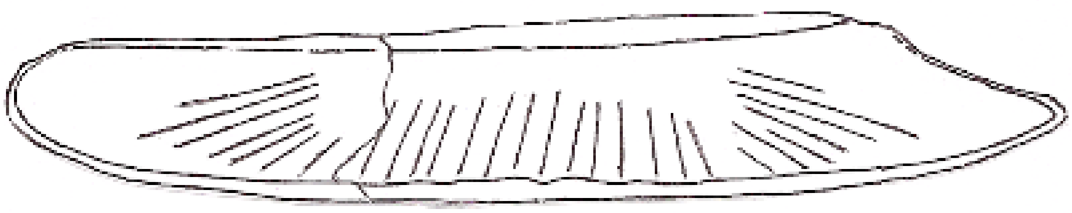
SOLSTICE CALENDAR



Man's First Timepiece

William. W, Tennis

The Question

What do the

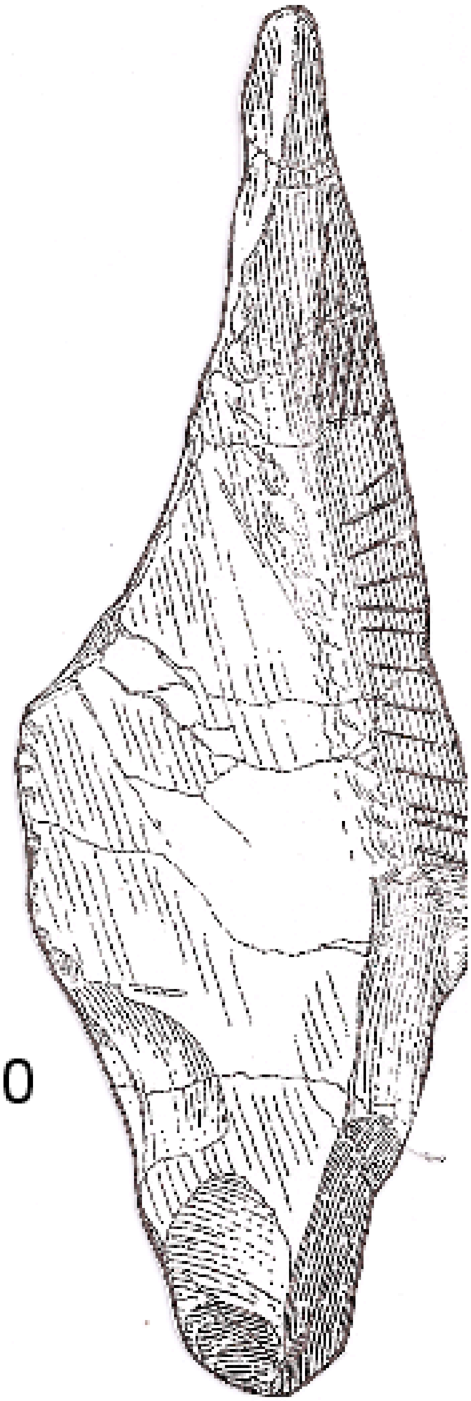
markings on

this elephant

bone buried

for over 300,000

years mean?



Art based on sketch by D. Mania in *Rock Art Research* 5/2/91 page 107.
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Scientists

Say

The lines were

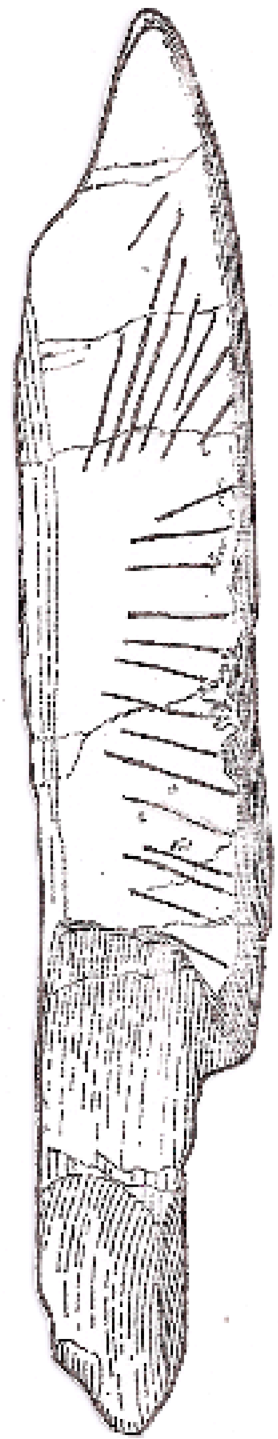
made on purpose

and not by animals.

They were made by

ancient man, but

why?



Art baed on sketch by D. Mania in *Rock Art Research* 5/2/91 page 17.
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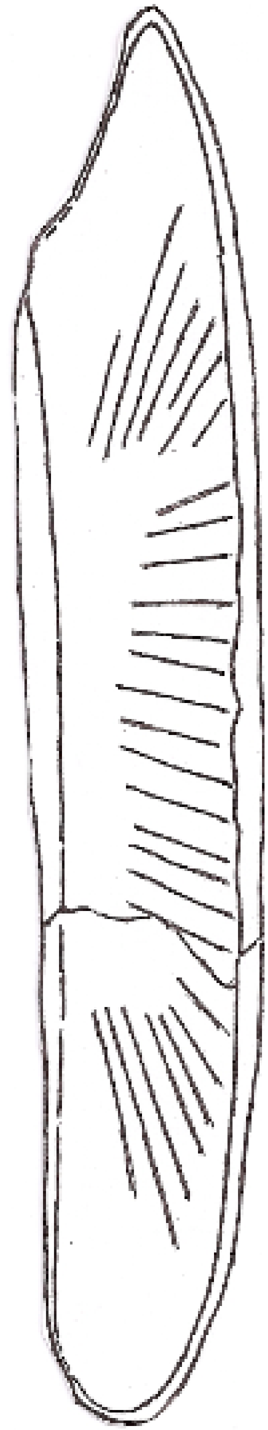
The Mystery

Seven lines at the top.

Fourteen lines in the middle.

Seven lines at the bottom.



(This is a reconstruction where it was chipped off. Art based on sketch by D. Mania in *Rock Art Research* 5/2/91 page 107. Used without permission.)

SOLSTICE CALENDAR

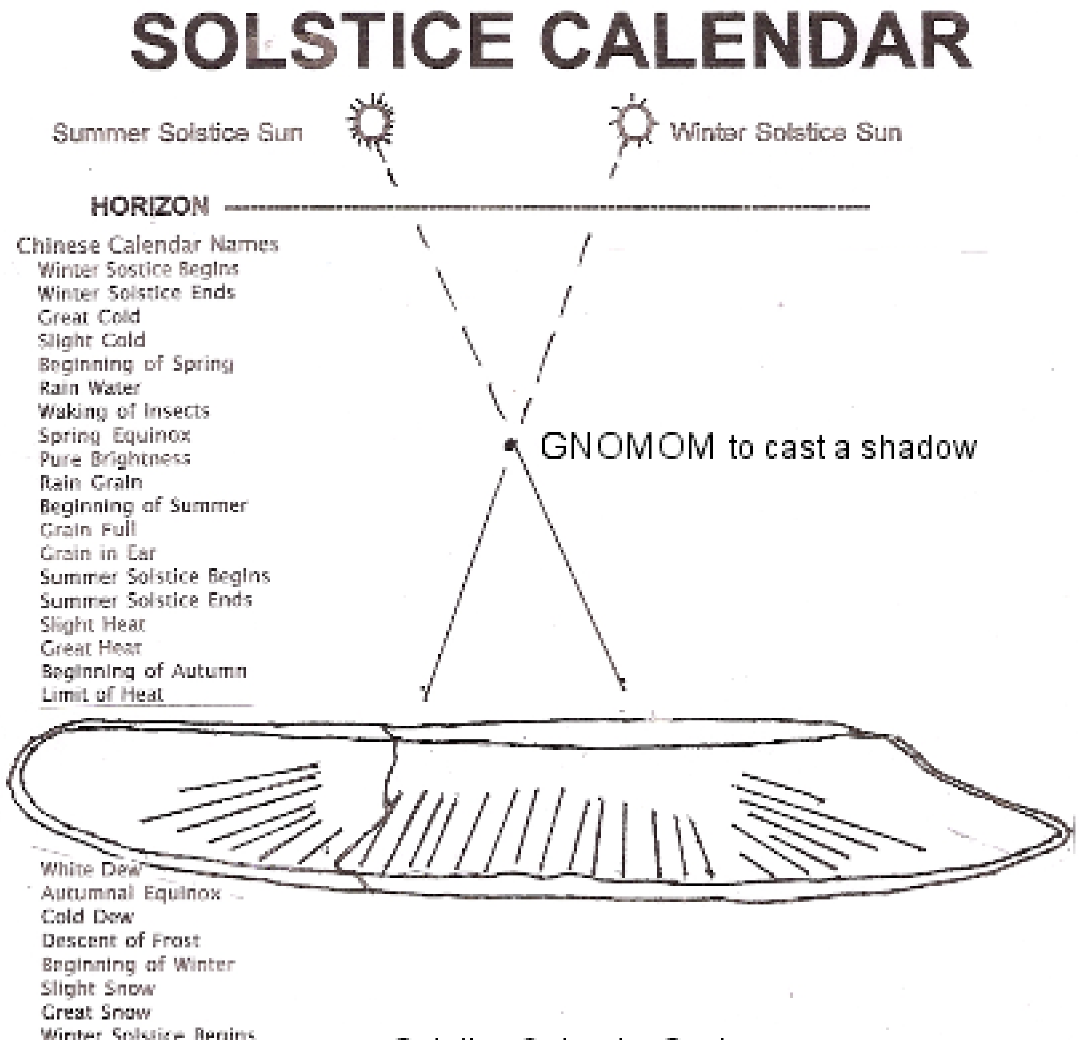
Man's First Timepiece

A solstice calendar carved on an elephant leg bone buried for more than 350,000 years is the earliest known example of man's thinking ability. The bone was discovered in 1969 by archaeologists Dietrick and Ursula Mania at Bilzingsleben near Halle, Germany, but only recently identified as a solstice calendar. Prior to their discovery, the oldest indication of man's intelligence were chipped pebbles in Ethopia 200,000 years ago and more recently cave paintings in France.

The solstice calendar was found in an interglacial layer of the Lower Old Stone Age along with fragments of human bones and teeth. The site resembled a cottage industry. There were three small round dwellings facing south with a hearth at each of their entrances. There were two work areas with rock anvils and a cleared area of unknown use marked by an unusual line of 13 rocks in a generally northeast to southwest direction bounded at the ends by elephant tusks. The Manias recovered four bones with similar fan shaped or almost parallel markings that tests showed were purposely engraved. Other bones with similar engravings have been found in France, Italy, Russia and Africa, but their purpose was unknown until the discovery at Bilzingsleben.

The most unusual of the four bones was a fragment of an elephant tibia, the larger bone in the hind leg, 395 mm long,120 mm wide and 65 mm thick with two sets of markings. At one end were seven lines pointed in the same general direction and then a series of 14 lines showing some convergence. The other end was blank where the outer surface of the bone had been chipped off.

When Dietrick and Ursula Mania announced their discovery (Rock Art Research 5/2/91 page 107), they reconstructed a sketch of the artifact and added seven more lines in the chipped off area. It was a fortuitous stroke of genius which enabled me to decipher the engravings on the bone as a calendar based on the summer and winter solstice



Solstice Calendar Scale

When light from the rising Sun hits the gnomon, it throws a shadow on the solstice scale. The scale is divided into 14-day periods and tells the observer the approximate day of the year. The lines at the ends of the bone enable the observer to keep track of days within a 14-day period. This diagram by William W. Tennis is based on a reconstructed sketch of an elephant tibia artifact by Dietrick Mania in *Rock Art Research* 1988 Vol 5 Number 2 page 93.

A Solstice Calendar operates on the principal that the Sun rises each morning from a slightly different point on the horizon as it moves from winter to summer solstice and the shadow cast by an upright object will also move along the solstice calendar scale. Because the daily movement of the shadow on the scale is very small, the primary scale on the tibia is marked at 14-day intervals. The lines at the ends of the bone could be filled with red ochre mixed with animal fat or some other pigment to mark and keep track of each passing day.

There are 52 weeks in a year. It takes the Sun 26 weeks to go from one solstice to the next or a total of thirteen two-week periods. Before the advent of writing, each of these twenty-six two-week periods had to have a name in a story or song to be remembered. Today, those names survive in the Chinese calendar describing the weather for each of the 26 periods. Their names according to L.E.Doggett's *Calendars* in *Astronomical Almanac*, P. Kenneth Seidemann, editor University Science Books, Sausalito, California and how they relate to today's calendar are:

Winter Sostice Begins	December 21
Winter Solstice Ends	
Great Cold	January 18

Slight Cold	February 1
Beginning of Spring	February 15
Rain Water	March 1
Waking of Insects	March 15
Spring Equinox	March 29
Pure Brightness	April 12
Rain Grain	April 26
Beginning of Summer	May 10
Grain Full	May 24
Grain in Ear	June 7
Summer Solstice Begins	June 21
Summer Solstice Ends	
Slight Heat	July 19
Great Heat	August 16
Beginning of Autumn	August 30
Limit of Heat	September 13
White Dew	September 27
Autumnal Equinox	October 11
Cold Dew	October 25
Descent of Frost	November 8
Beginning of Winter	November 22
Slight Snow	November 29
Great Snow	December 6
Winter Solstice Begins	December 20

(Note Because the weather, two weeks before and after each solstice is virtually the same, each solstice is shown as a four-week period.)

Solstice Calendar Design and Use

PURPOSE

The Solstice Calendar is an instument for showing the day of the year by the shadow of a gnomon on a horizontal surface. It operates on the principal the Sun rises every day from a different point on the horizon on a regular and predictable basis as it oscillates from Winter Solstice to Summer Solstice and back again.

DESCRIPTION

The Solstice Calendar is a simple instrument comprised of three elements: a flat base, a gnomon or vertical object designed to cast a shadow upon a scale when exposed to the Sun and the two scales. The only moving part is the Sun.

CONSTRUCTION

FLAT SURFACE – The flat surface which serves as the base for the Solstice Calendar needs to be large enough so that shadows cast by the gnomon falling on the Solstice Scale can be easily distinguished from shadows on previous days.

GNONOM – The gnonom should be a slender upright object tall enough to cast a shadow on the Solstice Scale. The thinner the gnonom, the more accurate will be the reading.

SCALES – The heart of the Solstice Calendar are the scales: the Solstice Scale and the Daily Scales. As the rising Sun moves along the horizon each morning from solstice to solstice, it traverses an arc of 46.9 degrees. It takes half a year or 26 weeks to go from solstice to solstice and from one end of the Solstice Scale to the other.

The Solstice Scale is divided into 13 spaces. Each space represents fourteen days in time and the arc angle between the marks is approximately 3.6 degrees which is the angular disance the Sun would travel in that period.

One end of the Scale represents the position of the shadow of the gnonom when the Sun is at the Winter Solstice and the mark at the other end of the Scale represents the shadow from the gnonom when the Sun is at the Summer Solstice. Every two weeks the shadow made by the Sun moves from one mark on the Solstice Scale to the next..

Two daily scales of seven units each keep track of the days between the marks on the Solstice Scale. The combined scales enable the user to know the number of days from the last solstice and how many to the next.

SETUP AND ORIENTATION

The Solstice Calendar should be located with an unobstructive eastern horizon so nothing blocks the rising Sun from solstice to solstice. It should be firmly attached to a fixed base or pedestal. For best results, it should be aligned initially at either of the solstices so the shadow from the gnomon falls on its respective mark on the Solstice Scale.

OPERATION

The Solstice Calendar is best read and most accurate at local apparent sunrise. Small changes will be hardly noticeable within the first few minutes. A cloudy or hazy morning will make it difficult to see the shadow on the Solstice Scale. For best results, the Solstice Scale should be light colored. After the shadow of the gnomon has fallen on a major point on the scale, the observer will need to note the passing of each day on the Daily Scales. At each solstice the orientation should be checked for orientation.

Because the Solstice Calendars are highly localized and vary from site to site, it would be useless to make exact copies, however the idea of the Solstice Calendar to keep track of the days of the year is worthy of being passed on from generation to generation.

Thus, it would not be unexpected to find a hand model of a Solstice Calendar which could be easily carried to keep track of the days from solstice to solstice. In essense, it would be a simple counting device on the lines of a Solstice Scale, but not useful for actually making observations.

IDENTIFYING SOLSTICE CALENDAR ARTIFACTS

UNIQUE FEATURES TO LOOK FOR

7 Day Lines - 14 Sun Lines - Solsticle Angle

1. **Day lines** 7 lines intentionally engraved on a bone.
2. **Sun Lines** 14 lines which may appear parallel or be converging.
3. **Solstice angle** the outtermost of the converging lines form an angle of approximately 47 degrees matching the angular movement of the Sun from solstice to solstice.

Any one of these characteristics merits a more careful examination of the artifact. Deviations are to be expected because it is not known if the artifact under examination is a copy or was the orginal made by direct observations of the rising Sun. There may be many other marks on the bone which could be interpreted as notations on a calendar of significant events meaningful to its owner, just as people today mark their calendars.

Minor variations in spacing between the lines is to be expected because of weather conditions, fog, rain, snow, clouds which could have made it impossible to get a sighting every 14th day. It would be rare to expect clear weather to occurr each 14th day of the year.

Variations between artifacts may occur based on the orientation of the Solstice Scale to the gnonom. The solstice scale illustrated here is a theoretical model based on equal spacing between the shadows cast by a gnonom on a circular scale. It is more likely that the engraved marks on an artifact were made on a straight piece of bone which would be different from the curved presentation of the theoretical model and could be further distorted depending on the angle of interception of the bone scale in relationship to the gnonom.

A common variation between artifacts is due to the location where the Solstice Calendar was made. The Solstice Calendar is based on local apparent sunrise. The Solstice Scale gives a true reading for the day of the year, soley for that location. When the Sun rises from behind a hill, a mountain or other object on the horizon, its rising will be delayed. The higher the object and the longer the delay, the more the Sun's rising will deviate from the projected theoretical model. The Sun, except when it rises on the observer's meridan, does not rise straight up. It makes an arc across the sky. The Sun will appear to rise at a slightly different angle than the theoretical model would suggest. This could even distort the expected 47 degree angle of view. When the horizon is uniformly level, that portion of the Solstice Scale should follow the theoretical model for both spacing and pointing to the gnonom. When this does not occur, it can be assumed the horizon was not level. It would be relevant to observe the horizon from where the artifact was found to see if there is a variation on the horizon which might match that of the Solstice Scale.

EXAMPLES

Oldisleben Cave, Germany

Sun Lines

7 Day Lines

Taken from Internet photo by Robert Bednarik and used without permission

Remouchamps Cave, Belgium

14 SUN LINES

7 DAY LINES

Temnata, Bulgaria