THE ORIGINS OF MEGALITHIC ASTRONOMY AT LE MANIO

LUNAR SIMULATORS

A revolution in what megalithic people could understand




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Contents

ABSTRACT

Our survey at Le Manio revealed a coherent arc of radial stones, at least five of which were equally long, equally separated and set to a radius of curvature that suggested a common centre. They can be found set into the public walkway at Le Manio, Carnac, Brittany, between the southern kerb of the Quadrilateral and the recent dry stone wall that defines the pathway. This southern kerb has been shown[1] to incorporate a day-inch count for three solar years to its extreme eastern tip [from Point P to Q' on our plan]. These stones were found to have a centre of curvature at stone 29 of the southern kerb and the arc they suggest would represent, if complete, a circle of 82 similar stones 17 inches apart whilst the radius of curvature was determined to be 221 inches or 13 times 17 inches. This provides a reasonable approximation to 2 times Pi as a ratio 82/13.

The angle of the southern kerb was measured in our survey as being 22.3 degrees north of east, the acute angle in comparison to an east-west line creating the geometry of a right-angled triangle whose two longer sides form the ratio 12.368 to 13.368, an invariant triangle based upon the frequencies of lunar synodic months to lunar sidereal orbits occurring in a solar year. The known day-inch count for three lunar years on the southern kerb is 88.59 feet long which becomes the hypotenuse of a right-angled triangle whose baseline runs east-west and is of length 82 feet. This reveals 82 beneath the fragment of an 82 stone ring as being the length of 36 lunar sidereal orbits in day inches versus the 36 month day-inch count above.

It appears therefore that the astronomers at Le Manio understood that following three lunar sidereal orbits, after 82 days, the moon would appear again at the same point on the ecliptic at the same time of day[2], a very important observational fact and one that would have enabled them to build circular 82-

[1] The Origins of Megalithic Astronomy as found at Le Manio, based on a theodolote survey of Le Manio, Carnac, Brittany, 22nd – 25th March 2010, by Richard Heath and Robin Heath.
[2] less than 20 minutes shorter than a lunar orbit and one hour short of 82 full days.

stone circles representing the ecliptic in which a moon marker could be moved by three stones a day, completing an orbit in 27.333 days and returning to the original 'start' stone after 82 days had elapsed.

ACKNOWLEDGEMENTS AND BACKGROUND

This document, prepared by Richard Heath and co-edited by Robin Heath, continues from our paper detailed in Origins of Megalithic Astronomy as found at Le Manio in which our survey appears in appendix. Our thanks to *L' Association pour le Connaissance et l'Etude des Megalithes* or ACEM, to which we both belong.

Thom's plan of Le Manio was reported in Megalithic Remains in Britain and Brittany, Clarendon Press, Oxford, 1978 and figure 9.11 on page 112 used beneath diagrams in the main body, 'The enclosure and menhir at Le Manio…'

A POSSIBLE LUNAR SIMULATOR AT LE MANIO

The practice of day-inch counting leads to linear lengths which can then be formed into triangles. These triangles present the invariant ratios that exist between the periodic cycles of celestial bodies, most immediately those between the sun and the moon. They also start to reveal useful aggregated lengths, namely:

1. The Megalithic Yard, which represents the difference in day-inches between three lunar and three solar years, and
2. The Metre, as representing a day-inch count for a lunar synodic month as ¾ of its length and therefore for a lunar year, as a nine metre length.

Celestial periods are recurrent orbital phenomena so that day-inch counts as perimeters simulate cyclic phenomena more clearly than linear lengths. It appears to have been a natural next step of development for the linear use of day-inch counting to have evolved into a circular form with considerable new potentials. For the sun, an observer can note that after four years, the sun rises at the exact same point on the distant horizon because the solar year is nearly 365 plus ¼ days in length. Through this observation, the day-inch astronomer could model a single solar year by using the four solar year length of 1461 day-inches as follows: Each inch can be viewed as a quarter day so the day becomes four inches long, and no longer one inch to one day – creating a new aggregate unit for simulating the daily movement of the sun through its ecliptic path on a metrological circle.

Achieving a similar facility for the lunar orbit required a similar observation of the moon's orbital recurrence so that a suitable integer perimeter could simulate the moon's daily motion upon the ecliptic plane via another metrological circle. Such a discovery and the consequent development of simulators in the megalithic would have enabled the complex world of sky movement to be simplified down into a picture on the ground of where the sun and moon were located, in their apparent orbits through the stars. Coupled with the sidereal astronomy naturally developed by naked eye astronomers, the rising and setting of the sun and moon on the horizon could then be seen alongside their known ecliptic longitude and the daily rotation of the stars.

The first step to achieving ecliptic astronomy in megalithic times would have been to identify an accurate integer recurrence for the lunar orbit.

The Quadrilateral's Alignment to the Moon's Orbit

In each solar year, the moon completes one more orbit than there are lunar (synodic) months in a year. The reason for this is that in one year the sun appears to have gone once around the Earth (relative to the stars), illuminating those months and their phases during the year. This 'extra' orbit would have been obvious to megalithic observers, who we have assumed were tracking the moon's position every night and day both on the horizon and relative to the stars. The moon makes 13 and 1/3rd complete circuits of the heavens during the 12 and 1/3rd months or lunations of the solar year, a numerical difference of exactly one because of the apparent circuit of the sun around the ecliptic.

In the 3 year triangle at Le Manio, the three solar year length is available at the eastern end of stone Q', the most eastern stone of the southern kerb, after having been brought down from the three-year count (from P to R on our plan). This length, pivoted down from point P to the southern kerb, would have directly revealed the excess between the three solar year count and the three lunar year baseline, a length which we have shown equals one megalithic yard, of 32.625 day-inches.[3]

The fractional part of the 3 solar year length (the "0.368" of the 12.368 months per solar year) was therefore present as the megalithic yard – the excess

[3] The four solar year hypotenuse was also coincident with this point so as to form a common end point for the three and four solar year day-inch counts).

in three years. Adding the count for three months, to the end of it, the number (or frequency) of lunar orbits in three solar years, rather than the number of lunations (lunar months), could have been articulated. This extended line[4], when arced southwards, will form a right-angled hypotenuse with the three solar year baseline, at 22.3 degrees. At this point it faces exactly to the East (see figure 1).

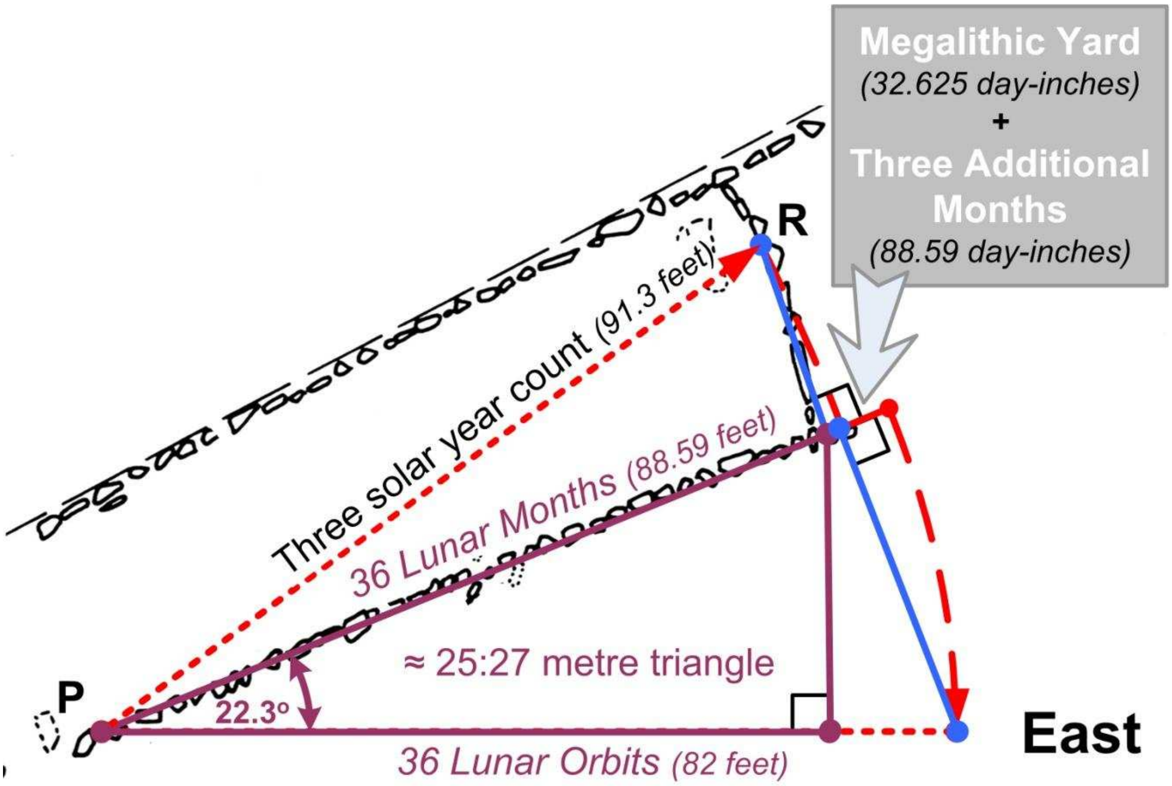

Figure 1 Extending the three solar year count by three months realises the number of lunar orbits in three years. This can be arced down below the three year count to create a right angled triangle whose hypotenuse points directly east. This triangle allows the orbit of the moon to be known as 27 1/3 days and can be accurately built using a ratio of 27 units to 25 units.

This reveals that the angle of the southern kerb was defined so as to be exactly that of a 12.368:13.368 right-angled triangle; a triangle that uniquely defines the ratio between the length of a lunar month and its orbital period. The angle of this triangle exactly matches the surveyed angle of the southern kerb - 22.3 degrees relative to east.

[4] The length will be the solar count (1095.75 inches) plus the megalithic yard (32.625 inches) plus three day-inch counted lunar months (88.5 inches) giving a total length of 1216.875 inches.

This month-to-orbit triangle is very nearly a 25:27 triangle: the 27 metres of the three lunar year count (see above) projects southwards, down onto the west-east line as a 25 metres length[5], 25 metres is 82 feet long, three times 27 and one third.

However, the simple ratio of 27/25 in metres has an inner angle of 22.2 degrees whilst the kerb appears to have been oriented at 22.3 to East. A geometrical construction based upon day-inch counting would have given this more exact 1.08085 ratio of a 12.368:13.368 triangle (angle 22.302 degrees).

Since 1.08085 is 29.53059/27.32166, the resulting baseline beneath three lunar years would then be:

> 29.53059 times 12 times 3 day-inches (the three lunar year day count), times 27.32166/29.53059 (=1.08085)
>
> giving 27.32166 times 12 times 3 day-inches (= 81.96498 feet)

and this is the exact average lunar period in units of three feet to one day. The utility of the foot of twelve inches emerges naturally from the fact that lunar years have twelve months; a lunar year (in day-inch counting) is therefore 29.53 feet long, and numerically the same as a single lunar month.

The 82 day Sidereal Recurrence of the Lunar Orbit

A lunar simulator can therefore be constructed from the observation, implicit in the Quadrilateral, that three lunar orbits take 82 days 'so that a single lunar orbit through the zodiacal band takes 82/3 days (27 and one third days). The moon’s orbit can be visualised as dividing the ecliptic into 82 equal parts, the moon as moving three such divisions or parts every day. In the northern hemisphere, the moon is observed as moving anticlockwise, as does the sun around the ecliptic, and a linear count of 82 days would translate into a circular

[5] 27/25 being 1.08 whilst the 29.53059 day month over 27.32166 day orbit is 1.08085, a difference of only one part in 1272.

and metrological 82-unit simulator for every single orbit, where the moon moves three times per day.

A suitable circle for simulating the moon on the ecliptic requires a perimeter 82 units in length, and a corresponding radius to form this would need to be 82 units divided twice by Pi; approximately 13 of the same units (13.05). The ratio 82/13 is a sufficiently accurate representation of two times Pi to reliably create a circumference whose perimeter length is comprised of 82 units with a radius of 13[6]. This is precisely what was found during our survey at Le Manio.[7]

Remains of an 82 Stone Simulator at Le Manio

While conducting our March 2010 survey, we located a contiguous radial set of regularly spaced stones. They were apparently set as part of a circular construction and each is separated exactly 17 inches from its neighbours.

Figure 2 (a) The radial pavement stones located in the public walkway that, if entire, would form a circle of 82 stones,(each separated by 17 inches) centred on stone 29 of the *Quadrilateral's southern kerb, (b) Stone 29 provides the centre of radius, 221 inches from the* outer edge of the pavement stones.

[6] Alexander Thom noticed this was a well-known procedure in megalithic monuments; to obtain a rational circumference by means of manipulating either Pi (by making it a rational approximation such as 22/7) or adjusting the shape of the perimeter (creating the "flattened circles" and ellipses found in stone circle designs).
[7] An even more accurate version of Pi, 820/261 is discussed in appendix.

The centre of this radial construction was found to be the top of stone 29 of the Quadrilateral's southern kerb, and the radius to these stones was measured as 18 feet and 5 inches, or 221 inches. In later analysis this was recognised as being 13 x 17 inches (see figure 2). These stones are therefore ideally arranged to have formed, in principle, part of a lunar simulator of 82 stones from which the moon's motion and hence its ecliptic longitude could have been tracked with reasonable accuracy.

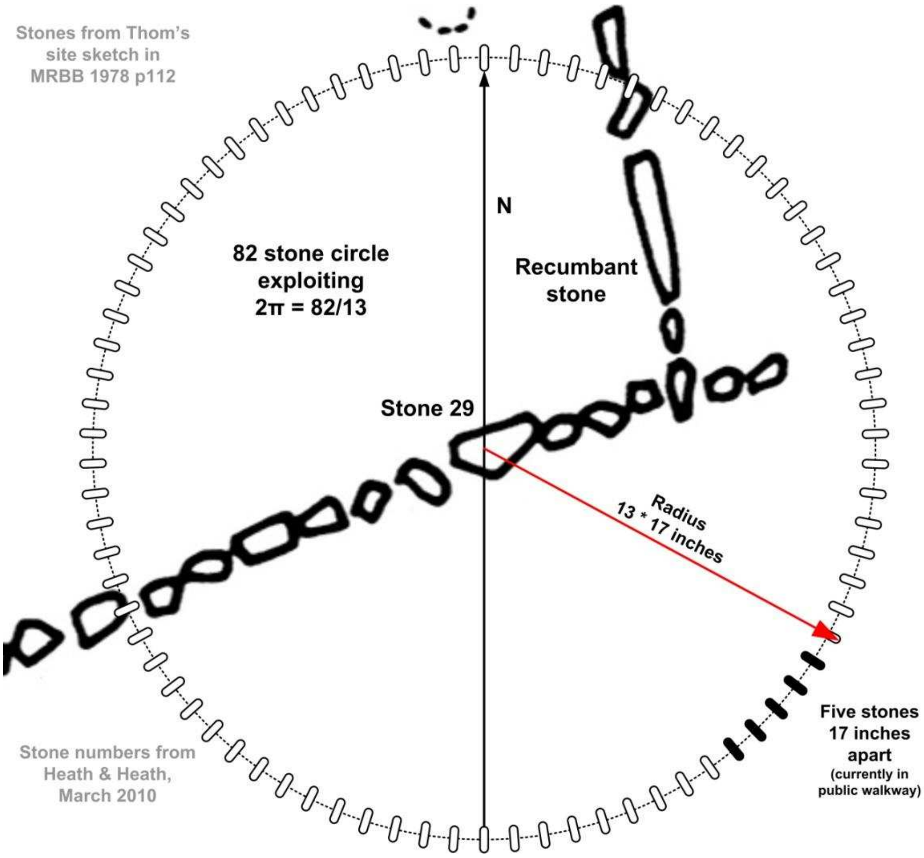

Figure 3 How a lunar simulator would be located, based upon a centre at stone 29 and the radius of the five well-preserved pavement stones. The conflict with existing stones would correspond with our reasonable hypothesis that the original day-inch counting, and other preparatory works including this simulator, were pursued prior to building the Quadrilate*ral's* presentation of that work, which summarised earlier findings.

On the ecliptic, the distance between stones represents 4.454 days of solar motion giving three stones the angular equivalent of 13.363 days of solar motion, whilst the true average daily motion of the moon would be 13.368 days of solar motion. The accuracy achieved would be one part in 2340 which, supplemented by occasional corrections based upon observation, would have provided an effective simulation of the moon's motion upon the ecliptic[8]. The location of the moon above or below the ecliptic could be represented by placing a moon marker on the outer or inner edge of the perimeter stones that would then have been seen as representing the ecliptic itself, calibrated in terms of lunar motion (see figure 4).

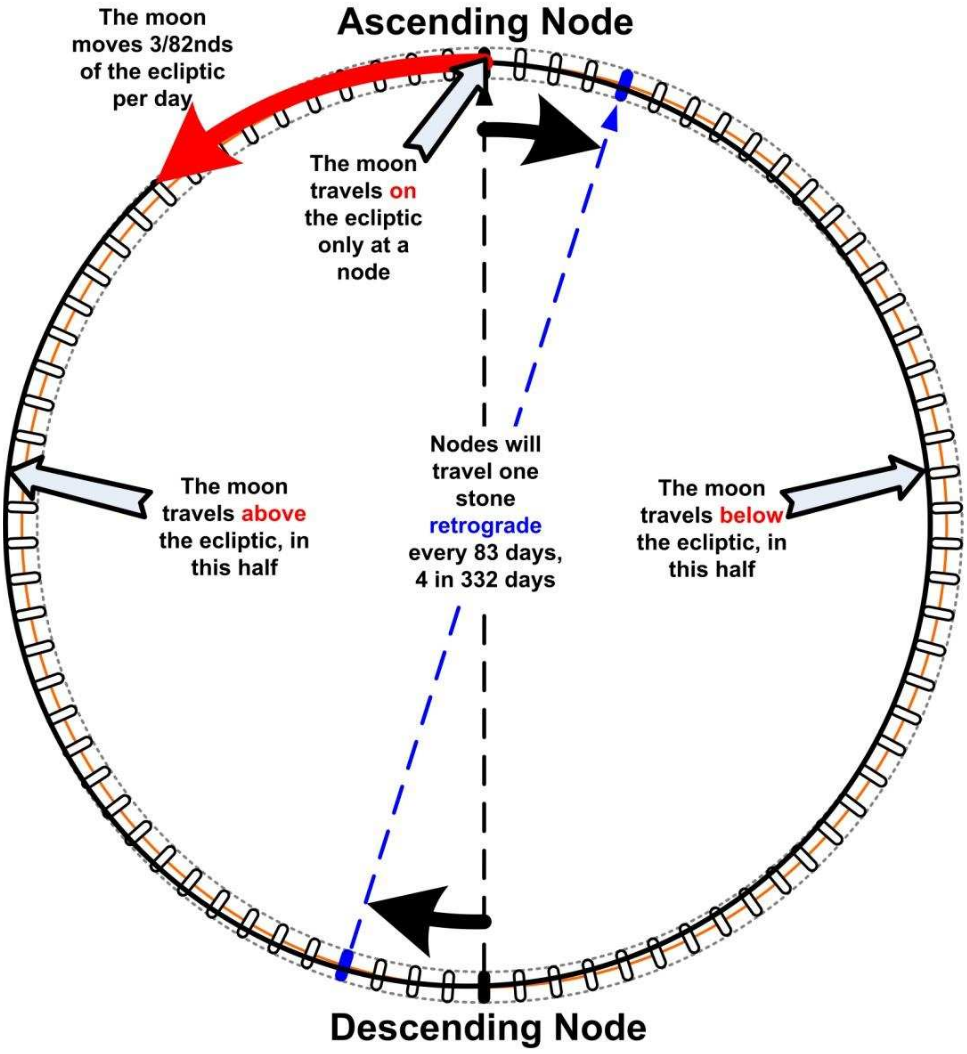

Figure 4 In addition to simply tracking the location of the moon along the ecliptic, its observed location above, on, or below the ecliptic can reveal where the nodes are and that their movement is retrograde. The length of the stones represents the 10 degree range of the lunar orbit above and below the ecliptic.

[8] We must note that the moon's daily motion is not constant but this accurate average is correct for each complete orbit. Also, whilst the moon moves in the sky at this rate, angular motion on the horizon is distorted by seeing the ecliptic edge on, solstice to solstice.

Implications of Simulation for Megalithic Astronomy

The operation of the simulator over time, supplemented with observation of the moon's nightly position with respect to the stars lying behind the moon at night, would have revealed a periodic oscillation in its ecliptic latitude during its orbit and this variation would also have been seen to move retrograde, that is counter, to the direction of the moon and sun.

It would be seen that at two moments during the sidereal month the moon lay upon and was crossing the ecliptic – at points we now term the lunar nodes – and if these also correspond with a full or new moon then these mark the only moments when eclipses occur. This knowledge would have enabled a significant leap in understanding the moon's complex motion.

The retrograde movement of these nodal points, backwards around the solar calendar, would have revealed that there were two periods each year when eclipses occurred, each separated by a period averaging about 173 days, that divide the 18.6 year nodal cycle into 38 eclipse seasons. The moon's extreme risings and settings to north and the south climax every 9.3 years in a major or minor lunar standstill and this would always coincide with the nodal axes lying across the equinoctial stars. In addition the extreme monthly positions of rise and set would be seen to always occur when the moon was placed in front of the solstitial stars.

There is therefore a shorter type of year that we call an eclipse year, of 346.62 days (two eclipse seasons of 173 days), the time taken by the sun to revisit the same lunar node, and we are suggesting that it was much easier to integrate and then quantify the above facts when using an 82 fold lunar simulator. It is even possible the Quadrilateral embodied eclipse year counts to present the short eclipse cycle today called the Octon, in which 47 lunar months approximate four eclipse years (as in figure 5 below) where the monument can be seen as 10 eclipse seasons of 173 day-inches in length.

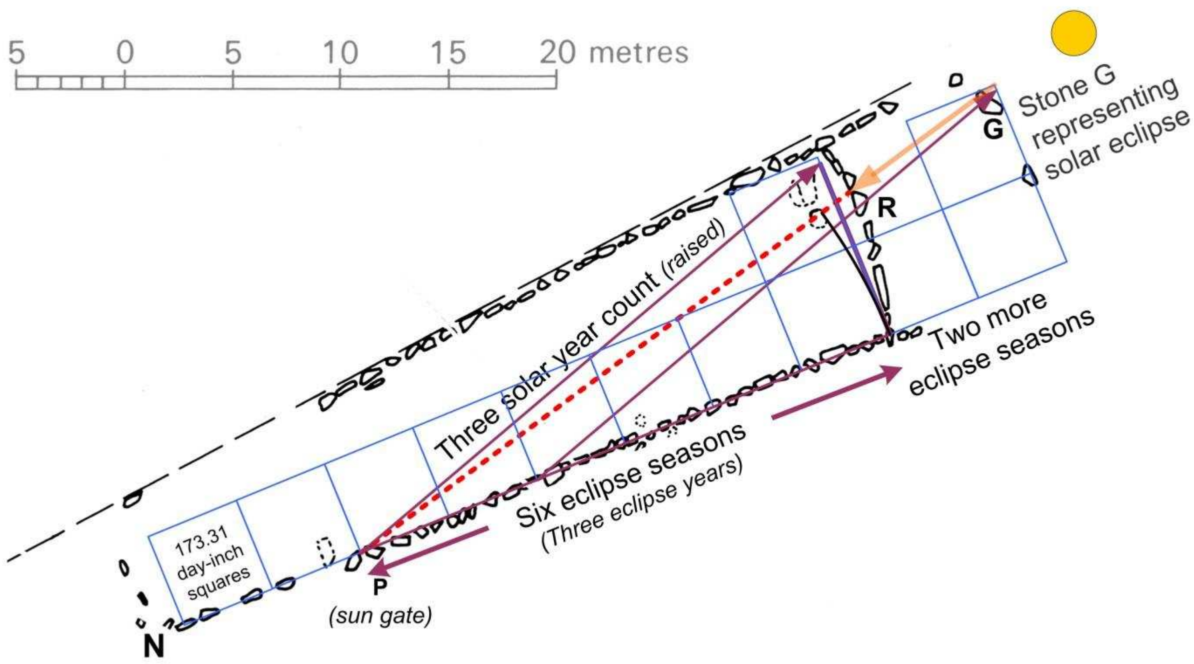

Figure 5 The day-*inch counting at Le Manio's Quadrilateral could have been developed,* through an 82-stone simulator, to incorporate the 173 day time periods between eclipses and then to note the 4 eclipse year periodicity called the Octon, shorter than the 18 year Saros period. The grooved stone G is then the moon eclipsing the sun as well as the solsticial sun in the three year day-inch count to stone R.

If the Quadrilateral were the megalithic equivalent of a textbook on astronomy, using day-inch counting, then the Octon was short enough in day-inches to be shown within this relatively small monument, which is only 5 eclipse years in length when using day-inch counting.

Figure 6 Stone G is the larger stone on the left, that could symbolise both summer solstice sunrise and eclipses within the Quadrilateral (to the right) which extends 5 eclipse years west. The far right near stone is 65 megalithic yards from the distant Geant menhir on the left.

CONCLUSIONS

Centred on stone 29 of the Quadrilateral's southern kerb, and below its kerb of stones, this fragment of an 82 stone circular setting, found during our survey of Le Manio, provides significant evidence that lunar astronomy assumed importance by 4000 BCE and was using an ad hoc geometrical metrology to quantify invariant ratios between astronomical time periods and then simulate the daily movement of the Moon using a metrological circle.[9]

We have shown how, through day-inch counting and the subsequent formation of an invariant triangle to East, the moon is found at the same point on the ecliptic, at around the same time of the day, every 82 days, because the moon's orbit takes on average twenty seven and nearly one third days to complete its passage around the zodiac.

In addition we have demonstrated how moving a moon marker anticlockwise by three stones a day around an 82-stone circle would have enabled an observer to know four important things:-

1. Where the moon was with respect to the Zodiac stars along its orbit.
2. Whether the moon was above, below or on the ecliptic.
3. Where the moon was likely to rise and set.
4. When, in the year, a full or new moon was likely to produce an eclipse.

[9] This was tried by Fred Hoyle in his On Stonehenge, Chapter 5 where he demonstrated the possible use of the 56 Aubrey Circle of post holes at Stonehenge for simulating the Sun and Moon plus moving a lunar nodes all according to simple numerical rules. Interestingly the ratio 27.32166 to 18.618 close to 82/56.

EPIPHANY

The ACEM Equinox event group blunders into the radial stones (beside foot, centre frame) whilst building a 5-12-13 triangle, all to demonstrate orientation of Quadrilateral (on left) to East (on the right). Robin Heath is constructing an intermediate hypotenuse within a 5-12-13 triangle and using the southern kerb *as the '13' side, dividing the '5' side into 3 and 2 units, and thereby forming* the invariant 3-12-√*153 triangle for the solar and lunar year. This constructio*n had never been found in an actual megalithic structure until 2009, when the Quadrilateral was shown to have this triangle centrally built into its construction whilst also, unexpectedly, demonstrating day-inch counting.

Remarkably, the intermediate hypotenuse terminates directly over the radial stones that, we propose, once formed part of an 82-stone simulator of the Moon.

[photo courtesy ACEM's Jean-Yves Collin]

APPENDIX:
A NATURAL AND ACCURATE PI, RELATED TO THE MEGALITHIC YARD

The value of 82/13 for 2 times Pi is not very accurate and this would require adjustment of a perimeter formed by a radius of 13 units. Such a method also presupposes that the megalithic astronomers used to work from the radius to form a circumference. In the course of our work we have had to question this presupposition since the work of relating a circumference to a radius was most likely to have involved an empirical process.

If one is looking for a circle which has an integer number of 82 inch lengths, a more natural approach is to form a rope of N times 82 inches long and then try to lengthen a radial rope until the circumference fits what the rope generates as a circumference. If N were made equal to six then the target rope length could be formed by adding an 82 inch length to itself, to give a length of 410 inches. Dividing this by Pi times two gives a radial rope 65.254 inches which is exactly two of the megalithic yards defined by the three year triangle of Le Manio, to one part in 18,500. The reason why 82 inches on the circumference is commensurate with megalithic yards on the radius is that the megalithic yard is 216/8 inches long whilst the ratio of 820/216 is accurately Pi, to one part in 18,500.

This value of Pi would have naturally emerged when looking for circumferences that divide by 82 inches and one already has the megalithic yard generated from the Quadrilateral as a unit length of 261/8 or 32.625 inches. This has ramifications beyond simple circular structures since the eggs and flattened circles found by Thom all manifest radial dimensions, as if they employed the megalithic yard in their construction. Once it was known that integer multiples of 82 inches on the perimeter led to rational radii in megalithic yards, then compound radial structures could also display this characteristic, providing only symmetrical alterations of the circle were involved, as is the case with most eggs and flattened circles. A prime local example is the egg of the western cromlech of Le Menec. Here Thom deduced a primary circle of radius 17 times 2.5 megalithic yards[10] (i.e. Thom's megalithic rods), extended radii of 32 megalithic rods and a completing radius of 7 times 2.5 megalithic rods. By employing radii in a balanced way within the egg design, the outer perimeter can divide by 82 day-inches to achieve a significant utility for the perimeter, in representing the lunar orbit.

In the case of the 82 stone circle at Le Manio, the circumference appears to have been chosen to be 17 units of 82 inches giving stones 17 inches apart. This length is then the same as that using 82/13 as an approximation to 2 Pi, namely 1394, whilst the inner radius would then be 221.862 inches or 6.8 megalithic yards, a number that preserves 17 as 17 divided by 2.5.

Le Geant Menhir (*Thom's stone M*)
Spring Equinox Sunrise at Le Manio 2010

[10] Equal to the 1394 inch circumference of the 82 stone simulator at Le Manio, if the "megalithic rod" used were 82 inches long rather than being 2.5 megalithic yards of 32.625 inches equalling 81.56 inches, half an inch the lesser.

This paper can generally be found at two websites.

www.AncientNumberScience.org

www.SkyandLandscape.com

through which updates and related matters published
and contact with the authors made.

