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NEOLITHIC LUNAR MAPS AT KNOWTH AND BALTINGLASS, IRELAND

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1. INTRODUCTION

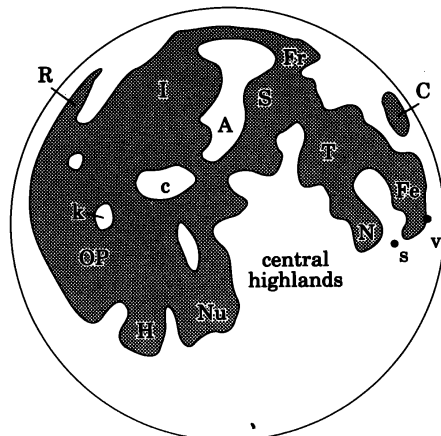
The oldest known depictions of lunar surface markings are usually said to be drawings made by Leonardo da Vinci from about 1505 to 1514.¹ Earlier images representing the moon are common, but are symbolic rather than strictly representational. In this report I describe a group of rock carvings from the great passage tomb of Knowth in Ireland (and perhaps one from Baltinglass, Ireland) which resemble the pattern of lunar maria visible to the unaided eye. These carvings, about 5000 years old, are the oldest depictions of lunar markings yet identified. Five are sufficiently complex that they may be considered simple maps, and may be said to extend the history of lunar cartography back in time to the same general period as the oldest terrestrial and celestial maps.²

2. THE EARLIEST DEPICTIONS OF THE MOON

Leonardo da Vinci drew the markings on the half and full moon some time between 1505 and 1508 at Florence or Milan, and made at least one drawing a few years later.³ No older depictions of the lunar markings are known.⁴ It is difficult to believe that such striking and significant features, prominent in the skies of every land and era of human experience, would have altogether escaped depiction until 1505 A.D.

The moon itself, of course, is frequently represented in the carvings, paintings and other media of many cultures and periods. These representations are of two kinds. The first is a geometric symbol representing the body of the moon, sometimes a circle but more often a crescent, the most distinctive of the phases and a shape otherwise rare in nature. In medieval and Renaissance Europe the lunar symbol was often ornamented with a human face, as was that of the sun. Because the sun was also portrayed in this way it is reasonable to interpret both faces as purely decorative, or at most symbolic, rather than as actual representations of the Man in the Moon or other manifestations of the lunar markings.

The second kind of lunar symbol is more complex, and is more closely associated with the markings themselves. If the spots were thought to resemble a rabbit or hare, a drawing of the creature might be used to represent the moon. This is seen, for instance, in the pottery of the Mimbres people of southern New Mexico, of about 1000 to 1100 A.D.⁵ The Mimbres interpreted the lunar markings as “the rabbit in the moon”, a jumping rabbit whose ears are our Maria



| | | | |
|----|-------------------|----|----------------------|
| A | Alps, Apennines | N | Mare Nectaris |
| C | Mare Crisium | Nu | Mare Nubium |
| Fe | Mare Fecunditatis | OP | Oceanus Procellarum |
| Fr | Mare Frigoris | R | Sinus Roris |
| H | Mare Humorum | S | Mare Serenitatis |
| I | Mare Imbrium | T | Mare Tranquillitatis |
| | c Copernicus | s | Santbech |
| | k Kepler | v | Vendelinus |

FIG. 1. A map of the moon drawn by the author without the aid of a telescope. Features named in the text are identified.

Frigoris and Imbrium and whose hind legs and tail are our Maria Nectaris, Fecunditatis and Crisium respectively.⁶ The rabbit was frequently portrayed on their pottery, sometimes in association with a crescent shape. In every case, however, the details of size, orientation and decoration are such that it is clear the depiction is of a rabbit representing the moon, not the moon itself. For instance, the rabbit's tail is attached to the rabbit, not isolated as Mare Crisium is from its neighbouring dark markings. Similar occurrences of a rabbit as a symbol of the moon, but not a direct pictorial representation of it, are seen in Mexico and China.⁷

I have previously described medieval European and Arabic world maps which may contain stylized or more realistic depictions of markings on the moon.⁸ The connection becomes apparent when the old belief in the lunar mirror is recalled. Plutarch, Leonardo da Vinci, Johannes Kepler, Alexander von Humboldt and many others described the curious notion that the lunar markings were a reflection of Earth's lands and seas. The idea seems to have originated with Clearchos of Soli, a pupil of Aristotle, and survived in European and Middle Eastern folklore until the nineteenth or twentieth century. Reversals of continent names or coastlines and specific details of the coastline of southern Africa in some Arab and European *mappaemundi* may be based on supposed views of terrestrial continents in the lunar mirror. While they may be based on features seen on the

moon they are clearly not intended as maps or drawings of the moon itself. This appears to leave Leonardo da Vinci as the author of the oldest known realistic depiction of the markings on the moon.

3. THE KNOWTH CARVINGS

1. *Knowth and the Lunar Calendar*

Knowth is a passage tomb, an artificial hill containing one or more (in this case two) stone-sheathed passages.⁹ Many of the large stones around its perimeter and in its passages are decorated with complex carvings including hundreds of spirals, arcs and circles. Similar carvings are found at the nearby tomb of Newgrange¹⁰ and elsewhere around the west coast of Europe.¹¹ The age of the main passage tomb at Knowth is uncertain, but it appears to postdate a smaller satellite tomb called Site 16 which contained charcoal having a ¹⁴C date of 4399±67 B.P. (3330–2790 B.C.). Dates from Newgrange are very similar to those from Site 16, and Knowth is expected to postdate Newgrange since its carvings appear more sophisticated.¹² In the following descriptions of individual stones I have used Eogan's numbering scheme except where noted.

Brennan¹³ has developed a detailed interpretation of the Knowth carvings as astronomical symbols, in particular interpreting semicircular arcs as pictures of the crescent moon. By counting crescents and other features of the Knowth carvings, he claimed to have discerned evidence of a sophisticated lunar calendar. It is not my intention in this paper to support or reject this calendrical interpretation, which will not be discussed in detail. My concern is with the patterns of single or multiple arcs supposed to represent lunar crescents.¹⁴ I interpret them as depictions of the markings on the lunar surface, the broad arc of maria extending west, north and east of the lunar central highlands (Figure 1).

This interpretation was first suggested by the carvings on a stone referred to as SW22 by Brennan¹⁵ and as Kerbstone 52 by Eogan.¹⁶ A loop of symbols arcs over the top of the stone and returns horizontally across the centre of the flat rock face, surrounding a long wavy line (Figure 2). The seven uppermost symbols

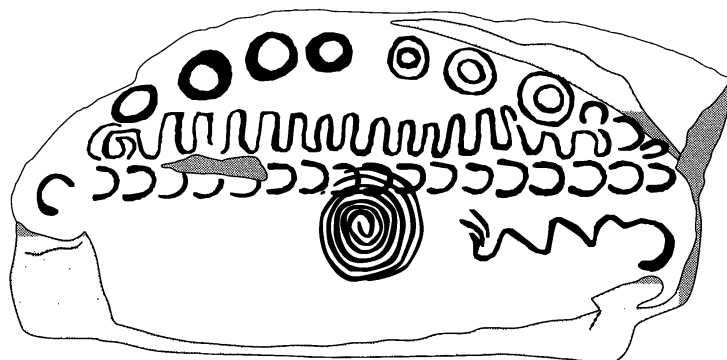


FIG. 2. The carvings on Kerbstone 52 at Knowth.

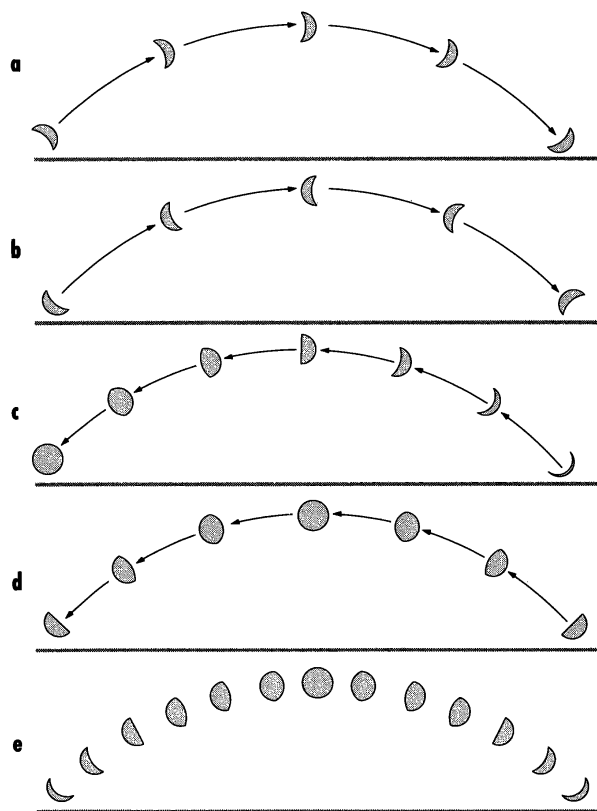


FIG. 3. (a) A six day lunar crescent followed across the sky from rising to setting; (b) a twenty-three day lunar crescent followed across the sky from rising to setting; (c) appearance of the moon at sunset every other day following the new moon; (d) appearance of the moon at roughly midnight every other day following first quarter; (e) lunar phases for alternate days drawn in their correct orientation and arranged along the path of the moon in the sky.

are single or double circles. On the left are two semicircular arcs opening to the lower right. On the right are a single arc opening downwards and two opening to the left. The horizontal chain of symbols, 17 in number, are all semicircular arcs opening to the left. The total number of symbols is 29, said by Brennan to represent the period of the cycle of lunar phases, the lunation, which is 29.53 days. The wavy line surrounded by the 29 symbols has 31 turns, explained by Brennan¹⁷ as follows:

... 12 lunar months are 355 days, falling short of a solar year of 365 days by about 10 days. After 2.5 years this amounts to nearly a full month. In other words, after 30 months, a month must be added to bring the lunar and solar cycles into harmony.... Each turn of the wavy line represents one month....

In other words, the stone represents an elaborate lunar calendar, and elsewhere¹⁸ Brennan calls Kerbstone 52 “the calendar stone”. He explains the arcs as lunar crescents and the sequence of arcs and circles as a representation of the cycle of phases during a single month. The first visible crescent of the month

appears immediately to the left of the spiral near the centre of the boulder. After seven days (crescents) the arc reverses left to right, signifying the first quarter phase. The crescent turns into a circle around the period near full moon, then reverts to a crescent at the right edge of the stone. The symbols continue across the bottom row of the drawing until they become partly obscured by the spiral, representing the period around new moon when the narrow crescent is almost invisible.

2. *Crescents or Maria? The "Calendar Stone" Reinterpreted*

I accept that the numbers 29 and 31 may have the significance suggested by Brennan. However, the details of Brennan's interpretation of Kerbstone 52 may be criticised in view of the orientations of the arcs shown in Figure 2. The shapes shown are all crescents or circles. There are no gibbous phases. The one foreshortened circle at upper left is carved on the curved edge of the boulder and is really more circular than Figure 2 suggests. The distinctive semicircle of the quarter phase is not shown at all, and Brennan's suggestion that the crescent reverses its orientation to signify the quarter phase is unconvincing both logically and because it does not occur at the third quarter in his scheme.

More damaging still is the fact that the arcs are oriented incorrectly to be considered lunar crescents unless they are used purely symbolically. This becomes clear if we consider the types of observation which the builders of Knowth might easily have undertaken. There would seem to be four obvious ways to depict the changing shape and position of the moon:

(a) *Waxing crescent followed across the sky.* A young crescent could be followed only for a short period near and after sunset before setting itself. More likely, a wide crescent (about 6 days old) could be followed across the sky from early afternoon to shortly after midnight (Figure 3(a)). The open (concave) side of the crescent would swing around from lower left to upper left as the crescent moved from east to west. There is, of course, no circular phase in this sequence.

(b) *Waning crescent followed across the sky.* A wide crescent about 22 days old could be followed like the waxing crescent, from midnight to near noon (Figure 3(b)). The crescent opens to the right, from upper right to lower right as the moon passes from east to west. Again, there is no circular phase.

(c) *Moon observed at the same time every day over one lunation.* A quite different approach would be to draw the moon at sunset (or some other clearly identifiable time) each day during one lunation. The result is shown in Figure 3(c). The moon appears to move from right to left in this diagram. It changes in phase, but for half the lunation it is beneath the horizon at the time of observation. By selecting as the time of observation the moment of setting of a bright star or planet instead of the sun, the position of the full moon in the sequence can be



FIG. 4. The lunar maria represented as a single arc.

changed. It would be easy to derive a diagram more like Figure 3(d), which more closely resembles the sequence of images on Kerbstone 52. The flanking quarter moons might be drawn as semicircular arcs opening upwards along the path of the moon.

(d) *Phases followed through one lunation, arranged schematically along the moon's path.* Although more abstract than the other three approaches, which could be drawn from direct observation, this would be a straightforward diagram to construct. Phases, in the correct orientation, would be drawn from memory or preliminary sketches in sequence along the moon's curving path. The order might be left to right or right to left, to suggest respectively the daily or monthly motions of the moon. In Figure 3(e) the sequence is right to left.

In all cases illustrated in Figure 3 the crescent and quarter phases are bisected symmetrically by the curving path of the moon. This is a natural consequence of the viewing and illumination geometry. The representation on Kerbstone 52 is very different. On that stone the carved crescents open towards the centre of the path of the moon, perpendicular to the chain of images extending across the top of the boulder.

Only one simple lunar observation convincingly reproduces this geometry. It is the passage of the full moon across the sky during a single night. The arcs depicted on the kerbstone are not crescents but a simple schematic representation of the broad arc of maria extending from Nubium and Humorum through Imbrium and Serenitatis to Nectaris and Fecunditatis, surrounding the central highlands (Figure 4). This arc of maria appears to rotate as the moon crosses the sky (Figure 5). At moonrise and moonset the disk is seen against a bright sky and the maria are clearly visible. When the moon is higher in the black night sky, excessive contrast renders the subtle lunar markings less easily visible. This may account for the change in appearance of the disk in the carvings, the arc of maria being drawn only when the disk is low in the sky and it is easily visible.

Another simple observation, which must have been made at a very early date,

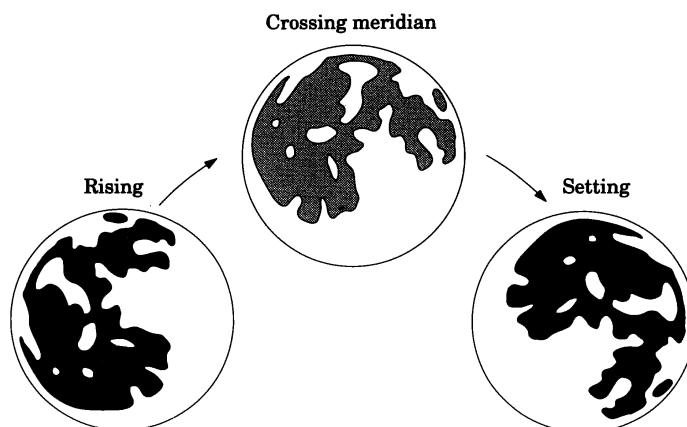


FIG. 5. Apparent rotation of the lunar disk as it crosses the sky.

is that the elevation at which the moon crosses the meridian varies with the seasons, since the lunar orbit is inclined only a few degrees to the ecliptic. If the full moon is observed while crossing the sky on two successive months its change in elevation can easily be seen. There are roughly 12.4 lunar months in a year, so that some years have twelve and others thirteen full moons. Thus, the elevation of the full moon at the meridian seems to rise for six or seven successive months, then fall for six or seven months. This path might be represented as a set of concentric circles or a spiral path with six or seven turns, the moon rising outwards through the pattern for about six months, then descending inwards for the rest of the year.

Beneath the horizon line and superimposed on the returning moon on Kerbstone 52 is a large tight spiral with six turns, and a branch giving a seventh half-turn on the right side. The association of the pattern with the apparent depiction of the passage of the moon across the sky suggests that this is a representation of the lunar orbit, as proposed above to account for the seasonal shift in the elevation of the moon as it crosses the meridian. An alternately growing and shrinking spiral path could also be represented as a pair of connected spirals, a common motif in neolithic Irish carvings.

The setting moon is shown on Kerbstone 52 passing beneath a wavy line and returning to the beginning of its cycle. This may be a depiction of its passage beneath a schematic horizon, the convolutions representing hills or waves, and its return by some mysterious path to the point of its rising to complete the daily voyage of the moon. While beneath the horizon the moon is shown with the orientation it had at its setting. Since the moon is not actually being observed at this point its true orientation is not represented, and the number of symbols can be arbitrarily set to a value previously determined to have astronomical significance, if indeed a calendrical function is intended. In other words, it is only the nature of the object represented by the carved crescents that is put into question by this reinterpretation. The change in emphasis has no direct bearing on the

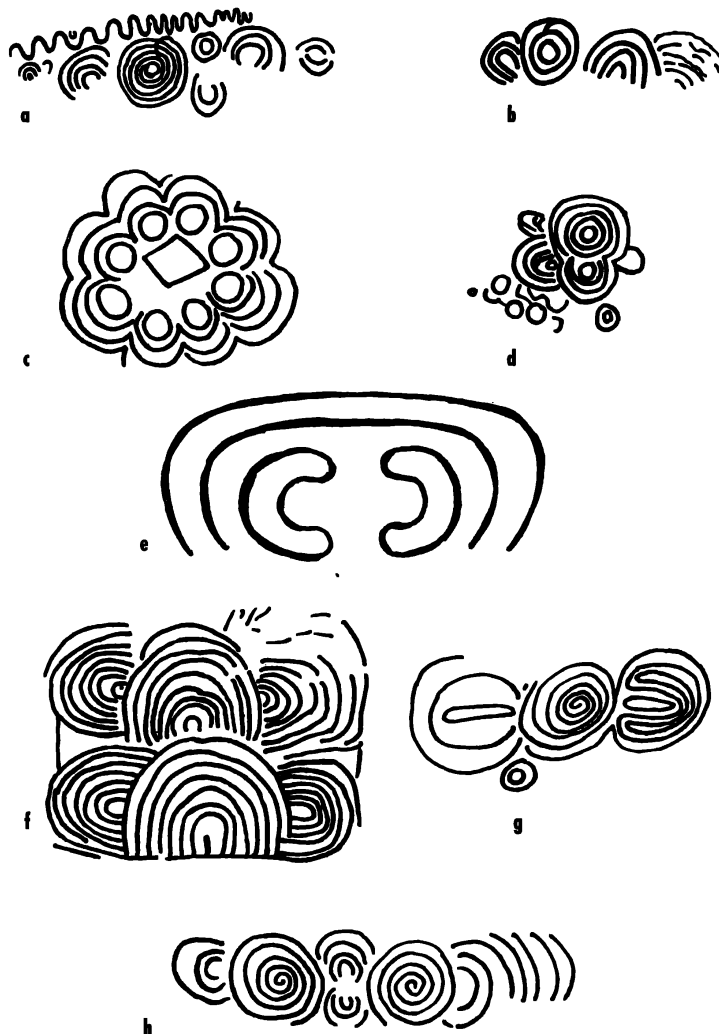


FIG. 6. Carvings of the maria on various stones (see text for descriptions).

calendar hypothesis.

To summarize this interpretation of Kerbstone 52, three significant elements are present: (1) a series of arcs and circles, the arcs changing in orientation in a manner consistent with the arc of lunar maria seen during the passage of the full moon across the sky (but not the lunar crescent in any obvious scheme of observations); (2) the association of this distinctive pattern with one or more spirals or concentric circles, interpreted as an attempt to account for the changing elevation of the full moon in successive months; (3) a representation of the moon returning to its place of rising to complete its daily motion, including an hypothesis regarding the orientation of the maria during the return journey.

Kerbstone 52 is not alone in appearing to represent the change in orientation of the lunar markings as the full moon crosses the sky. Strikingly similar but

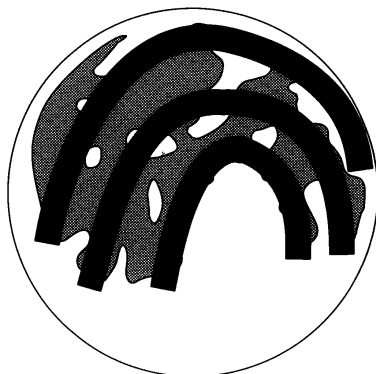


FIG. 7. The lunar maria represented as three parallel arcs.

less fully developed patterns are found on a number of other stones. Kerbstone 4 (Brennan's stone NE7) includes the set of arcs, circles and spirals shown in Figure 6(a).¹⁹ Two systems of multiple arcs and a double circle flank a spiral like that at the centre of the Kerbstone 52 design. The orientations of the arc systems are like those of the lunar maria a little after rising and a little before setting, similar to the arrangement of Figure 5. This stone contains additional arcs including two pairs shown upside down, which may record a speculation on the orientation of the arcs while the moon is beneath the horizon, as seen (in a different orientation) on Kerbstone 52. The marks are again associated with a wavy line having 30 turns. This whole design gives the impression of being closely associated with that of Kerbstone 52, differing mainly in the number of symbols and in that the arcs are multiple (sets of three or four) rather than single.

A similar but simpler design is seen at Loughcrew, Ireland, where Stone C9 of Cairn U²⁰ displays a set of three concentric circles flanked by two, possibly three, groups of three concentric arcs (Figure 6(b)). The orientations are the same as those of the arcs on Kerbstone 4 at Knowth. This same stone has many overlapping carvings, among which further examples of the changing orientation of a set of arcs might be noted. Another set of arcs gradually changing in orientation about a curved line is seen on Kerbstone 15 at Knowth,²¹ a stone that also contains a design resembling a sundial. The curve of arcs changes to circles, and within the curve is another seven-turn spiral. Again, a set of arcs and circles in the same sequence arches across the top of Knowth Kerbstone 75.²² The repetition of this sequence on stones at several locations strongly suggests that the sequence itself was important.

This apparent interest in sets of arcs changing in orientation suggests a link with another group of motifs among the Irish carvings. The carving on the roofstone of the east recess at Newgrange²³ includes a complex design consisting of a diamond surrounded by eight circles, each surrounded on its outer side by three concentric arcs (Figure 6(c)). Two apparently very similar designs, but with four or five arcs per circle, are partly visible nearby, their missing sections



FIG. 8. Carving on Kerbstone 97 at Knowth (left) and its correlation with the lunar maria (right).

covered by adjacent stones. Between these three designs and numerous other marks runs a chain of circles with associated semicircular arcs and a seven-turn spiral. The main design may be interpreted as a full moon revolving around a diamond (presumably representing the land, either Earth or Ireland). The multiple arcs may represent the maria severally rather than as a single arc, as discussed below, or may again relate to the varying elevation of the moon through the year. Petal-shaped designs seen on Newgrange Kerbstone 91 (Figure 6(d)),²⁴ stones C4 and L3 of Cairn L at Loughcrew,²⁵ the roofstone of Cell 2 at Cairn T at Loughcrew,²⁶ and the entrance stone at Dowth²⁷ may be simplified versions of this design. A petal design is repeated six times with variations in the number of arc positions around the central motif (a dotted circle) on Loughcrew's Cairn T stone C8.²⁸ This stone also displays rayed circles and sets of concentric arcs. The rayed circles are also presumably astronomical symbols, and might be taken to represent crepuscular rays, the solar corona seen in eclipse, a meteor shower about its radiant or simply stars.

Another common motif in Irish megalithic art consists of pairs of single or multiple arcs opening towards each other, the “opposed Cs” of Eogan²⁹ (though here interpreted more broadly). The simplest example (Figure 6(e))³⁰ shows two opposed arcs surrounded by a pair of sweeping curves. Brennan comments on the overall symmetry of the design and says of the sweeping curves that they “may represent the dome of the heavens”. Here I interpret the two “opposed Cs” as images of the maria on the rising and setting full moon (Figure 5), the surrounding curves schematically representing the path of the full moon at maximum and minimum (or at least two different) elevations. On Kerbstone 86 at Knowth³¹ two pairs of arcs face each other across a horizontal line. Here we may see the maria on the full moon both above and below the horizon. They are again surrounded by a sweeping curve, interpreted as the complete path of the moon.

Some pairs of “opposed Cs” contain a central motif, a circle or spiral. The central motif may appear as a spiral representing the lunar path in successive months, as concentric circles representing successive lunar paths or the brilliant

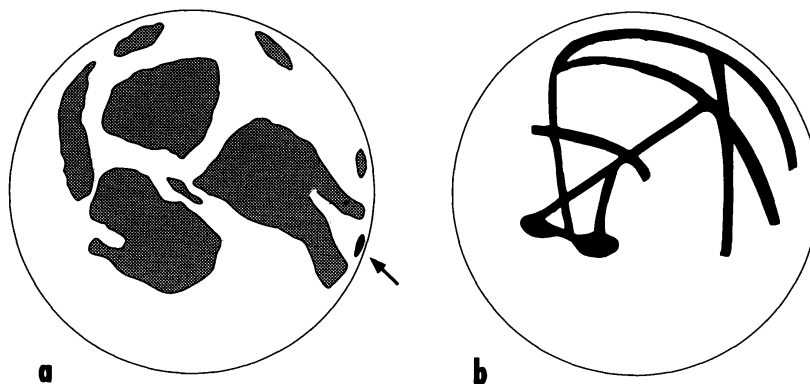


FIG. 9. (a) Pre-telescopic map of the moon by William Gilbert confirming the visibility of the dark patch at the south end of Mare Fecunditatis (shown in black, arrowed); (b) drawing of the moon with 'canals' by Flammarion.⁴⁵

full moon high in the sky, or as a set of arcs facing downwards to duplicate the appearance of the lunar maria as the moon crosses the meridian. Both the latter cases closely resemble Figure 5. The design on Knowth Kerbstone 5³² consists of a tight spiral with six turns flanked by two groups of concentric arcs opening inwards (Figure 6(f)). Knowth Kerbstone 79 is similar but the centre is occupied by two concentric circular motifs, perhaps the full moon above and below the horizon. Stone C6 at Sess Kilgreen, County Tyrone³³ carries a similar design with a set of six concentric circles (including the central dot) between a pair of multiple arcs. The central motif appears as a set of arcs opening downwards on Stone C3 at Cairn U, Loughcrew,³⁴ a figure described by Herity³⁵ as "the owl-like face figure". It looks far less owl-like in the more complete drawing by Twohig.³⁶ A similar design appears at the passage grave of Gavrinis, Morbihan, France.³⁷ On Stone L4 the design is repeated twice (Figure 6(g)), on R9 it appears three or four times in association with other arcs. The designs on both stones are repeated one above the other, again as if showing the same phenomenon at different elevations in the sky.

A further arrangement of symbols, found once each at Knowth and Newgrange, may be a further development of the "opposed Cs" style just discussed. On Kerbstone 65 at Knowth two opposed Cs at left and right enclose a pair of spirals turning in opposite directions (Figure 6(h)).³⁸ Between the spirals are two more opposed Cs, this time opening downwards and upwards. Here the maria are shown at rising and setting and at the meridian both above and below the horizon, together with representations of the moon's path rising and falling across the sky, a very detailed portrayal of its motions. At Newgrange the elaborate carving on Kerbstone 52³⁹ includes these elements in a different pattern. The spirals are displayed separately, additional pairs of multiple arcs are included (always in the appropriate orientation), and in the positions occupied by spirals on Knowth Kerbstone 65 are two almost identical motifs consisting of a pair of elongated loops surrounding a cluster of dots and triangles. The loops may represent the

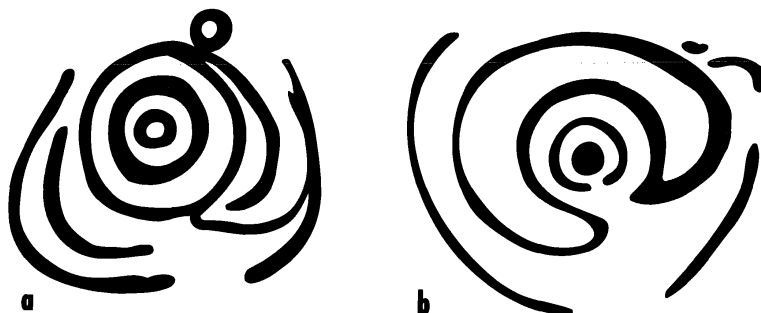


FIG. 10. (a) Carving on the exterior of the basin found in the right recess of the eastern passage at Knowth; (b) carving on Kerbstone 68 at Knowth.

high and low paths of the moon or the land about which the moon revolves.

Similar groups of semicircular arcs are found on many stones at Knowth and Newgrange, as well as at the Long Meg stone circle in Cumberland,⁴⁰ Navia, Spain⁴¹ and elsewhere. In most cases there is no obvious interpretation for a solitary motif, so the intentions of the carvers may never be known. What seems remarkable, however, is that in the examples cited above groups of individual motifs are arranged in a sequence which can be readily accounted for by the same simple astronomical observation.

The use of several semicircular arcs as representations of the lunar maria is probably not just an example of emphasis by repetition but a more detailed portrayal of the lunar markings themselves. The eastern maria Nectaris, Fecunditatis and Crisium and the long narrow northerly arc of Mare Frigoris lend themselves to representation as a set of three or more arcs. The three distinct lobes of the southwestern maria (Nubium, Humorum and Oceanus Procellarum) are less obviously like parallel arcs, but once the pattern is established in the east and north it can be followed with relative ease to the west (Figure 7).

3. Lunar Maps at Knowth

A still more complex representation of the lunar maria is found on Kerbstone 97 (stone NW23 of Brennan⁴²). It consists of six arcs of varying length and two isolated spots or short arcs arrayed in a semicircle (Figure 8). Brennan dismisses the pattern without detailed explanation: "Approached this way [the calendar interpretation], even a simple set of 6 arcs, like those on NW23, have purpose and meaning." This carving may be explained more convincingly as a map of the lunar markings. The six arcs may be roughly correlated with the maria as shown in Figure 8, though the exact correspondence in Oceanus Procellarum is uncertain. The two isolated spots are particularly diagnostic: one is obviously Mare Crisium. The other is either Mare Frigoris (as suggested in a preliminary account of this study⁴³) or the small patch of almost isolated mare material at the south end of Mare Frigoris lying between the craters Santbech and Vendelinus,



FIG. 11. (a) Carving on Orthostat 47, eastern passage, Knowth; (b) carving on stone G at Baltinglass.

as suggested in Figure 8. This latter dark patch is marginally visible to the unaided eye, as demonstrated by William Gilbert in his pre-telescopic lunar chart of about 1600.⁴⁴ Gilbert's map clearly shows this spot (Figure 9(a)), though its depiction of the western maria is less satisfactory.

Astronomers might object that modern observers never see a pattern of lines among the lunar markings. However, Camille Flammarion⁴⁵ published a drawing of the moon "seen through binoculars" which shows the maria as a set of lines similar to those discussed here (Figure 9(b)). His drawing may have been made with the help of low power binoculars but is in fact more like a view with the unaided eye. His intention was to explain the 'canals' of Mars as optical illusions by pointing out that linear features could also be seen on the moon, where telescopes clearly showed them to be non-existent or at least natural rather than artificial.

When Eogan excavated Knowth he discovered a carved basin in a recess deep within the mound.⁴⁶ The bowl is decorated inside and out, and one of the carvings on the outer surface is similar in some respects to the lunar map just described (Figure 10(a)). Mare Crisium (or possibly the eastern end of Mare Frigoris) is depicted as a small circle at the top of the carving. A larger circle may correspond to Mare Imbrium, surrounded by the bright arc of the Alps, Apennines and the bright ray crater Copernicus on the east and south and the Jura mountains to the northwest. The other mare regions are apparently represented as a series of arcs branching out from the circle on both sides. The pattern is less obviously lunar than that on Kerbstone 97, but appears related. A very similar carving (Figure 10(b)) appears on Kerbstone 68.⁴⁷ Another carving displaying this level of complexity appears on Orthostat 47, the end stone of the centre recess in the eastern passage at Knowth⁴⁸ (Figure 11(a)). Three arcs represent the main band of maria from Nubium to Tranquillitatis. Separate dots correspond to Mare Humorum in the southwest and Nectaris and Fecunditatis (or the Santbech-Vendelinus patch) in the east. An additional short arc in the far east represents Mare Crisium. This carving is in the orientation of the setting moon and is accompanied by a pair of simpler arcs in the orientations of the rising moon and the moon under the horizon, spaced equidistantly around the

stone. These latter arcs are single, but each has been given extra ornamentation corresponding with the particularly distinctive eastern maria.

Another carving with some similarities to those described above is known from a site in Ireland about 85km from Knowth.⁴⁹ It is found on Stone G on the southwest side of the ring of stones at Baltinglass, Co. Wicklow. It consists of several concentric arcs with an isolated arc in the appropriate position for Mare Crisium (Figure 11(b)). The small mark at lower left is probably Mare Humorum and the small innermost arc represents Mare Vaporum and Sinus Medii, the small dark mare patches near the centre of the lunar disk. This identification would almost certainly not be made without prior recognition of the lunar nature of the Knowth carvings.

Taken together, these five detailed representations of the maria (Figures 8, 10 and 11), the numerous less complex carvings and the illustrations of the diurnal motion of the moon suggest a considerable interest in the lunar markings and motions. Brennan's interpretation also implies considerable astronomical knowledge, but the emphasis is quite different. If the arcs seen in these carvings are maria rather than crescents, the evidence for measuring time by the phases of the moon rests solely on the presence of astronomically significant numbers. This may be said to weaken the calendrical interpretation, without being sufficient to reject it. Rather, I suggest that at Knowth we have a detailed record of astronomical observations, particularly of the lunar maria and motions, which possibly incorporates a representation of a lunar calendar. Similar patterns of two or three arcs are found in various places in western Europe, as cited above, suggesting a widespread interest in lunar observations throughout this region which was apparently most fully developed in Ireland. The moon is likely to have had a central role in the culture of the builders of Knowth.

5. CONCLUSION

Prior to this study, the oldest known depiction of lunar markings was that by Leonardo da Vinci. Now several older carvings of lunar features may have been identified. Five of them (Figures 8, 10, 11) are sufficiently complex that they may deservedly be called maps, at least comparable in sophistication to the earliest maps of terrestrial and celestial subjects.⁵⁰ I have called them maps because of the large number of recognisable features portrayed on them. If accepted as lunar maps these carvings at Knowth, about 5000 years old, extend the history of lunar cartography back to the same general period as the oldest maps of the Earth and the sky. These are unlikely to be the only prehistoric lunar maps. Careful interdisciplinary work may reveal more ancient portrayals of lunar markings. For instance, a rock painting very similar to Figure 6 is also known from the George Gill Range in central Australia.⁵¹ That image has been interpreted as a representation of people sitting around a campfire, without any astronomical significance. Of course, allowances must be made for uncertainties in the inter-

pretation of ancient paintings even by the direct descendants of the painters.

The Knowth carvings can be interpreted as I suggest only if it is accepted that at least some neolithic Irish art may be representational. These carvings are often considered purely decorative, or at most abstractions whose original meanings are forever lost to us.⁵² Is it reasonable to assert that a carving like that on Knowth Orthostat 47 (Figure 11(a)) represents the lunar maria? Where an obviously anthropomorphic figure occurs there may be no doubt, but such figures are completely unknown at the sites I refer to here. In that sense it is true that “these motifs are geometric and non-representational”,⁵³ that is, there are no easily recognisable depictions of people, animals or familiar objects. However, the situation is not nearly as straightforward when less familiar objects are considered. A simple zig-zag line might be used as pure decoration without representational intent. It may be a deliberate representation of a hilly skyline, ocean waves, a meandering river or a bolt of lightning. It may be a symbolic representation of water or of a mythical mountain range, perhaps an abode of the gods. There is no way to distinguish between these possibilities. Previous statements that neolithic carvings in Ireland are not representational are too strong. We can say with certainty only that no representations have been recognized. I believe that some may now have been identified at Knowth.

It may be objected that the arcs that I claim represent the maria are not contained within a circle, the limb of the full moon. I suggest that in at least some cases the disk may have been outlined with pigment, chalk or some other superficial coating. I offer two arguments in support of this. First, the surfaces of some of the carved stones are quite irregular, so that the relief of the carving is less than the relief of the rock face it is carved on. The fact that these rocks were not rejected for carving or dressed to a nearly flat surface before carving suggests that they were intended to be seen with perpendicular rather than grazing illumination. This would make the carving difficult to see, and so it may well have been painted for easier viewing. In fact, at least some of the carving might have been intended merely to serve as a template for the painter. Second, some carved rocks in Spain and Portugal were indeed painted,⁵⁴ the painting often coinciding with the carving in the manner suggested here. Twohig denies any evidence for such painting in Ireland,⁵⁵ but the difference in climate between Ireland and the Iberian peninsula may account for the lack of preservation of paint if it ever existed in the former country. This hypothesis is not entirely untestable, though it is unlikely that any traces of such material remain on Kerbstone 52 or any other stone exposed to the elements for very long. The carvings that were protected in the inner chambers of Knowth or other sites may retain detectable amounts of such decoration if any was ever applied. In fact, such a claim has been made for Loughcrew,⁵⁶ though rejected by Twohig.⁵⁷ The application of modern analytical techniques might reveal minute traces of decoration that were missed in the past.

This interpretation of carvings has no bearing on the question of alignments

of structures with astronomically significant points on the horizon. On the other hand, it does suggest that some details of Brennan's complex calendrical interpretation⁵⁸ (though not the central issue of astronomically significant numbers) are based on a misunderstanding of the carvings on Knowth Kerbstone 52. My proposal that some of the Knowth carvings are depictions of the markings on the moon suggests considerable attentiveness to the sky without requiring the sophisticated background in theoretical astronomy and mathematics claimed by Thom⁵⁹ and others. The great emphasis that this study places on observations of the full moon indicates that the lunar alignments discussed by Brennan⁶⁰ should be investigated further.

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