Megalithic Astronomy or Megalithic Moonshine?

By John R. Hoyle

Introduction.

In attempting to understand the reasons for building stone rings and erecting standing stones, a considerable number of researchers have regarded them as astronomical tools to act as calendars, to help early man to understand the cosmos and to aid the prediction and timing of eclipses. Much of this research is mathematical and is not easy to follow, with the result that many archaeologists have not been persuaded. The Website standingstones.com provides much of the astronomical information in a graphic form, which is easy to understand. The following paper is an example of one possible use of the vast amount of information that this website can provide.

Around fifty years ago, Alexander Thom, a professor of engineering at oxford, surveyed a large number of prehistoric sites and deduced where on the horizon the Sun, Moon and some stars would rise and set when seen from these sites. This necessitated using his theodolite to survey the sites and then plot the horizon altitude as seen from those positions. If a site was remote it could take days to get there and do the surveying. It was always possible that the weather could ruin the whole expedition. The same information could be obtained using large scale O.S. maps, but the accuracy was not quite as good and it was a very tedious process.

Thom concluded that many of these stone remains were indeed astronomical observatories for eclipse prediction, but his ideas were not well received and were even contemptuously dismissed as Megalithic Moonshine. Thom himself was relegated to the fringe, even though he had backed up his theories with a mass of accurate data. It also became increasingly difficult to obtain publication of anything relating to the design of megalithic rings or megalithic astronomy. Other researchers, myself included, worked quietly on the subjects and made substantial progress. Books such as ***Alexander Thom - Cracking the Stone Age*** *by* Robin Heath and ***Megalithic Matters*** by John R. Hoyle continued to follow Thom's ideas. The website **standingstones.org** enables a great leap to be made in the subject as it provides highly accurate data for many thousands of megalithic sites for the skylines and rising and setting points of both Sun and Moon. The following article merely scratches the surface of what is possible.

Background.

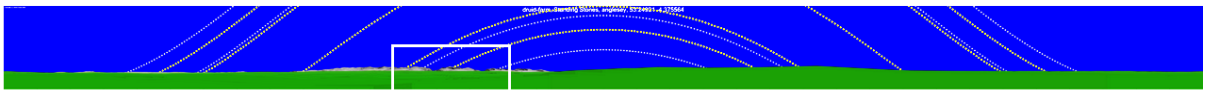
Whilst I was following in Thom's footsteps, surveying stone rings and assessing their astronomical significance, my son David was programming the computer to use essentially the same process, to produce accurate representations of the skyline as seen from selected positions, such as standing stones, stone rings, or any other remains that may be of interest. This was made possible because the Ordnance Survey had tabled the heights of land throughout the UK at regular and frequent positions and this information had been made public. He later discovered that NASA had tabled similar information, but to a higher degree of accuracy and the distances between the points was less, enabling the final drawing to be of higher quality and accuracy. Some of the skylines use LIDAR data provided by the Environment Agency. This gives still higher resolution although the coverage of the U.K. is incomplete, it does cover 80% of the country . David also darkened the colour shade where the land was steeper, so it is often possible to see steep slopes, tracks, roads and even tumuli. This is particularly impressive in the rendering of mountains.

In this way several thousand skylines were produced covering not just the U.K. but many other countries as well and these have been made available on this website:

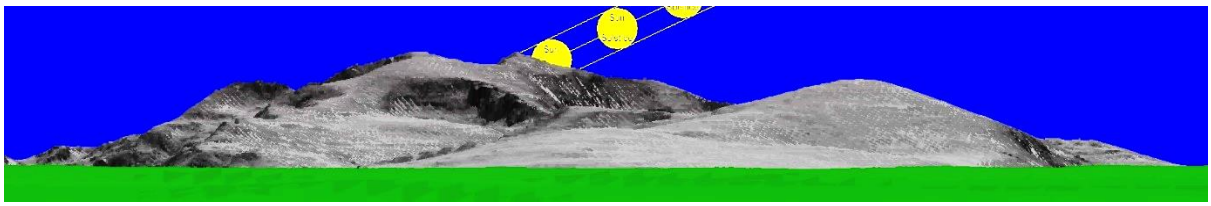
Important positions of the Sun and Moon have been superimposed on the sky, so it is possible to determine in a few minutes what would have perhaps taken Thom days to obtain.

The accuracy of the reconstruction was of the utmost importance and corrections have been made for the curvature of the Earth and atmospheric refraction, or the average value of it. The illustration below shows part of the skyline as seen from Druid Farm Standing Stones on Anglesey.

This site would provide a very sensitive test for the winter solstice sunrise, as the top of the rising Sun would be on the limit of visibility in the dip to the left of the summit of Snowdon.



The above illustration is the complete skyline as seen in the program. The portion in the white rectangle is shown below, highly magnified. When using this website the white rectangle can be moved around to select different portions and its size can be changed to obtain different magnifications.



The content of the white rectangle is automatically shown below the complete skyline as illustrated above and shows the Sun at the Winter Solstice rising behind the summit of Snowdon. The backsight is at Druid Farm, SH416751, Lat. 53.24921, Long. -4.375564.

The significant positions of the Sun and Moon superimposed on the sky are:

Starting from the left in order:

1. Most northerly Rising of the Moon at a Major Standstill.
2. Rising of the Summer Solstice Sun.
3. Most northerly rising of the Moon at a Minor Standstill.
4. Sunrise at the equinox.
5. Most southerly rising of the Moon at a Minor Standstill.
6. Rising of the Winter Solstice Sun.
7. Most southerly rising of the Moon at a Major Standstill.
8. Most southerly setting of the Moon at a Major Standstill.
9. Setting of the Winter Solstice Sun.
10. Most southerly setting of the Moon at a Minor Standstill.
11. Sunset at the Equinox.

12. Most northerly setting of the Moon at a Minor Standstill.

13. Setting of the Summer Solstice Sun.

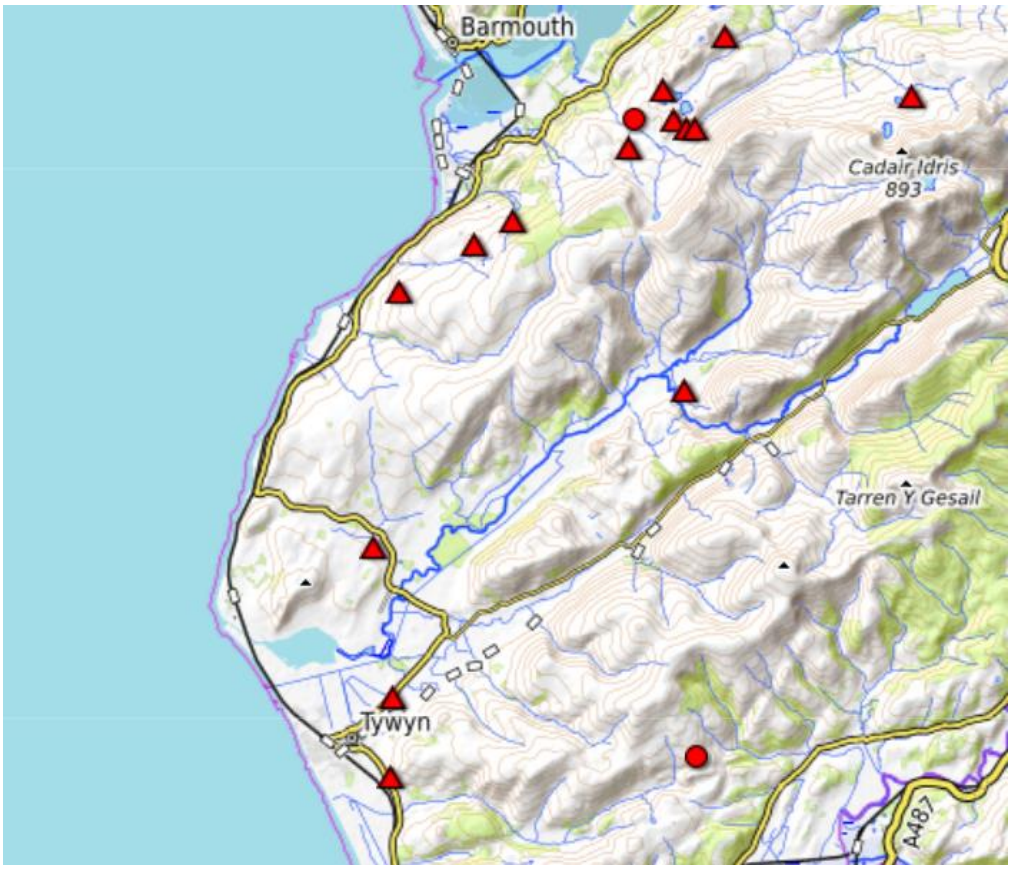
14, Most northerly setting of the Moon at a Major Standstill.

The curved arcs in the sky are not the actual paths of the Sun and Moon at the indicated times, but are limiting values of these paths, although in the case of the Sun at both the winter and summer solstices, there is virtually no difference. The Moon though moves from one limit to the other and back again in a period of about four weeks and so spends only a short time at its limiting position.

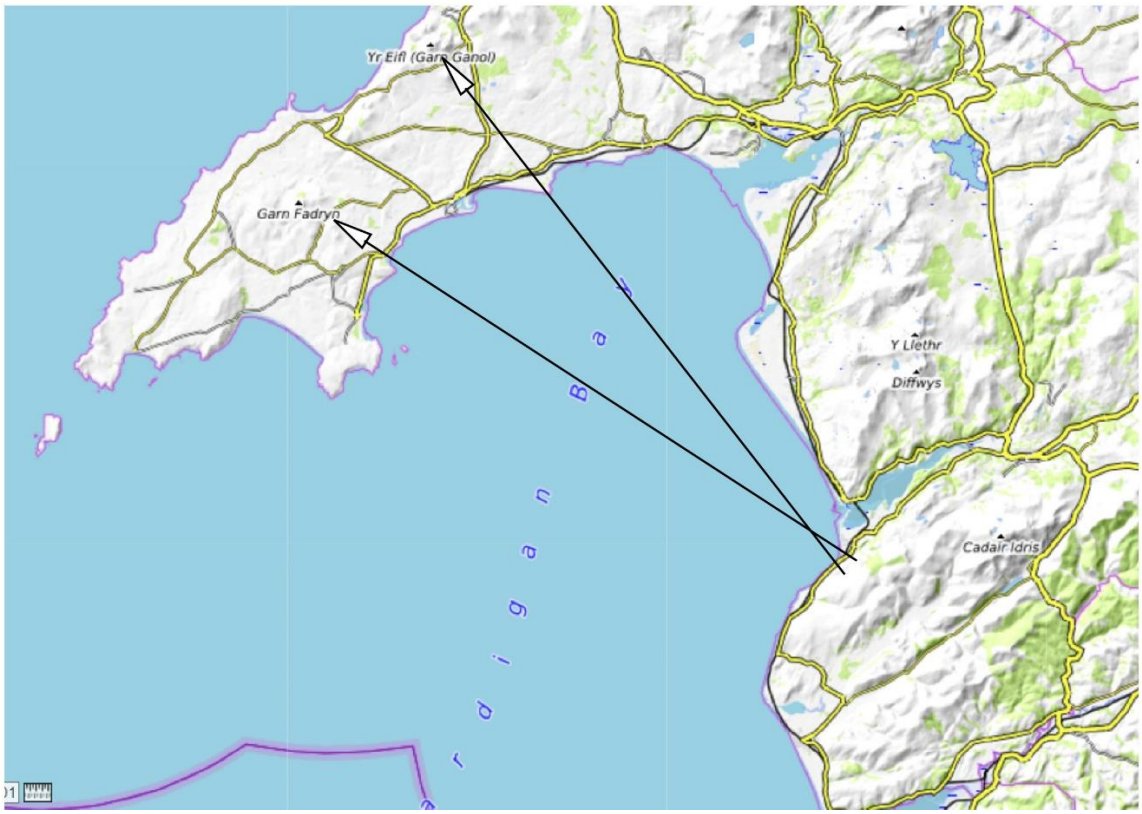
On some of the skylines there are two other solar lines known as cross quarters. These give the positions of the Sun at the times half way between the Solstices and the Equinoxes and thus divide the year into eight equal parts.

Purposes of rings and standing stones

A great many suggestions have been proposed for the building of rings and the erecting of standing stones. The theory considered here is that many of them were erected to study the movements of the Sun and Moon. In the past it has not been easy to obtain the necessary information without visiting the site and making accurate measurements of both the altitude and azimuth of much of the horizon. It also requires a considerable mathematical ability to determine where the Sun and Moon would rise and set. This program provides much of this information at the press of a few keys and the following examples, mainly chosen from a relatively small area within about ten miles of the mountain Cadair Idris, illustrate what the program is able to do. The sites were deliberately chosen from this small area to limit the number of examples, so that all the sites could be considered.



Map of the area showing many of the sites.



Major and minor Moonsets over the Llyn Peninsula, as seen from Waun Oer over the Rivals and Bryn Seward over Carn Fadryn.

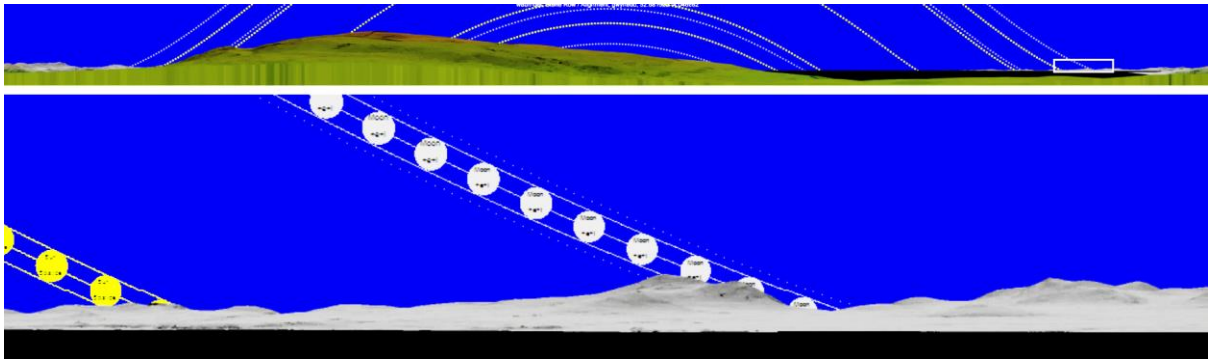
The Waun Oer Stone alignment.

Position SH 6174 1128. Lat. 52.6815 Long. -4.0467

This alignment is situated in Southern Gwynedd overlooking Cardigan Bay and it has a clear view towards the Lleyn Peninsula in the North West. The Alignment itself is roughly at right angles to the view over the bay. It is ideally situated to study the northernmost moonset at the Major Standstill behind the hills called The Rivals.

The top part of the picture shows the complete skyline, starting with north on the left, then east, south in the centre followed by west and then north again on the right. The small rectangle towards the right hand side encloses an area of the northwest part of the horizon, which is shown enlarged below. This rectangle can be dragged by the cursor to any part of the skyline. Two tracks can be seen in the area selected. The one on the left is the track of the setting Sun at the Summer Solstice and the one on the right the Moon at its extreme northerly setting point over the mountain called The Rivals, at the Major Standstill. By observing moonsets on successive days it would not be difficult to determine the approximate time when the Moon had reached its most northerly moonset position. The observer could move to different parts of the alignment to fine tune the observations to find a position where the edge of the Moon is seen to graze the mountain top.

As seen from Waun Oer.



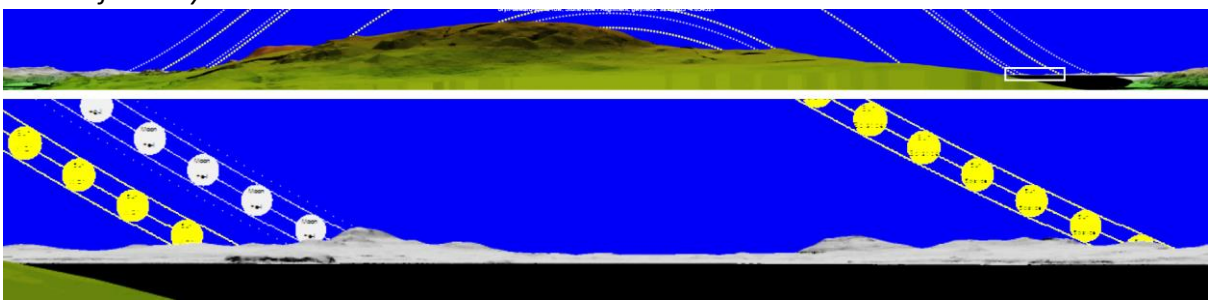
Sunset Summer Solstice behind the Rivals. *The Rivals.*

The Bryn Seward Stone Alignment

Position SH 623 117 Lat. 52.6861 Long. -4.0343.

This alignment has a similar situation and orientation to the Waun Oer alignment but is about 1km. to the north east. It is in a position to make observations of the most northerly setting of the Moon behind Carn Fadryn at the time of the Minor Standstill. The following illustrations show the limiting paths, from left to right, of the Sun when half way between the equinoxes and the summer solstices, then the Moon setting behind Carn Fadryn at the Minor Standstill and lastly the Sun at the summer solstice.

As seen from Bryn Seward.



Carn Fadryn *Sunset Summer Solstice.*

The view, as with the Bryn Seward alignment, looks towards the Lleyn Peninsula. By moving to the right along the alignment, a positions could be found from which the top edge of the Moon, as it set, would just graze the slope of the mountain Carn Fadryn.

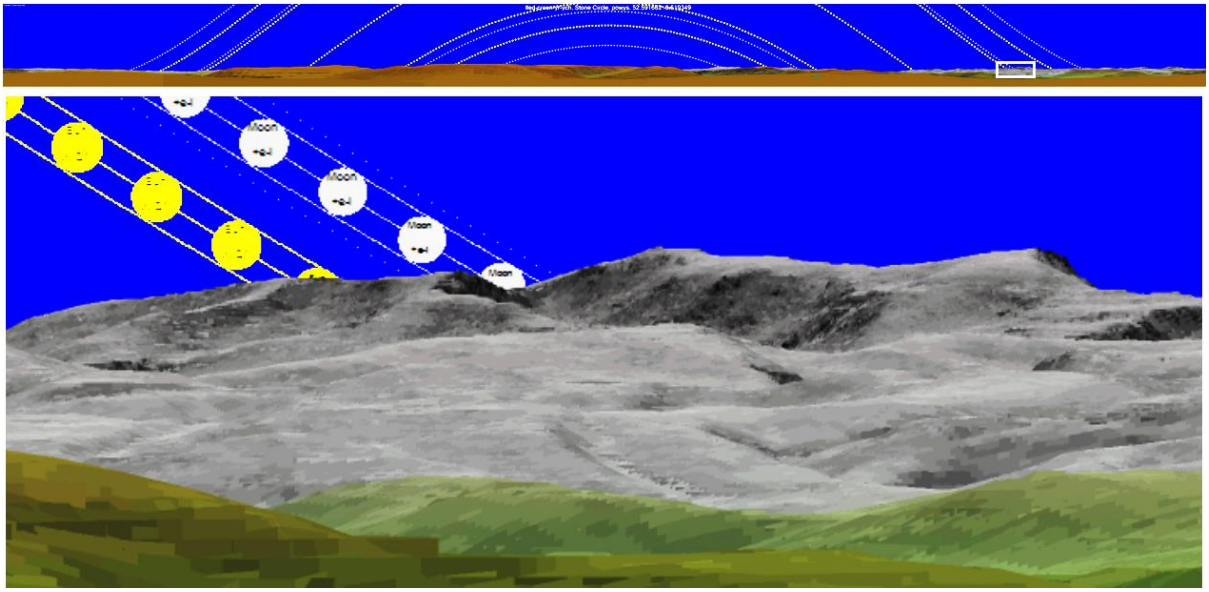
Contrary to what has often been stated, the direction by the alignment is not particularly important, it is the direction at right angles to this that is the important aspect of it. The importance of these alignments is that they enable observers to follow the setting points of the Moon on successive nights by moving to different parts of the alignment and so determine when the Moon had reached its extreme position. As long as the weather is clear, it is a simple and accurate way of following the motions of the Moon.

Note that the above illustrations do not show the Moon setting with the top edge grazing the hill slope. To see this the observer would have had to move to a different part of the alignment. In the case of Waun Oer the observer would have had to move to the left and with Bryn Seward, to the right. Both would have been possible within the lengths of the alignments and the positions would have been marked in some way. The two sites together would have enabled an observer to study the major and minor standstills from nearly a single location and follow the northerly setting points

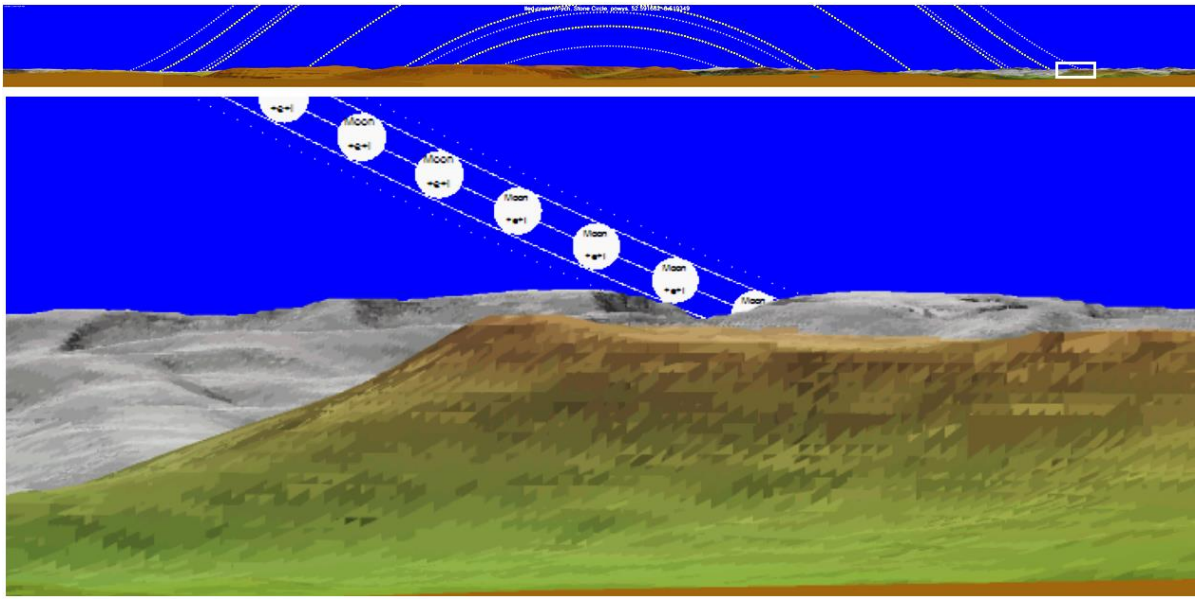
of the Moon over the whole 18 year Saros Cycle. The summer solstice sunset could also have been determined from either, or both, positions using less imposing hills as foresights.

Stone circles Cerrig Gaerau GR 9029 0048 and Lled Croen yr Ych GR 9044 0055.

These two stone circles lie on the hills to the south of Lllanbrynmair. Cerrig Gaerau was probably destroyed in ancient times, as the stones appear to have been thrown down. The other is Lled Croen-yr-Ych which is larger than its close neighbour, but is made from smaller stones. It also has an outlying stone. From these rings there are very extensive views from southwest to north. The top part of the following illustration, shows the complete skyline starting at north. The bottom section shows the part selected in the white rectangle and is greatly enlarged. The first pair of pictures shows the gap in the mountains where the Moon, at the time of the Minor Standstill sets, and it lies between Craig Cae to the left and Cadair Idris. Just below the setting point is Llyn Cae, but it is hidden from view. The second pair of illustrations show the moonset at the time of the Major Standstill in the gap in the ridge to the northeast of the hill Wein Oer.

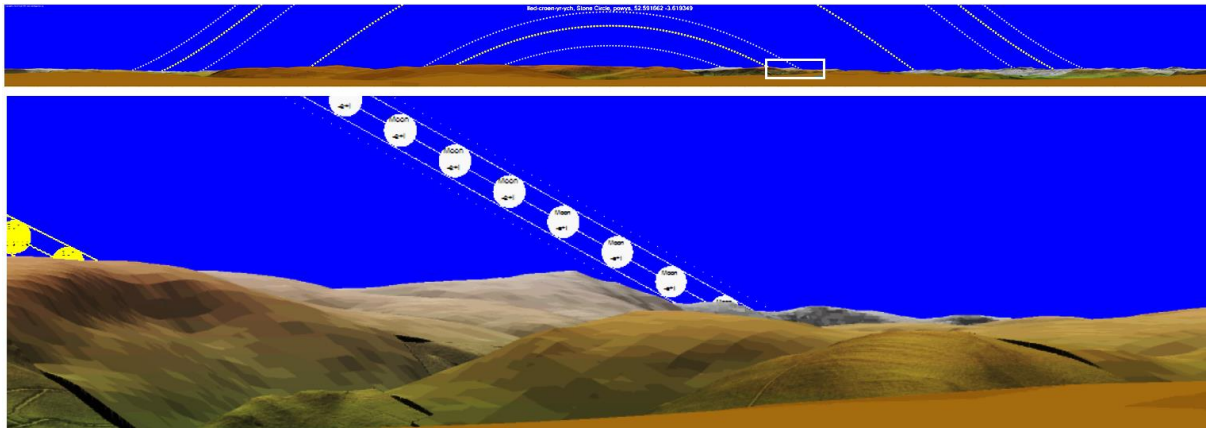


The most northerly Setting of Moon from Lled Croen yr Ych at the Minor Standstill. It sets between Craig Cae and Cadair Idris. (The Sun's setting point (at a cross quarter date) is not marked.)



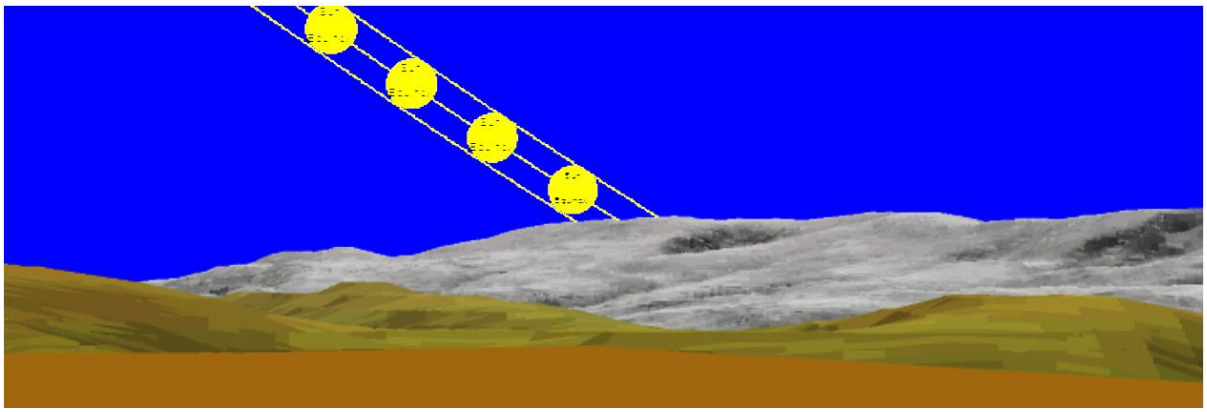
The most northerly setting of the Moon from Lled Croen yr Ych at the Major Standstill, to the north of the hill Wein Oer.

What is also quite well marked is the most southerly setting point of the Moon at the Minor Standstill. The observer though would have to be familiar with the site in order to identify the sightline correctly.



Southerly Moonset at the Minor Standstill from Lled Croen yr Ych.

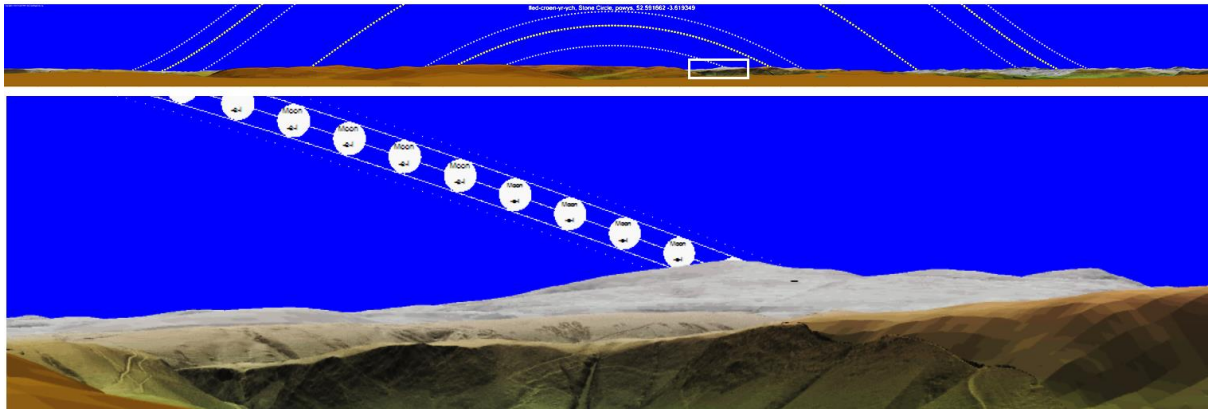
The **equinoctial sunset** takes place over the top of a rounded hill and does not look to be of particular significance. However this setting takes place to the east of Tywyn over the hill Trum Gelli. On the top and visible is a group of three cairns. The last trace of the setting Sun at the equinox takes place between the most northerly pair of these. These cairns have long puzzled me, but it now seems that they could have been markers for the equinoctial sunset when viewed from this Stone ring.



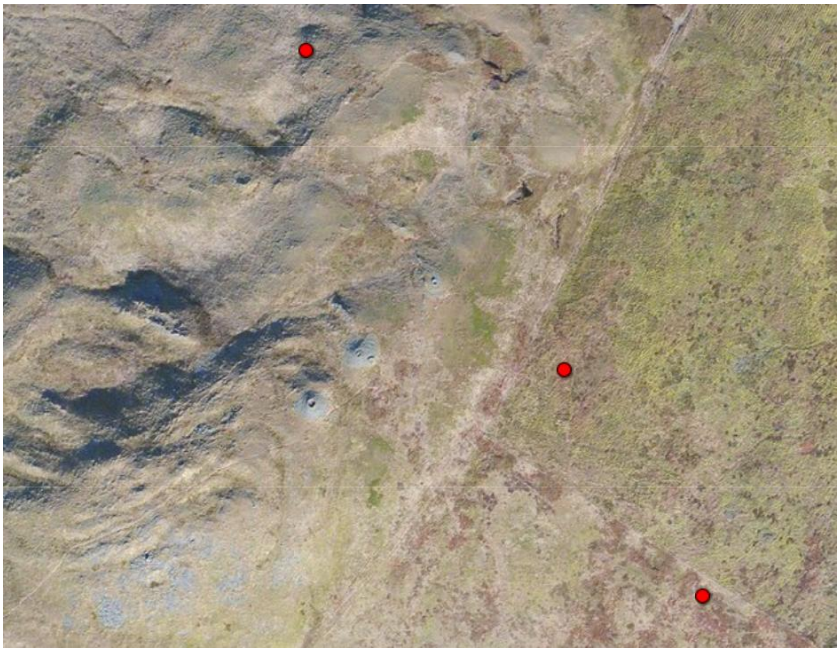
Equinoctial sunset over Trum Gelli. As seen from Lled Croen yr Ych.

Two of the cairns on Trum Gelli

The most **southerly moonset** at a Major Standstill takes place over another gently rounded hill top. This is Pen Pumlumon Arwystli and again there is a chain of cairns around the top, which are large enough to be visible and mark the setting position.



Major Standstill southern moonset over Pen Pumlumon Arwystli. From Lled Croen yr Ych.



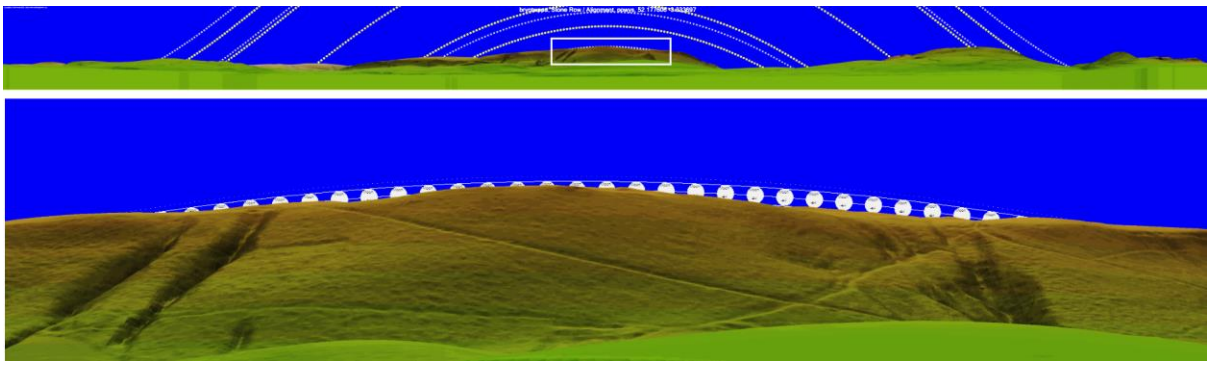
Cairns on Pen Pumlumon Arwystli. The three red circles are the setting points for the top, middle and bottom of the Moon as seen from the ring which is to the north east.

This site is quite remarkable in that all four lunar setting points are indicated, as well as the equinoctial sunset. Three of the five have natural foresights and the other two have man made ones in the form of cairns. Finding a site from which five of the seven important setting points are visible and well indicated is a remarkable achievement.

Cerrig Gaerau appears to have been demolished in ancient times and replaced by the ring Lled Croen yr ych, a ring a little to the north east. This may have been due to the decrease in tilt of the Earth's axis, as that would have made the setting points, as seen from Cerrig Gaerau, inaccurate.

Bryntwppa. Stone row. Powys.

GR SO 0890 5410 Lat. 52.177606 Long. -3.33697

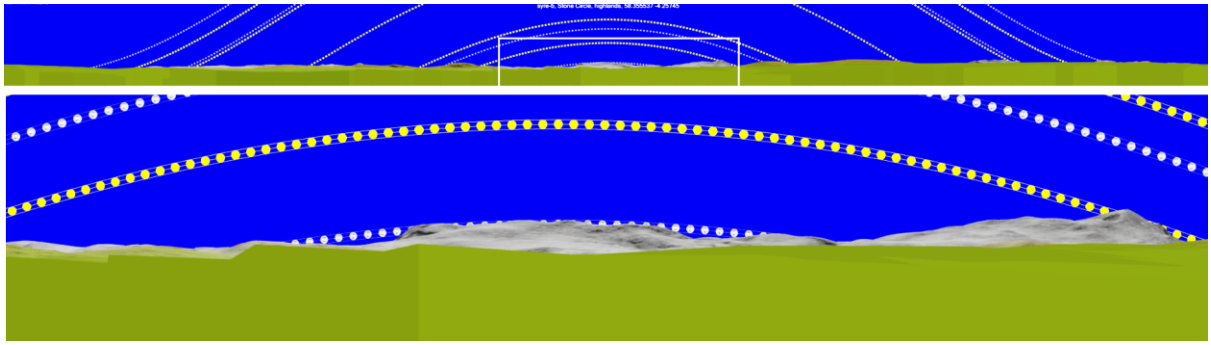


View of southerly limit of the Moon as seen from Bryntwppa.

Bryntwppa is a short alignment of three stones. It is aligned East South-East to West North-West. The actual path of the Moon as it approached its extreme southerly limit would be a little above the path shown above. It would then gradually merge with it, before very slowly rising above it.

Bryntwppa is not in the area which contains the other sites. It is though, a very good example of sites which could be used to track the movements of the Moon. Such sites are not uncommon, particularly in Scotland, as being further north the Moon's path is lower in the sky and it is easier to find hill tops that have a similar shape to the Moon's limiting position.

An example from Northern Scotland: **Syre B.**



From Syre b Stone Circle. Northern Scotland.

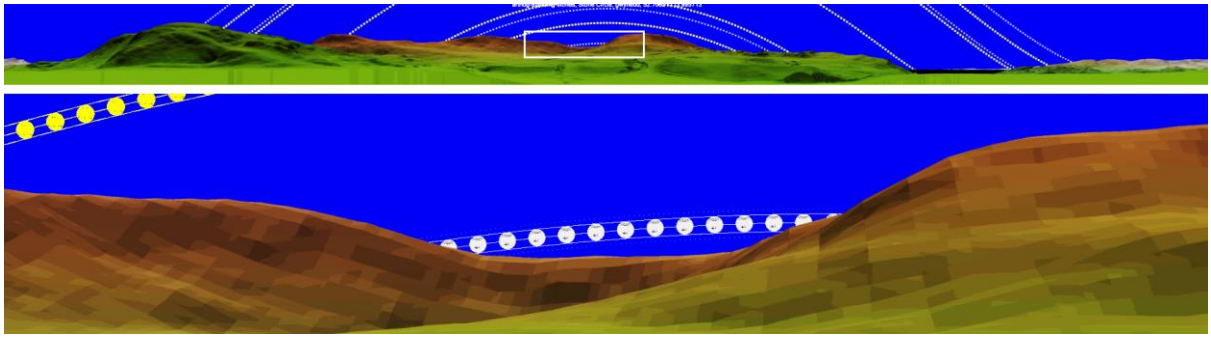
One of the problems in using this type of site is that the Moon can only be followed for about two or three hours and the Moon probably will not reach its minimum position during that period. It would also take skill and experience to estimate how the actual path of the Moon deviates from the minimum track.

The Arthog Standing Stones and Planwydd Helyg Standing Stone

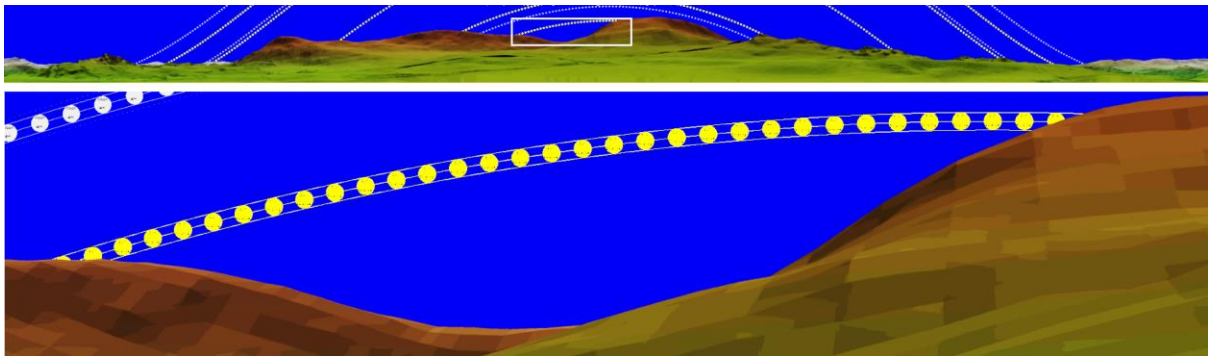
GR SH 6526 1393 Lat. 52.7062 Long. -3.9957

GR SH 6516 1325 Lat. 52.7001 Long. -3.9969

These two sites in combination can be used in a radically different way to study the movements of the Moon. There are indications that the winter solstice sunset and the moonset at the minor standstill could have been studied, but they are not very convincing. The feature that stands out is the fact that the Moon in its lowest position, when seen from The Arthog Standing Stones passes low down through a gap between two hills, but does not skim the bottom of the gap. At the same time the lowest track of the Moon cannot be seen at all from the Planwydd Helyg standing stone, which is almost due south of the Arthog Standing stones. It follows that from some point in between the Arthog Standing Stones and Planwyth Helyg the Moon would be seen just skimming the lowest part of the gap. This spot from which this is visible could be marked by placing a stake in the ground. By repeating the operation on successive nights it would be quite easy to obtain some idea of when the Moon had reached its lowest position. The distances from the Arthog Standing Stones and these stakes would give some quantitative measure of the height of the Moon. The smaller the distance the lower the position of the Moon. Unfortunately the relationship between the distances and the positions is not a simple one and depends on a whole list of factors, such as the slope of the land, the shape of the cross section of the dip along the line of sight, and the distance from the stones of the observing point. Even so, if used, this technique must have been one of the first applications of mathematics to astronomical problems.



View from Arthog Standing Stones.



From Planwyth Helyg Standing Stone. This stone is a short distance to the south of the ring. No trace of the limiting position –(e+i) is visible from this standing stone.

The Pennal Observatory.

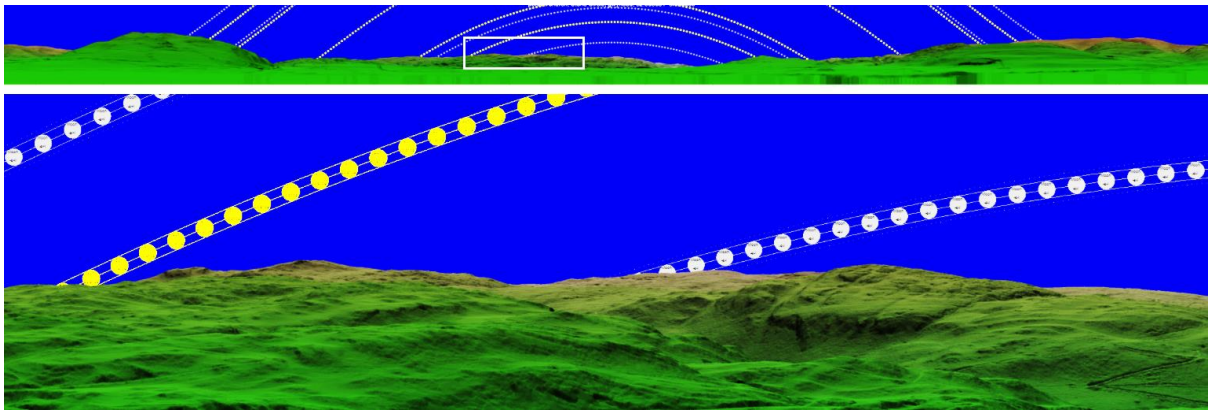
Alexander Thom in his book Megalithic Lunar Observatories, describes the essential features that observatories must have had if they were to provide accurate and meaningful information on the movements of the Moon. It is not surprising that many archaeologists found it difficult to accept that Neolithic man could devise such advanced observatories, particularly as these observatories appear to have emerged fully developed. It seemed like a step too far. The proposed method of observing at the Arthog Standing Stones though does give an indication of how these ideas could have developed.

The difficulties in obtaining accurate observations with the Arthog Standing Stones observatory have been listed. In the Pennal observatory these difficulties have been overcome in ingenious ways. The ill-defined gap between two hills has been replaced by a hill top cairn, behind which the Moon can be seen to rise. The errors due to moving closer to the gap are eliminated by moving at right angles to the direction of the hill top cairn so that the distance to the cairn remains constant and finally the valley floor provides a large flat area from which to observe. These changes transform a rather crude, but effective observatory into one of precision and a clear line of historical development can be detected.

The church in Pennal has an oval churchyard wall and local opinion has it that the church has been built in the site of a prehistoric stone ring. The wall of the churchyard contains several large stones, some of which are composed of white quartz, which supports this idea. The south part of the wall has been moved at least twice to enable the road to be widened, but the north and eastern parts of the wall may still be close to the perimeter of the original stone ring. Two hundred and ninety metres to the west south-west is the mound Tomen Las and it is in almost perfect alignment with the axis of the church. The general opinion is that it is medieval, but as it in the exact position to observe the moonrise exactly one day before or one day after the Moon had reached its most

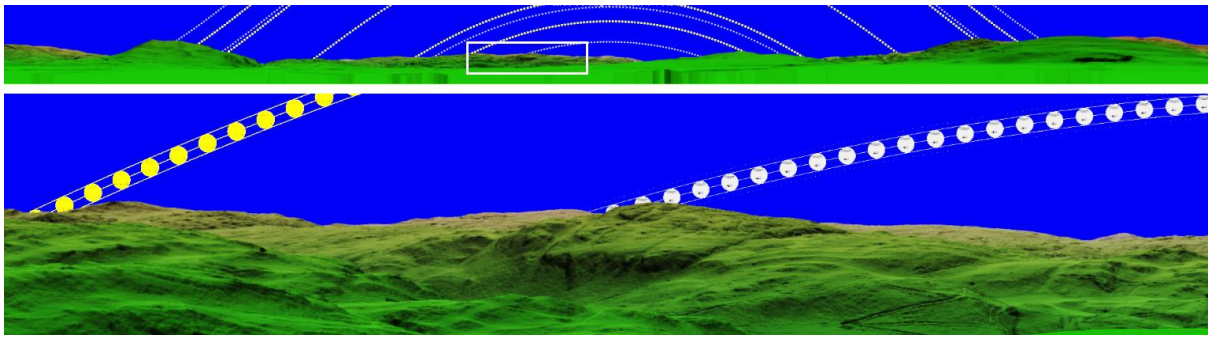
southerly position, it could well be a part of a lunar observatory, as described by Thom. It follows that at the time of the major standstill, the most southerly moonrise over the hill top cairn, could always be observed from a position between Pennal Church and Tomen Las. Tomen Las also gives a good indication of the winter solstice sunrise. From the Church the equinoctial sunset takes place in the west behind the small stone circle called Eglwys Gwyddelod. There is a second mound similar to, but smaller than Tomen Las, to the north of the main road, from which the upper limb of the Moon will be seen to skim the hill top cairn at the time of the Major Standstill. This site is an excellent example of a megalithic lunar observatory and it is one of the most perfect examples in Britain. It deserves to be better known.

View of the extreme southerly moonrise as seen from the Church. The Pen Carreg Gopa cairn is not visible in the horizon profile, but is clearly visible to the naked eye.

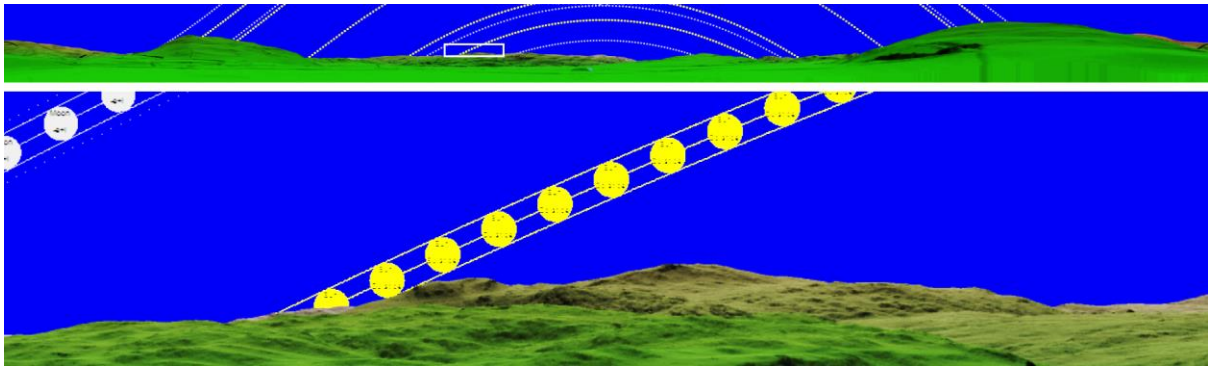


From Pennal Church *Moonrise over the cairn.* ^

View of the extreme southerly moonrise as seen from Tomen Las. One day before or after this, the Moon would be seen to rise above the Pen Carreg Gopa cairn, as in the above illustration.

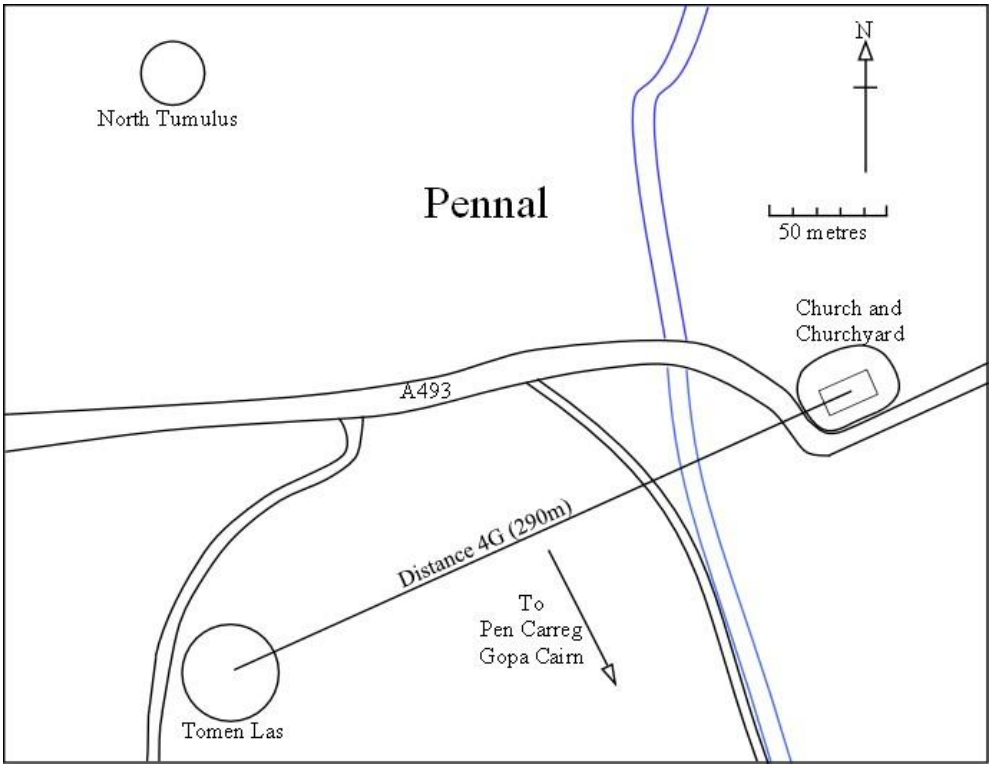


The extreme southerly moonrise as seen from Tomen Las. The winter solstice sunrise is also indicated.



Winter solstice sunrise from the North Tumulus

The map of the area is shown in the following illustration.



Eglwys Gwyddelod. SH 6628 0018

Eglwys Gwyddelod is a small ring in the hills due west of Pennal. From the ring there are no convincing features that could be useful for astronomical observations, as the view to the southeast is blocked by a nearby hill. There are however other features which appear to be of interest. To the north of the ring is a track cut into the hillside and heading in a north easterly direction. A short distance up this track, on the right, there is a cutting aligned to the south east. At the junction of the track and this cutting a distant hill, Pen Creigiau'r Llan, comes into view in line with cutting, as shown in the following illustration. The arrow indicates the position.

Summit of Pen Creigiau'r Llan ↓

Photograph taken from the junction of the track and cutting.

A little higher up the track another track joins it from the left. This track heads in a west southwest direction and at a point directly above the junction of the lower track with the cutting there appears to be a portion which has been built up to form a small platform. From this platform, Pen Creigiau'r Llan would mark the most southerly moonrise position at the time of the Minor Standstill. A little further along the upper track the main mountains of Mid Wales come into view. Pumlumon, the highest mountain in Mid Wales is visible and marks the winter solstice sunrise, with the lower limb of the Sun grazing the summit cairn.

Pen Creigiau'r Llan ↓ *Pumlumon* ↓

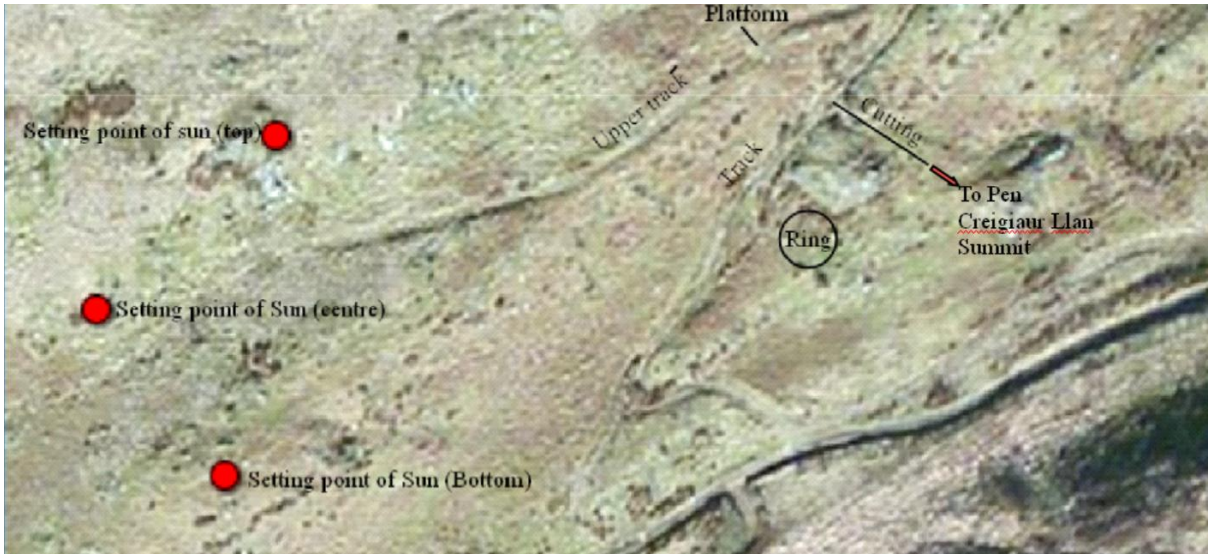
Photograph from near the centre of the upper track looking southeast.

↓ *Pen Creigiau'r Llan* *Pumlumon* ↓

Skyline showing the southerly rising point of the Moon at the Minor Standstill and the rising point of the Sun at the winter solstice as seen from the platform. Pen Creigiaur Llan is more obvious in the photograph and also to the naked eye than in the above skyline.

The following map shows the features described above. It also shows the equinoctial setting points of the Sun as seen from Pennal Church. The equinoctial sunset would therefore be seen immediately behind the Eglwys Gwyddelod ring.

Map of the area.



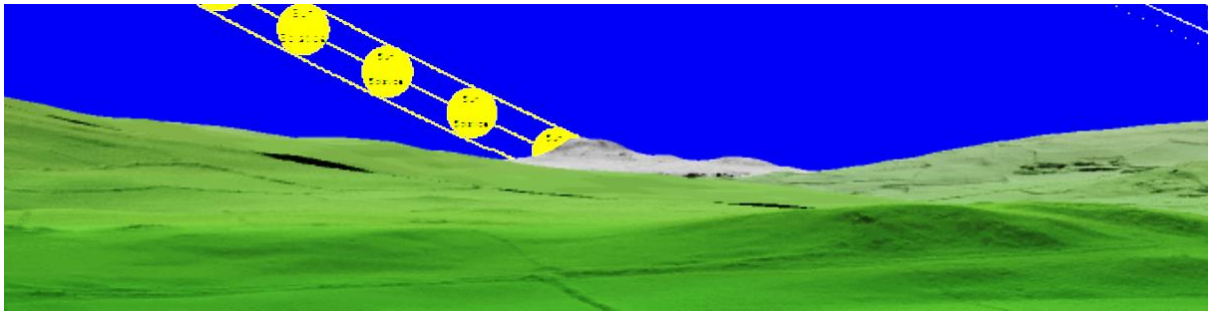
Eglwys Gwyddelod illustrates the fact that, at times, there is no substitute for a visit to the site. The skyline program though can provide information that would be difficult to obtain in other ways.

Other sites in the area.

Castell Cynfael (Bryn Y Castell) SH 6151 0161

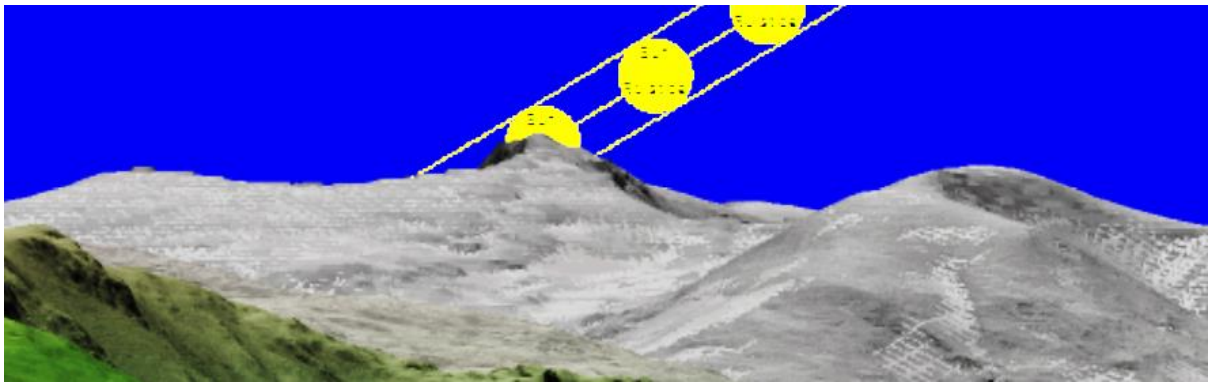
Frances Lynch in *A Guide to Ancient and Historic Wales. Gwynedd,* states that "*This is a castle Mott formed by cutting a deep ditch around the upper part of a small hill. It is known to have been constructed by Cadwaladr in 1147*." As this "mott" is ideally placed to observe the summer solstice sunset at about 3000B.C. it could be that Cadwaladr fortified a much earlier structure.

Summer solstice sunset behind Carn Fadryn. (At 3000 B.C.)



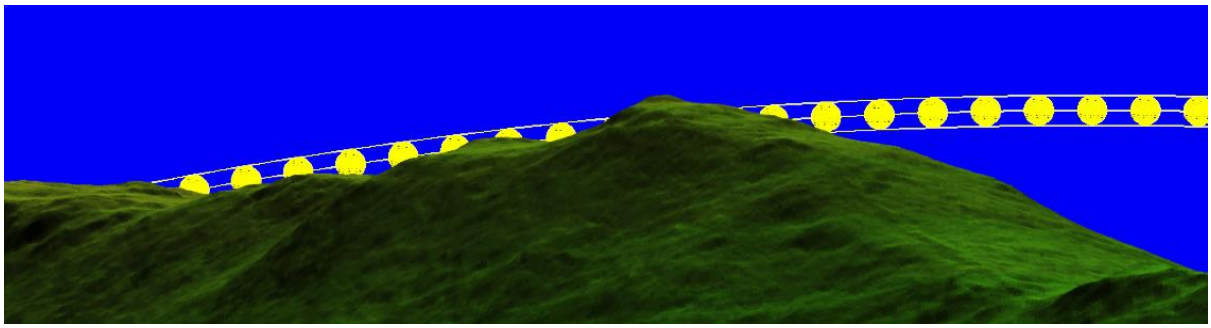
Waun Fach Standing Stone. SH 594 048

Summer solstice sunrise behind Cadair idris.



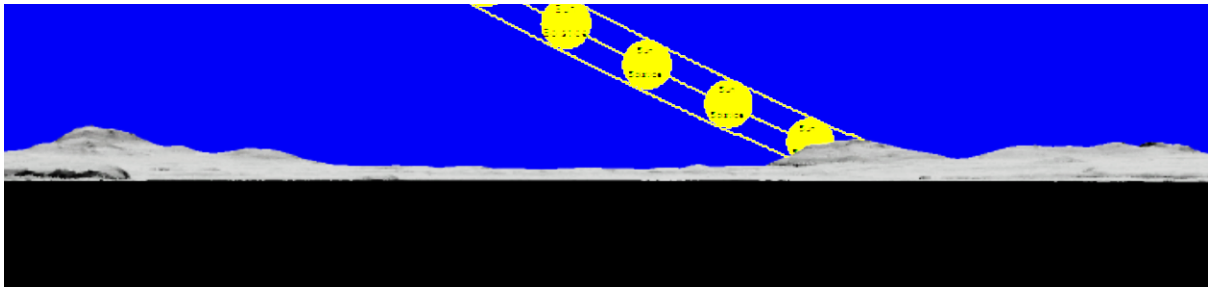
Caer Berllan. SH 6623 0798

Winter solstice sunrise.



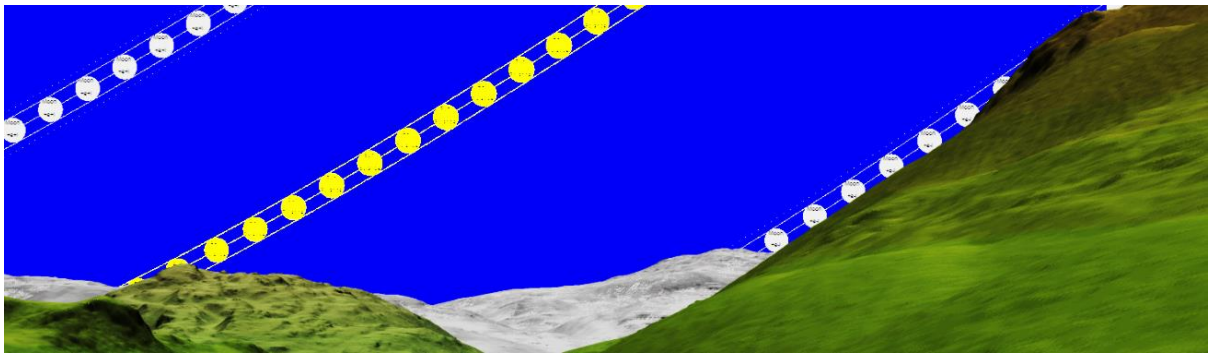
Gwastad Goed Standing Stones. SH 601 103

Summer solstice sunset.



Rhos Hafotty Stone setting. SH 6659 1362

Summer solstice sunrise. Minor standstill northerly moonrise.

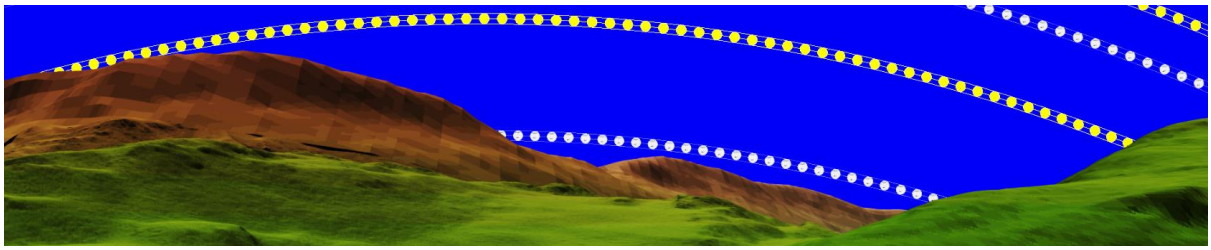


Rhos Hafotty standing stone. SH 6642 1363

No convincing sightlines.

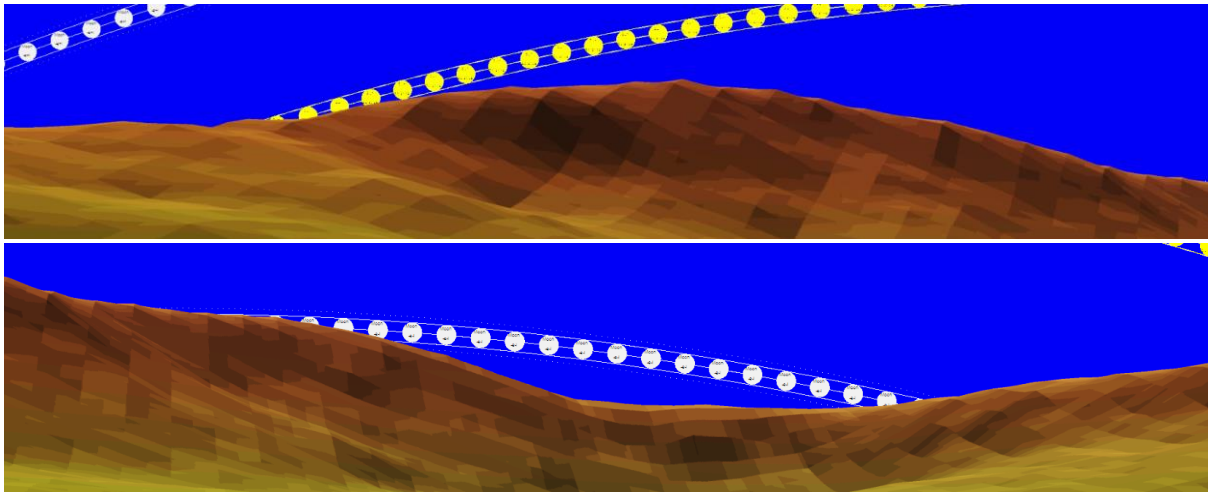
Tyn Llidiart Standing Stone. SH 673 156

Winter solstice sunrise. Moonrise, southerly limit, Minor Standstill.



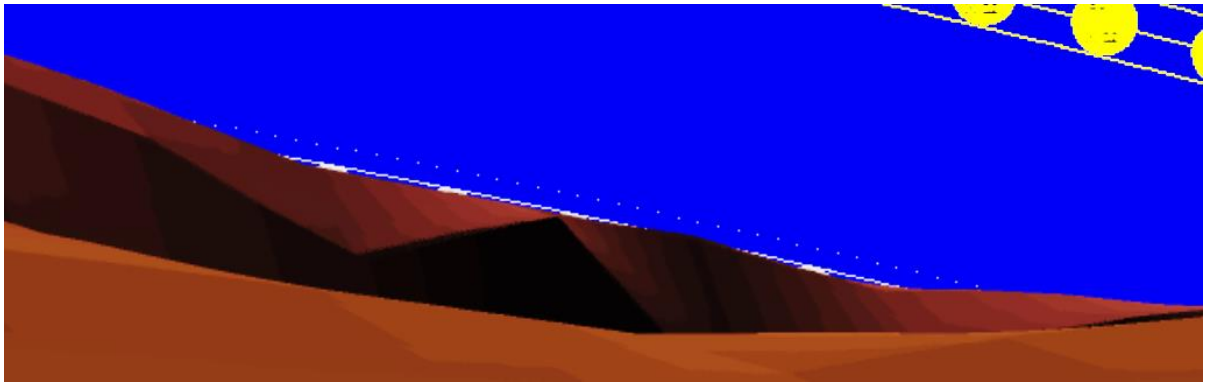
Carreg y Big Standing Stone. SH 6617 1384.

Winter solstice Sunrise. Also possible observations of the Moon at its most southerly position.



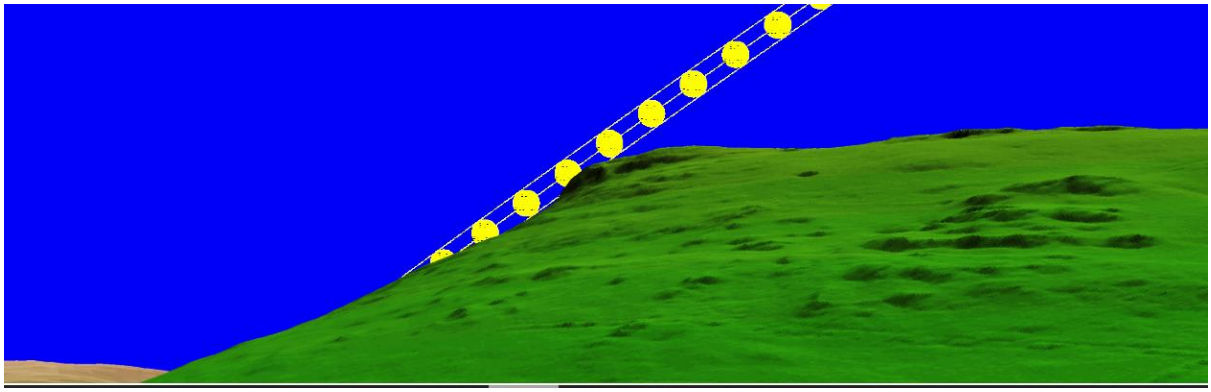
Llyn Gafr. Standing stone. S H 713 142.

Southerly limit of Moon at Major Standstill.



Croes Faen standing stone. SH 5968 0154.

Equinoctial Sunrise.

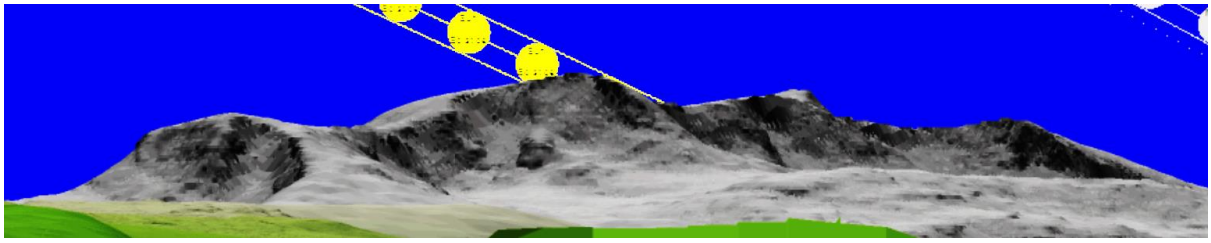


Esguan standing Sstone. SH 5961 9984.

Southerly limit at the Major Standstill Moonset behind the most distant visible hills in Pembroke.

Dolddeuli standing Stone. SH 826 236.

Winter solstice sunset behind the eastern summit of Cadair Idris at 2000B.C.



Notes on the above sightlines.

Of all the fourteen lunar and solar rising and setting points, only the most northerly rising point of the Moon at the Major Standstill is not indicated by one or more of the sightlines. This may be because the geography of the area makes it difficult to see distant hills to the north east.

Some of the sites, such as The Arthog Standing Stones, and Eglwys Gwyddelod, have no sightlines that are obvious, but they seem to be part of complexes that work in conjunction with other archaeological features around them, as previously described. This could be true of other sites and we must not make simplistic assumptions about how Neolithic people could have used these archaeological features for astronomical purposes. Although this website can provide a vast amount of information that is not otherwise easily available, there is still no substitute for a personal visit and a detailed examination of the sites and their surroundings.

Some of the sites give indications of the use of cross quarter Sun risings and settings, that is, the risings and settings of the Sun at dates half way between the solstices and the equinoxes. These have not been included in the above analyses.

In the selection of the above sightlines there are two main problems. Firstly there is the possibility that the Sun or Moon could rise or set in line with a geographical feature purely by chance and occasionally it is bound to happen. Secondly the selection of a sightline is a subjective decision and not everyone would agree that a supposed sightline is a genuine one. I do not believe there is a satisfactory way round these problems. If the astronomical theory is correct then the original builders of these monuments would also have had to hunt for suitable sightlines and would have had to make do with what was available to them. The choice of sightlines would have been subjective, with some sightlines being better than others. In mountainous country the problem would not have been too difficult, but in more flat terrain they would have had to improvise and perhaps build cairns or set up standing stones as foresights. A great many such structures would have disappeared over the four thousand or so years, making it almost impossible to infer any possible astronomical uses. This was one of the reasons for choosing a mountainous area for the above survey. Any sightlines would be far easier to detect. A second reason was that the area is bounded on the south by the river Dyfi and the north by the river Mawddach and so limits the area and sample size. It also helped that I am also familiar with the area.

A surprise finding was that not all the remains used sightlines. Several of them were situated where the Sun or Moon could be seen to skim part of the horizon, a few examples are given above and

there are many more. I find it difficult to explain this unless the sites were intended for astronomical purposes.

Solar and Lunar sightlines covered.

Major Standstill North Moonrise:	No sightline identified.
Summer Solstice Sunrise:	Waun Fach, Rhos Hafotty Stone setting.
Minor Standstill North Moonrise:	Rhos Hafotty Stone setting,.
Equinox Sunrise:	Croes Faen.
Minor Standstill South Moonrise:	Pennal Church.
Winter Solstice Sunrise:	Caer Berllan. Tyn Llidiart, Carreg y Big,
Major Standstill South Moonrise:	Llyn Gafr,
Major Standstill South Moonset:	Lled Croen yr Ych, Llyn Gafr, Esguan standing stone.
Winter Solstice Sunset:	Dolddeuli standing stone.
Minor Standstill South Moonset:	Lled Croen yr Ych.
Equinox sunset:	Lled Croen yr Ych.
Minor standstill North Moonset:	Bryn Seward, Lled Croen yr Ych.
Summer solstice Sunset:	Castell Cynfael (Bryn Y Castell), Gwasted Goed.
Major Standstill North Moonset:	Waun Oer, Lled Croen yr Ych.