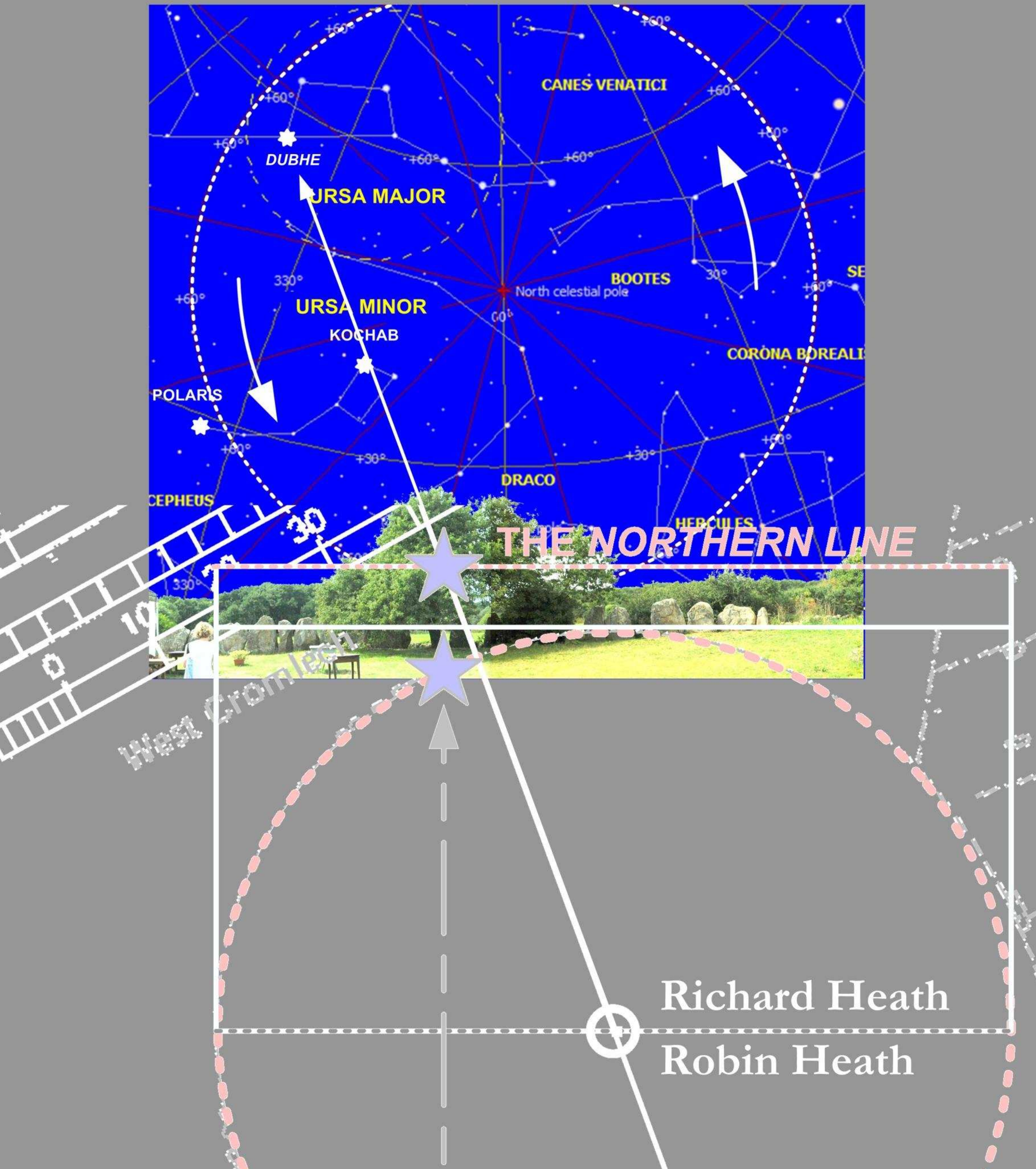
The Meaning of Le Menec

A Study of the Moon using Circumpolar Stars and Sidereal Time



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THE MEANING OF LE MENEC

This work is dedicated to,
Hélène Fleury and Alexander Thom
They made it possible.

Thanks to Jean-Yves Collin for cover art photo

The Meaning of Le Menec is the third in a series of monographs by the Heath Brothers regarding their work at Carnac, Brittany, France and elsewhere within the megalithic inventory. The previous two titles form a two part article on The Origins of Megalithic Astronomy at Le Manio and reveal evidence for the following:

1. the practice of day-inch counting leading to a definition of the megalithic yard (32 and 5/8 inches) from the relative lengths of lunar and solar years, that is as a natural metrological consequence of counting days in inches.
2. the evidence for megalithic lunar simulators, using metrological geometrical constructions involving 82 elements, based upon stones discovered set within a partial ring.

Papers in this series can be found at matrixofcreation.co.uk/megaliths.html and skyandlandscape.com. Communications on the subject of these papers are welcome at sacrednumber@gmail.com.

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Abstract

This paper proposes that an unfamiliar type of circumpolar astronomy was practiced by the time Le Menec was built, around 4000 BCE. This observatory enabled the rotation of the earth and ecliptic location of eastern and western horizons to be known in real time, by observing stellar motion by night and solar motion by day. This method avoided stellar extinction angles by measuring the circular motion of a circumpolar marker star as a range in azimuth, which could then be equated with the diameter of a suitably calibrated observatory circle. The advent of day-inch counting and simple geometrical calculators, already found at Le Manio's Quadrilateral, enabled the articulation of large time periods within Carnac's megalithic monuments, the Western Alignments being revealed to be a study of moonrises during half of the moon's nodal period. Le Menec's Type 1 egg is found to be a time-factored model of the moon's orbit relative to the earth's rotation. This interpretation of Le Menec finds that key stones have survived and that the gaps seen in the cromlech's walls were an essential part of its symbolic language, guiding contemporary visitors as to how its purpose was to be interpreted within a probably pre-literate megalithic culture.

Two key lengths are found at Le Manio and Le Menec: The first, of 4 eclipse years is a day-inch count of the Octon eclipse cycle; the second is a four solar year count that, with the first, forms a triangle, marked clearly by stones at Le Menec. The principles worked out at Le Manio appear fully developed in Le Menec's western cromlech, including the use of an 8 eclipse year day-inch count, consequently forming a diameter of 3400 megalithic inches which equals in number the days in half a nodal period. The scaling of the Western Alignments is found to be 17 days per metre, a scaling naturally produced by the diagonal of a triple square geometrical construction. A single sloping length on the top of the central stone initiating row 9, indicates a single lunar orbit at 17 days per metre, a length of 1.607 metres. This control of time counting within geometrical structures reveals that almost all of Le Menec's western cromlech and alignments express a necessary form, so as to represent a megalithic study of (a) circumpolar time as having 365 time units, (b) the moon's orbit as having 82 times 122 of those units and (c) the variations of successive moonrises over most of a lunar nodal period of 18.6 solar years.

The Start of Carnac's Famous Alignments

In this report, alignments are taken to be long rows of stones that run in parallel for long distances through the landscape. The alignments in Carnac, Brittany, often have a starting point in what the French call a cromlech. Based upon a circular geometry, these monuments are made up of stones following arcs to form a single compound shape. The stones of a cromlech can be touching or they can be spaced out and in some cases, stones might have been removed during the historical period but in some cases also, gaps in the "walls" of a cromlech were probably intentional and are there on purpose.

The alignment we will be considering here is called Le Menec. Its western end is defined by a cromlech since occupied by later buildings and some of the breaks in the cromlech's walls enable access whilst also, a number of stones in some of these buildings were probably "harvested" from the cromlech or the alignments. Some stones may well have been employed where they stood, as foundations for the buildings of the hamlet of Le Menec. The cromlech provides visitors with a car park, where one can stand before the alignments, at their start. The initial stones are very large and impressive – reminding one of Britain's largest monuments, in particular Avebury where the stones are similar in their shapes but only used within a very large circle and circles inside or "avenues" of just two "rows" wandering the local landscape in parallel.

Both Avebury and Le Menec's circular cromlech employ 3-4-5 triangles in their geometrical design, and in general all the circular structures in Britain follow the same design rules and units of measure as those found in Brittany. For example, the Le Menec cromlech is an egg shape in which a circle has been extended to form a longer perimeter length, a technique first identified by Alexander Thom in his pioneering surveying work undertaken between 1934 and his death in 1985.

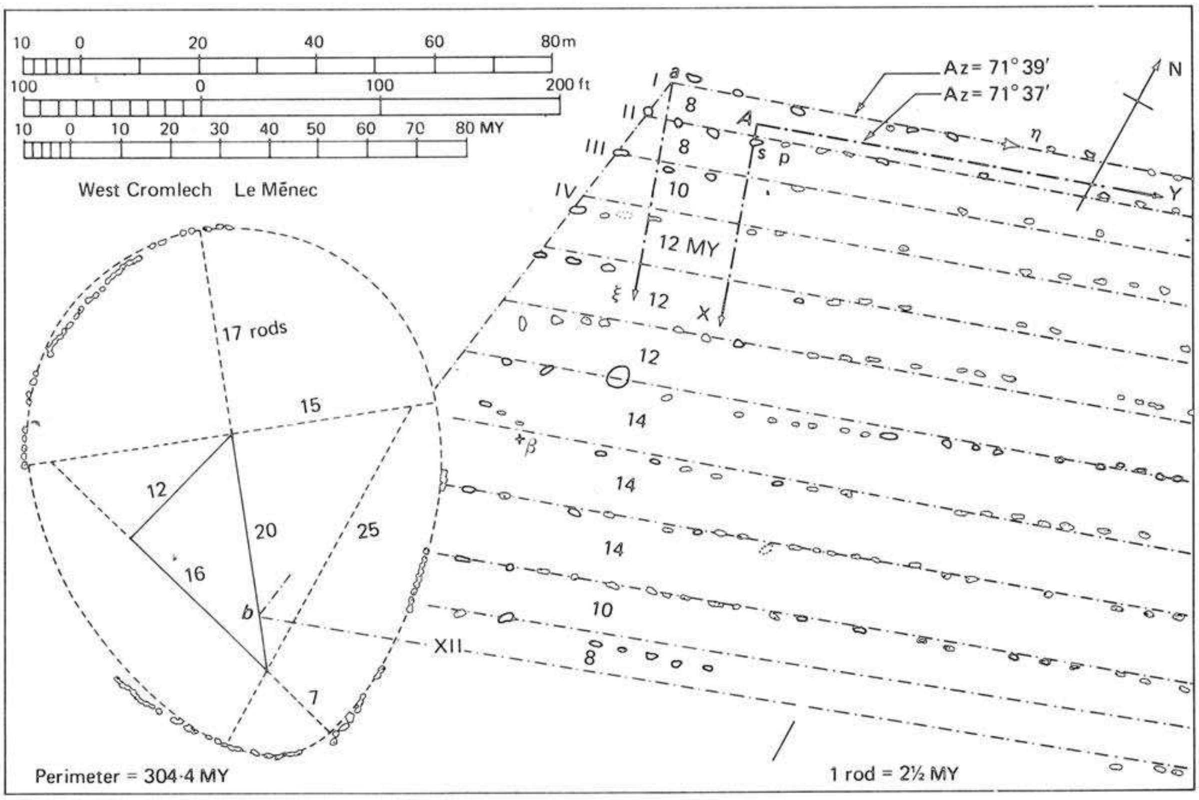

Figure 1 Thom's detailed survey of the Le Menec cromlech and its interface with the start of the western alignments. Note the use of 3-4-*5 triangles employing megalithic "rods" (2.5* megalithic yards) and a circle in which the triangles enable one half to be lengthened in perimeter. The rows also appear separated using megalithic yards though they significantly stray from forming a straight line. The azimuth Thom determined (18.383°) has turned out to *symbolise what the alignments probably represent, the moon's nodal year of 18.6 years* through a solar year to eclipse year relationship to East..

Thom had found 'families' of geometrical design rules in British stone rings while undertaking the first accurate surveys of them, a hobby he developed before the war. Thom found a unit employed in megalithic structures which he named a megalithic yard (MY), of about 2.72 feet in length (0.829m). Following the publication of his controversial Megalithic Sites in Britain (1967), the British archaeological fraternity challenged Thom, in 1970, to survey the largely un-investigated Carnac Alignments as a test for the same or similar geometrical and metrological rules. The then editor of the journal Antiquity, Dr Glyn Daniel, oversaw the project which was also filmed by the BBC for a Chronicle[1] documentary about Thom's work. Thom spent only 6-8

[1]First broadcast 31 October 1970 and viewable at http://www.bbc.co.uk/archive/chronicle/8604.shtml

weeks in Carnac but achieved an astonishing amount including providing an accurate survey of the alignments and their cromlechs.

Le Menec's cromlech (see figure 1) is a Type 1 Egg - perfectly in accord with Thom's already developed morphology – a fact that can be determined in spite of the large gaps in its perimeter. There are many surveyed Type 1 eggs in Great Britain and Le Menec's egg is laid out using the same megalithic yard length used in Britain to define its egg shaped rings. The alignments also employed this unit in their row separations, if not in the separations between stones within the rows, running eastwards.

Figure 2 The north-*western quadrant is a wall or "kerb" that follow*s the circle upon which *the cromlech's geometry acted to generate a longer perimeter, nearly 82/72*nds [1.138] of the *circle's circumference*.

Interpretations of Le Menec

The interpretations of Le Menec largely comprise folklore stories that may relate somewhat to their original purpose. The name Le Menec apparently means “moving stones” in Breton and this name might well be relevant to the original purpose of this monument. For instance, the Moon is often clearly represented by megaliths, whilst the moon itself being a very large moving stone, and within the many monuments around Carnac, the battalions of stones appear to represent something actual such as the march of moon risings or settings on the eastern or western horizon.

The land of Brittany was settled by Welsh speakers between the 2nd and 4th century whilst before this the lands had been visited by the Romans, hence the idea that the alignments represented in some way a Roman Legion monumentalised. The romantic notions of the 19th century were excited by this hard-to-visit region of France, where dirt tracks restricted access, helping to preserve the many megalithic constructions that spread out for many kilometres in every direction. The interest of a few gentlemen antiquarian/ archaeologists led to some documentation of sites, even a photographic record and early cataloguing by Felix Gaillard, whose hotel still stands in Plouharnel and which now includes a megalithic museum with much of his only recently re-discovered work on display. Gaillard thought that some observations were possible from the cromlech and across the alignments, in particular that an anomalous, larger stone or menhir marked the sun at summer solstice sunrise. The menhir would today be called a foresight and the observer’s location the backsight, this possibly located behind the western kerb of the cromlech as in figure 3.

When Thom visited in 1970, nearly a century after Gaillard, he appears to have deviated from his usual procedure of checking for the four possible alignments to the solstice sun – otherwise he would have noted the prominent 'table stone' amongst the rows. Instead, he focussed on revealing the geometry of the cromlech as founded on the same megalithic yard and design that employed 3-4-5 triangles to enlarge the circle into an egg. He then began a statistical analysis of the alignments to test whether they too were originally laid out using megalithic yards and separated along the rows by whole numbers of megalithic "rods" of 2.5 MY or 6.8 feet. These megalithic rods figured in the diameter of the cromlech and sides of the triangles used to extend its perimeter into an egg.

Figure 3 By stretching a book illustration of Gaillard's survey of Le Menec on the Google Earth view of the site, his survey makes some sense. However the chosen backsight was *obscure and his sightline needed to be brought down to the 'table stone' so that it then passes through the centre of the cromlech's forming circle*[2].

Thom left us the only complete survey of the alignments and of many other monuments at Carnac. He achieved a masterful but preliminary overview of the whole area around Carnac and the Bay of Qiberon but (because of a lack of time, failing eyesight and advancing years) he did not follow up on all the

[2] The survey, circa 1890, has a faulty compass and this was probably added later since it erodes the significant *angle of the alignments to east and at odds with the survey's correlation of angular realitie*s and stones still found today.

questions he otherwise would have. Amongst these lay the question :What was the intended function of the alignments and their relationship to the highly specific cromlech at their start?

In Britain, Thom had found lunar observatories to be associated with stone rows which, unlike Carnac's alignments, were divergent and not parallel. Thom had identified that these enabled megalithic astronomers, at sites with different latitude, to take two observations of the moon on the horizon, on successive days, when approaching its extreme orbital azimuth, and from these alignments deduce a greater azimuth that would have occurred had the horizon caught the moonrise at the exact moment of extreme monthly azimuth.[3]

It was only using extrapolation that the azimuth for lunar maximum and minimum standstill could become established to the high levels of accuracy found between Carnac's stones as backsights and distant foresights such as large menhirs visible on the horizon. This proposal for ancient technical competence evoked great resistance from the often technophobic archaeologists of Thom's day. Also, and somewhat ironically, his discovery that stone rows could be used for extrapolation almost certainly prevented him recognising a simpler use of the western alignments of Le Menec as marking successive moonrises during the south to north portion of the moon's orbit.

The alignments appear to have recorded the moon's ecliptic latitude relative to sun's path throughout half a lunar orbit during most of the 18.6 year cycle in which the moon's orbital nodes complete a single circuit of the ecliptic, called a Nodal Year (see later). However, Thom could not have seen how the cromlech might function as a sidereal observatory required for the building of the western

[3] This highlights the problem with horizon event astronomy and especially lunar observation where the moon moves more rapidly than the sun, per day, and horizon events are therefore unlikely to occur at the exact moment when the maximum lunar azimuth would occur. To work out an extreme that occurs between horizon observations one must extrapolate between those two observations. This was done by building a divergent "fan" of stone rows or a right angled triangle also using megaliths, from which the extreme horizon alignment which never actually occurred can be located accurately, as if it had occurred on the horizon.

alignments – the task undertaken here and made possible through the discovery of its inch-counted metrological geometries.

To achieve their mastery of the moon in its orbit, the cromlech builders had to contemplate a new type of astronomy that indicated where the moon was on the ecliptic, then to deduce its deviation in latitude relative to the sun's path, when seen on the horizon at rising. To do this the megalithic astronomers needed to know three things: the azimuth angle of a moonrise on the horizon, the location of the moon relative to the ecliptic, and where that part of the ecliptic rose (each day) on the horizon. Irregularities in where and when the moon rises can make its ecliptic latitude measurable (see figure 11).

Le Menec's Sidereal Observatory

Today, an astronomer resorts to the calculation of where sun, moon or star should be according to equations of motion developed over the last four centuries. The time used in these equations requires a clock from which the object's location within the celestial sphere is calculated. Such locations are part of an implicit skymap made using equatorial coordinates that mirror the lines of longitude and latitude. Our modern skymap tells us what is above every part of the earth's sphere when the primary north-south meridian (at Greenwich) passes beneath the point of spring equinox on the ecliptic. Neither a clock, a calculation nor a skymap was available to the megalithic astronomer and, because of this, it has been presumed that prehistoric astronomy was restricted to what could be gleaned from horizon observations of the sun, moon, and planets.

Even though megalithic people could not use a clock nor make our type of calculations, they could use the movement of the stars themselves, including the sun by day, to track sidereal (or stellar) time provided they could bring this stellar time down to the earth. This they appear to have done at Le Menec, using the cromlech's defining circle, which was built into its design so as to become a natural sidereal clock synchronized to the circumpolar stars.

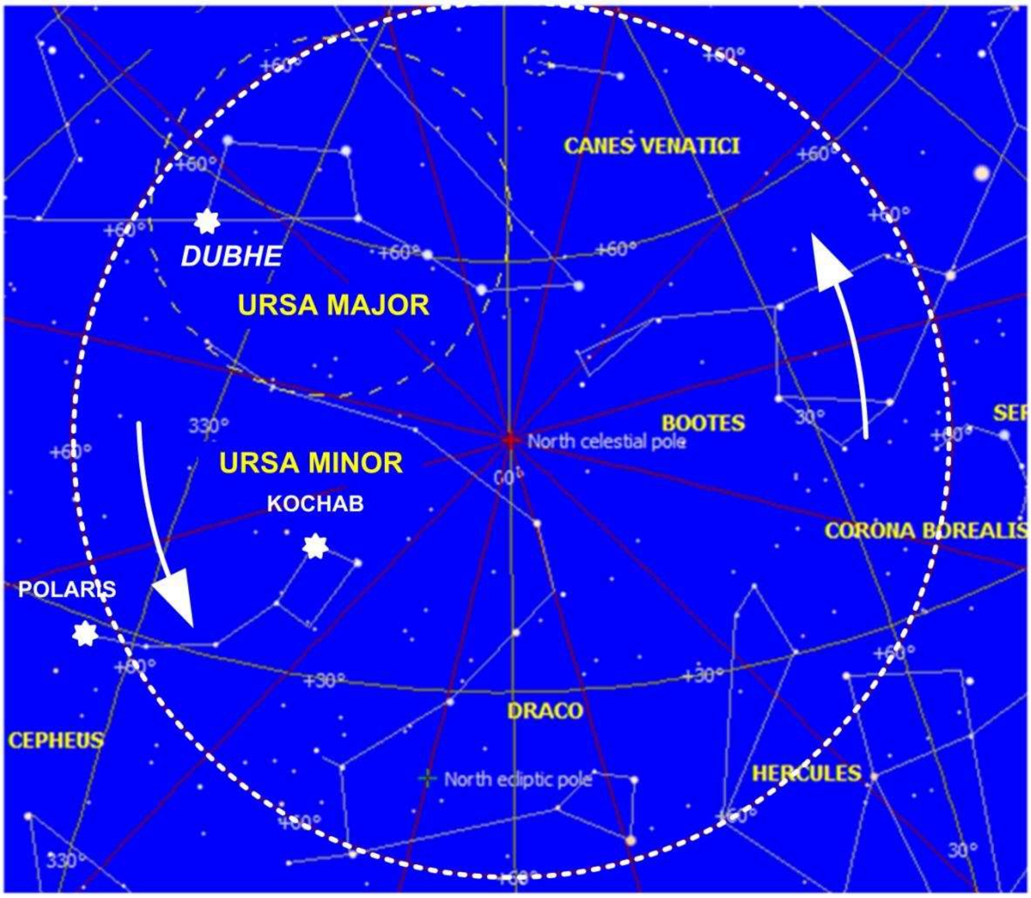

Figure 4 The Circumpolar Stars looking North from Le Menec in 4000 BCE, when the cromlech was probably built. There is no north star but marker stars travel anti-clockwise *and these can align to foresights at their extreme azimuthal "elongation", as explained* below.

The word sidereal means relating to stars and, more usually, to their rotation around the earth observer as if these stars were fixed to a rotating celestial sphere. This rotation is completely reliable as a measure of time since it is stabilized by the great mass of the spinning earth. However, in a modern observatory this sidereal time must be measured indirectly using an accurate mechanical or electronic clock. These clocks can only parallel the rotation of the earth in a sidereal day, which is just under four minutes less than our normal day. Nonetheless, a sidereal day is again given 24 'hours' in our skymaps and it is these hours which are then projected upon the celestial sphere as hours (minutes and seconds) of Right Ascension, hours in the rotation of the earth during one sidereal day.

Using Circumpolar Marker Stars

The marker stars within the circumpolar or arctic region of the sky have always included Ursa Major and Ursa Minor, the Great and Little Bear (arctic meaning “of the bears” in Greek), even though the location of the celestial North Pole circles systematically through the ages around the pole of the solar system, the ecliptic pole. In 4000 BC our pole star in Ursa Minor, called Polaris, was far away from the north pole and it reached a quite extreme azimuth to east and west each day, corresponding to the position of the sun (on the horizon in 4000 BCE at this latitude) at the midsummer solstice sunrise. This means angular alignments may be present to other important circumpolar stars in some of the stones initiating the Alignments at Le Menec, when these are viewed *from the centre of the cromlech’s circle* implicit in its egg-shaped perimeter.

This original “forming circle” of the cromlech could be used as an observatory circle, able to record angular alignments. Therefore the distinctive “table” stone which aligns to the cromlech’s centre at summer solstice sunrise, also marked the extreme angle (to the east) of Polaris, alpha Ursa Minor, our present northern polestar. That is, in 4000 BCE Polaris stood directly above the table stone, once per day - whether visible or not.

Such a maximum elongation of a circumpolar star is the extreme easterly or westerly movement of the star, during its anti-clockwise orbit around the north pole. Thus, if the northern horizon were raised (figure 5) until it passed through the north pole, the maximum circumpolar positions for a star to east and west would be equally spaced, either side of the north pole. If these extreme positions are brought down to the Horizon in azimuth, the angles between these extremes forms a unique range of azimuths on the ground between (a) the horizon (b) a foresight such as a menhir and (c) an observer at a backsight. Observations of these extreme elongations naturally enable the pole (true north) to be accurately established from the observing point as the point in the middle of that range. A marker stone can usefully locate a circumpolar star at one of these maximum elongations and come to symbolize that important star. A star's location could have been brought down to the horizon using a vertical pole or plumb bob, between the elongated star and the horizon, at which point menhirs could later be placed, relative to a fixed viewing centre or backsight. This method of maximum elongations would have escaped the atmospheric effects associated with observing stars on the horizon which causes a variable angle of their visual extinction below which stars disappear before reaching the horizon.

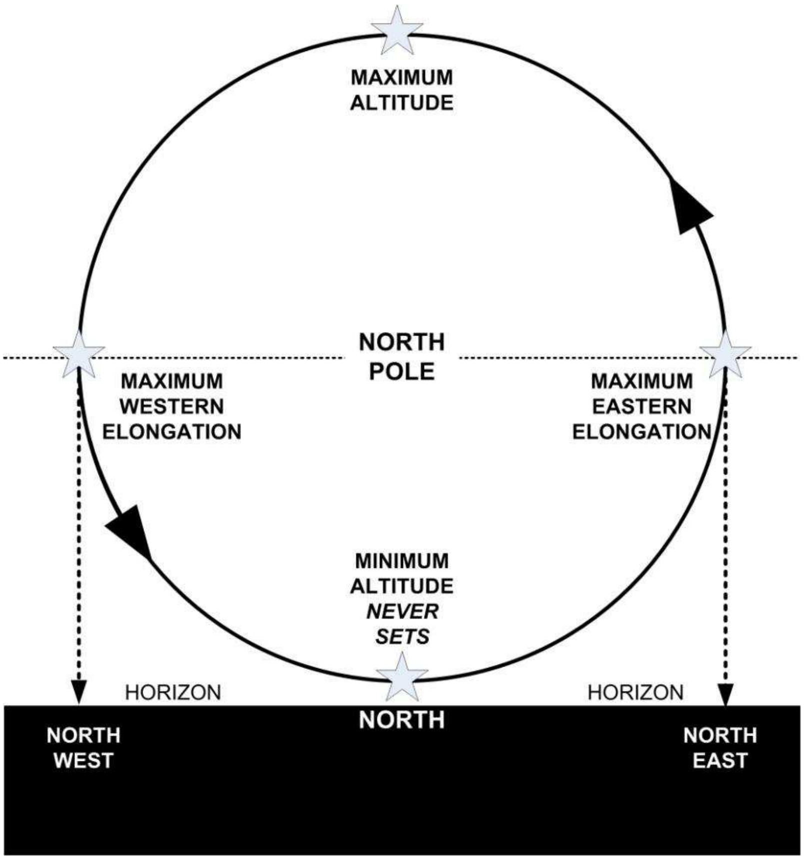

Figure 5.The Maximum Elongation of Circumpolar Stars is a twice daily event when, looking at the horizon, the star*'s circumpolar "orbit" momentarily stops moving east or west a*t maximum elongation in azimuth and reverses its motion.

At Le Menec the azimuths of the brightest circumpolar stars, at maximum elongation, appear to have been strongly associated with the leading stones of the western alignments (see figure 6). However, it is likely that only one of these circumpolar stars was used as a primary reference marker, for the purpose of measuring sidereal time at night when this star was visible.

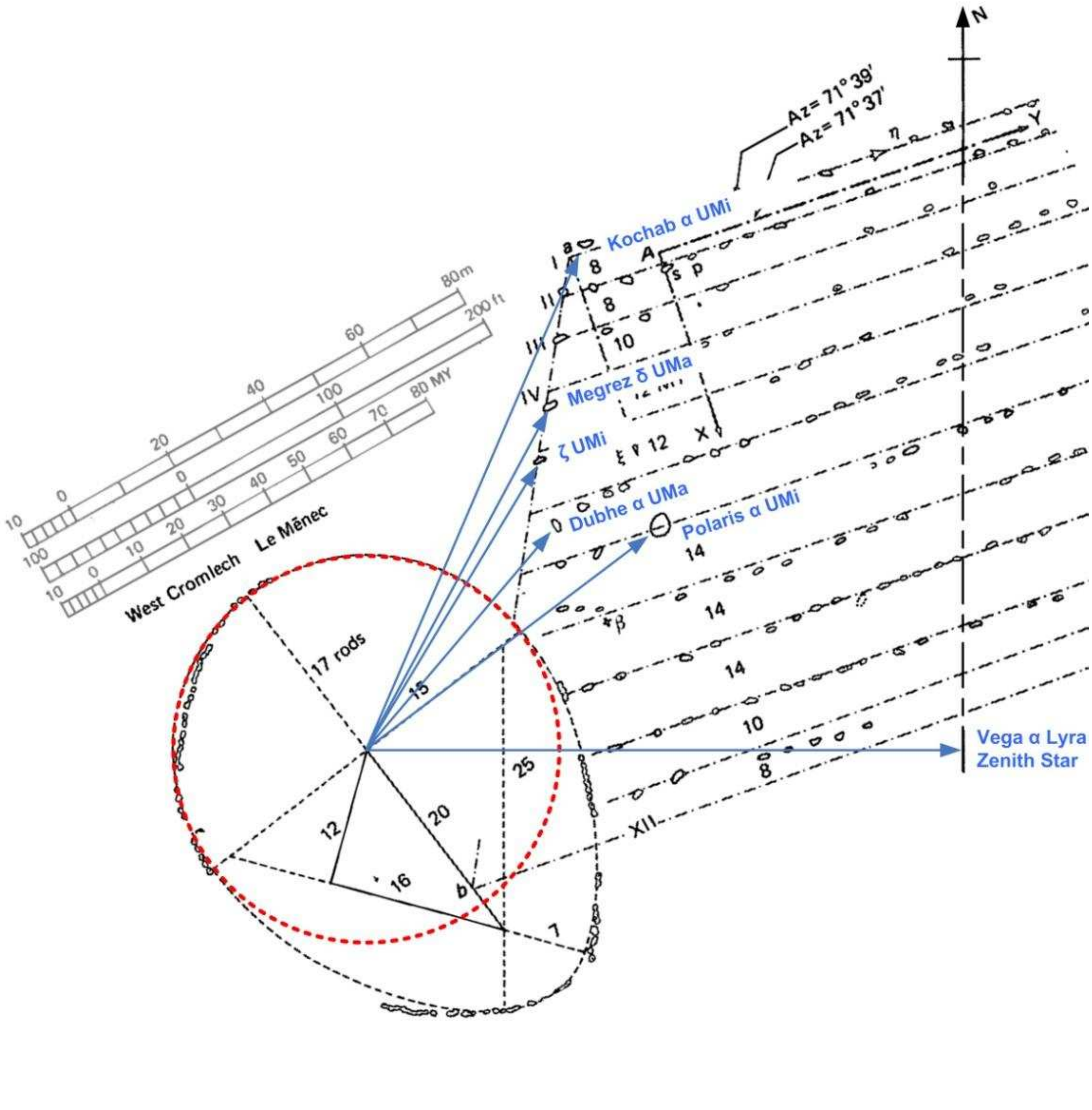

Figure 6 Some of the associations between circumpolar stars and stones in the western alignments. These alignments are all to the maximum easterly elongations, perhaps established during the building of the sidereal observatory and only later formalized into leading stones at the start of different rows. Dubhe was then selected as the primary marker star for the Le Menec observatory.

To achieve continuous measurements of sidereal time from the circumpolar stars requires a simple geometrical arrangement that can draw down to earth the observed position of maximum elongation to east and west for one bright circumpolar star, the observatory's marker star. A rectangle must then be constructed to the north of the cromlech's east-west diameter and containing within it the observatory's northern semicircle. The northern corners must align with, relative to the centre of the circle, the eastern and western elongations of the chosen marker star. For Le Menec the rectangle had to be extended northwards until it reached the first stone of row 6[4]. This stone is aligned, from the centre, to the maximum eastern elongation of Dubhe or alpha Ursa Major. The first stone of row 6 is therefore the menhir marking Dubhe. To the south, the initial stones of further rows all stand on the eastern edge of this rectangle, so that any point on the rectangle's north face could be brought down, unobstructed, to the circumference of the circle.

Figure 7 shows how the form of the circumpolar region, within the "orbit" of Dubhe, is repeated by the cromlech's forming circle. It is also true that the "northern line" then has the same length as the diameter of the forming circle, which has therefore been metrologically harmonized with row 6's initial stone and the alignment to Dubhe in the east.

This arrangement has the consequence that wherever Dubhe is (above the northern line and when seen on a sightline passing through the centre of the cromlech) its east-west location in the sky can be brought down, directly south, to two points on the forming circle of the observatory – all due to the star observation having been made *upon a length equal to the circle's diameter* (the Northern Line of figures 7 and 8). One of these two points, on the northern or southern semicircle of the observatory, must then correspond exactly to where Dubhe is in its "orbit" around the north pole, as in figure 8.

[4] Thom's row VI.

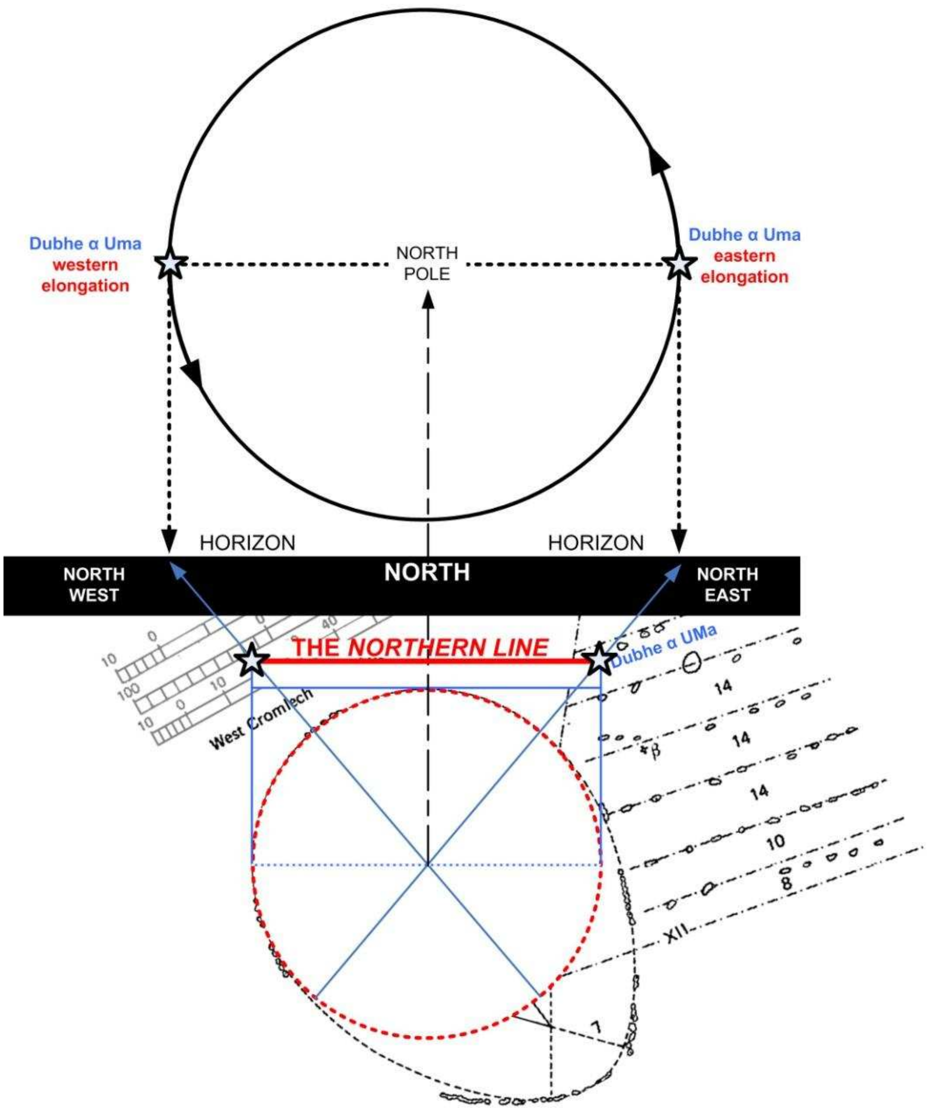

Figure 7 Bringing down the marker star, Dubhe, onto the northern line created between maximum elongations and with the same length as the diameter of the observatory circle.

So, what is being measured here and what would be the significance of having such a capability? Whilst the movement of all the stars is being accurately measured, using this northern line and forming circle combination, the monument also has a reciprocal meaning. The forming circle also represents the earth's rotation towards the east, the cause of the star's apparent motion. This is because, when looking north, the familiar direction of rotation of the stars, when looking south, is reversed from a rightwards motion to a leftwards, anticlockwise motion. Circumpolar motion therefore directly represents the rotation of the earth. The Dubhe marker star would have represented the movement of a point on the surface of the earth, moving forever to the east. Perhaps more to the point, the eastern and western horizon are moving as two opposed points on its circular path, each moving at about the same angular speed as Dubhe. This deepens the view of the forming circle as representing those ecliptic longitudes in which the fixed stars, rising or setting on the eastern and western horizons, are fixed locations on the circle through which these horizons are moving as markers on the circle's circumference.

These two views, of a moving earth and of a moving background of stars, could be interchangeable when understood and both viewpoints are equally useful and were probably relevant to the operation of this observatory. Whilst the circumpolar stars move around the pole, the eastern and western horizon move opposite each other, running along the ecliptic, as the Earth rotates. The first view enables an act of measurement which would have given astronomers access to sidereal time and the second view provided knowledge of where the eastern and western horizons were located viz a vis the equatorial stars and therefore knowledge of which part of the ecliptic was currently rising or setting.

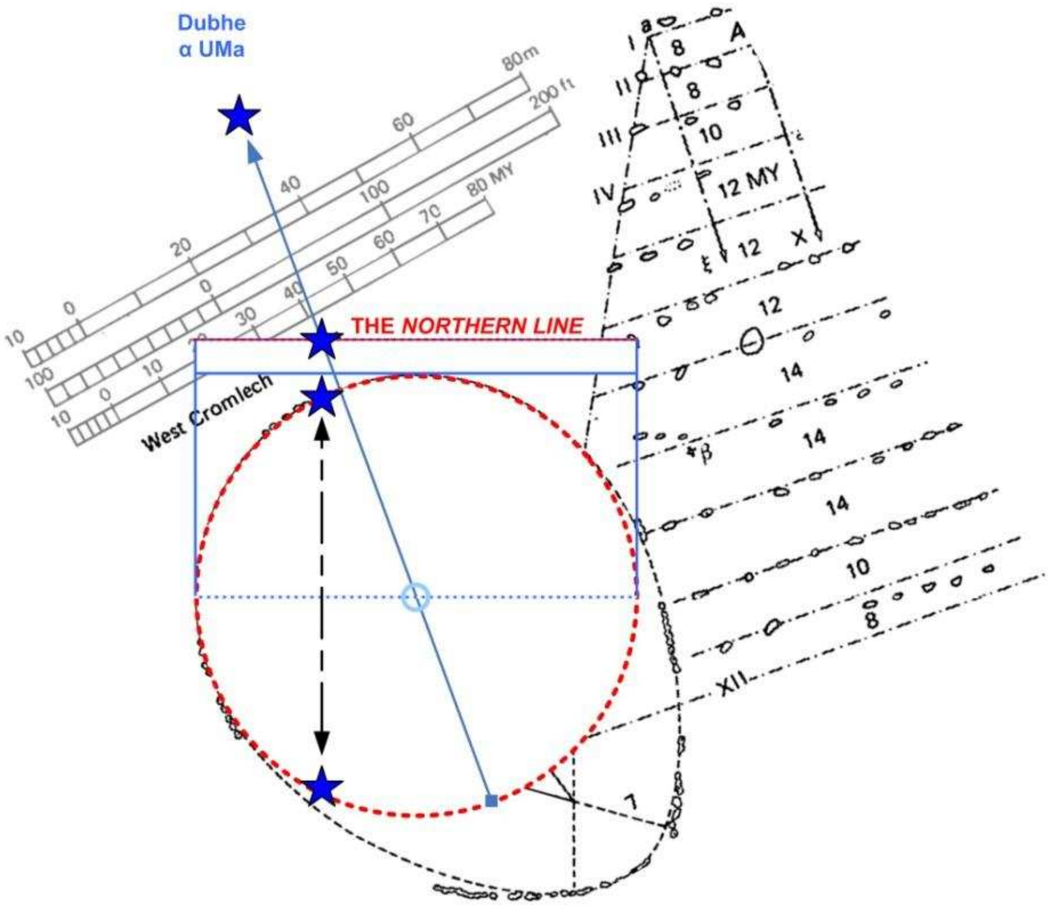

Figure 8 Recreating the circumpolar region with marker star Dubhe at the correct angle on *the forming circle of the western cromlech. The star's alignment on the northern line is* dropped to the south so as to touch the two points of the circumference corresponding to that *location on the circle's diameter: one of these will be the angle of Dubhe as seen within the* circumpolar sky but now accurately locatable in angle, on the observatory circle.

Dubhe had, in 4000BCE, a fortunate relationship to the circumpolar sky and equatorial constellations which would have been very useful. When Dubhe reached its maximum eastern elongation (marked by the first stone in the sixth row) the ecliptic's summer solstice point was rising in the east. However, *Dubhe's* maximum western elongation did not correspond to the winter solstice, this due to the obliquity of the ecliptic relative to north. It is the Autumn Equinoctal point of the ecliptic that is rising to the east at *Dubhe's* maximum western elongation. It was when Dubhe was closest to the northern horizon, that the other, winter solstice point was found rising on the ecliptic. It is important to realize that these observational facts were true every day, even when the sun was not at one of these points within the ecliptic's year circle.

Dividing the Circumpolar Sky

The proposal here is that a great deal could have been achieved during prehistory by employing a simple geometrical observatory where units of length were being used to track where the sun, moon, stars and horizon are. A strong clue to this function can be found in the circumference of the cromlech's forming circle which is 365 times 24 inches long[5]. It would obviously be the case that such an observatory would be the result of a process of refinement through earlier steps taken and lessons learned. Thus, the cromlech's design should be seen as having been evolved from work already done on counting the solar year in day-inches, as monumentalized at Le Manio.

At Le Manio's 'Quadrilateral', 2.6 Km east-north-east of the Menec observatory, my brother and I surveyed a monument which records a count of days in inches over both a three year and a four year period. This monument visually demonstrates that the Megalithic Yard of 32.625 inches, ubiquitous at megalithic sites in Britain and Brittany, had an astronomical derivation based upon counting days as inches – that is as day-inches. The inch is shown to have been a contemporary unit employed for counting time, when the Menec cromlech was being developed. As one discovers the meaning of its western cromlech, the need for a unit of measure as small as the inch becomes apparent, despite the large scale of such monuments.[6]

[5] A radius of seventeen megalithic "rods" of 82 inches gives this circumference to one part in 7000. Such a radius length is found as the circumference of an 82-stone circle found in fragmentary form at Le Menio. The number 82 relates to the period taken for the moon to return to the same ecliptic longitude – see later in text.
[6] It is important to see the "English" foot of twelve such inches as a naturally useful megalithic measure, evolved from the practice of day-inch counting applied to lunar years of 29.53 feet.

Today we understand that a solar year is made up of 365 whole days and about a quarter day over and this quarter must be accounted for in longer counts. An equinoctial solar observatory records sunrises four years apart in the exact same location, a 1461st sunrise, because the quarter days have accrued into a whole day. A four year count can therefore be re-used as a single year count of 1461 quarter-day-inches, where the additional day becomes the quarter day excess within a single year.

The situation is subtly different in an observatory based upon the rotation of the circumpolar stars by night (and the sun by day). Here, one is interested in defining a smaller unit of time that can naturally divide up a single (sidereal) day. The modern day is presently divided into 24 coarse units (called hours), while 60 minutes divide into the hour and 1440 minutes (24 times 60) therefore define the day. However each day is actually defined by a single rotation of the earth plus the extra 4 minutes the earth takes to catch up with the sun, which has now moved relative to the stars in an anti-clockwise direction, along its ecliptic path. At this smaller scale of time, within a single day, the sun's movement, per solar day, is 1/365th of the daily rotation of the circumpolar stars and therefore, for this purpose, the circumpolar region can be represented on the flat earth as a circle made up of 365 day-inches or multiples thereof. In the case of Le Menec, a scaling up of each inch into 24 inches was adopted for reasons that had to do with a compatibility with the required length of the egg's perimeter as will become clear when the egg design is considered. It is also relevant that days came to be divided into 24 hours by the Dynastic Egyptians which, on the Le Menec's observatory circle, would each be 365 inches long.

Just as, after a year of 365 days, the circumpolar stars will have rotated 366 times, the small amount of angular change per solar day is 1/365th of one complete rotation of the circumpolar stars[7]. This unit of time will be called the chronon[8] and its duration is 3 minutes and fifty-six seconds. The 365 divisions of Le Menec's forming circle were effectively counting time in units of 24 inches, each unit representing a chronon in the angular rotation of the Earth[9]. There are then 365 + 1 chronons in a solar day, that is 366 chronons.

However, the geometrical task of dividing a circle's perimeter into 365 defined units has to have had some natural process behind its achievement. This can be found in the astronomers seeing the "hour angle" at each moment of sunrise moving anti-clockwise from day to day when operating earlier versions of the sidereal observatory.

The time of sunrise and hence the time between successive sunrises, varies according to the sun's location on the horizon at that latitude, but at solstices the time between successive sunrises is almost constant and has its true average value. The divisions of an observatory circle between moments of sunrise, suitably marked, would be constant at a solstice. The advancement of a circumpolar marker star during a solstice could reveal the 1/365 divisions of the circle so as to naturally calibrate such circles. The total number of marks must then be inferred as 365, any shorter and longer divisions cancelling out. These solstice sunrise separations could also have been found useful for measuring the diameter of the observatory circle as always being just over 116 of these same divisions of the observatory circle. This would have been a crucial empirical discovery.

If an observatory circle is constructed using a 116 inch diameter, the circumference measures 364.5 inches but if feet are used then a more exact

[7] The meditation is simple. The sun appears to move through the stars once per year so that the number of solar days in a year must include one extra rotation of the earth. Furthermore, the earth rotates continuously and the sun moves at a consistent rate so that the ratio of solar motion within the sidereal rotation of the earth must be 1/365.

[8] Obviously after the god of time, in my first book Matrix of Creation in which its theoretical possibilities were presented without any evidence of monuments within which prehistoric astronomers demonstrated any uses for the simplicity it offers in understanding time on earth.

[9] see Matrix of Creation by Richard Heath, page , Inner Traditions, 2002.

diameter of 116 feet 2 inches can be determined as that required to generate 365 feet around the circumference. It is this length of 1394 inches which, at Le Menec, was doubled up by using it as a radius of 116' 2" so that the circumference was 365 times two feet long - each double foot on the circumference marking a single chronon of celestial time. This length of 116 feet and 2 inches is the 17 megalithic rods each worth 82 inches or 100 megalithic inches (of 0.82 inches each) and a total length of 1700 megalithic inches, numerically one quarter of a lunar nodal period in days (see page 30 onwards).

However, Thom's survey delivered a radius of 17 megalithic rods of 6.8 feet equaling 115.54 feet (1386.5 inches) so that a radius only 7 ½ inches greater would have enabled the observatory circle to measure 365 chronons per sidereal day. Thom's length is numerically equal to the days in four eclipse years in day-inches, whilst also being 1700 megalithic inches (of 0.816 inches) so that both lengths have great meaning for the moon's nodal time periods, associated with eclipse phenomena. We will also shortly show how the monument's distinctive egg-shaped enlargement provided a perfect integration of the moon's orbit. But first, it will be necessary to explore how the cromlech could have provided a sidereal timepiece during the day, when the circumpolar stars were invisible.

Maintaining Sidereal Time in Daylight

As long as the marker star was visible, the progress of the earth's rotation could be tracked accurately. But just prior to the sun's rising, the distant stars disappear in the dawn light and only the sun (and the moon) can be observed. Sidereal time needs to be maintained during the day since the moon, the major object of study, often rises or sets in the daylight hours. Fortunately, the sun's angular movement from dawn to dusk is almost identical to that of the distant stars and the sun could be measured using the same angular calibration as that used for the circumpolar stars, through the use of a Gnomon or shadow stick.

A shadow stick could have been installed at the centre of the forming circle, through which sightlines to the marker star were already passing during the night period's circumpolar observations. At sunrise, the sun's first shadow would be marked on the circumference as also would have been the last night-time measurement of the marker star. The sun's shadow would then move clockwise, the opposite sense to the star clock's anticlockwise motion. This problem could have been solved by translating each 24 inch clockwise movement of the shadow on the circumference into a 24 inch movement anti-clockwise of the Dubhe marker. This procedure would have been made easier by using a rope which has lengths of 24 inches alternately marked along its length and by which the shadow could be seen to advance through its divisions.

The location of the Dubhe marker would continue providing an accurate estimate for the current angular orientation of the earth and hence of the stars. Since the sun only moves along the ecliptic by one chronon per day, this motion relative to the stars would not have been significant during the daylight hours of a single day (though even this figure of around one foot might have been correctable by experienced operators).

It seems that our use of solar clocks (sun dials) to measure time by day has blinded us to the possibilities of the gnomon (or shadow stick) to provide a prehistoric technique capable of the measuring earth rotation in the hours of daylight. A 365 unit circle, with the means to track circumpolar stars by night and the sun by day is, and it appears was, an achievable representation of time on earth. It gives direct access to sidereal time and hence to the rotation of the earth and can say where the equatorial stars will rise and set relative to the eastern and western horizons. That the megalithic culture was able to access such a type of astronomy changes the scale of possibilities achievable to a megalithic astronomy. The role of metrological geometry, that is, the use of repeatable linear measurements within geometrical constructions, would have been the necessary step in developing such megalithic monuments, which could integrate the sidereal world with those events on the ecliptic, found on the eastern and western horizon, as figure 10 indicates.

Measuring the Moon's Progress

The lunar orbital period is visible in the cycle of moonrises and settings on the horizon that march northwards and then southwards within each orbit. Each orbit of the moon resembles the oscillations of the sunrises and sunsets across the eastern and western horizon over the year. The lunar orbital period completes two days faster than the more familiar lunar month (of the moon's phases illuminated by the sun).

The units of time provided by a Menec-style observatory would have allowed periodicities to be studied with time periods less than a day, being more accurate than day-inch counting. One such period is the lunar day, the time between moonrises. The lack of a conceptual mathematics in 4000 BCE need not have been an obstacle to measuring the lunar orbit itself, because a key phenomenon existed which could reveal a non-conceptual way to address this problem.

The phenomenon required was found when it was noticed that the moon always returned to the same place on the ecliptic after 82 days, when seen against the stars (rather than the horizon).[10] We know that this type of phenomenon had already been noted when the sun rose over the same distant mark on the horizon after 1461 days. The 1461 day-inch period (found diagonally at Le Manio) represents this four year anniversary in its whole

[10] We moderns would say that this is because its orbital period is 27.32166 days, nearly 27 and 1/3rd, so that three such periods are just 50 minutes short of 82 whole days. The horizon only samples the moon once every lunar day.

number of inches. Also at Le Manio, the near-anniversary of three years and 37 lunar months had been employed to define the megalithic yard[11].

Therefore one might expect there to have been a similar search for a period in which the moon, in any phase, returned to the exact same constellation of stars – at about the same time of night – every three lunar orbits or 82 days. The moon's orbital period is very nearly 27 and 1/3rd days so that three orbits take 81 days plus 1 extra day to complete. A rope 82 day-inches long would represent this 82 day period, produced naturally by an observer counting whilst waiting for the moon to return to the same star position.

The circumpolar clock counts each day as 366 chronons long, and using 82 ropes (or reusing the same rope) end-to end (each 366 inches long) a total length of 30012 inches would be formed, representing three lunar orbital periods now counted in inches of length equal to chronons of time or chronon-inches. Despite the fact that the megalithic astronomers did not have our numerical notation or arithmetic, a little more contemplation and experimentation on their part would have revealed that these 366 inch ropes inherently divide into three equal parts, each part having a whole number of inches. If it is visually apparent that the 82 day period is made up of three complete lunar orbital cycles (or transits past the same star) then 82 applications of 122 inches (or equally 122 applications of 82 inches) must generate the length of a single lunar orbit in chronon-inches. This is 10,004 chronon inches, while modern astronomers have determined that the lunar sidereal period is 27.32167 days, which is 10,002 chronons, i.e there are almost exactly 10,000 chronons in the average lunar orbital period.

This result is significant to us today in our base_{10} notation for it is ten to the fourth power (10^4) and therefore forms, for us, a considerable coincidence. However, the megalithic astronomers could only produce this length as

[11] The Origins of Megalithic Astronomy, Part 1: Day Inch Counting and the Megalithic Yard, by The Heath Brothers, see frontispiece.

described above. They would however be fully aware of the key factors within the lengths they were using, 82 and 122, and it is interesting that Thom's estimate for the width of the western alignments was 122 megalithic yards.

Much more significantly, a 10,000 inch length was purposely generated at Le Menec as the perimeter of Le Menec's distinctive egg shape. In addition the 17 megalithic rods of Thom's survey plan[12] of the egg, if each rod is 82 inches long, forms a radius of 116 feet and two inches. The 82 "ropes" of 122 inches (82 times 122) naturally divide the egg's 10,000 inch perimeter into a picture of the lunar orbit in which the moon moves three such divisions per day, that is 3 times 122 which equals 366 chronon-inches per day. The observatory circle, divided into 365 units plus one extra chronon, equals the 366 chronon-inches per day on the egg's perimeter, in a direct equation of motion between the lunar orbit and the rotation of the earth.

Le Menec therefore represents an integrated sidereal clock and model of the lunar orbit, one that required the very definite size of its forming circle initially discovered by Alexander Thom's 1970 survey. The circumference of the circle is 365 units of 24 inches which can represent the 365 chronons within a day or, alternatively, 24 sidereal days each 365 chronons long. Since there are 27.4 sidereal days in a lunar orbit, the western cromlech's observatory circle needed to be extended by a further 3.4 times 365 inches. If the forming circle had not been built to the scale of 24 inches per chronon, the egg perimeter could not have been integrated so as to represent the lunar orbit at one inch per chronon.

Laying out a Type 1 Egg

In the megalithic period, circles could be extended to make larger perimeters using a range of at least four egg designs. Thom thought the purpose of such

[12] Thom's work on Brittany is to be found in Megalithic Remains in Britain and Brittany, by Alexander and Archie Thom, Clarendon Press, Oxford, 1978. Chapter 6 is devoted to Le Menec whilst Le Manio is part of chapter 9.

enlargement of the perimeter was to achieve whole number perimeters but we have seen that such whole numbers had a definite purpose in modeling celestial time, especially within circular monuments marked by astronomical alignments. The length of the egg's perimeter is 82 times 122 chronon-inches whilst the observatory circle is just less than 72 times 122 inches in circumference.

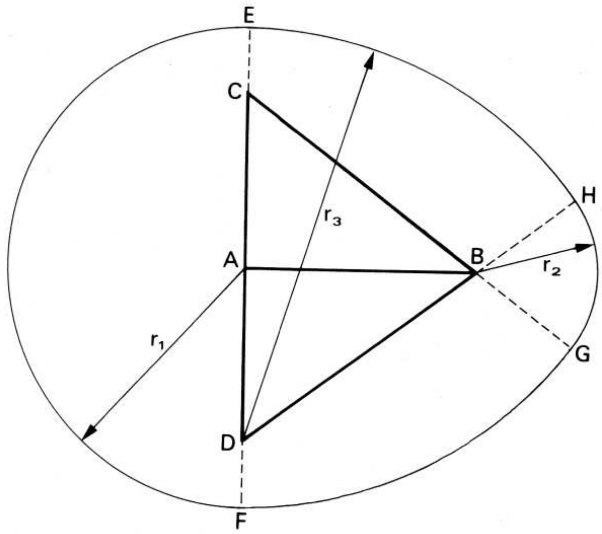

Figure 9 The Type 1 Egg geometry involves a circle being extended by moving three pegs, marked B, C and D, away from the centre, A, of a circle; with D four units from A and; C and D three units from A. The larger the units relative to the centre, the more pointed the egg becomes as the total perimeter becomes elongated from that of a circle. Point B can be found using arcs from C and G of radius 5 units.

Menec's western cromlech is a Type 1 egg in which double foci are generated along one diameter of a circle, as in figure 9. The method uses two 3-4-5 triangles with a common 4-side. The symmetrical foci define a radius of curvature longer than that that of the circle, which radii overlap across the chosen diameter of the circle. This method only extends the perimeter of one half of the circle – hence the term "egg". It is very possible that trial and error was used and not the modern procedures based upon analytical geometry. By gradually growing the size of the 3-4-5 triangles used, a target rope length of 82 x 122 inches could eventually be fully utilised as a perimeter formed from the longer radii of curvature.[13]

In figure 9: As points C and D move away from the centre A, the distance CD equals two three sides of the 3-4-5 geometry, or six units. Folding by two

[13] see Appendix 3 for The Modern Approach to Egg Design and also Appendix 1 of The Origins of Megalithic Astronomy at Le Manio, Part 2: Simulators - A Natural and Accurate Pi related to the Megalithic Yard.

and then three will reveal a unit length but this is only relevant once the two arcs (EH) from C, and (FG) from D, are approaching a shape with the required length for the target perimeter rope length. By marking five units on ropes six units long, the point B can be located from arcs drawn from C and D, whereupon a peg (at b) locates the radius of curvature for the ‘sharp’ end of the egg (HG).

It is likely that the monuments we see today started life as designs laid out using rods, ropes and stakes before becoming elaborated with more stakes and finally the stones that seem to symbolize what was originally a working apparatus.

Any preferred method allows the same result, an outline for the entire Menec cromlech in which the semi circular section would remain at a radius of 116 feet and two inches (17 times 82 inches) but the overall perimeter could be enlarged by changing B, C and D in relation to each other. Whether an 82 inch rope was used 122 times or a 122 inch rope used 82 times we cannot determine, but using the 122 inch division would have enabled the egg to function like an 82 fold simulator synchronized to the 3 x 122 chronon per solar day, sidereal clock.

Every day a moon marker would have been moved 366 inches anti-clockwise on the egg’s perimeter but, as the sidereal clock advanced, the exact position of the moon could also be co-related to the rising of that part of the ecliptic in which the moon sat.

The Menec Design

Before adjusting the egg’s perimeter, the axis for the egg had to have been chosen, a choice then defining its unchanged semicircle to the northwest of the cromlech. The major and minor axis of the monument, were all set at an angle of 36.8 degrees anticlockwise, relative to all of the cardinal directions (N-E-S-

W), this being the smaller acute angle of a 3-4-5 triangle[14]. As a result, the minor axis of the monument defines the midsummer solstice sunrise and the midsummer solstice sunset in its two directions east and west. This occurs because, around 4000 BCE and uniquely at this latitude, the solstice sun rose and set at the smaller angle of a 3-4-5 triangle (relative to east and given a level horizon[15].) The principle axis of symmetry for the egg has previously been assumed to have no significant alignment but this axis points very accurately to the maximum elongation of an abstract point, the ecliptic pole. This is true because at midsummer the northern hemisphere of the earth is fully tilted down and at this instant complex spherical geometry reduces to there being a right angle between the solstice sun (on the horizon) and the north pole of the solar system, a system inferred from the ecliptic "equator" of sun and planets, on the horizon at the midsummer solstice. Le Menec's architects seem to have grasped the true significance of the ecliptic pole as being like a North Pole, which also had no star to mark it in this period. The north pole belongs to the equatorial world of the rotating earth whilst the ecliptic world of the sun and planets has its own ecliptic pole shifted by the obliquity of the earth's rotating frame. Besides setting the principle axis to the ecliptic pole at its westerly elongation, they also erected a stone aligned to the ecliptic pole at its maximum elongation to the east, as shown in figure 10.

The cromlech is revealed as a wonderfully integrated representation of the sky. The principle axis points to the ecliptic pole whilst the minor axis points to the summer solstice thus representing the ecliptic world as viewed on the horizon. The rotation of the earth is observable using the marker star Dubhe and this could have been measured as 365 units of 24 inches, around the forming circle's circumference, each unit representing a chronon of time. The orbit of

[14] This meant that its major and minor axes were equally also set at the other 3-4-5 angle, 53.2 degrees, to the cardinal directions but then in a clockwise sense.

[15] Alexander Thom first revealed the importance of this triangle's utility at Carnac, though he fails to note this fact about Le Menec, perhaps because to him it would have been obvious. Aubrey Burl does note it in Megalithic Brittany, probably because of his contact with Thom.

the moon is represented in the egg shaped perimeter as taking 10,000 chronon-inches of earth rotation to complete. It is these two scales; of 24 inches for the circle and 1 inches for the egg, per chronon, that allow these two aspects of time to form this integrated whole.

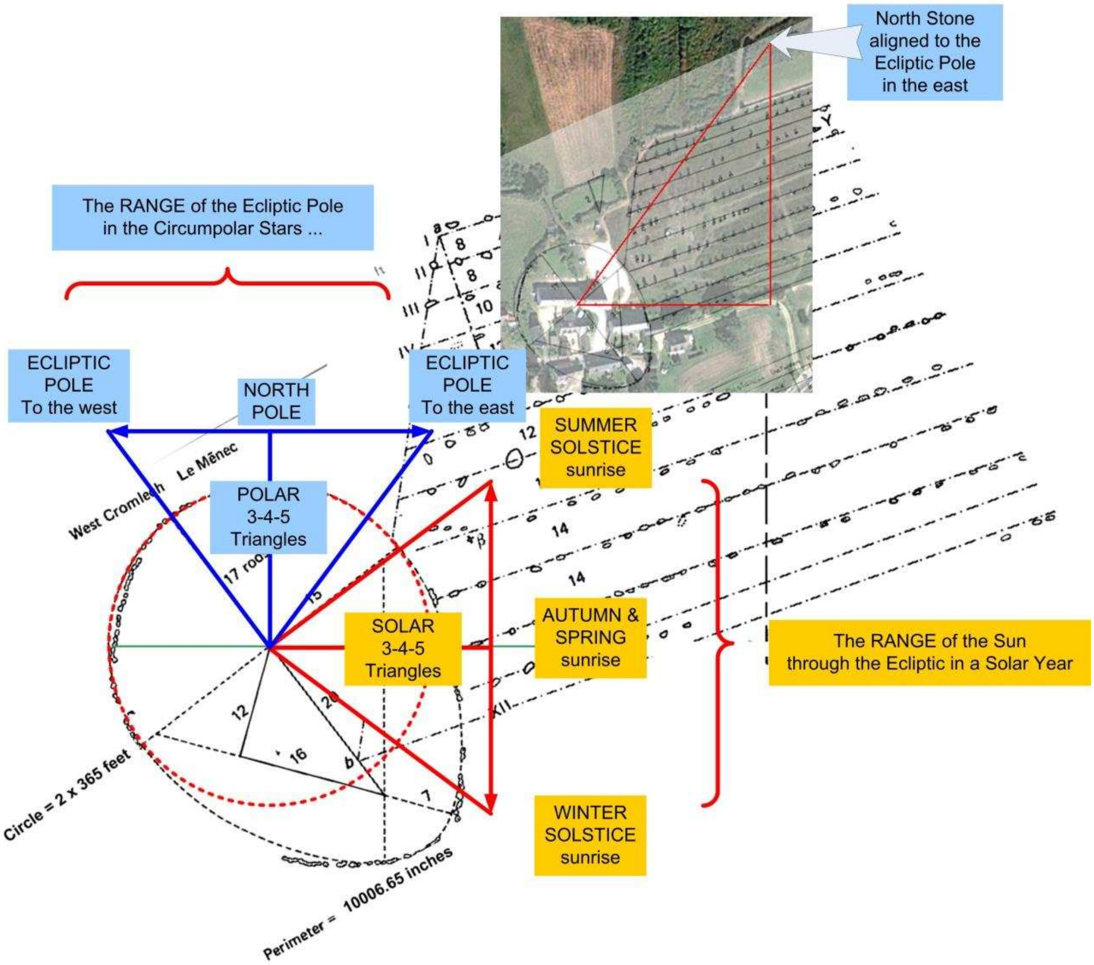

Figure 10 A surviving *menhir, noted by Thom's survey, marks the same angle to the* northeast as the principle axis of the cromlech has to the northwest, equal to 36.8 degrees to North and marking the extreme azimuth possible of the ecliptic pole to east and west. The important astronomical events are circumpolar, occurring on the horizon to the north, and ecliptic, on the eastern horizon.

Very big astronomical opportunities would have arisen out of this megalithic discovery, that the surface of the earth and the orbit of the moon have a common unit of time, just three minutes and fifty-six seconds, related to the movement of the sun every day when seen from earth. It becomes possible to know which part of the ecliptic is rising on the eastern horizon whilst also knowing where the moon is in its orbit, and hence when and where the moon will rise up along the eastern horizon. Any time difference between when the moon should rise on the ecliptic and when it actually rises indicates that the moon is not on the ecliptic. How far the moon's orbit travels above or below the ecliptic causing a measurable advance or delay in the horizon position of the moonrise, as shown in figure 11. This apparently led to the production of the western alignments using the western cromlech's ability to know where the moon was on the ecliptic, based upon the regularity of sidereal time.

This form of observatory indicates when the moon is at one of its nodes on the ecliptic and a lunar eclipse highly likely.

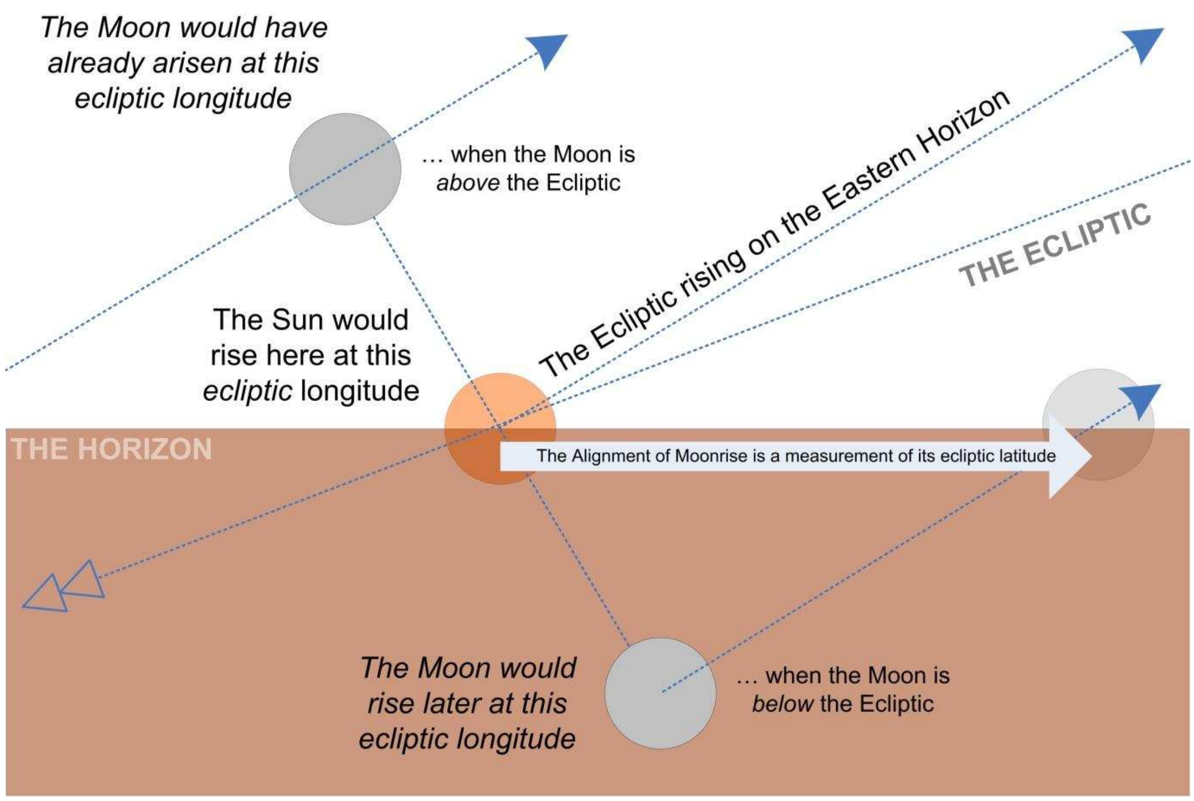

Figure 11 How the moon's distance above or below the ecliptic path of the sun manifests in *its rising earlier or later than would be expected. This means the moon's ecliptic latitude can* be determined from a knowledge of where the moon is in ecliptic longitude (on the *cromlech's elongated perimeter) and* where it actually rises, apparently at a different ecliptic longitude.

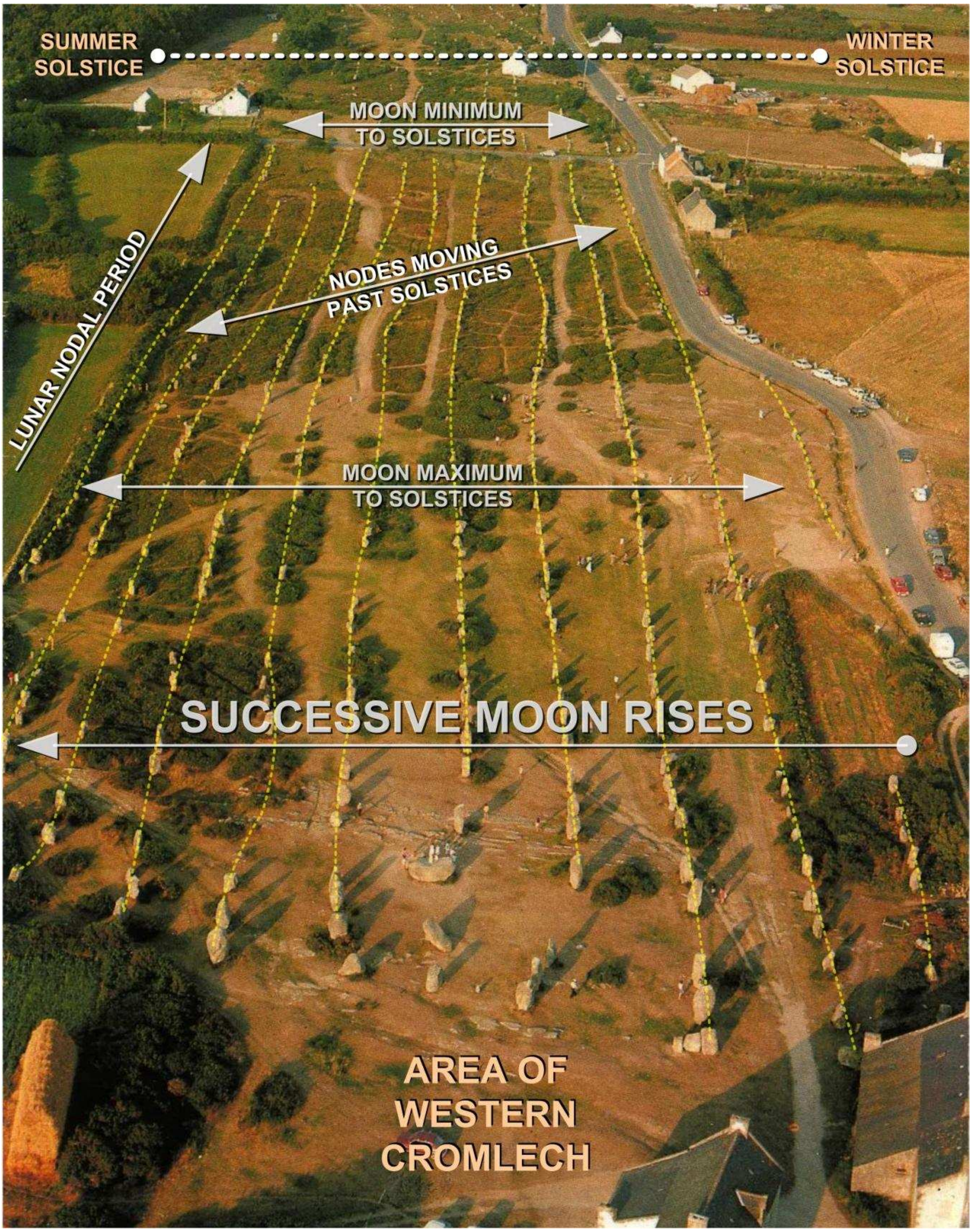

Figure 12 A preliminary analysis of the form and metrology of the alignments points to successive moonrises recording ecliptic latitude during a lunar nodal period. A further survey may confirm that surviving stones still hold the pattern of actual lunar moonrises, separated by a whole number of lunar orbits during one or more lunar nodal periods.(photo *by Dominique Le Doare in P.R Giot's Menhirs and Dolmen*)

The Transition From Manio to Menec

At Le Menio, a 4 solar year 'rope'[16] of 1461 inches would fit the southwest to northeast diagonal of the Quadrilateral (see figure 14) and point towards the midsummer sunrise, in 4,000 BC. As discussed earlier, a length of 1461 inches could equally form a natural cyclical count for a single year if arranged as the circumference of a circle. This encoding of four inches to a day leads naturally to the desire to encode another length of time, taken for the sun to revisit the same lunar node and called an eclipse year (346.64 days) because eclipses can only occur when the sun sits near transits one of the two lunar nodes. A four eclipse year rope could form the base of a right angled triangle with a four solar year rope as its hypotenuse.

One can then come to the Alignments with a new sense of what they were recording since the limitations of simple horizon astronomy were overcome by an ecliptic and sidereal astronomy. It was this astronomy that discovered facts and generated monuments in unfamiliar ways, inconsistent with our present expectations of a prehistoric culture and revealing astronomical facts unknown today.

A previous paper discussed a fragment of an 82 stone '3 lunar orbit' simulator at Le Manio.[17] If complete, its circumference would have been around 1390 inches plus or minus up to six inches. An eclipse year count, at four inches per day, would suggest a length of 1386.5 inches[18], as its intended length given that such a simulator would then form a model of the ecliptic "circle" surrounding the earth and would also have given its operators an ability to track the moon's ecliptic latitude against the stars with reasonable accuracy using

[16] Diagonals and other significant lengths are most easily realised as ropes using a material and twining it to resist stretching, such as nettle and hemp.

[17] The Origins of Megalithic Astronomy at Le Manio, Part 2: Simulators available at www.matrixofcreation.co.uk/megaliths.html and www.skyandlandscape.com. Each surviving stone was found to measure 17 inches from adjacent stones.

[18] the eclipse year is an average 346.62 days which, multiplied by 4, equals 1386.48 days.

day-inch counting. The two nodes of the lunar orbit could then be located on the ecliptic which the circumference of a orbital simulator represents. It is fairly easy to also place the sun on a circle representing the ecliptic, enabling the time between eclipse seasons to be inch-counted. Two eclipse seasons are called an eclipse year which is 346.62 days, or at four inches per day 1386.5 inches, corresponding to the circumference of the Le Manio simulator. Such a suitable circumferential length would have evolved from experience using earlier simulators, so that the one discovered at Le Manio could have been built with the count for the eclipse year in mind, as a circumference (see Table 1 for this length's triple metrological significance).

1386.5 divided by 4 equals 346.625 whilst an eclipse year equals 346.62	1386.5 inches is close to 17 times 82 = 1394 inches, which enables 82 stones separated by 17 inches to simulate the moon's orbit as 82/3 days	1386.5 inches and 1394 inches can both be 17 megalithic rods of 100 megalithic inches (see later) to give 1700 megalithic day-inches for counting one quarter of the lunar nodal period of 6800 days

Table 1 The triple resonance of significant time periods within a Le Manio circumferencial range of 1386.5 to 1394 inches relating to (a) the eclipse year, (b) the simulation of a lunar orbit and (c) the day count for one quarter of the lunar nodal period.

The moon moves 51 inches per day on the simulator, while a day count of the eclipse year moves at four inches per day (see table). Half way through the eclipse year, an eclipse season occurs and there are possible eclipses then whenever the moon is conjunct the solar marker or diametrically opposite.

A circumference of 1386.5 inches also has a relationship to the megalithic yard in that there are 16.999 megalithic rods within that length, that is seventeen rods of 2.5 megalithic yards of 32 and 5/8ths inches (to one part in 16800). This length of seventeen megalithic rods is exactly that found by Alexander Thom when surveying the circular part of Le Menec's western cromlech so that its forming circle would have had a direct relationship to the eclipse year as a four inch per day count (or 4 eclipse years of day inch counting, see later). It also happens that this length is 1700 megalithic inches, one quarter of the moon's nodal period in days and this could have made a third type of counting feasible within the same design of simulator, an idea further developed at Le Menec.

From this we can infer a connection between the eclipse year and the study of the lunar nodes between Le Menec and Le Manio. A Le Manio style circle would have been suited to measuring the retrograde motion of the lunar nodes through the ecliptic during successive lunar orbits. Its circumference, whilst equal to the eclipse year, also represented the nodal period of 6800 days or 18.618 solar years that, interestingly, equals 19.618 eclipse years.[19] Le Menec's cromlech can therefore be seen as having a radius travelling east from its centre, of length 17 megalithic rods and equivalent to an eclipse year, counted at four inches per day. At the easternmost point of the cromlech[20], a perpendicular can travel north to the circumference of a concentric arc with a radius equal to the four solar year rope, that is 1461 inches (see figure 13), to form a right angled triangle.

The difference in time between the eclipse year and the solar year is 18.6 days, revealed here as being (18.6 x 4) days = 74.4 inches, the difference between the radius of the cromlech and a four solar year arc. The angle of this triangle defines the angle of the alignments, in their general bearing of 18.38 degrees, about which median they wander no more than 5-6 metres in their rows (see figure 15). At the northernmost tip of this triangular construction the builders have left a further confirmation of their intent through erecting the three stones that terminate Thom's row 9 (inset lower right within figure 13).

[19] This occurs because the lunar nodes move by one DAY of solar daily motion in 18.618 days, and there are 18.618 DAYS of solar motion in an eclipse year.
[20] Already used within the cromlech's circumpolar observatory.

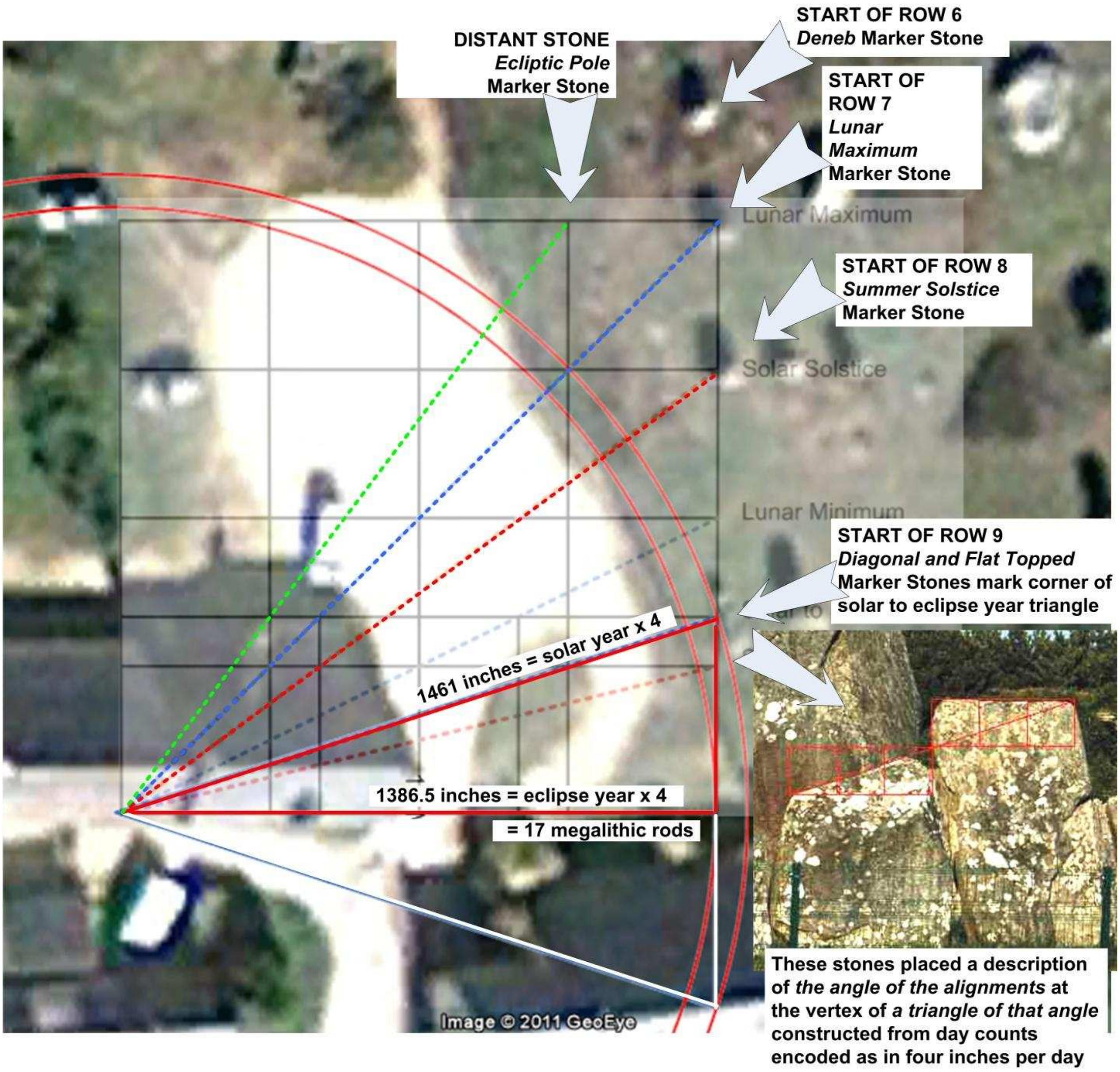

Figure 13 A right-angled triangle, whose two longer sides are in the ratio of the solar year to the eclipse year, appears to have been built at Le Menec. The starting stones of Row 9 replicate the slope angle (18.383 degrees from east) of that triangle, an angle that would later be used to define the angle of all the rows of the western alignments relative to east. Directly north of this, following the right-hand side of the grid, the summer solstice and lunar maximum standstill are marked by the starting stones of rows 8 and 7 respectively whilst an alignment to Deneb, the circumpolar marker star completes this line as the first stone of row 6. (Inset photo and diagram by Howard Crowhurst)

The three stones at the start of row 9 are set at the angle of the triangle, 1461 inches from the cromlech's centre, and clearly represent the three squares geometry of both their own location and the angle to the east of the western alignments beyond. This provides no small confirmation that this triangle was actually employed in setting up the alignments and that a second, larger radius of 1461 inches was once employed as an arc to build the triangle.[21]

Figure 13 also shows that this construction can interpret three further stones to the north, each of these being the first stone of the row to which they belong. A 4 by 4 grid can be used at Carnac to show the three major alignments in each quadrant of a backsight or middlesight, and this has 16 squares within which,

a) the direction of lunar major and minor standstills, unique to this latitude, can be shown as diagonals between a 4 by 4 unit square and 4 by 2 unit square, respectively

b) The diagonal of 4 units by 3 units reproduces the 3-4-5 triangular arrangement for the risings and settings of the solstice sun at this latitude.

It then becomes apparent, when such a grid is overlaid onto satellite imagery[22], that the first stone of row 8 is aligned to the solstice sun whilst the first stone of row 7 is aligned to the maximum lunar standstill. This can be interpreted as meaning: “this monument is focussing upon the period when the extreme moonrises, north and south, within the moon’s orbit occur outside of the sun’s solstitial extreme rising positions, in summer and winter (during half the Nodal Period)”. In the middle of this period when the moon ‘exceeds the sun’, the lunar maximum standstill occurs.

Beyond the 4 by 4 grid shown in figure 13 lies the start of row 6, identified as an alignment to the extreme eastern elongation of Deneb, the circumpolar marker star used to drive the cromlech’s sidereal observatory. This was identified earlier as marking a ‘northern line’ of the same diameter as the

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[21] or perhaps as a full circle to simulate the sun’s position on the ecliptic, parallel to the circumpolar model.
[22] using Google Earth

cromlech's circle which is two eclipse years in diameter when counted in one day to four inches, as well as being 2 x 17 = 34 megalithic rods.[23]

There is evidence therefore of a strong relationship between the Quadrilateral at Le Manio and the western cromlech at Le Menec, through the length of 17 megalithic rods having been employed at both sites and the remains of a possible 82-stone simulator at Le Manio, capable of studying the lunar nodes, which led to the lunar nodal period being studied in detail at Le Menec, through its ability to record sidereal time from the circumpolar stars.

The Octon of Four Eclipse Years

The seventeen megalithic rods equate to four eclipse years in day-inch counting which could be a reference to the so-called Octon period of that length in which quite reliable repeating of eclipses occurs, this also being the periodicity of 47 lunar months to reasonable and effective accuracy. This would indicate one inch to one day counting over four eclipse years since 47 lunar months is 1½ days longer than 4 eclipse years. This also gives a connection to the Metonic period of nineteen years which completes in exactly 235 lunar months which equals five periods of 47 lunar months.

There is a very real possibility that an earlier lunar simulator was built at Le Manio at its eastern square "extension" as shown in figure 14. In this illustration the Quadrilateral is shown having four eclipse years (1394 inches or 17 megalithic rods) within its length and four solar years (1461 inches) across its diagonal. This diagonal can be transferred to commence at the 'sun gate' (point P) and and it then terminates within the extra eclipse year added to the northeast of the monument. The eclipse to solar year dimensionality found at the western cromlech of Le Menec, is therefore already stated at Le Manio. The grooved

[23] Also of interest regarding this 4 by 4 grid is the possibility of laying a bearing on the eastern elongation of the ecliptic pole and marker stone (outside the alignments), which bearing is at right angles to the winter solstice sunrise and summer solstice sunset and symmetrical, relative to north, with the principle axis of the egg, which is at right angles to the summer solstice sunrise and the winter solstice sunset.

stone area (point G on plan) has stones suited to define the centre and radius of the 82 stone simulator and the four solar year rope could exceed this to furnish an exact model of the western cromlech at Le Menec, but at the lesser scale of one over PI.

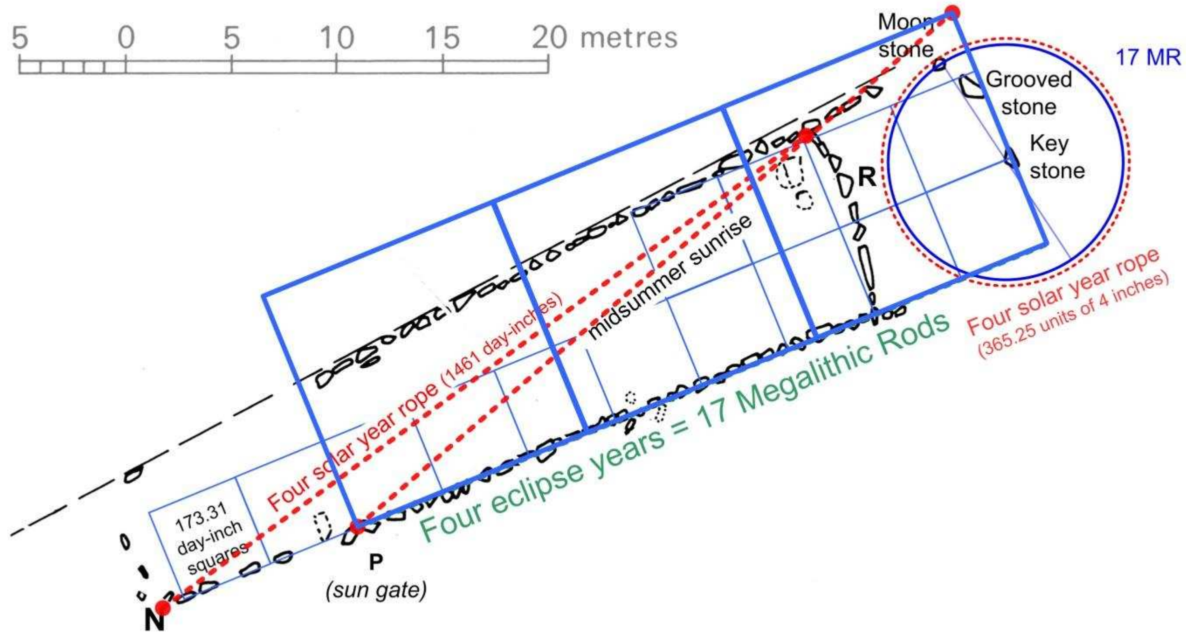


Figure 14 The layout of the Quadrilateral at Le Manio contains identical lengths to those found at Le Menec but there as radial lengths rather than circumferences. These lengths are significant for showing *the eclipse year's* relationship to the solar year over the Octon period of eclipses which repeat over a 47 lunar month period, just 1½ days longer than 4 eclipse years.

This comparison between the two sites prepares us for another important aspect of the western cromlech in that the diameter of its forming circle is 3400 megalithic inches. This alternative type of inch measure was originally discovered by Alexander Thom following extensive analysis of the dimensions employed in fabricating the many cup and ring marks found carved onto many the megaliths found in the British Isles.[24] Thom called this the megalithic inch, defined as one fortieth of a megalithic yard and which measures 0.816 inches

[24] See Alexander Thom, Cracking the Stone Age Code by Robin Heath, chapter 2, pp71-74. Bluestone Press, Wales, 2007.

(going down to theoretical thousandths). The megalithic rod is therefore divided into one hundred parts by this inch and seventeen megalithic rods would be 1700 megalithic inches long and the diameter of the cromlech 3400 of such inches.

The moon’s nodal period is 6800 days so that the diameter found at Le Menec equals half a nodal period in day-megalithic-inch counting. This means that, were one to count in days from one end of the diameter to the other, one would have counted exactly half a nodal period. If the count began at the lunar minimum standstill, the moment at the end of the count would be the exact lunar maximum standstill. This diameter, seen as a megalithic inch count, is expressing units and dimensions which quantify the exact periodicity the builders need to track. Furthermore, when the count is projected at right angles it will strike the circle with the appropriate sinusoidal reduction of the maximum possible difference between the moon’s extremes and sun’s solstitial extremes, on the horizon.

It therefore appears that megalithic inches were used for day counting of the lunar nodal period, most significantly across the minor axis of the equally long Le Menec egg and Northern Line, whilst the forming circle of the egg was showing sidereal time relative to the circumpolar stars and day time sun’s shadow angle. There are megalithic day-inch count lengths for the nodal year of 4 times 1700 megalithic inches at both Le Menec and Le Manio.

The Building of the Western Alignments

Looking along the Alignments, there is an overall systematic variation in the positions of the twelve rows relative to their general bearing. The maximum event appears to occur over a length not much different to 200 metres. As suggested earlier, the alignments seem to show the period within which the monthly extreme moonrises of a lunar orbit occur outside of the sun’s solstitial extreme rising positions (during 9.3 years or 3400 days). If so, then a scaling factor of 17 days per metre appears to have been used to record this 3400 day half-cycle of the lunar nodes, as rows of megaliths. Though a modern unit of length, the metre appears clearly as a significant unit within Le Manio's Quadrilateral, because 3/4 of a metre is equal to a lunar month of 29.53 day-inches and therefore a lunar year of 12 lunar months is represented by 9 metres of day-inch counting and. It is also true that the 10,000 inches around the egg's perimeter at Le Menec divides into exactly 254 metres because the metre happens to be 10000/254 inches in length.

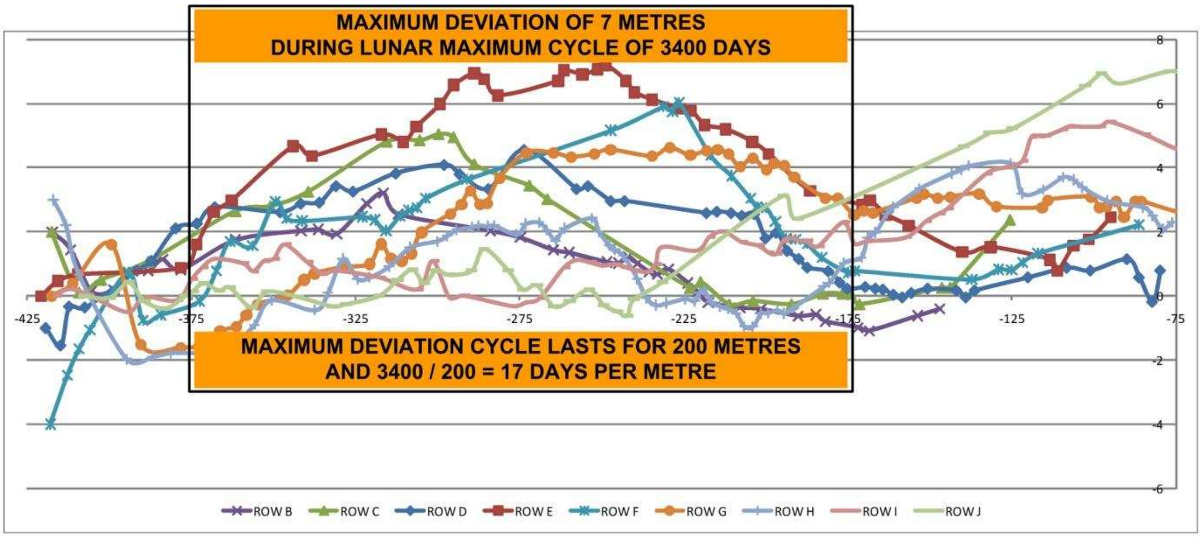


Figure 15 The variation of the location of stones in the alignments, relative to their general bearing, shows a clear deviation over a similar range that implies measurements and observations *of the moon's ecliptic* **latitude** during the maximum half of the lunar nodal period. The rows relate to different portions of half of the lunar orbit, from south to north, looking east and the easterly march appears to have been scaled at 17 days per metre though data from more than one nodal period might have been accumulated within the same alignments.*(data extracted from Thom's survey of the alignments, scale 1 mm to the metre)* My thanks to David Blake for his capturing of this dataset from .

Of note in this respect are the 254 lunar orbits in the 19 year Metonic period so that the perimeter of the egg at Le Menec's western end is both a model of the lunar orbit, viewed in chronon-inches, yet also a model of the Metonic period, viewed in lunar orbital-metres. Dividing 254 metres by 19 gives the 13.368 orbits within one year, in metres. It therefore seems possible that such an odd scaling as 17 days per metre could have been employed to locate the stones along their rows, according to when in the nodal period the observation they represent took place. However, one expects of the megalith builders a direct visual cue of their approach and indeed, the key stones initiating row 9 show a triple square which demonstrates how 82/17 metres can be generated by the diagonal of three 5 foot (60 inch) squares. As Figure 16 explains, the square root of ten (which is generated automatically by the diagonal of a triple square) has an approximation that suits exactly this transformation between inches, metres and the numbers 82 and 17.

Figure 16 The three key stones of row 9 have a base length of 15 feet and the implied triple square a diagonal of 82/17 metres. This happens because the square root of 10 (the diagonal relative to the one third length of the base) has a close approximation involving the ratios 82/17, the metre of 10000/254 inches and the fraction 1/60, the latter provided by five foot sides(equalling 60 inches) of the three squares. The middle *section's* diagonal is mirrored by *the middle stone's slope angle and* , at a 17 days per metre rate, this represents the length of a single lunar orbit, 1.608 metres or 63.3 inches.(Graphic adapted from Howard *Crowhurst's* book, Carnac, The Alignments.)

By removing 17 within the day counting along the alignments, half a nodal cycle was reduced in length to 200 metres, whilst the 3400 megalithic inch diameter of the cromlech would have been too small to practically locate megaliths.

The required unit for locating row stones is therefore given by the middle stone's slope length, literally carved in stone, which we have shown represents a single lunar orbit. This might well have been the key factor since the stones in a given row recorded the moon's current ecliptic latitude at the same region of the moon's orbit. By such a definition, stones are separated by a whole number of orbits and this unit of 1.609 metres would provide the key to placing stones, not by generating a detailed time-line time but by spacing lunar stones, orbits apart. If the alignments were used during more than one nodal period, which was possible because of the accurate 3400 megalithic day-inch count, then this would have offered an opportunity to fill in any gaps in later nodal periods. However, stones from different nodal periods would then be staggered relative to those of previous periods because the moon's orbit is not commensurate with its nodal period. The proposed inter-stone distance needs to be applied to see if irregularities between stones can be explained through their belonging to different nodal periods.

The Key Lengths of Time on Earth

This report and the two preceding papers indicate that the act of counting time, using any small unit of length, led to early astronomers being able to compare different celestial periods as counted lengths within right angled triangles. In the case of Carnac's monuments at Le Manio, the same inch that we use today was used to compare three solar years with three lunar years, so as to make a differential length equal to the megalithic yard of 32 5/8th inches.

The evidence further points to the use of a counted length as the perimeters of circular and compound rings, so as to form models of the ecliptic around which celestial bodies appear to orbit the earth. Le Manio's four solar year count could conveniently represent a single year, so that the sun could then be simulated through the simple rule of moving a solar counter around the circumference by four inches per day. Such a simple rule is exactly like the counting process that resulted in such a length in the first place. Such a simulator would show where the sun was on the ecliptic without using the inferential methods of later periods, such as the helical rising of the sun on the horizon (which records the stars visible before dawn). It would in effect be a practical and accurate calendar useful for astronomical observations on the eastern and western horizon.

The other important body was the Moon, already counted as the lunar year of 354 days but also having a clear observational cycle in the way moonrises "march" from the south east to the northwest over half of (what we call) the moon's orbit and then march back again over the other half. However, when counting the lunar orbit, Carnac's astronomers had to look at where the moon was against the stars and evidently discovered that, in 82 solar days the moon returned to the same stars, having then completed three orbits.

This discovery of an 82 day repeat cycle meant that another circular count was then possible in which 82 units of length equally spaced around the circumference of a circle would enable a moon marker moved anticlockwise by three units per day, to return only after three full lunar orbits to the same part of the circle and hence to the same part of the ecliptic.[25] The remains of such a possible 82 stone simulator at Le Manio appears to have a stone separation of about seventeen inches which would then make the circumference 1394 inches.

This length of 1394 inches is only a few inches longer than the 1386.5 inch (17 megalithic rod) radius Alexander Thom measured at Le Menec's western cromlech. The best way to compare these two lengths is to see the lesser (cromlech radius length) as Thom had, as being 17 megalithic rods where a rod

[25]It would have been desirable to integrate solar and lunar simulators, by making them concentric.

was 2.5 megalithic yards of 32.625 inches. The greater length, of 1394 inches, can then be seen as 17 megalithic rods of a different variation, where a rod equals 82 inches.[26] Both these lengths when used as the circumference of a circle will have very similar radii, differing only by about 7.5 inches, a difference less than the radial length of the stones discovered at Le Manio. Both lengths seem to be have been intended and used for important reasons.

We have shown above that the shorter length of 1386.5 inches is simultaneously the count of two aspects of the eclipse behaviour of the moon. Firstly, a count of four eclipse years in regular inches is the period of the Octon eclipse cycle in day-inches. Secondly, 17 megalithic rods hold 1700 megalithic inches and this is the count for one quarter of the moon's nodal cycle of 18.6 years.

It has been made clear above that the longer length, of 1394 inches, is the exact length of a diameter or radius required to create a circle with a circumference divided into 365 portions, these divisions being two feet in length at Le Menec where it was used as a radius.

Therefore these two key lengths are shown in circumference at Le Manio and then in radius at the western cromlech. Together they enabled the cromlech to count eclipse years, nodal periods and the chronons of earth rotation, the latter using the circumpolar stars. The monuments appear to incorporate these key lengths in order to achieve sophisticated astronomical results without the use of modern equipment or methods.

[26] This megalithic foot would be 2.7$\underline{3}$ feet long, a length found in variations of the Spanish Vara.

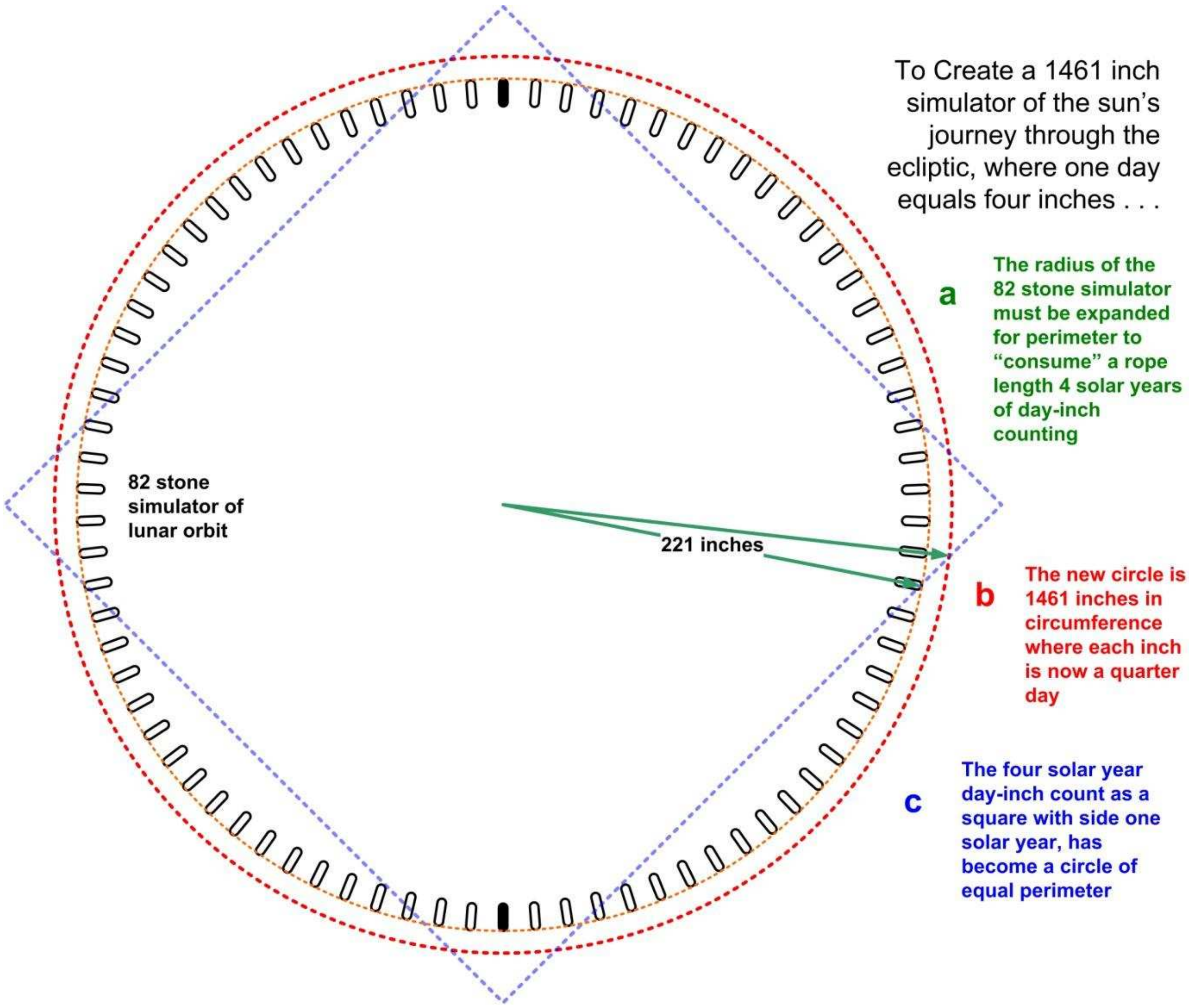


Figure 17 How a 1461 day-inch rope could have been laid around the outside of a 1394 inch circumference so as to provide an 82 stone lunar simulator concentric with a solar simulator at four inches per day. Within the radial length of the stones lies a circumference of 1386.5 day-inches, a count for four eclipse years and one quarter of a nodal period.

The transitional step would have been the construction of a lunar simulator with concentric solar simulator (see figure 17), so that the deviation of the moon above and below the ecliptic could be studied and the moon's nodes located. The concentric simulators would not be able to go further without the circumpolar division of time into 1/365 of a sidereal day and hence the advent of a sidereal astronomy. This could measure a lunar orbit as being 82 times 122 chronons in length and, in chronon-inches, this length could be harmonised with the 365 times 24 inch circle using the perimeter enlarging technique identified as a Type 1 egg. The resulting western cromlech is then seen to have a scaling factor between its forming circle and its egg of 24:1 in chronons per inch.

The axis of the egg was set to face the western maximum elongation of the ecliptic pole since this ‘pole of the solar system’ lies at right angles between midsummer sunrise and midwinter sunset. This meant that pointing the minor axis of the cromlech towards the midsummer sunrise ensured the major axis would point towards the ecliptic pole. The ecliptic pole appears to have been significant for the builders as the other, eastern, maximum elongation of the ecliptic pole is marked by a special menhir, outside of the western alignments.

The main task of the western alignments was to record the ecliptic deviation of the moon, based upon moonrises being earlier or later than the rising of the part of the ecliptic nearest to the moon. These results were gathered into twelve rows, representing the ecliptic deviation of any moonrises falling within one of twelve sectors of the ecliptic.[27] There are two mechanisms possible whereby this may have been achieved.

The first method would use angular sightline observation of each moonrise on the horizon whilst the second would simulate the moon around the egg shaped perimeter, using the sidereal time generated by the sidereal observatory. Both of these candidates need further practical investigation but the general form of the astronomical works at Le Manio and Le Menec are all consistent with the knowledge required and constructions necessary to achieve such a modelling of the lunar nodal period down to the level of individual moonrises within the nodal period.

As a by-product of their work, Carnac’s astronomers founded a science of metrology and geometry that we know evolved by the time megalithic monuments in Britain were built, using the system of related feet evident in

[27] It is worth noting that this was a division of the moon’s orbit into 24 parts as with the sidereal observatory’s division of the earth’s rotation. Also, the radius of the observatory is 82 times 17 inches so that, at two inches per day, the moon’s orbit could have been counted from the cromlech centre to its circumference and back again.

these monuments.[28] This metrology came to be the basis of all of the measures subsequently recovered from the ancient world and surviving into the modern age as our historical measures. Therefore, Carnac gives a fascinating glimpse not only of the earliest known precision astronomy but also of the birth of our metrology.

It is also true that, through studying Carnac's astronomical knowledge, there are implicit discoveries of a scientific nature which the builder's would have been unable to identify. One such is the numerical relationship found at Le Manio between the solar and lunar years and that these two years then appear numerically related to the eclipse year and thence to the moon's nodal period. The many numerical coincidences exploited perfectly by the megalithic astronomers are probably indicative of some simple level of order as yet unknown to modern astronomy yet revealed through the completely different approach to studying the moon, six thousand years ago.

Our culture's model of stone age capabilities does not include any means to become competent sidereal astronomers. However this report, and those on Le Manio, have shown that day-inch counting and simple geometrical constructions could supplement the megalithic competence in horizon astronomy. Such methods could be used by many stone age cultures but the path to finding them would take centuries. Le Menec and its alignments were a sublime demonstration by a culture deserving the greatest respect, as the likely precursor of today's exact sciences.

[28] Metrology evolved into a system of interrelated feet based upon the so-called English foot of twelve inches, the same inches originally used for day-inch counting at Le Manio and Le Menec.

APPENDIX 1: THE ASTRONOMICAL RELATIONSHIPS BEHIND THE METROLOGICAL LENGTHS

At Le Menec, the western cromlech's radius of **17 megalithic rods** = 42.5 megalithic yards was first found to equal **four eclipse years** in day-inch counting but then seen to contain the same number of megalithic inches (1700) as would be generated by counting **one quarter of the moon's nodal period** of 18.6 years (6800 days).

The number of these two types of inch, found within **seventeen** megalithic rods, cannot **without a reason** correspond to the number of days in (a) **four eclipse years** (a length of time significant as being the **Octon eclipse cycle**) and (b) **one quarter of the moon's nodal period**. Two such unlikely correspondences occurring within the same unit length (effectively multiplying each individual unlikeliness) forming a probability lower than either taken individually.

There is therefore **likely to be a systematic reason** for why this singular length should **simultaneously represent the key day counts** for eclipse year and the related nodal cycle that regulates eclipses.

The nodal cycle can be expressed as equal to **19.618 eclipse years** and 19.618 eclipse years, divided by four eclipse years, is the ratio 4.9045, which ratio is **six times a megalithic inch of 0.8174 inches**. This numerical value for the megalithic inch is therefore 19.618 eclipse years divided by 24 eclipse years, and the latter period is six times 17 megalithic rods or 255 megalithic yards. **This would make a megalithic yard equal to 24 eclipse years of day-inch counting divided by 255 or 32.623 day-inches, as found at Carnac.**

The **three main types of year**, solar, lunar and eclipse, **are therefore commensurate**, dividing into each other in a rational fashion, involving whole numbers.

This megalithic yard was derived at Le Manio's Quadrilateral from a day-inch count enabling three lunar years to be subtracted from three solar years, to make a megalithic yard **then defined as**,

megalithic yard = 3 times (**Solar Year** minus the **Lunar Year**)

or 3*(365.25 - 354.375) = 261/8 =**32.625 day-inches**

Since, as above, **24 eclipse years as a day count equals 255 MY** then,

The eclipse year, **EY** = 255/24 x 3*(**SY** - **LY**) = 30 * 17/16 * (**SY** - **LY**)

and (**SY** - **LY**) = 87/8 = 10.875 days

Therefore, **EY** = 30 * 17/16 * 87/8 day-inches **(relationship A)**

the solar, lunar, eclipse years being abbreviated as **SY**, **LY**, **EY**

This can be expressed as, **the eclipse year** is **thirty** times **the ratio of the squares of the solar and lunar years** times **the excess of the solar year over the lunar year**.

Meanwhile, the moon's nodal period of 19.618 eclipse years is 6800 days long = 17 ×4 ×100 days. **Le Menec's** western cromlech has a radius of 17 megalithic rods which equal 17 x 100 megalithic inches, where a megalithic inch (**M-inch**) is 1/40th of a megalithic yard, 1/000th of a megalithic rod. This length at Le Menec is therefore **a quarter count for one lunar nodal period**, counting one day per megalithic inch so that

an eclipse year (**EY**) in megalithic inches equals
(17 * 4 * 100)/ 19.618 megalithic-inches **(relationship B)**
which is that same length as
30 * 17/16 * 87/8 day-inches **(relationship A)**

therefore,

(17 * 4 * 100)/ 19.618 megalithic-inches = 30 * 17/16 * 87/8 day-inches

The number of eclipse years in the nodal cycle is therefore numerically produced when 19.618 is taken to one side as,

400/30 * 17/16 * 8/87 = 19.616585

This demonstrates the identity within the parallel usage of **inches to count four eclipse years** and **megalithic inches to count one quarter of a nodal cycle** as the **same length**of **seventeen megalithic rods** found as the radius of Le Menec's western cromlech.

APPENDIX 2: CIRCUMPOLAR OBSERVATORIES WITHIN OTHER MEGALITHIC DESIGNS

There are few stone circles, of the egg shaped or flattened types, whose axes point North. One is Long Meg in Cumbria, UK. When its design is reasonably made to point exactly north then it appears such a flattened circle would have emerged naturally from the same circumpolar astronomy as Le Menec's western cromlech. The marker star (Alkaid, or eta Ursa Major) would be aligned relative to the midsummer solstice sunrise and sunset, using the diagonals of two squares, which works at that latitude.

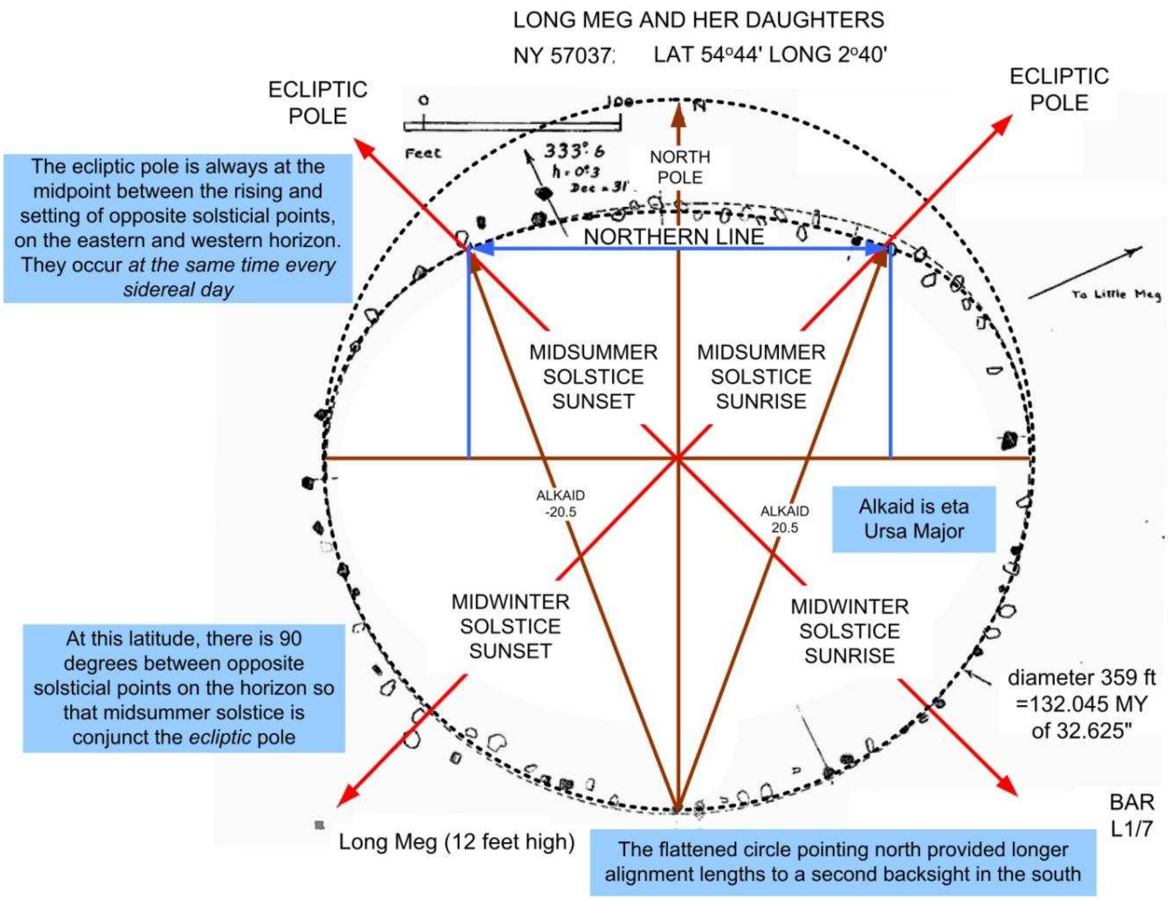


Figure A.1 How the flattened circle at Long Meg, *"facing" north*, could have arisen as a natural consequence of building a circumpolar observatory to measure sidereal time.

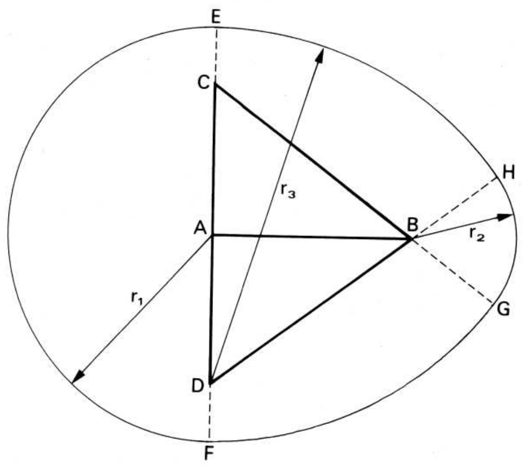
The ecliptic pole would then be at right angles to each solstice alignment. The backsight, where these two diagonals meet, was then moved south, until a chosen circumpolar marker star was aligned, at its maximum elongations east and west, to the two summer solstice marker stones. These stones then became a common foresight to both summer solstice (sunrise and sunset) and a circumpolar star's maximum elongations, but the latter from a backsight moved south, so as to form the apparent radius for the flattened circle design.

The flattened design then becomes a natural set of arcs, completed in stone, to give the monument an integral shape using arcs from the centre, the crossings of the Alkaid sightline and east west diameter and the new backsight to Alkaid. It is not unreasonable to see the resulting shape as a symbolic eye pointing towards the north. However, this north-facing design is rarely found but the same geometry, Thom's Type B, was widely used in both Britain and Brittany according to the number known today. It appears likely that such a clever manipulation of sightlines had other uses and that this geometry does not get built until the core alignments have been established.

APPENDIX 3: THE MODERN APPROACH TO EGG DESIGN

My own proposed approach is more pragmatic than the typical modern explanations such as Edwin Wood's description from Sun, Moon and Standing Stones[29] (adapted)

> The Type I egg (Fig. 3.5) has two triangles placed back to back. Its perimeter is a combination of the arcs of three circles, one centred at A with radius AE, two sections centred at C and D with radius DE, and the sharp end of the egg is an arc of a circle centred at B with radius BG. The figure is surprisingly easy to set out.
>
> a) Lay out the Pythagorean triangle on the ground using ropes in the ratio 3:4 to place pegs at the corners, B, C, and D relative to A.
>
> b) Having decided what size the egg is to be, take a loop of rope, place it over the post at C, take it round the post at A and back to E, where the marking stake is at the start of drawing the circular part of the egg.
>
> c) Draw the rounded end of the egg, taking the stake right round to F, but on reaching F, lift the rope over the post D and carry on anticlockwise. The radius of the circle has automatically changed as the loop of rope clears the post at A and has a radius of curvature longer than that of the semicircle.
>
> d) Carry on to the point G, and this time allow the rope to pivot about B, so that the stake marks out the sharp end of the egg as far as H.
>
> e) Now unhitch the loop from C and put it over the post at D to trace the remaining arc HE.



[29] Sun, Moon and Standing Stones, John Edwin Wood, Oxford University Press, 1978, pages 43-44