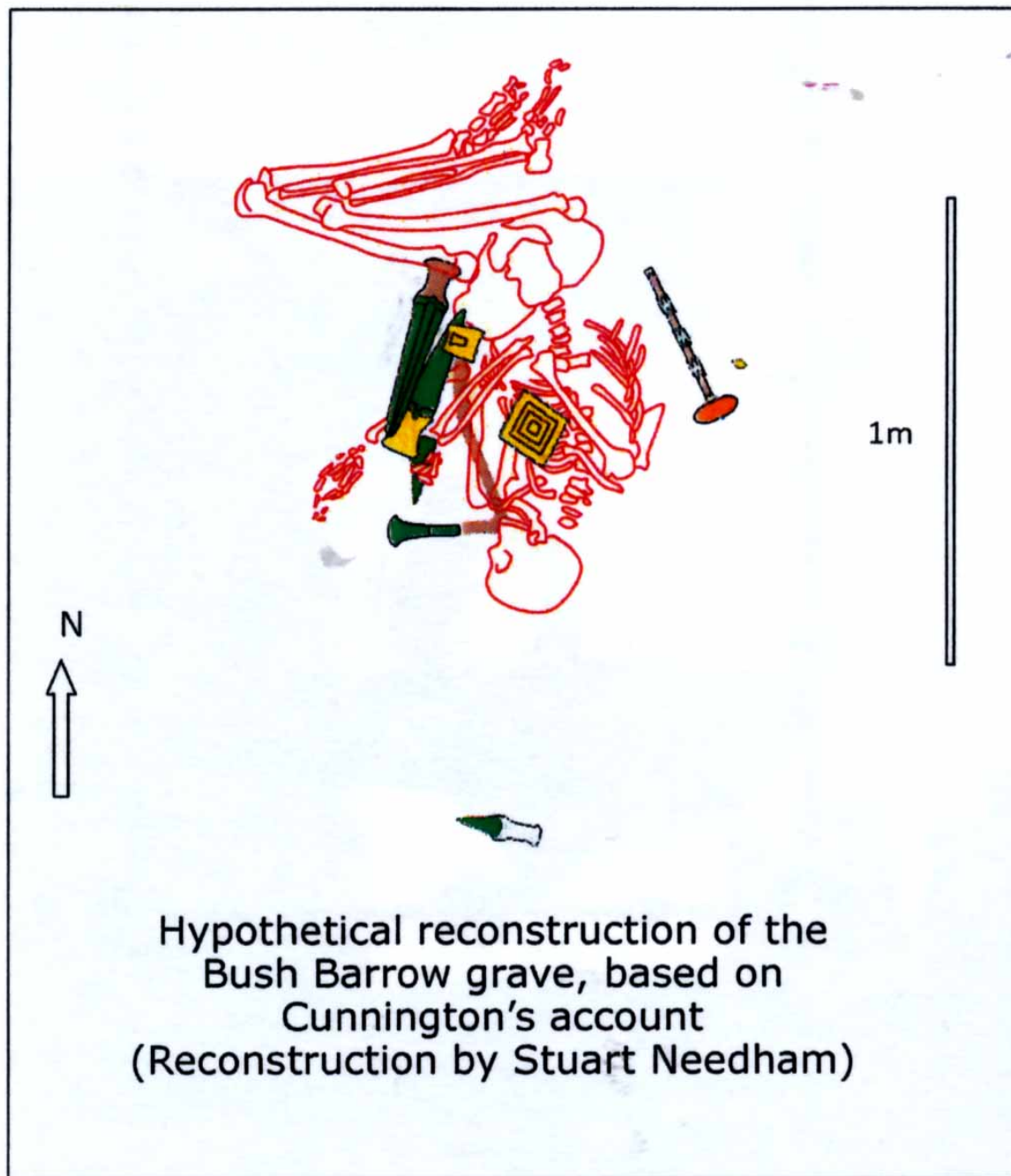
Image © David Bukach and Birmingham University



Bush Barrow, Gold Lozenge, 185 x 157 mm. Excavated by Wm. Cunnington in 1808, c. 2000-1500 BCE  
Photo by AnthonyThorley



Bush Barrow Grave assemblage with belt buckle and small lozenge, 31 x 19 mm  
Photo Devizes Museum postcard



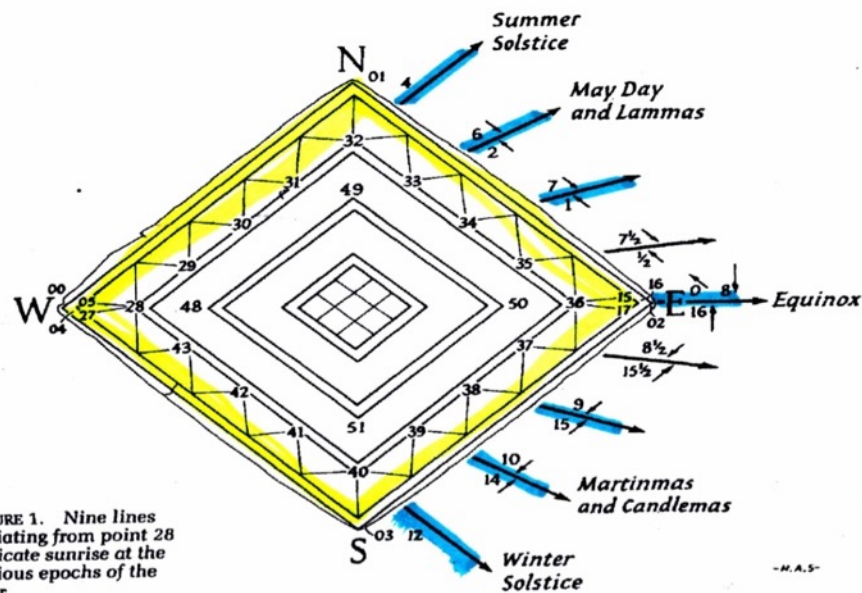


FIGURE 1. Nine lines radiating from point 28 indicate sunrise at the various epochs of the year.

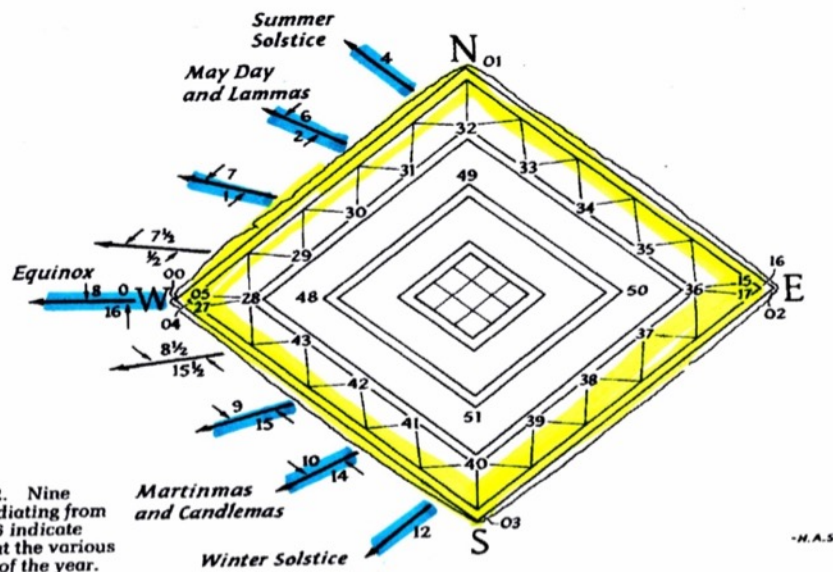
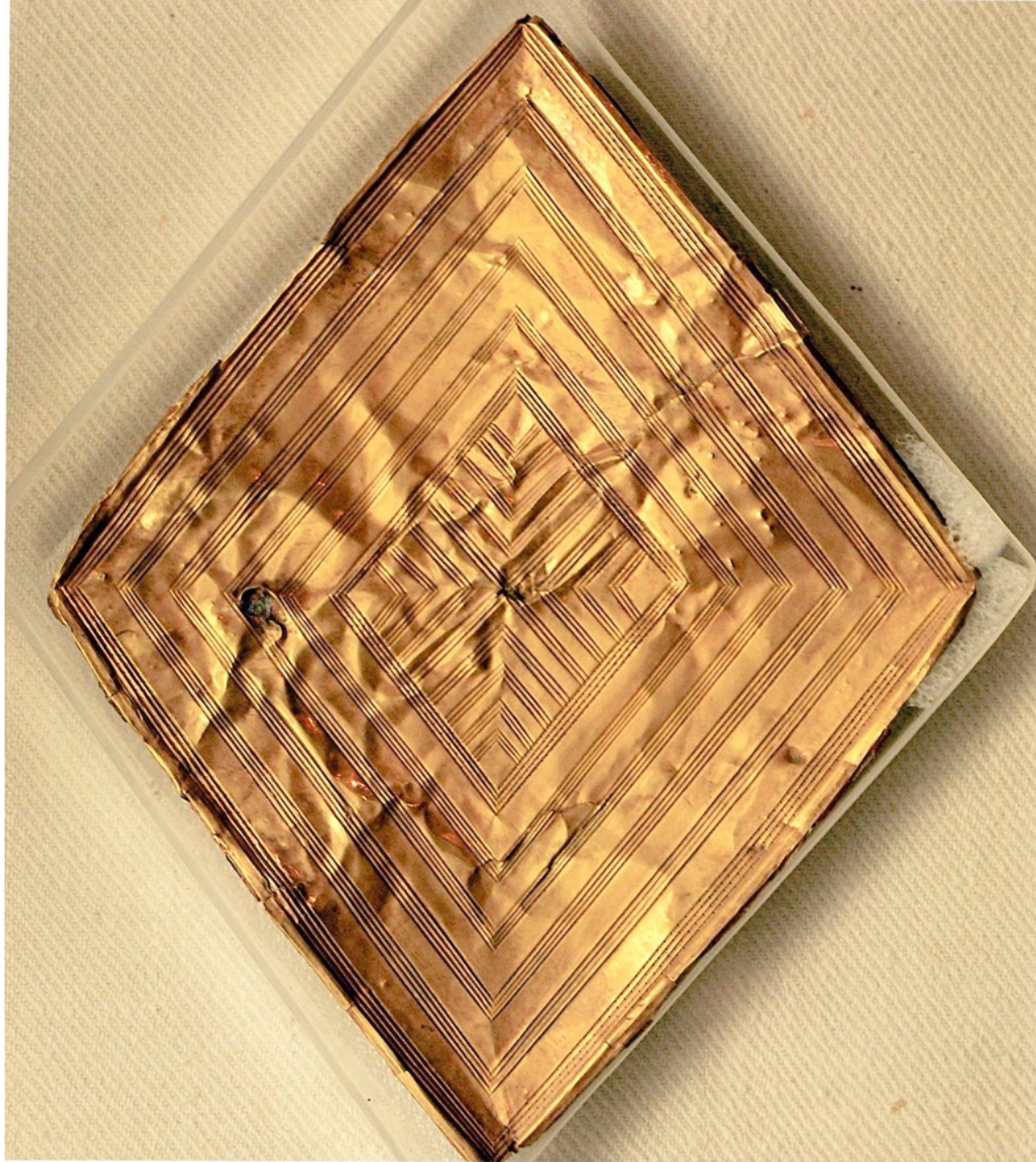


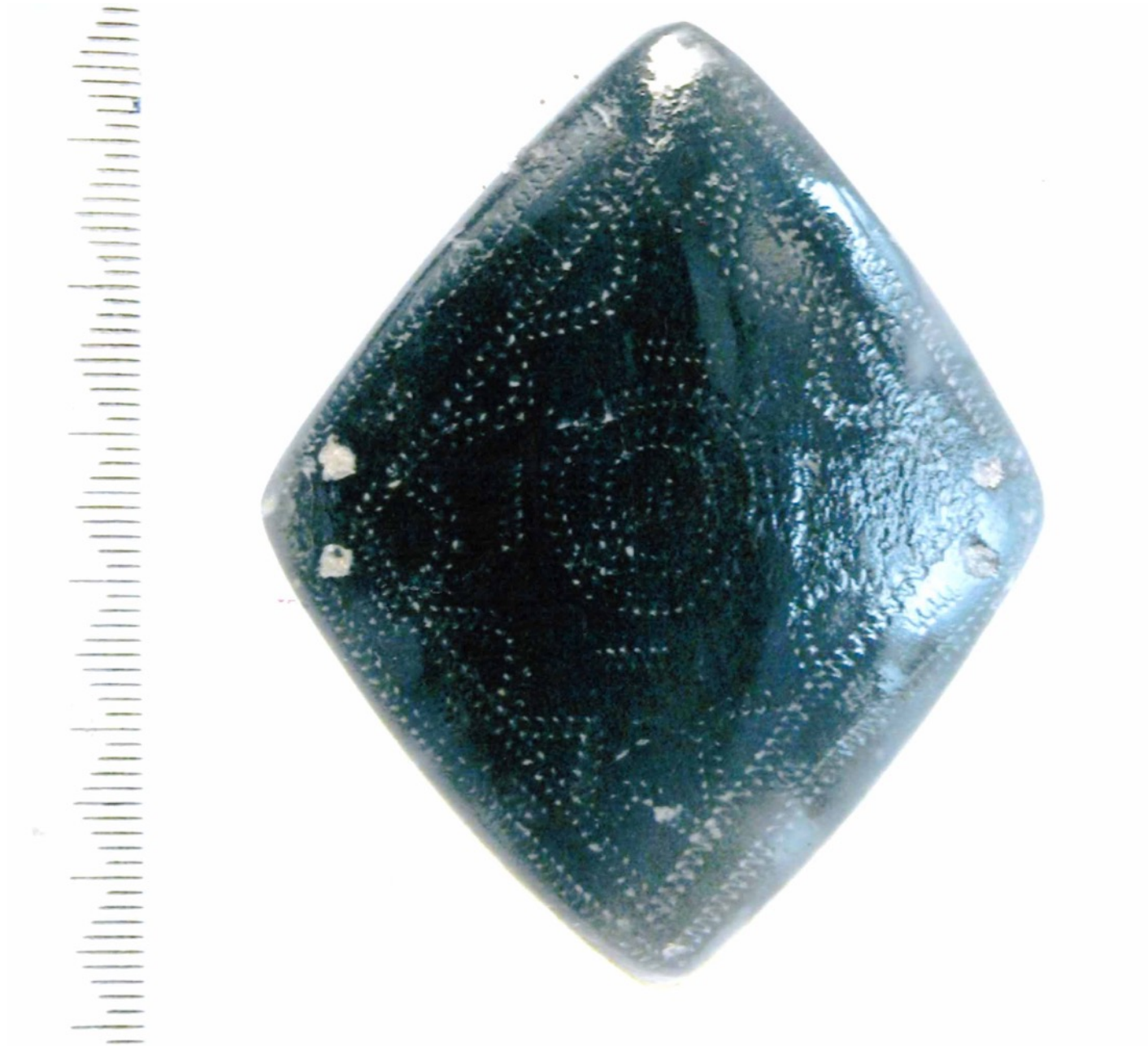
FIGURE 2. Nine lines radiating from point 36 indicate sunset at the various epochs of the year.

From Thom, Ker and Burrows, *Antiquity*, 62 (1988) 492-502

This shows how the lozenge reveals the Stonehenge horizon alignments of the 16 solar 'epochs' or sunths between the solstices



Clandon Barrow lozenge, c.150 x 120 mm. Found c. 1810, Clandon , Dorset, UK, by Wm. Cunnington, c.2000-1500 BCE  
Photo by Anthony Thorley



Jet Lozenge, found near Gt Yarmouth, c 2009. 60 x 50 mm. No published data as yet  
Photo by permission of National Museum of Scotland

# Lozenge Lore

- All the lozenges I have studied (there are only four in all of the UK!) carry the same 16 fold properties.
- Suggesting a Hypothesis....
- The shape of a diamond or lozenge seems to have something to do with representing or indicating Time or a period of Time



Fordham pottery cup. 128mm high. Bronze Age. Found by poachers in East Anglia, in 1900  
Photo from 'Symbols of Power', 1985



Fordham Cup base showing central lozenge and radiating markings  
Photo from 'Symbols of Power', 1985

# Fordham Cup Base

- A diamond/lozenge in the centre
- A five sided figure surrounding the lozenge
- A set of 11 laddered rays
- A set of 11 un-laddered rays
- A circle of 114 semi circular 'nicks' suggesting pauses by the potter at 30 and 50 nicks...
- Was he or she counting carefully?
- A strange triangle of 3 dots at the end of the 114 nick sequence – like a 'therefore' sign. Does this mean count the nicks three times??

# Fordham Cup numbers

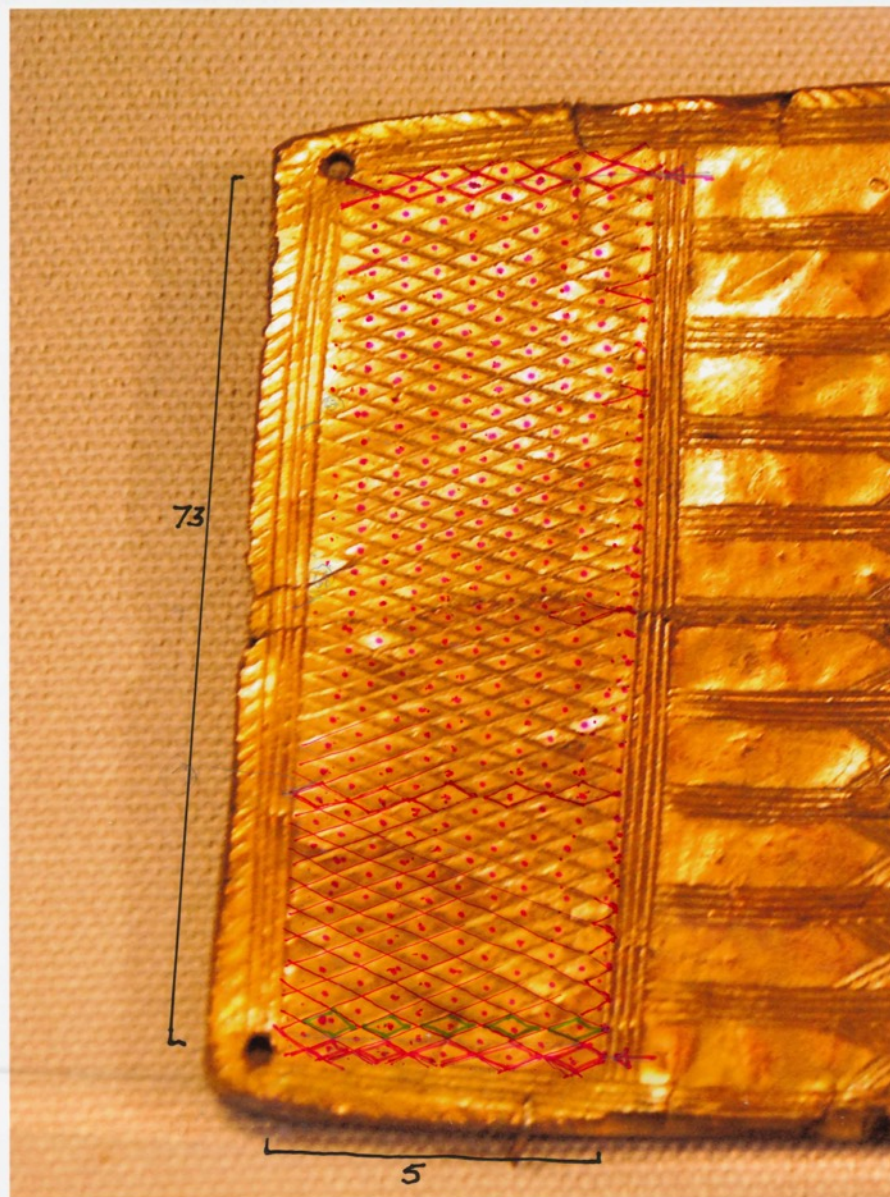
- 114 nicks Therefore  $3 \times 114 = 342$
- $342 + 1 + 11 = 354$  (synodic lunar year)
- $342 + 1 + 11 + 11 = 365$  (solar year)
- $5 + 11 = 16$  (Number of Sunths in a solar year)

# Upton Lovell Gold Plaque

- Now located in Devizes Museum, Wiltshire, England
- Excavated from a Barrow in Wiltshire in 1812, part of a woman's grave goods
- Seeing this artefact and the potential information on it, was my instant **epiphany!**
- Was it another 'breast-plate' ?ritual object?
- I photographed it....

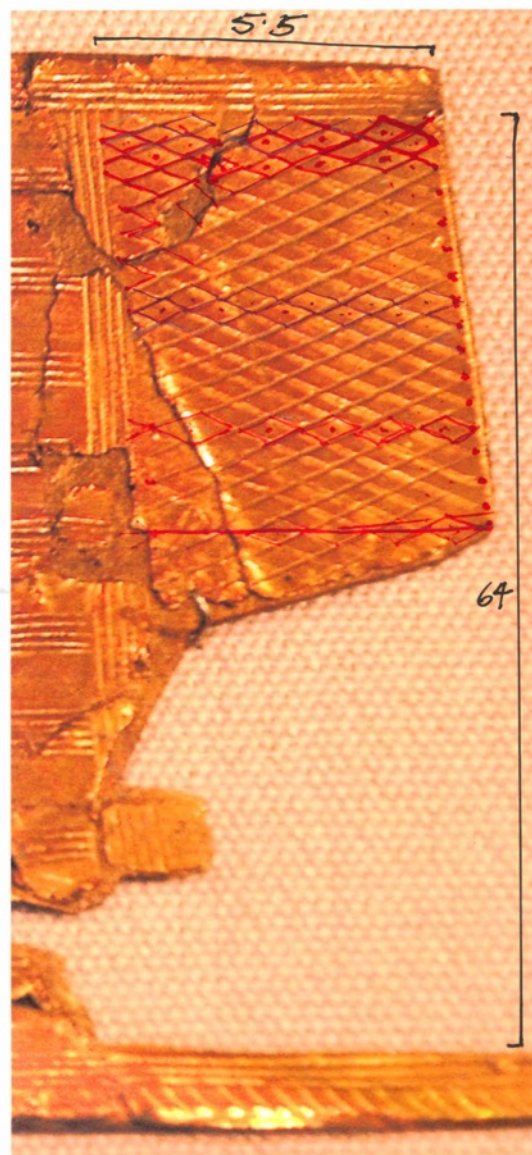


Upton Lovell Gold Plaque, c156 x75 mm; found in Bowl Barrow, Wiltshire , UK. c. 1812. c. 2000-1500 BCE  
Photo by Anthony Thorley



$5 \times 73 = 365$  LOZENGES  
? SOLAR YEAR

Upton Lovell Gold Plaque: Left panel  
Photo Anthony Thorley



$5.5 \times 64 = 352$  LOZENGES  
 $352 + (4 \times 0.5) = 354$  LOZENGES  
 ? LUNAR YEAR

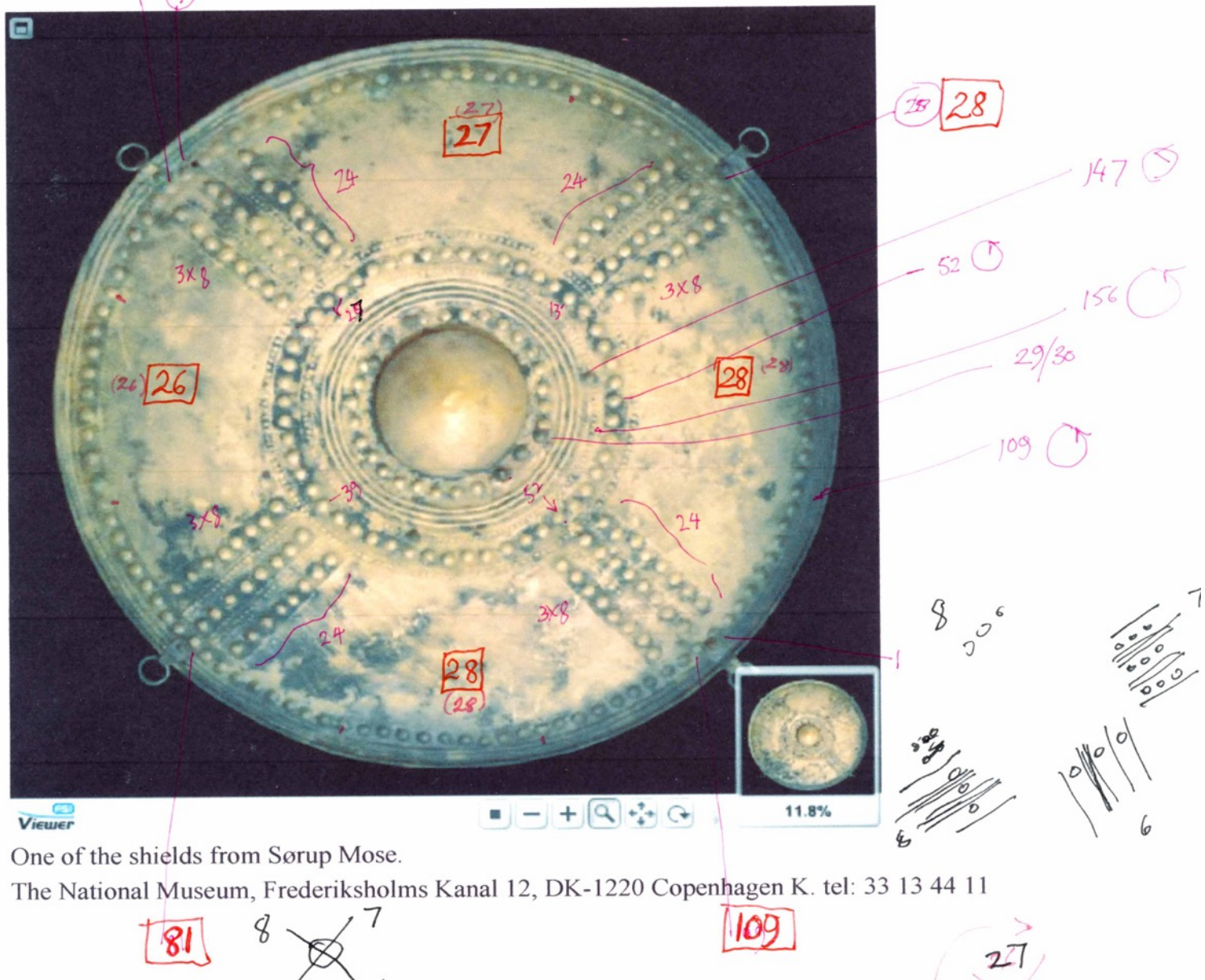
Upton Lovell Gold Plaque; right panel  
 Photo by Anthony Thorley



The Upton Lovell Gold Plaque, showing solar and lunar year panels. The central panel also contains mensuration data.  
Photo Anthony Thorley



8 Shield, Sorup, Eskilstrup, Maribo, Denmark  
Late Bronze Age, 11<sup>th</sup>–10<sup>th</sup> centuries BC (Cat. No. 149)



The Sørup Shield, discovered 1920 in Denmark . C 1400BCE

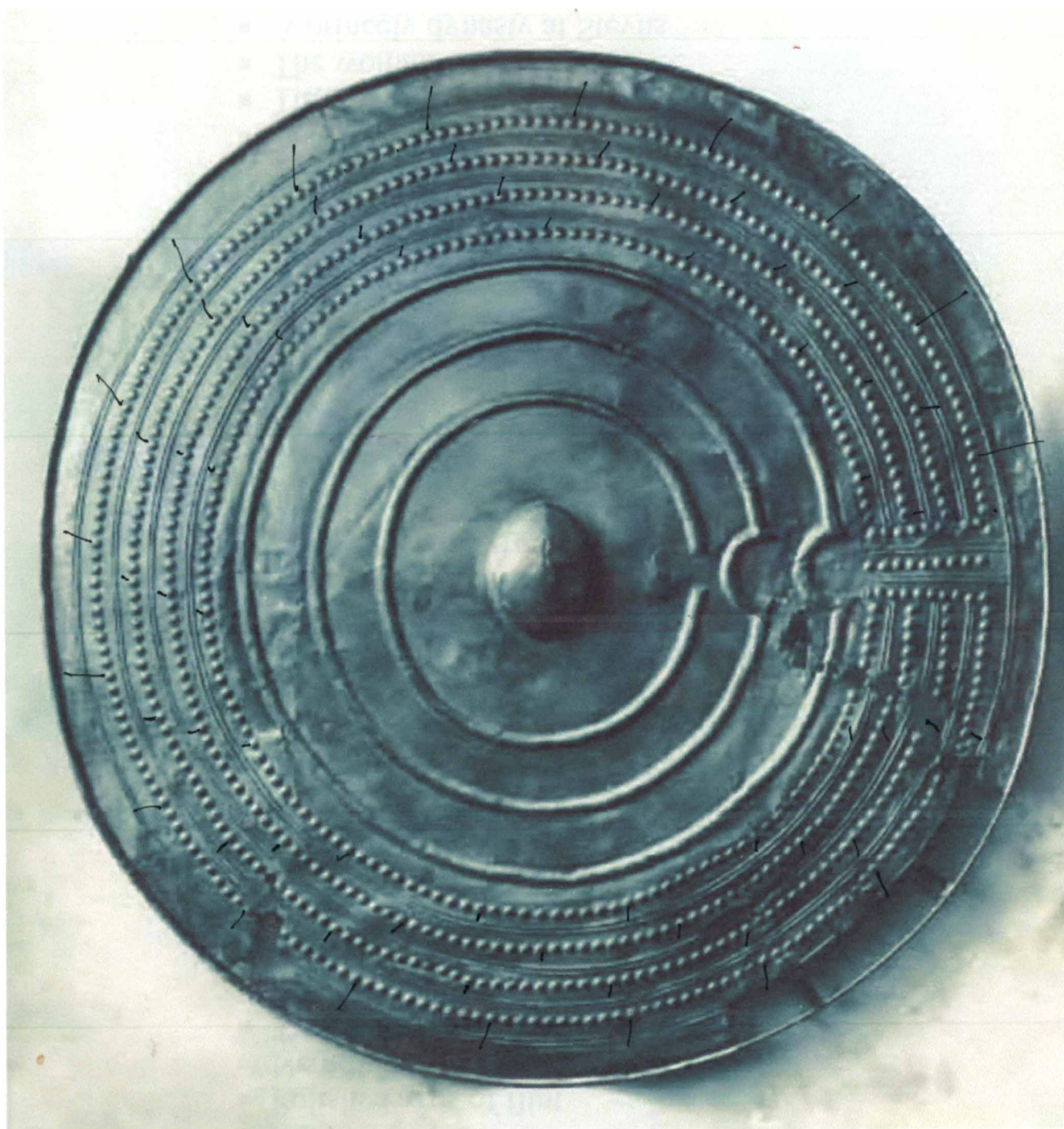
Note my working on the patterns of punches, and the anticlockwise sequence 28, 27, 26, 28 = 109 round the four quarters of the rim

# Sorup Shield numbers

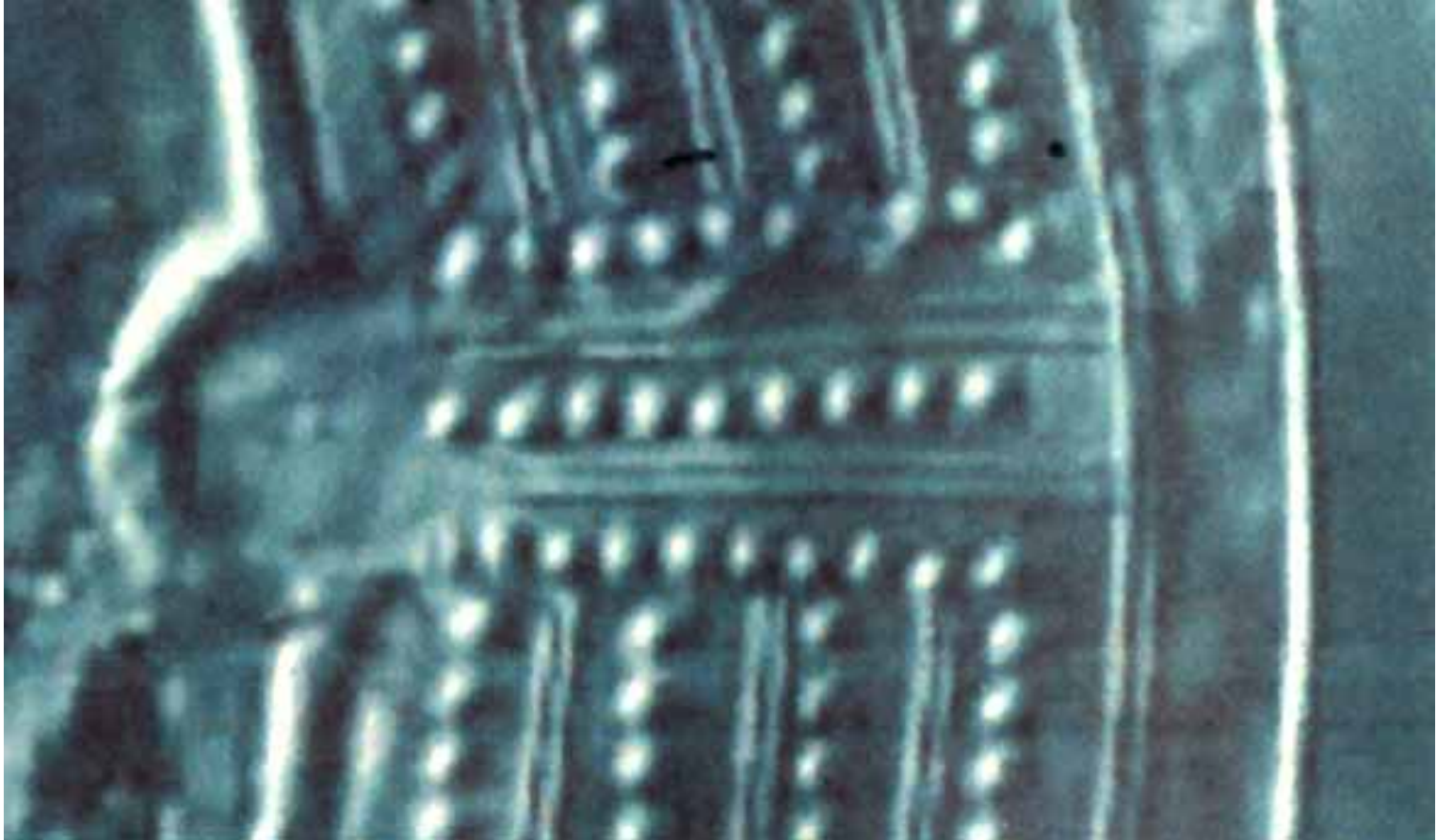
- Four quarters
- $28, 27, 26, 28 = 109$
- $109 / 4 = 27.25$  (not 27 but close to 27.322)

From other artefacts

- 82 dots divided by 3 = 27.333 ( close to 27.322)

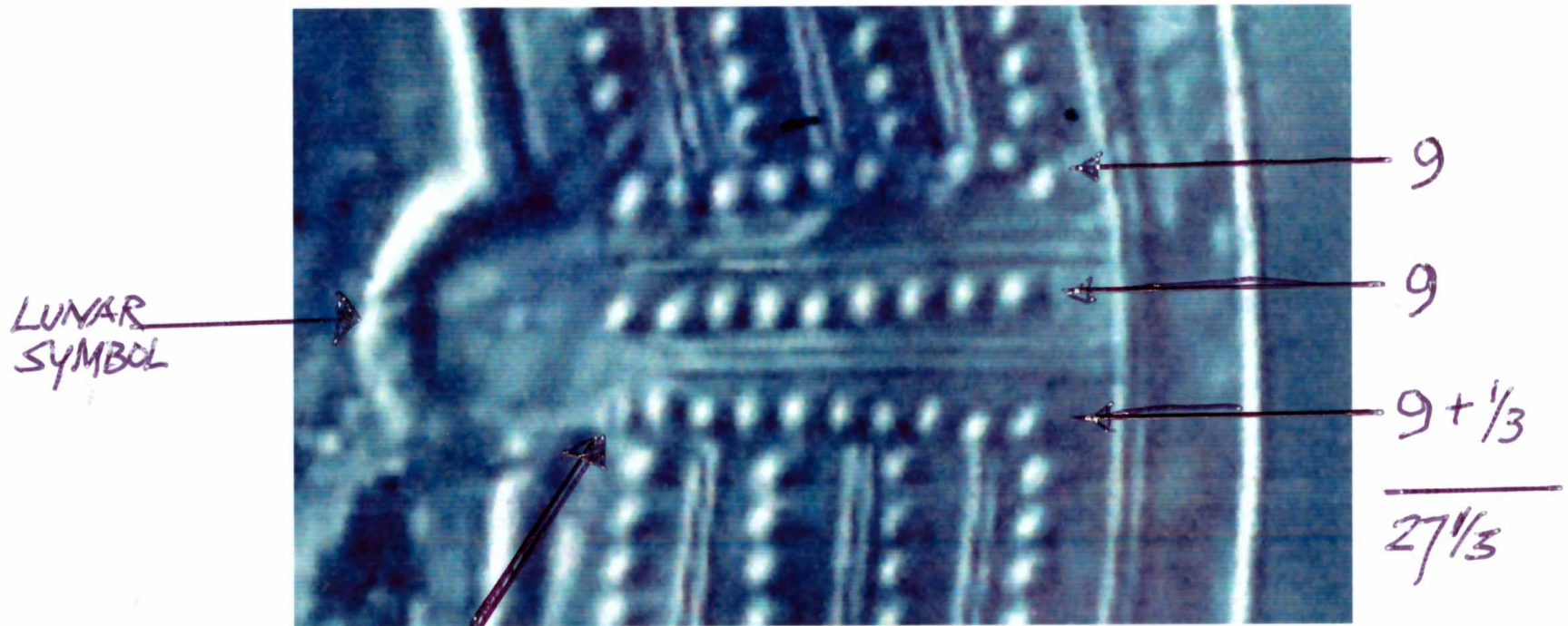


The large bronze shield from Svenstrup.  
The National Museum, Frederiksholms Kanal 12, DK-1220 Copenhagen K. t



Svenstrup Shield, discovered in Denmark in 1948, c. 1400 BCE  
This section shows three rows of 9 punch marks opposite a lunar symbol

SVENSTRUP  
~~SERIES~~ SHIELD CLOSE-UP



IS THIS PART-PUNCH A SYMBOL FOR  $\frac{1}{3}$  DAY?  
(THERE ARE OTHER EXAMPLES OF 'HALF-DAY' PUNCHES)

# The Sidereal Lunar Cycle

- A body of evidence derived from different Bronze Age artefacts, but especially from Ireland, which supports the idea that the Sidereal Lunar month of  $27 \frac{1}{3}$  (27.322) days was summated into long periods of time.



Trundholm Sun Chariot, Denmark's most iconic Bronze Age Artefact. C. 1400 BCE. Discovered by ploughing in 1902. About 65 cm long, disk about 30 cm.  
Photo National Museum of Denmark



Trundholm Sun Chariot, The ungilded 'Dark' side . Originally when new the bronze would have been golden coloured.  
Photo Wiki Commons

# T Sun Chariot Dark side numbers

|        | Centre | Ring 1 | Ring 2 | Ring 3 |
|--------|--------|--------|--------|--------|
| Number | 1      | 2 X 8  | 3 X 20 | 4 X 25 |

$$1 + 16 + 60 + 100 = 177$$

- The Synodic Lunar year of  $12 \times 29.5 = 354$  days. 177 days is half this period. So the Dark Side of the disk reflects the Synodic Lunar Year
- This form of calculation was first suggested by Professor Klaus Randsborg from Copenhagen Dept of Archaeology (see references)
- I have found that it turns out to be so universal for examining ringed artefacts I have termed it the Trundholm Summation Formula (TSF)



The Gold leaf gilded side of the Disk. Note the damage.  
Photo Wiki Commons



Gilt side of disk showing detail of spiral patterns and concentric engraved circles

CENTRE

FIRST  
RING

SECOND  
RING

THIRD  
RING



1 2

3 4 5 6

7 8 9 10

11 12 13

13 ENGRAVED RINGS (INCLUDING CENTRE)

# Gilt side numbers

|         | Centre | Ring 1 | Ring 2 | Ring 3      |
|---------|--------|--------|--------|-------------|
| Numbers | 1      | 2 X 8  | 3 X 16 | 4 X 27      |
|         | 1      | + 16   | + 48   | + 108 = 173 |

The Eclipse Year is 346.6 days so 173 is half this period in whole days. So the Gilt Sun Side of the disk reflects calculating eclipses.



Close up of Gilt side showing fine gold moulding and the radial rays on the perimeter rim



Dividing up the damaged peripheral radial rim into 90 degree segments for counting

# Trundholm Sun Chariot gilt side radial lines numbers

- I counted six 90 degree units of the radial lines, great care taken not to double count. Total 801 lines.  $801 / 6 = 133.5$  lines per quarter. Therefore  $4 \times 133.5 = 534$  lines for the whole circle
- 534 lines
- 13 tooled/patterned rings. Using the TSF...
- $534 \times 13 = 6942$  (Metonic period is 19 years, or 6939.6/6940 days)  
This Trundholm figure is just over two days more in 19 years ! Easy to adjust..

And

- $533 \times 13 = 6929$  Too little to match 6939.6
- $535 \times 13 = 6955$  Too large to match 6939.6
- So the Trundholm Sun Chariot may carry the earliest representation of the Metonic Cycle

# Conclusions about the TSChariot

- It Expresses solar and lunar relations, both in its design and aesthetic as an object, but also in its derived numbers.
- It has 16 spirals on the gilded solar side reflecting 16 sunths in a solar year.
- It has 27 spirals on the gilded side reflecting the sidereal lunar year.
- It reflects the Synodic Lunar Cycle on the non-gilded side (177 days)
- It reflects the Eclipse Year (173 days) and therefore the juxtaposition, conjunction or 'marriage' of the sun and moon
- It reflects the Metonic Cycle of 6339.6 days, as the only time in 19 years the sun and moon are found within 2 hours of each other in the same point in the sky. Another form of conjunction.
- To calculate the Metonic Cycle you have to use the period of the solar year as 365.242 rather than 365!
- Bronze Age people were apparently sophisticated at mensuration!



The Tedavnet Sun Disks found in Co. Monahan, Ireland. C. 1800 BCE .Note the elaborate use of the lozenge in the centre and the 16 fold nature of the inner circle periphery. The whole piece is rich with solar and lunar mensuration.  
Photo National Museum of Ireland

# Tentative General Conclusions

- Bronze Age culture in Western Europe, including the UK and Ireland, seems to produce artefacts of gold and bronze which show ordered or patterned markings which demonstrate a significant consistency.
- There emerges from the markings a cultural preoccupation with certain numbers which reflect, or actually represent, astronomical factors such as short and long solar and lunar cycles.
- If these numbers represent calendrical material, there may be three or more concurrent calendars, or counting systems, in use.

# Brief Bibliography

- Taylor, Joan J, *Bronze Age Goldwork of the British Isles*. Cambridge University Press: 1980. (Still the essential sourcebook for academic description of these British, Irish and European gold artefacts. 199 pp.)
- Demakopoulou, Katie et al., *Gods and Heroes of the European Bronze Age*. Thames and Hudson: London, 1999. (Good academic background and excellent illustrations of an international Exhibition Catalogue. 300 pp.)
- Woodward, Anne and John Hunter, *Ritual in Early Bronze Age Grave Goods*. Oxbow Books: Oxford, 2015. (The up-to-date authoritative and exhaustive monograph of this material culture. Important sections by Stuart Needham on Wessex Culture gold. Photos of everything but disappointing photographic quality for an academic monograph. 578 pp)
- Crowhurst, Howard, *The Nebra Sky Disc: cycles in the cosmos*. Epistema: Plouharnel, France, 2017 (Very interesting speculations over mensuration and usage of disc, marred by poor textual organisation and inconsistent referencing. But, affordable and recommended for a useful introduction. 64 pp.)