LUNAR OBSERVATORIES OF MEGALITHIC MAN

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I have shown elsewhere that megalithic man has left us sites which record the position of the Sun at the solstices with an accuracy which is limited only by the vagaries of refraction. One or two of these sites show a declination of 23° 54′ ±1′ corresponding to the obliquity of the ecliptic at 1700 B.C. ±140 years.

Using the same technique, megalithic man has left records in stone of the maximum and minimum lunar declinations. In the sense that "solstice" means the standing still of the Sun, the Moon has four solstical positions. If the orbit of the Moon were exactly in the plane of the ecliptic the lunar solstices would be shown by the same marks as those for the Sun. But the lunar orbit is inclined to the ecliptic at an angle i with a mean value which has remained constant at 5° 08′ 43″ for thousands of years. Thus, as the line of nodes rotates (once in 18·6 years), the Moon's solstices occur when its declination is $\pm (e \pm i)$ where e is the obliquity of the ecliptic. In 1700 B.C. e was 23° 53′ 49″ (De Sitter) and in 1600 B.C. 40″ less.

There are more than twenty places where megalithic man has left slabs or alignments or outliers to show one or other of these four declinations[1]. But six or seven sites show a great deal more and must be reckoned among the most important in Britain. To understand their importance it is necessary to look a little more closely at the movements of the Moon.

In the course of a lunar month the declination of the Moon goes through a cycle from a positive maximum to a negative maximum and back again. As already explained, these maxima are limited by two boundaries (between which the declination oscillates) which show two periodicities. The first is the obvious one mentioned earlier with an amplitude of $\pm i$ and a period of 18·6 years. Superimposed on this is a short period ripple with an amplitude of about ±9′ and a period of 173·3 days or half an eclipse year. Fig. 1 shows the state of affairs as the Moon passed through one of the maximum positions $(e+i)$ in the seventeenth century B.C. The dots show the monthly maxima. Each month the declination rose to one of these points and then, 2 weeks later, fell to roughly an equal negative value. The dotted curve is the top of the 18·6 year cycle with a maximum of $e+i=29°\ 03′$. Superimposed on this is the 9′ ripple.

Now suppose that megalithic man chose a suitable mountain peak (or notch) as a foresight and proceeded to observe one limb of the setting Moon near its maximum declination. He would mark the backsight or position where he had to stand to see the limb grazing the mountain at each monthly maximum. The position so found would oscillate about a mean position just as the dots in Fig. 1 oscillate. Eighteen years later he would find the same limits for the one or two oscillations nearest the maximum. The natural thing to do is to mark either the mean or the extremes. Since 18 years elapse between each set of observations he did not rely on memory but indicated the backsight and the foresight unequivocally. This is well shown at Fowlis Wester (Fig. 2) near Crief in Perthshire. Standing at the centre of the ellipse and looking along the major axis, the high outlier A obscures the distant peak (Creag na Criche) but just allows the point P to be seen. This is shown in Fig. 3, which also shows how the Moon rose at its maximum declination. The points on the skyline which have been determined astronomically (and checked on a second visit) are shown by small rings. Correcting for mean winter refraction, mean semidiameter and mean parallax, the declination of the Moon with its upper limb grazing the point P is 29° 03′ or exactly $(e+i)$ at 1700 B.C.

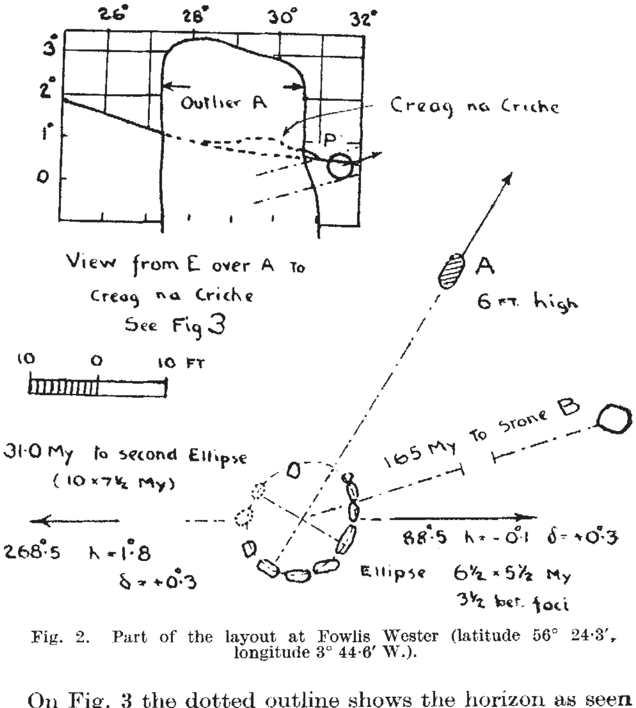

Fig. 2. Part of the layout at Fowlis Wester (latitude 56° 24·3′, longitude 3° 44·6′ W.).

On Fig. 3 the dotted outline shows the horizon as seen (and measured) from the large stone which lies some 450 ft. to the east. So, using this stone as the backsight, the declination would be about 10′ greater and would correspond with the absolute maximum declination which, as we have seen, is some 9′ greater than the mean maximum. One, at least, of the stones in the other ellipse has been blasted, presumably to provide material for the small modern building which lies to the west. So we do not know to what extent the western end of the monument has been despoiled; there may have been a stone there to mark the lower limit of the ripple.

It will be seen that the site is so carefully chosen with regard to the surrounding horizon heights that the line

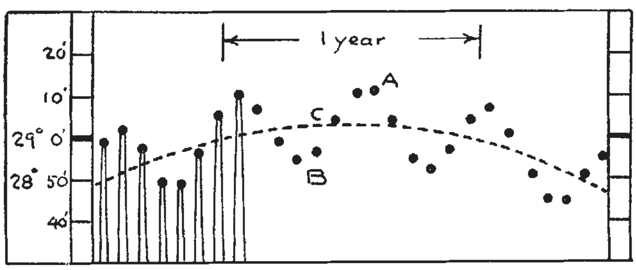

Fig. 1. Moon's declination around one of the maxima.

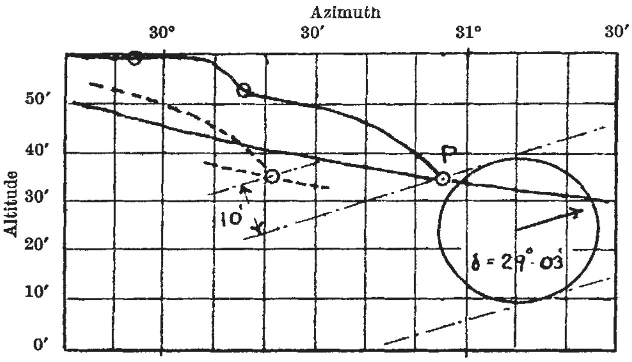

Fig. 3. Rising Moon at mean maximum declination (dotted outline is from stone *B*).

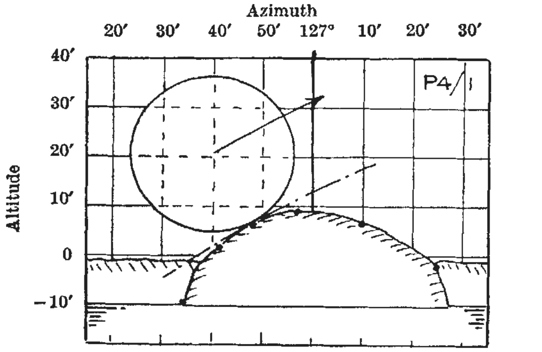

Fig. 4. Bass Rock from stones at Lundin Links (No. 403027). Moon rising with declination = −18° 44′. Note that $e-i=18°$ 45′.

joining the ellipses succeeds in showing in both directions the equinoxial solar declination of +0·3°. As I have shown elsewhere, this is close to the value necessary to divide the year into two equal parts. The axis of the west ellipse also gives a declination of about 28° and thus, presumably with a mark on the nearby hill, showed the most northerly setting point of the Moon.

An alternative method of observation to that evidently used at Fowlis Wester is to use a fixed backsight in such a position that two peaks or notches on the horizon would show either the two limits or the mean and the maximum. This must have involved years of experiment until a suitable site was found and yet these people have left many sites showing how successful they were[2]. The site near Dervaig in Mull is now ruinous but enough remains to show that the alignment must have been close to 190°. To the north, local high ground obscures the view and so we look towards the south and see that the peak Carn Mhor lies on the line. It appears that the Moon in its most southerly position grazed the top of Carn Mhor. The positions of the upper and lower limbs at mean maximum declination are pass near small notches.

Examples of $e-i$ are also found. One discovered this summer is at Lundin Links on the south coast of Fife. The direction of the alignment of stones is such that it showed the Moon setting with a declination about −18°. The view is now obscured by buildings and trees, but the Bass Rock (Fig. 4) can be seen and the rising Moon just grazes the eastern fall of the rock when the declination is −18° 44′. At 1700 B.C., $e-i$ was 18° 45′. Here apparently only the mean is shown unless indeed there is a mark near the summit which I missed in the imperfect conditions of visibility which existed when I measured the profile.

Another $e-i$ site is found near Fishguard. The impressive alignment Parc-y-mierw (SM 999359) is directed to Mount Leinster. Geodetic calculation using the contours on the Ordnance Survey of Ireland shows that the point where the massif runs into the sea as seen from the stones gives the Moon's lower limb when the declination was about 10′ below $e-i$.

Enough has been said to show the great care which was taken to place these sites to give an accuracy of nearly ±1′. This is remarkable when we remember that the temperature effect on refraction is of this order and that lunar parallax can range some ±2′, depending as it does on the Moon's distance. During the years of experiment which must have been necessary to locate these backsights with this kind of accuracy the ±9′ ripple must have obtruded itself. When we find its upper and lower limits both recorded at a number of sites we see that there is no doubt it was well known to these people. It was not again known until it was discovered by Tycho Brahe (born A.D. 1546).

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[1] Thom, A., *Vistas in Astron.*, **7**, 1 (Pergamon Press, London, 1965).

[2] Thom, A., *Megalithic Sites in Britain* (Clarendon Press, Oxford, in the press).