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A NEW STUDY OF THE ABERDEENSHIRE RECUMBENT STONE CIRCLES, 2: INTERPRETATION

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In Part One of this paper (*Archaeoastronomy*, no. 6 (1984), S55-79) one of the authors (CR) described the data obtained during a recent study of the Aberdeenshire Recumbent Stone Circles. In this paper we attempt to interpret the function of the sites, and in particular their possible astronomical significance, in the light of these new data and of existing evidence. Some previously unpublished data by both authors are also introduced here in Part Two: a record of horizontal-topped recumbent stones and the azimuths of cup-marked stones obtained by AB between 1975 and 1978, and measurements of horizon features obtained by CR during 1981.

In Sections 9 – 14 we discuss those features which are common to all RSCs, and the overall trends which are evident amongst the group of sites as a whole. In Section 15 we proceed to discuss regional variations in orientation. Some remarks on sites with cupmarks are added in Section 16. We conclude in Section 17 with a brief general discussion, adding some suggestions for future work.

9. *Common Features and Overall Trends*

In this section we attempt a general interpretation of the function of the sites and the nature of the builders, based upon a range of common features and overall trends.

Some 99 sites of certain and possible Recumbent Stone Circles were identified in Table 1. Many of them are in good condition. Their architecture has been described in detail by one of the authors (AB),^{58,59} and several architectural features common to all sites in the group are evident. Further general trends in the placement and orientation of the sites are immediately evident from the survey data presented in Part One of this paper. The trends identified are largely based on surface features and such evidence can be very deceptive. Excavations have taken place at several RSCs in recent years and they have shown that some rings such as Berrybrae (RSC5) were altered in Antiquity by antagonistic groups,⁶⁰ while others like Strichen (RSC7), Midmar Kirk (RSC71) and Castle Fraser (RSC66) have been landscaped or 'enhanced' in modern times.^{61,62} Excavation will be an important arbiter of many of the interpretations presented here.

The main distinguishing feature of the RSCs is the presence of a heavy recumbent slab flanked by two upright pillars (Plate 1). At a few sites only the recumbent and flankers exist in various states of repair. However, generally there are also the remains of a ring of standing stones (Plate 2). Sherds of early prehistoric pottery, flints, an archer's stone wristguard and two radiocarbon dates from Berrybrae (RSC5) of 1360 ± 90 b.c. and 1500 ± 80 b.c. the equivalent of about 1750 B.C. in real years,⁶³ suggest that the majority of the sites belong to the Scottish Early Bronze Age between 2500 and 1750 B.C. at the time when the huge sarsens of Stonehenge's final phase were being erected.

A number of possible functions for the RSCs can be dismissed. They were not defensive. Despite the fact that in some cases the circle stones are set in a low



PLATE 1. Esslie the Greater (RSC90) from the south. Photograph by AB.

rubble bank without any sign of a break or an entrance, this would have been totally inadequate as a defensive structure. The lack of appropriate artefacts shows furthermore that they were not domestic or industrial sites. Quite often there is an internal ring-cairn, a low penannular bank of small stones around an open central space in which small pockets of human cremated bone were placed. There are, however, too few of these for the rings to have been cemeteries and the bones must be regarded as ritual deposits or offerings.

On the other hand the RSCs were, it seems, deliberately sited in conspicuous settings. Nearly all of them stand on hillside, terraced locations offering long views. They were sometimes placed on deliberately levelled sites, as at Loanhead of Daviot (RSC59) (Plate 3) and Druidsfield (RSC52), or on shelves cut into the hillside, as at Castle Fraser (RSC66) (Plate 4). At Berrybrae (RSC5) the ring was placed on an artificial clay platform.⁶⁴ Furthermore the general trends noted in Part One strongly suggest that certain considerations of no obvious practical use — such as the absolute orientation of a site and the presence of a non-local horizon behind the recumbent — were of great importance, and that similar considerations affected the placement and design of every RSC. Taken together, these observations imply that the sites were ceremonial or ritual centres, and that they reflect a tradition that was adhered to over an area spanning some 80km from north to south and 50km from east to west.

It is evident from the geographical distribution of the RSCs (Figure 7) that they tend to cluster in areas of low hills, away from more mountainous regions and from low-lying river valleys. They are positioned alongside patches of deep, fertile and well-drained soil suggesting that their planners were agriculturalists.⁶⁵

No RSC or other structure in the region appears significantly more grandiose than its fellows: a situation that can be contrasted with, say, that in Orkney⁶⁶ and in Wessex⁶⁷ where the inconspicuous earlier Neolithic burial places were eventually replaced by gigantic monuments such as Maeshowe and Stonehenge in its later phases, apparently reflecting the development of an organized,

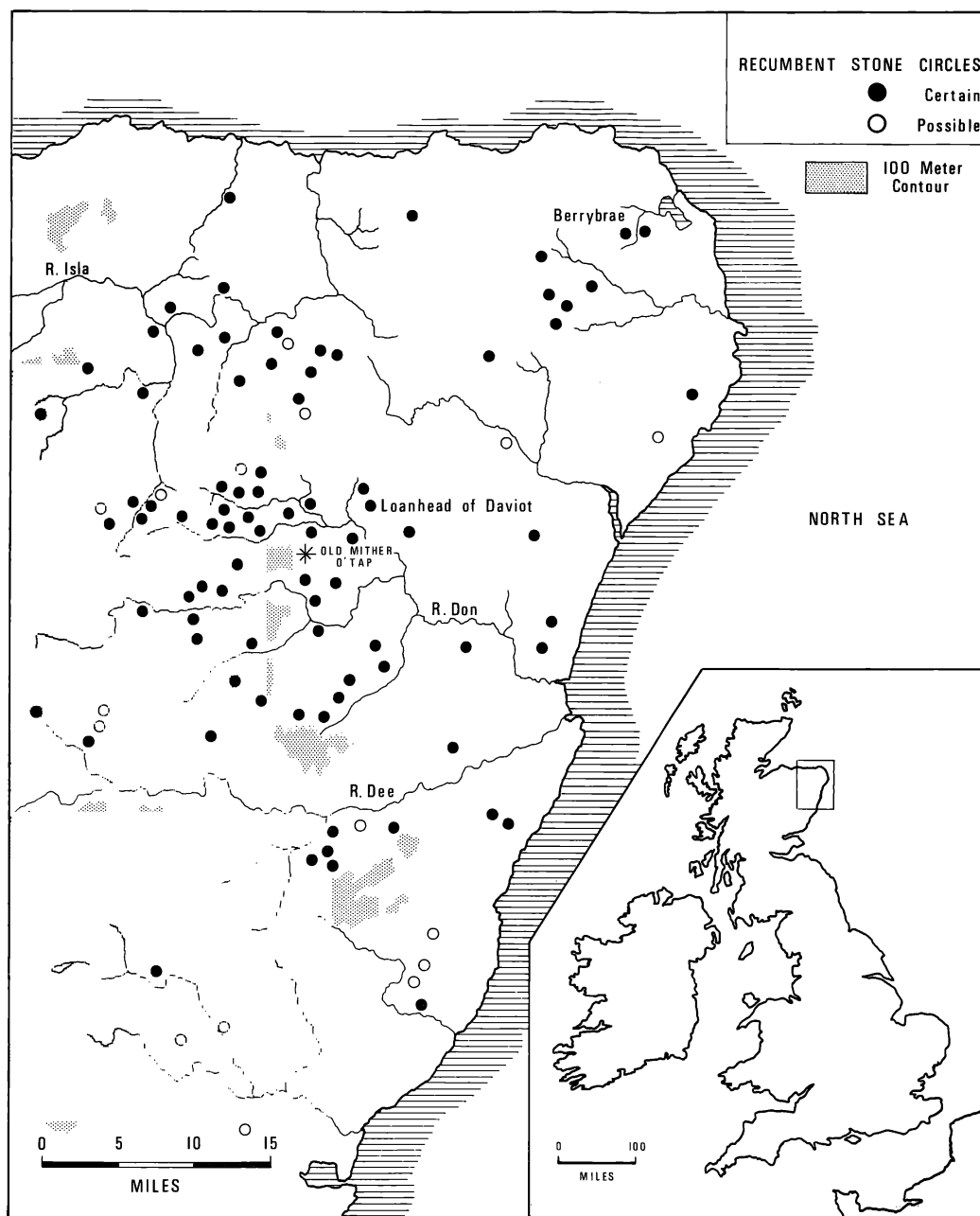


FIG. 7. The geographical distribution of the Recumbent Stone Circles.

hierarchical society. The impression, by contrast, in late third- and early second-millennium Aberdeenshire is of egalitarian groups without powerful leaders or chiefs, who were not in competition with one another. This impression is reinforced by the fact, also evident from Figure 7, that even in the areas of greatest concentration the sites tend to be placed a few kilometres from one another. It seems likely that they were simply the local ritual centres for groups of people living in territories of around 10km². Consideration of the resources available suggests that each territory could have served the subsistence requirements of a

group no larger than about twenty or thirty, and that some may represent the domain of single family units of no more than ten to fifteen.⁶⁸ In other words, each monument served only a small group of subsistence farmers. The absence of exotic artefacts in the RSCs supports this conclusion.

There is a good deal of evidence that the recumbent and flankers were central to the primary function(s) of the site, whereas the remaining circle stones were more peripheral to this purpose. Firstly, there are several features which emphasize the position of the recumbent and flankers. At many sites there is a gradation in the heights of the circle stones. They rise in height towards the flankers, which are the tallest upright stones. Other significant features are often found in the vicinity of the recumbent and flankers, but never elsewhere. Here, or on the stones immediately adjacent, there are sometimes cupmarks, small bowl-shaped depressions that were artificially ground on the sides or the tops of the stones. Scatters of white quartz are frequently found near to the recumbent, but rarely in other parts of the circle. At one site, Auchmallidie (RSC15), the 3m-long recumbent and 2m-long flanker are made entirely of quartz. At North Strone (RSC54) the circle stones are of pink and grey granite, whereas the recumbent, significantly, is of quartz.

Secondly, the rings themselves are relatively small, on average no more than 20m in diameter, and consist of moderately-sized menhirs of local stone, often ten or eleven in number.⁶⁹ The recumbent, however, usually weighed 20 tonnes or more. Very often these great blocks were of a different stone from the circle menhirs, and needed to be brought from some distance. This is clear at Auchmachar (RSC10), Balquhain (RSC62), Cothiemuir Wood (RSC48), Easter Aquorthies (RSC63), Whitehill (RSC73) and many other sites. At Old Keig (RSC49) the monstrous block, over 50 tonnes of sillimanite, had probably been pulled uphill from the Don Valley 6km away. Thus while the circle menhirs could be constructed from readily-available stones, the need for a suitable recumbent slab did, it seems, impose conditions on the builders that involved them in a search sometimes over several kilometres for a suitable stone, and a much greater



PLATE 2. Easter Aquorthies (RSC63) from the south. Photograph by AB.



PLATE 3. Loanhead of Daviot (RSC59) from the SSW. Photograph by AB.

expenditure of manpower in order to manoeuvre it back to the intended site.

Finally, it seems that the recumbent and flankers were erected with considerable care. Despite their great weight, the parts of their upper faces in the centre of the recumbent, and in many cases their entire upper faces, are very often perfectly flat and less than two or three degrees off the horizontal. This was determined by one of the authors (AB) by placing a 2m ranging pole along the top of the stone and then placing a metre-long spirit level on top of the ranging pole. It is evident at such sites as Netherton (RSC6), Loudon Wood (RSC11), Aikey Brae (RSC12), Cothiemuir Wood (RSC48), Old Keig (RSC49), Loanhead of Daviot (RSC59) and Castle Fraser (RSC66). Indeed, of the fifteen sites where the test was carried out, only Easter Aquorthies (RSC63) failed to conform to the rule. Here the recumbent has tilted forwards, but its flat top suggests that it may well also originally have conformed. (Fuller notes on flat-topped recumbents are given in Table 6 of Section 14.) The recumbent stones had a tapering base, as the photograph of Midmar Kirk (Plate 5) reveals. The tapering end could have been levered up and down until the top of the recumbent was horizontal — something that could easily have been determined by placing a water-filled tub on it — before the chockstones were jammed underneath to secure it in place. It appears that it was usually the eastern end that rested on the ground and the western end that was levered, as can be seen at sites such as Aikey Brae and Midmar Kirk.

In contrast, the impression is that the ring was rather casually laid out some time after the positioning of the three major stones. Quite often the recumbent stone lies askew to the circumference of the circle. This is evident from the many accurate plans now available⁷⁰ (see also Figure 8) as well as from the differences between the Centre Line and Perpendicular Line azimuths given in Table 2.

There are several sites where no more than the recumbent and its flankers exist. In many cases this is because the lighter circle stones were removed by a 19th-century tenant farmer wishing to clear his land of an obstructive monument but who was incapable of shifting the biggest, heaviest stones. (After this happened at Strichen (RSC7) the indignant landowner had the circle stones replaced and



PLATE 4. Castle Fraser (RSC66) from the south. Photograph by AB.

landscaped them into a bank but to the *south* of the recumbent. The resulting primary azimuth to the north remained a puzzle⁷¹ until excavations revealed what had happened.⁷²) However, there are nine sites in Table 1 where there is no documentary evidence known to us that circle stones ever stood: Clochforbie (RSC3), Auchmallidie (RSC15), Cairnton (RSC26), Dunnideer (RSC42), Wantonwells (RSC43), Braehead (RSC44), Druidsfield (RSC52), South Ley Lodge (RSC67) and Nether Corskie (RSC69). At Potterton (RSC81) the evidence is equivocal.⁷³ It is just feasible (though without excavation it cannot be proved) that at some of these sites the recumbent and its flankers were the only stones erected and the site was left unfinished.

While it is not unthinkable that a small local group could have erected their circle stones, perhaps over a considerable period of time, it is unimaginable that even a moderately large local group could have achieved the transportation and erection of their recumbent. The conclusion is that neighbouring groups co-operated in the construction of new RSCs, at least to the extent of helping to drag the recumbent to the site and erecting it there. The possible mechanisms of such co-operation have been discussed, for example, by Renfrew⁷⁴ in the context of the megalithic tombs on Arran and Orkney. If it was indeed the common practice to erect the recumbent and flankers first, and it was these stones that were central to the purpose of a site, then we might imagine that their construction was undertaken in co-operation with neighbouring groups, culminating perhaps in an initiation ceremony in which the outside helpers joined and were rewarded for their efforts, perhaps with a great feast.⁷⁵ The particular group whom the site served might then have been left to complete the site.

We may sum up as follows. The Recumbent Stone Circles seem to be the elegant but simple ritual centres for small, egalitarian groups of subsistence farmers living in Aberdeenshire in the late third- and early second-millennium B.C. Various general features in their placement and design seem to reflect a ritual tradition that was adhered to over a wide area. The recumbent and flankers seem to be of central

importance to the ritual function of the sites. The heavy recumbent was carefully chosen, often transported from some distance and placed in position with great care, possibly as part of an initiation rite involving the participation of several neighbouring groups. The circle stones, in contrast, seem to have been added rather more casually later, and in some cases may never have been added at all.

10. *The Orientation of the Sites*

In this section we discuss rather more fully the most general implications of the data presented in Part One, which were only discussed briefly in Section 8.

The primary orientations of the RSCs are highly clustered in azimuth. Viewing from the site interior to the recumbent stone, the smallest and largest azimuths obtained at 57 sites, using the most reliable data available, were respectively 147° and 237° , only 90° apart (Table 2). This is despite the fact that we might define an azimuth along either the 'Centre Line' or the 'Perpendicular Line' (see Section 4). It is quite out of the question that this orientation trend can be fortuitous. A naïve calculation gives the probability that 57 azimuths will fortuitously occur in a single azimuth range 90° wide as $(90/360)^{56}$, or approximately 2×10^{-34} . We can

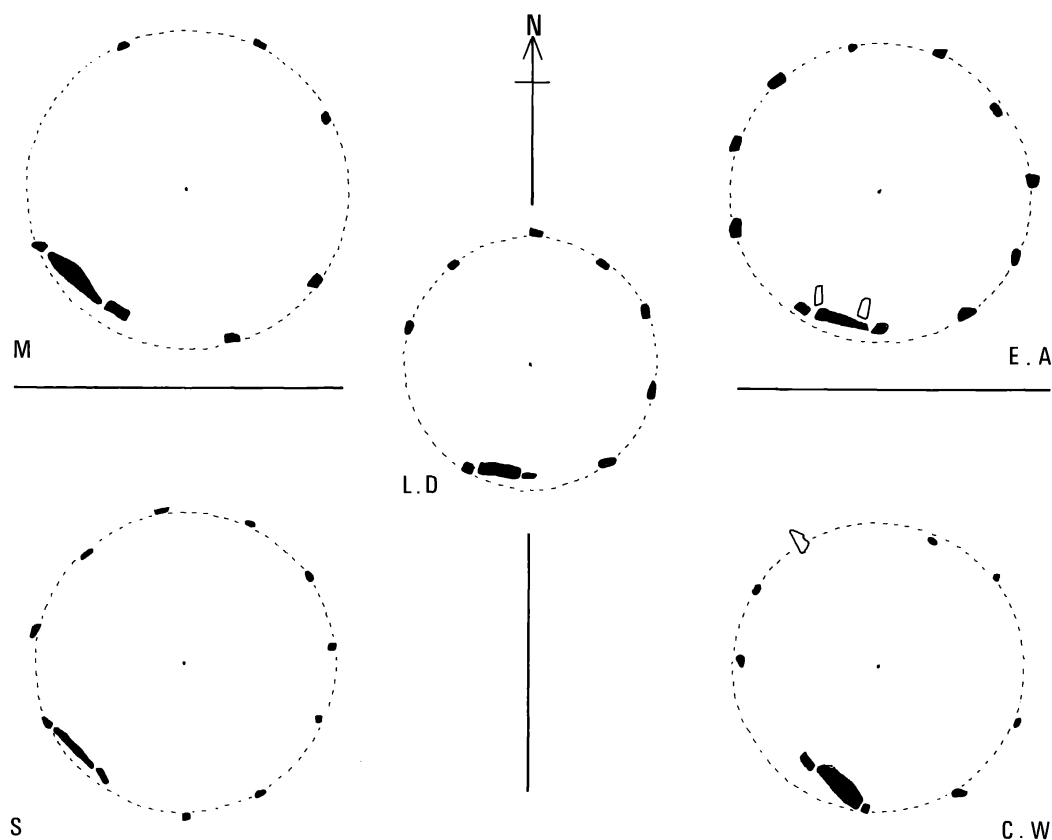


FIG. 8. Plans of five sites showing the skewed position of the recumbents. M = Midmar Kirk (RSC71); EA = Easter Aquorthies (RSC63); LD = Loanhead of Daviot (RSC59); S = Sunhoney (RSC72); CW = Cothiemuir Wood (RSC48). All after Thom⁷⁴ except CW (independent survey by Burl, 1978).

be certain that the absolute orientation of the sites was important, and that similar considerations affected the orientation of every RSC without exception.

Following the approach of Ruggles⁷⁶ we can consider three classes of factor which might have given rise to this overall trend: astronomical bodies, absolute directions, and features on the ground. The third category covers orientations upon particular types of terrestrial feature such as prominent hilltops, and orientations influenced by the local topography.

The geographical area spanned by the sites is sufficiently large that orientations upon particular types of terrestrial feature may be dismissed out of hand as a contributory factor to the *general* trend (but see Section 14 below). The local topography too, over such a wide area, is too varied to give rise to an overall orientation trend as is the case with, say, the earthen long barrows on Cranborne Chase.⁷⁷

A particular general direction might have been considered sacred throughout the region, say if it was thought to be that from which ancestors came. In other words the motivation for preferential azimuthal orientation need not directly have been astronomical. However it is hard to see any way in which the observed consistency in determining this direction over such a wide area could have been achieved except by means of astronomical observations, albeit of the roughest kind. Alternative explanations were quickly dismissed by one of the authors (AB) during his earliest investigations of the RSCs. For instance, the idea that RSC orientations might have been influenced by the prevailing wind, as is the case with hut circles, is ruled out since in this part of Scotland the wind direction is highly changeable, and comes most frequently off the sea to the east.

Certain general features are evident from the distribution of horizon distance with azimuth. There is a clear avoidance of local horizons (nearer than 1 km) around due south. The percentage of such horizons (Category 'A') is around 30% between azimuths of 300° and 350°, but falls below 5% between 156° and 211° (Section 3 and Figure 1b). Data from 88 sites contributed to this result. The mean percentage of Category 'A' horizons over the whole sample is 15.0, so that under the hypothesis of a random (uniform) distribution of horizon distance with azimuth the expected number of sites with Category 'A' horizon in any 1° azimuth bin is $88 \times 0.15 = 13.2$. In contrast, the actual number of sites with Category 'A' horizons between 156° and 211° (a 55° range) is only four, and between 165° and 186° (a 21° range) is only two. Also evident in Figure 1 is an apparent preference for non-local horizons to the east; the percentage of Category 'A' horizons is below 10% between azimuths of 55° and 230°.

We must ask what horizon distance distribution we might expect if sites were placed without regard for the distance of the horizon in any particular direction. The only overall trend appears to be that high ground, rising towards the Grampian Mountains, predominates to the west and northwest of the sites, whereas lower ground, falling towards the sea, predominates to the east. This may well explain the lower proportion of Category 'A' horizons in the east than in the west; however, local topography cannot account for the low proportion of local horizons around due south. There may of course have been many influences upon the placement of a site, such as territorial limitations, a desire to avoid prime agricultural land, or a desire to place sites at prominent locations, as has been suggested at Machrie Moor, Arran.⁷⁸ While, however, such factors may well have

TABLE 5. Sites with a local (Category 'A') horizon occurring within 40° of the Centre or Perpendicular Line axis.

Column headings

- 1 Site reference.
- 2 Site name.
- 3 Maximum azimuth of Category 'A' horizon to east of principal axis.
- 4 Minimum azimuth of Category 'A' horizon to west of principal axis.
- 5 Azimuth of principal axis (Centre Line).
- 6 Azimuth of principal axis (Perpendicular Line).
- 7 Maximum azimuth of Category 'A' relative to Centre Line azimuth.
- 8 Minimum azimuth of Category 'A' relative to Centre Line azimuth.
- 9 Maximum azimuth of Category 'A' relative to Perpendicular Line azimuth.
- 10 Minimum azimuth of Category 'A' relative to Perpendicular Line azimuth.

1	2	3 °	4 °	5 °	6 °	7 °	8 °	9 °	10 °
RSC59	Loanhead of Daviot		204	200	187		+4		+17
RSC89	Esslie the Lesser	176		183	?	-7		?	
RSC90	Esslie the Greater	162		176	183	-14		-21	
RSC54	North Strone		207	180	191		+27		+16
RSC44	Braehead	165		?	202	?		-37	

influenced the placement of individual sites, they are also unable to account for the low proportion of horizons around due south.

When horizon distances are examined relative to the orientation of the RSC (Section 6 and Figure 4), a complete avoidance of Category 'A' (local) horizons is evident along the axis of the site, in the direction viewing from the site interior towards the recumbent stone. This is true whether the axis is taken along the Centre Line or the Perpendicular Line, and implies (a) that this direction (rather than the opposite one, for which no horizon distance preference is observed) was of importance, and (b) that there was an interest in celestial observations near to the horizon behind the recumbent stone, ruling out a situation with local ground rising immediately behind the recumbent stone and obscuring the more distant horizon. Consideration (a) strongly implies that authors such as Lockyer,⁷⁹ who investigated astronomical possibilities in the direction viewing from the recumbent stone to the site interior, were missing the true intention of the builders. The architectural features within the ring which tend to emphasize the position of the recumbent (Section 9) back up this conclusion. Consideration (b), together with the fact that the orientations of the sites are clustered around SSW, provides an explanation for the low proportion of horizons around due south.

In the case of the Perpendicular Line axis, the avoidance of local horizons extends over a much wider azimuth range than it does in the case of the Centre Line axis (37° as opposed to 11°). The sample sizes are 37 sites for the Centre Line data and 40 sites for the Perpendicular Line data, but only one or two sites define the boundary of the 'non-local window' in each case. Whether this constitutes significant evidence that the Perpendicular Line axis was the preferred one is doubtful on statistical grounds alone. Further doubts arise when we examine the relevant data (Table 5) more closely.

At Loanhead of Daviot (RSC59) and the Esslie sites (RSC89, RSC90), performing the survey is complicated by the presence of trees on the local horizon. While the distant horizon can be measured by triangulation from a position

whence it can be clearly seen, it is impossible (without undertaking a traverse, something that time did not allow during 1981) to do more than roughly estimate the altitude of the local horizon. Furthermore it is doubtful whether such an effort would be justified, since at most of the sites the local horizon is so near that changes in ground level, vegetation and the height of the observer are critical. The results of the survey at Esslie the Greater are shown in Figure 9, but are subject to all the uncertainties just mentioned. Also shown in Figure 9 is a survey of Easter Aquorthies (RSC63) where similar problems are encountered. On rechecking the data obtained in 1981 it was found that the nearby horizon may cut the distant horizon at an azimuth of about 207° , i.e. 12° to the west of the Centre and Perpendicular Line axes. Thus this site should possibly be added to those listed in Table 5.

It is clear that the azimuths of the junctions between local and non-local horizons are difficult to determine and that in most cases they are uncertain within wide bounds. The width of the 'non-local window' gives some indication that it was the Perpendicular rather than the Centre Line axis that was important, but on its own the evidence is far from conclusive.

We may sum up as follows. Each RSC for which information is available has an axial orientation between WSW and SSE. Similar considerations clearly affected the orientation of every RSC. There were also common considerations in the positioning of a site. The local topography, which offers a wide variety of situations, does not dictate the hillside, terraced locations with wide views and non-local horizons to the south which were actually chosen by the builders. The preference for non-local horizons behind the recumbent provides evidence of an interest in celestial observations near to the horizon which should not be obscured by nearby land or vegetation.

The last conclusion provides a strong motivation for examining whether any more specific and precise astronomical observations affected the layout of the sites. This possibility is explored in the sections that follow, where we consider in turn axial indications (Section 11), indications formed by the inside edges of the flankers (Section 12), the entire horizon above the recumbent (Section 13) and finally prominent hilltops within the horizon above the recumbent (Section 14).

11. *Axial Indications*

In an earlier publication⁸⁰ Burl investigated the possibility of more specific astronomical observations at the RSCs. His data, fifty axial azimuths deduced from the surveys of earlier authors, are reproduced in column 5 of Table 2. Forty-two of the fifty azimuths were distributed between 155° and 204° ; seven grouped between 229° and 235° ; and the remaining one was at 217° .

For the latitude of the RSCs (57°) and for horizons of altitude 0° , the major standstill Moon rises at azimuth 155° and sets at azimuth 205° ; the winter solstitial Sun rises at 137° and sets at 223° ; and the minor standstill Moon rises at 127° and sets at 233° . Thus the bulk of the azimuths fall exactly within the southerly band between the rising and setting of the major standstill Moon, and the group of seven cluster around the setting point of the minor standstill Moon. Only the remaining single value, which was in the lowest reliability class, did not fit the pattern. Burl concluded that RSC orientations were strongly influenced by the motions of the Moon. Structures were generally not oriented upon the rising

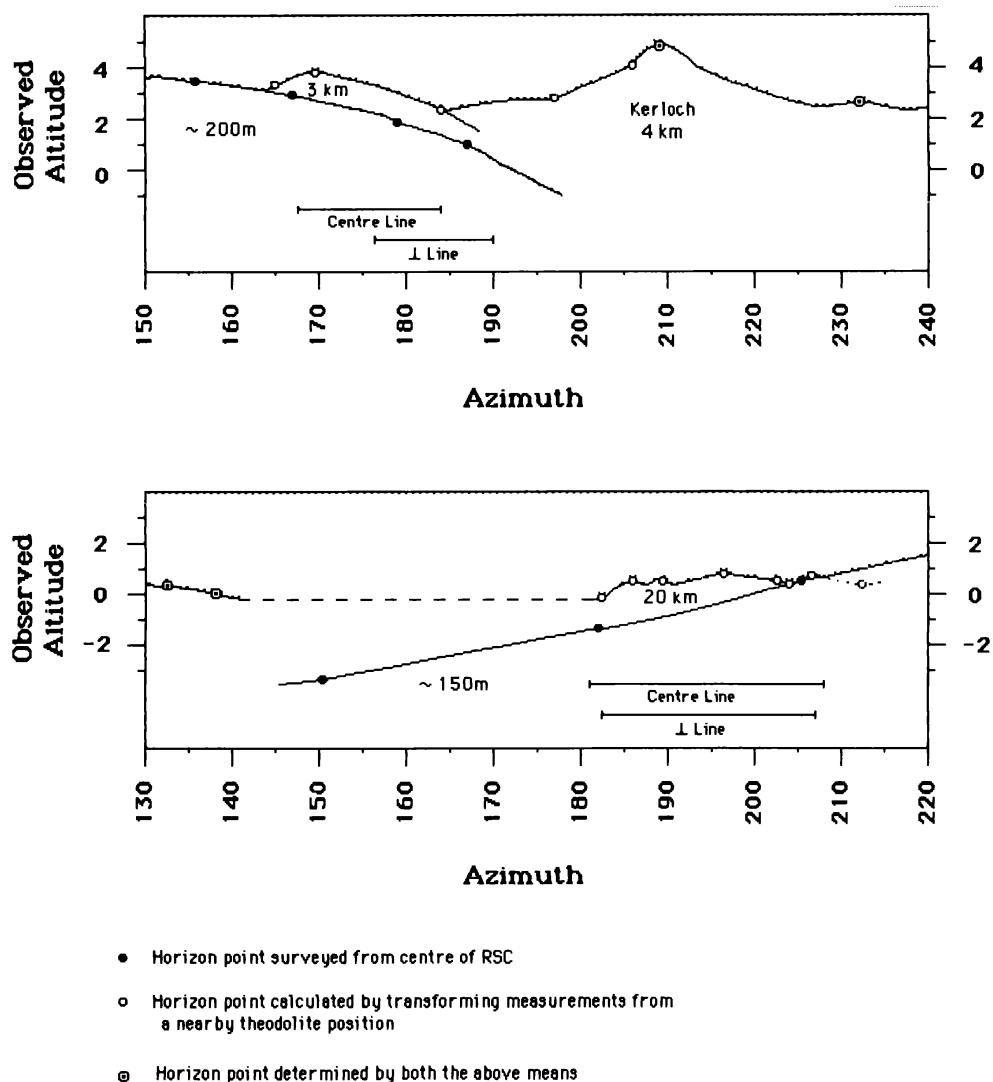


FIG. 9. Horizon profiles at Esslie the Greater, RSC90 (top) and Easter Aquorthies, RSC63 (bottom). The distant profiles are constructed by triangulation from theodolite stations about 1 km from the RSC; at both sites the distant profile is presently obscured by nearby trees.

and setting points themselves, but rather upon the Moon high in the sky. There was a complete avoidance of the azimuth of the setting solstitial Sun.

There are three reasons why these conclusions must be reassessed:

- (i) the azimuths quoted actually represent a mixture of Centre Line and Perpendicular Line values, and a variety of surveys;
- (ii) the interpretation depends critically upon a few sites whose azimuths fall near to 155° and 205° ; and
- (iii) horizon altitudes were not taken into account.

The Centre and Perpendicular Line azimuths obtained from the 1981 surveys are given in columns 3 and 4 of Table 2, alongside the original azimuths used by Burl which are given in column 5. Grades of survey are indicated by the various

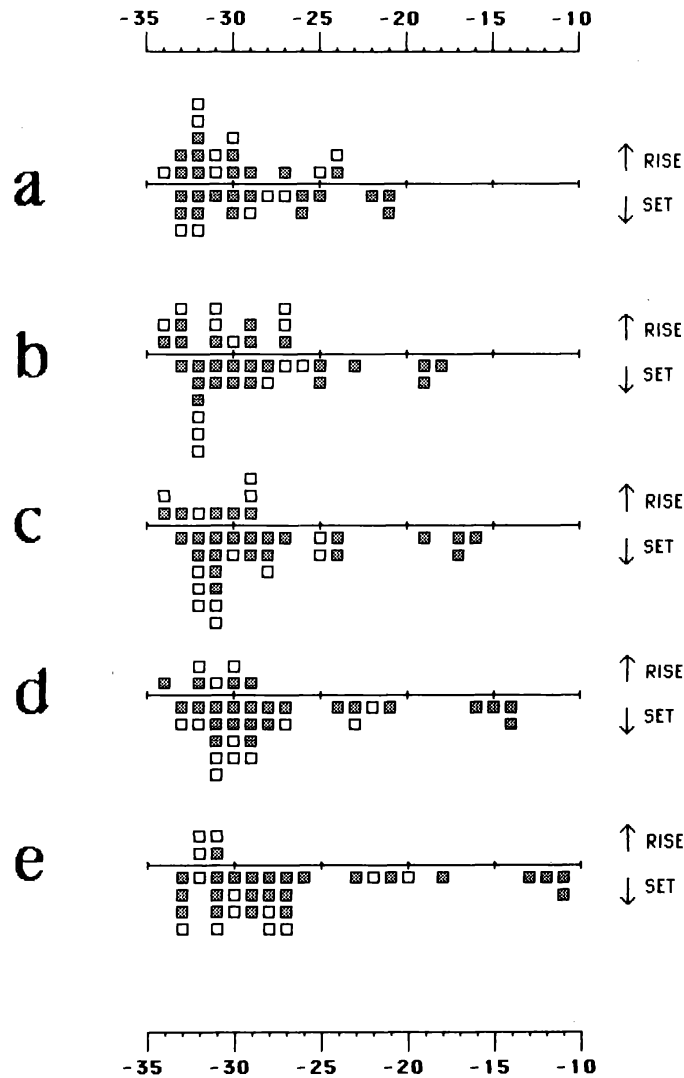


FIG. 10. Declinations indicated by the inside edges of the flankers on the 'centre' axis, to the nearest degree.

- a: east flanker from P_c ;
- b: east flanker from P_s ;
- c: axial indication (for comparison);
- d: west flanker from P_s ;
- e: west flanker from P_c .

Filled squares represent more reliable data (see Table 3).

brackets and asterisks. A pictorial idea of the azimuth distributions in the two cases, for comparison with Burl's original diagram,⁸¹ may be gained from examining the central strokes of the bars in Figures 2 and 3. The solid-line edges of the shaded areas represent the rising and setting positions at 0° altitude, and thus correspond to the rising and setting points marked by Burl. In our new diagrams the sites have been plotted in the same order as they were listed in Burl's original paper, in order to facilitate the comparison between the two.

It is immediately evident that both in the cases of the Centre Line and the

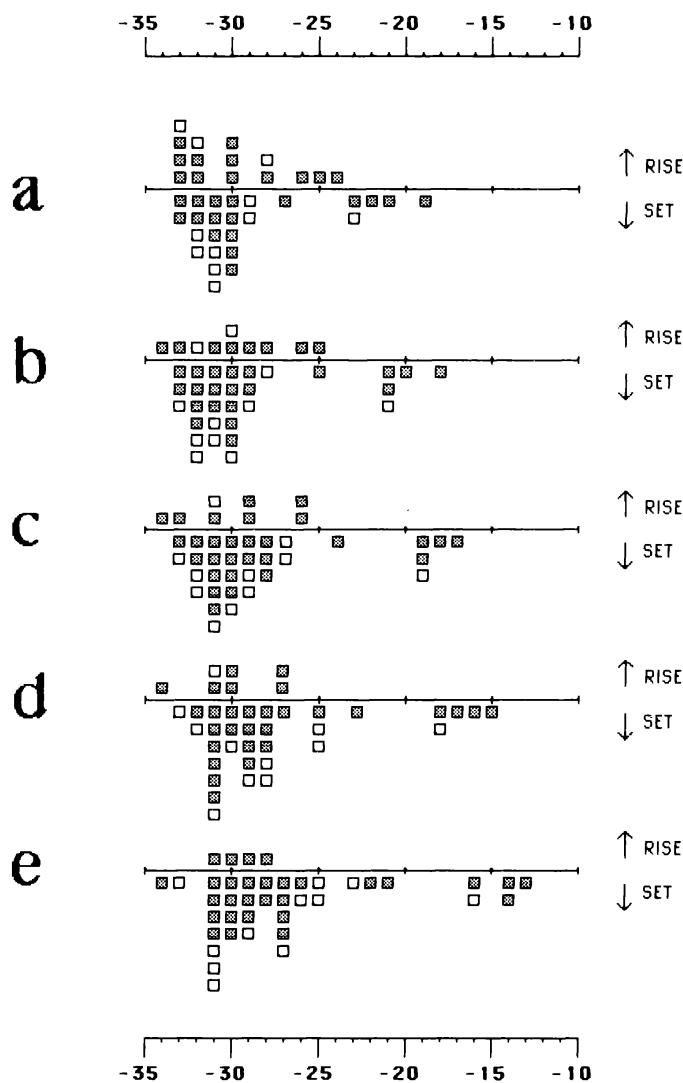


FIG. 11. Declinations indicated by the inside edges of the flankers on the 'perpendicular' axis, to the nearest degree.

a: east flanker from P_{10} ;

b: east flanker from P_{20} ;

c: axial indication (for comparison);

d: west flanker from P_{20} ;

e: west flanker from P_{10} .

Filled squares represent more reliable data (see Table 4).

Perpendicular Line azimuths, the particular patternings upon which Burl's original interpretation was based are now far less clear-cut. In both cases both major groupings are more scattered, and several azimuths now fall between the two. In the case of the Perpendicular Line, for example, thirty azimuths now fall between 155° and 205° ; two fall at 147° and 151° , somewhat outside the major standstill Moon band to the east; five occur between 224° and 236° , a rather more scattered grouping in the vicinity of minor standstill moonset; and three occur between 209° and 214° , and do not fit the Burl model. The failure of the model

becomes even more evident when we restrict ourselves to those azimuths most reliably determined (i.e. where no asterisk or brackets are given in column 3 or 4 of Table 2). In the case of the Centre Line, two of the fourteen azimuth values fall between the two postulated lunar groupings at $212^{\circ}.5$ (Old Keig) and $219^{\circ}.5$ (Hatton of Ardoyne). In the Perpendicular Line case, three of the fifteen azimuth values fall between the postulated groupings, at 214° (Stonehead), $224^{\circ}.5$ (Sunhoney) and 226° (Midmar Kirk), while a further two fall somewhat outside the major standstill arc to the east, at 147° (Ardlair) and $150^{\circ}.5$ (Garrol Wood).

It is obviously crucial to take horizon altitudes into account. This is done when declinations, rather than azimuths, are plotted in Figures 5 and 6. An examination of the central strokes in the bars reveals a rather different picture from that determinable from the azimuths alone. There is still some evidence of grouping; in both cases there is a small cluster of declinations around about -18° , and a main group with declinations below about -24° , with the possibility (at least in the Centre Line case) that the latter is itself split into a small grouping around -24° and the remainder below about -27° . It should be noted that the presence of the three shaded bands in Figures 5 and 6, representing the lunar standstill and solar solstitial declinations, may influence any purely visual interpretation. The distribution of declinations may also be examined in Figures 10(c) and 11(c) of the following section.

In the case of the Centre Line three declinations (Midmar Kirk, Sunhoney and Tomnaverie) are grouped between -16° and -17° , with an outlier (Berrybrae) at -19° . In the case of the Perpendicular Line four declinations (Midmar Kirk, Sunhoney, Berrybrae and Loanend) are grouped between $-18^{\circ}.4$ and $-19^{\circ}.4$, with

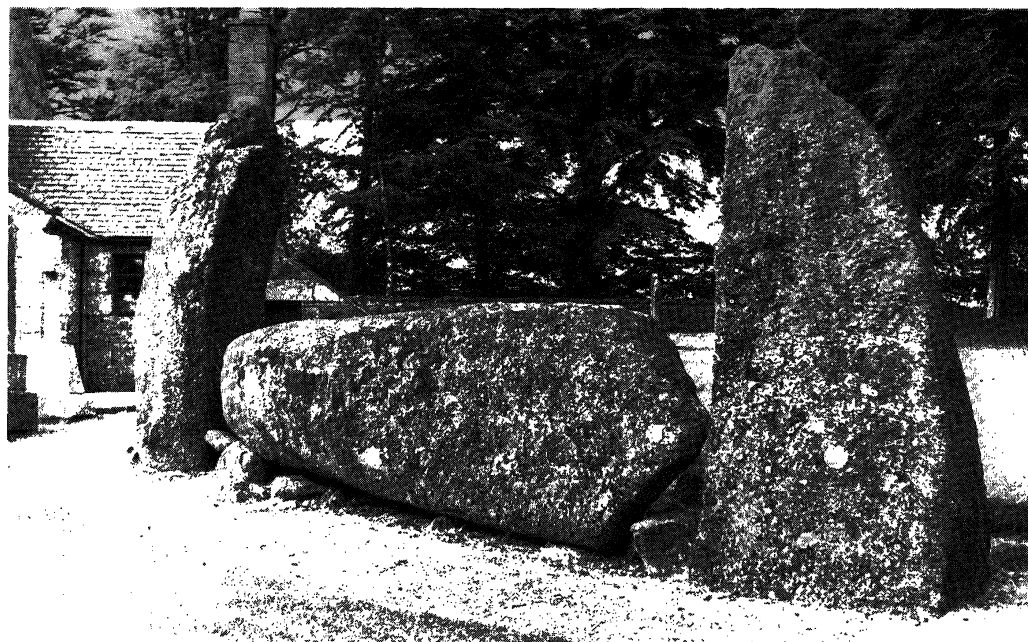


PLATE 5. The recumbent stone and flankers at Midmar Kirk (RSC71) viewed from the south (outside the circle). The photo shows the characteristic shape of the underside of the recumbent, with its thickest point near the eastern end, and the large chockstones jammed underneath the thinner western end to secure it once it had been manoeuvred into position. Photograph by AB.

an outlier (Hatton of Ardoyne) at $-16^{\circ}.6$. These groupings are in the vicinity of the minor standstill Moon ($-19^{\circ}.6$),⁸² and may hold the most valuable clues to the astronomical significance of the sites as a whole. The bulk of the axially indicated declinations, however, cover a range from well above the major standstill Moon ($-30^{\circ}.0$) to values as low as -33° where sites face due south. There is nothing amongst these data which draws particular attention to the major standstill declination itself.

Thus, although the small group of higher declinations do suggest a possible lunar motive, axial orientations do not yield any simple astronomical correlations, despite the earlier results of Burl.

However, it may not have been axial indications that were of prime importance. In Section 5 we mentioned that (with a single exception) the top of the recumbent is always below the horizon as viewed from approximate eye height in the interior of the ring.⁸³ The flankers, on the other hand, normally cut the horizon, although there are some important exceptions such as Ardlair (RSC37) and Midmar Kirk (RSC71). Thus the inner edges of the flankers appear to 'partition off' a stretch of horizon (the 'indicated horizon') which the recumbent lies beneath. It seems unlikely that just the centre point of this stretch of horizon (which, to our knowledge, was unmarked) was of significance.

Hence in the following section we examine indications by the inner edges of the flankers, i.e. the limits of the indicated horizon. In Section 13 we enquire whether the whole indicated horizon, or some event occurring at any point within it, might have been of importance. Finally, in Section 14, we investigate the possibility that natural features (notably prominent hilltops) occurring at some point within the indicated horizon were of particular significance.

12. *The Inside Edges of the Flankers*

On either the Centre or Perpendicular Line axis, the indication provided by the inside edges of the flankers depends upon the distance of the viewing position, though this is unlikely to have been longer than the ultimate diameter of the ring. For the purposes of this analysis we consider two possible viewing positions in each case: the ring centre (P_c) and the far side of the ring (P_s) on the Centre Line, and points 10m (P_{10}) and 20m (P_{20}) behind the recumbent on the Perpendicular Line (see Section 5).

The relevant information is extractable from Figures 5 and 6, but is represented more clearly in Figures 10 and 11. In each of these figures the top two levels (a) and (b) represent the declinations indicated by the east flanker from the two observing positions, and the bottom two levels (d) and (e) represent those indicated by the west flanker. The declination indicated by the centre of the recumbent (from any position on the axis) is given for comparison in (c). Thus, by extrapolating between and beyond the given levels, a pictorial idea may be gained of the declination pattern from any position on the axis concerned.

The east flanker indications are more symmetrical about south than the axial indications. The most symmetrical distribution of declinations is obtained by extrapolating a little above level (a) in each case, i.e. for a mean viewing position a little nearer than the ring centre (Centre Line) or about 8m from the recumbent (Perpendicular Line). From such a viewing position all the declinations lie at or below about -22° . From the ring centre itself, all the declinations lie below about

-20° . Very few west flanker indications, on the other hand, lie east of south. The mean viewing position for which the number falls to zero is very similar to those for which the east flanker indications are symmetrical about south. From such a viewing position west flanker indications as high as -13° and -12° are obtained at some sites.

The greater symmetry of the east flanker indications about south raises the possibility that it was this end of the indicated horizon that was of particular significance. An astronomical body at a declination greater than -20° would have passed above the left-hand end of the recumbent, as viewed from every ring centre in the sample. The solstitial Sun (-24°) can be ruled out as an explanation. The limiting declination of -20° is similar to that of the minor standstill Moon, and a possible explanation is that the Moon at its southern monthly limit (or the midsummer full Moon) should, at least at some point in the 19-year cycle, appear just above the recumbent by the east flanker. Where the east flanker orientation is nearer south (indicated declination $\leq -30^\circ$) it would do so nearer the major standstill, passing high above the recumbent at other times in the cycle. Where the indicated declination is nearer -20° the most southerly Moon would pass just above the left-hand end of the recumbent near to the minor standstill, but would not be visible there at other times in the cycle.

This explanation is not entirely convincing. Whenever the Moon passed above the left-hand end of the recumbent at its southern monthly limit, it would have done so at all other times in the month also, albeit much higher in the sky. Even at those sites where the Moon was not always visible above the recumbent at its southern monthly limit, it would always be visible there at other times in the month.

A more troublesome question is why, if only the eastern end of the recumbent was of significance, there was any need for a stretch of horizon to be partitioned off above it and demarcated at both ends. We might postulate that the Moon, having been observed passing just above the eastern end, was followed as it proceeded over the recumbent; but at many sites, oriented west of south, it would set before progressing very far. On the other hand if we postulate that the setting Moon was observed over the recumbent, we are unable to explain those sites facing due south or east of south, where the Moon would pass almost horizontally or gain altitude over the recumbent.

It is of interest, in view of the idea that the east flanker might have been of greater astronomical importance, to examine the archaeological evidence relating to possible differences between the two ends of the recumbent, or between the east and west flankers.

There is some indication that it was generally the eastern end of the recumbent that was placed in position first, and the western end that was manoeuvred and chocked. Where information is available, the pivot of the recumbent was usually on the eastern side, as at Midmar Kirk (Plate 5).

It seems that the east flanker was more often inside the ring, while the west flanker lay in the ring. This can clearly be seen at Rothiemay (RSC23), Loanhead of Daviot (RSC59), Midmar Kirk (RSC71), Sunhoney (RSC72) and Whitehill (RSC73).⁸⁴ Of the twenty-eight sites listed in Table 2 for which both Centre Line and Perpendicular Line azimuths are available, the Centre Line azimuth is greater (equivalent to the east flanker being further inside the ring) in

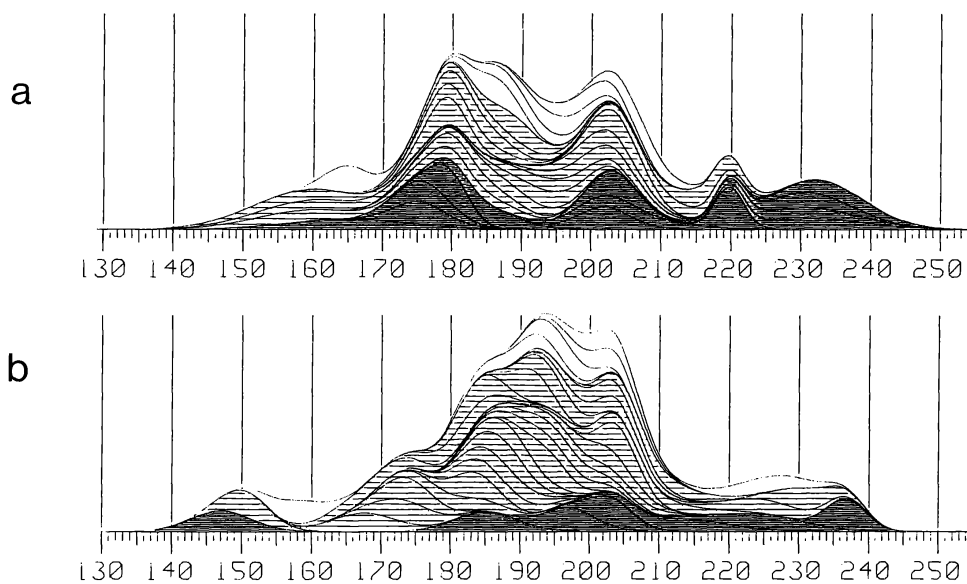


FIG. 12. Histogram of azimuths within the indicated horizons. The spread of azimuths within each i.h. is weighted towards the centre by means of a gaussian hump whose standard deviation is 0.25 times the width of the i.h. The area under each gaussian hump is equal.
 a: Centre Line, from P_c ; b: Perpendicular Line, from P_{10} .
 The three divisions of Tables 3 and 4 are represented by differential shading, Division I (first-hand data from reliably preserved sites) being the darkest.

thirteen cases, whereas the Perpendicular Line azimuth is greater in only seven. However, large differences are distributed more evenly. $AZ_C - AZ_P \geq 6^\circ$ in eight cases and $\geq 10^\circ$ in five; whereas $AZ_P - AZ_C \geq 6^\circ$ in six cases and $\geq 10^\circ$ in three.

There is no evidence that either flanker was generally taller: at the twenty-eight sites listed in Table 1 for which estimates of the heights of both flankers are available, in seventeen cases they are within 0.3m of each other. The east flanker appears to have been 0.3m or more taller at four sites: Aikey Brae (RSC12), New Craig (RSC58), Castle Fraser (RSC66) and Sunhoney (RSC72). The west flanker appears to have been 0.3m or more taller at seven sites: Yonder Bognie (RSC25), Candle Hill (RSC39), Dunnideer (RSC42), Easter Aquorthies (RSC63), Nether Corskie (RSC69), Whitehill (RSC73) and Colmeallie (RSC96).

Thus, while there are some indications, both archaeological and astronomical, that the east flanker was of particular importance, the evidence in both cases is rather equivocal. There is possibly some evidence from the east flanker declinations of an interest in the Moon, but there is no simple explanation of the data.

We have not yet studied why the RSC builders needed to demarcate a stretch of horizon rather than a single direction, and it is to this problem that we must now turn.

13. *The Horizon above the Recumbent*

We have already noted the complete absence of local, Category 'A', horizons (nearer than 1 km) above the centre of the recumbent, whether viewed along the Centre or Perpendicular Line. In Section 6 we noted that when viewed along the Centre Line from the ring centre (P_c) there is generally no Category 'A' horizon

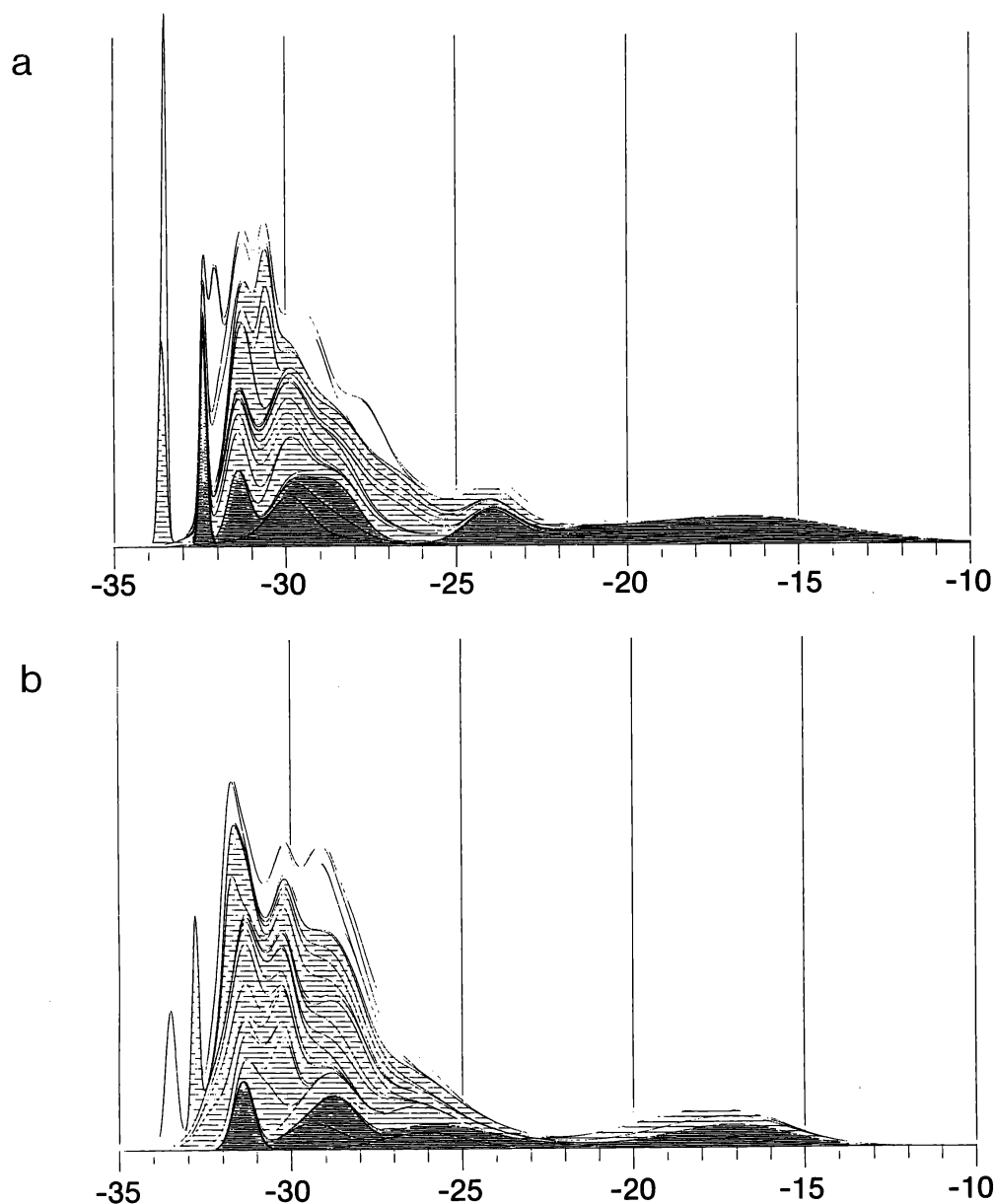


FIG. 13. Histogram of declinations within the indicated horizons. The spread of declinations within each i.h. is weighted towards the centre by means of a gaussian hump whose standard deviation is 0.25 times the difference between the maximum and minimum declinations occurring within the i.h. The area under each gaussian hump is equal.
 a: Centre Line, from P_c ; b: Perpendicular Line, from P_{10} .
 The three divisions of Tables 3 and 4 are represented by differential shading, Division 1 (first-hand data from reliably preserved sites) being the darkest.

within the entire indicated horizon (the 'i.h.'). There is no site known to us with Category 'A' horizon within the i.h. as viewed along the Perpendicular Line from P_{10} .

This suggests that the entire horizon above the recumbent stone might have been of significance. In order to investigate this possibility we have produced

cumulative plots of the azimuths and declinations occurring within the indicated horizons. In Figures 12 and 13 we consider the hypothesis that important events were more likely to be observed towards the middle of the demarcated stretch of horizon by weighting the azimuths and declinations accordingly. The area under each gaussian hump is equal. In Figures 14 and 15, by contrast, we consider the possibility that important events might have occurred anywhere within the i.h. Accordingly an azimuth or declination receives a y -value of 1 if it is within an i.h., 0 otherwise. Thus the y -value indicates at how many sites a given azimuth or declination is within the i.h.

The most interesting feature of the azimuth plots of Figure 12 is the difference between the bimodal structure of the Centre Line data in (a) and the unimodal structure of the Perpendicular Line data in (b). The dangers of basing conclusions purely upon the visual effect of a curvigram of this sort have been noted by one of the authors (CR),⁸⁵ and our interpretations must be tentative pending a rigorous statistical analysis which will be attempted elsewhere. However it does seem that there was a preference, in the Centre Line case, for the middle of the indicated horizon to be oriented either near to due south or at azimuth a little over 200° , with less interest in intermediate azimuths. Such a preference is not evident in the case of the Perpendicular Line data.

In the declination plots (Figure 13) there is again a noticeable difference between the Centre Line data (a) and the Perpendicular Line data (b). The former are distributed rather more as might be expected fortuitously, with an accumulation between about $-30^\circ.5$ and $-32^\circ.5$ (corresponding to sites oriented around due south at latitudes of approximately $+57^\circ.5$ and horizon altitudes between 0° and 2°) and an exponential fall-off towards higher declinations. The Perpendicular Line data also manifest a peak around -32° , but there is in addition a separate accumulation around -29° and -30° , as well as a minor accumulation around -18° .

Figure 13b appears to provide the strongest evidence so far for an interest not just in the Moon but specifically in declinations close to its major and minor standstill. The evidence is confined to the Perpendicular Line data. It implies that, at sufficiently many of the sites for the trend to be evident, the recumbent and flankers were set up so that the major standstill Moon (or, in a few cases, the minor standstill Moon) would be seen to rise or set over the recumbent, preferably near to its centre. The recumbent and flankers were set up perpendicular to the line of sight.

The general form of the azimuth distribution for the Perpendicular Line data (Figure 12b) may be a simple consequence of the observed declination trend. For a latitude of $57^\circ.5$, horizon altitudes between 0° and 2° (the most common values) yield declinations around -30° for azimuths between about 192° and 204° . The data yield no direct clues as to why the setting Moon should have been strongly preferred to the rising Moon.

The form of the azimuth distribution for the Centre Line data (Figure 12a) requires a separate explanation. Since there is independent evidence (Section 9) that the recumbent and flankers may generally have been erected first and the circle stones added later, it may be that when the circle stones were constructed other preferences, related to the main purpose(s) of the site in a way undiscernible to the present-day commentator, may have come into play. For example, there

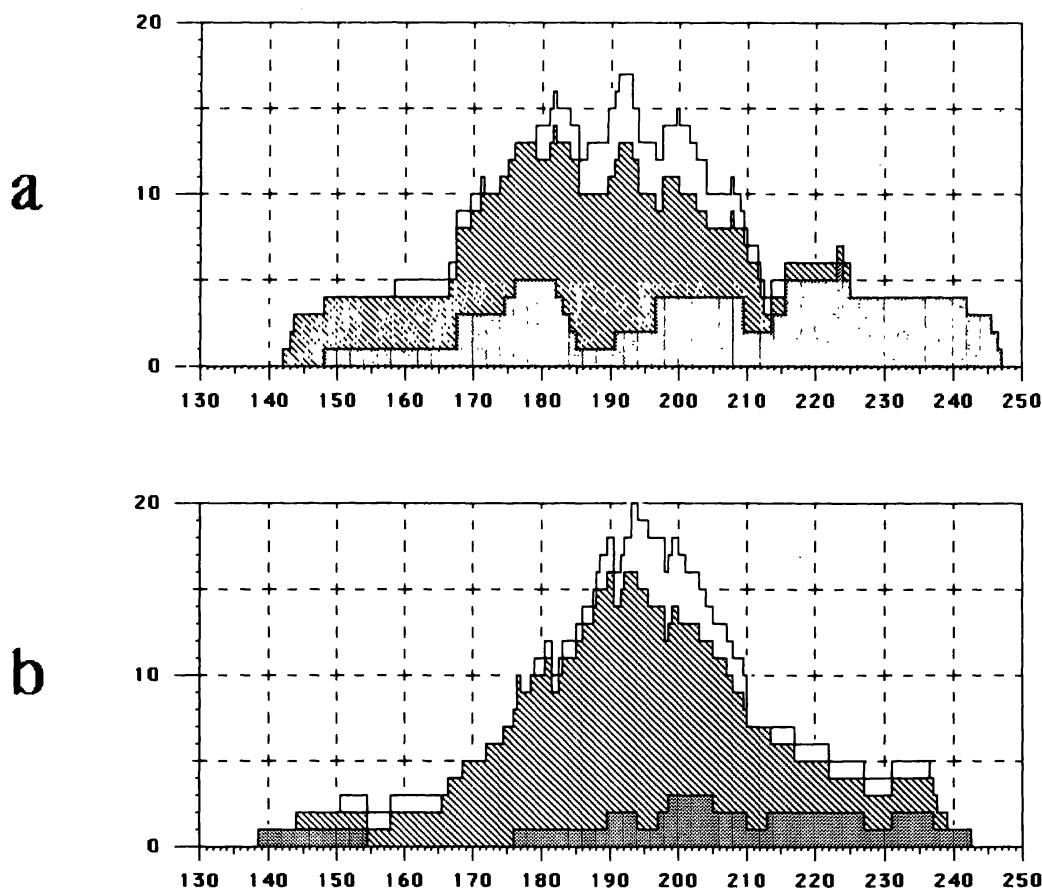


FIG. 14. Histogram of azimuths within the indicated horizons. Azimuths within each i.h. are weighted uniformly, so that the y -value indicates at how many sites a given azimuth is within the i.h. a: Centre Line, from P_c ; b: Perpendicular Line, from P_{10} . The three divisions of Tables 3 and 4 are represented by differential shading, Division 1 (first-hand data from reliably preserved sites) being the darkest.

may have been a desire to place the recumbent stone due south of the ring centre, and this might have conflicted with the desire to place the recumbent and flankers symmetrically in the circle. The conflict might have been resolved in different ways at different sites, a situation which might partially explain the peak at 180° in Figure 12a. However, it does not provide a full explanation of the form of the Centre Line data, since under this hypothesis we would expect less of a trough between 180° and about 205° than is actually observed. Furthermore, while there are one or two individual sites which appear to fit the model very well — notably Yonder Bognie (RSC25), North Strone (RSC54) and Raes of Clune (RSC92) — there are in Table 2 roughly as many sites whose Centre Line azimuth is farther away from due south than their Perpendicular Line azimuth as there are sites where the opposite is the case.

The azimuth and declination plots of Figures 14 and 15 appear to add little to the discussion. The distribution of Perpendicular Line azimuths (Figure 14b) is sharply peaked at 194° , whereas the Centre Line data are more widely spread. The Perpendicular Line declinations (Figure 15b) show a peak just above -29° , whereas the Centre Line declinations fall off above $-30^\circ.5$.

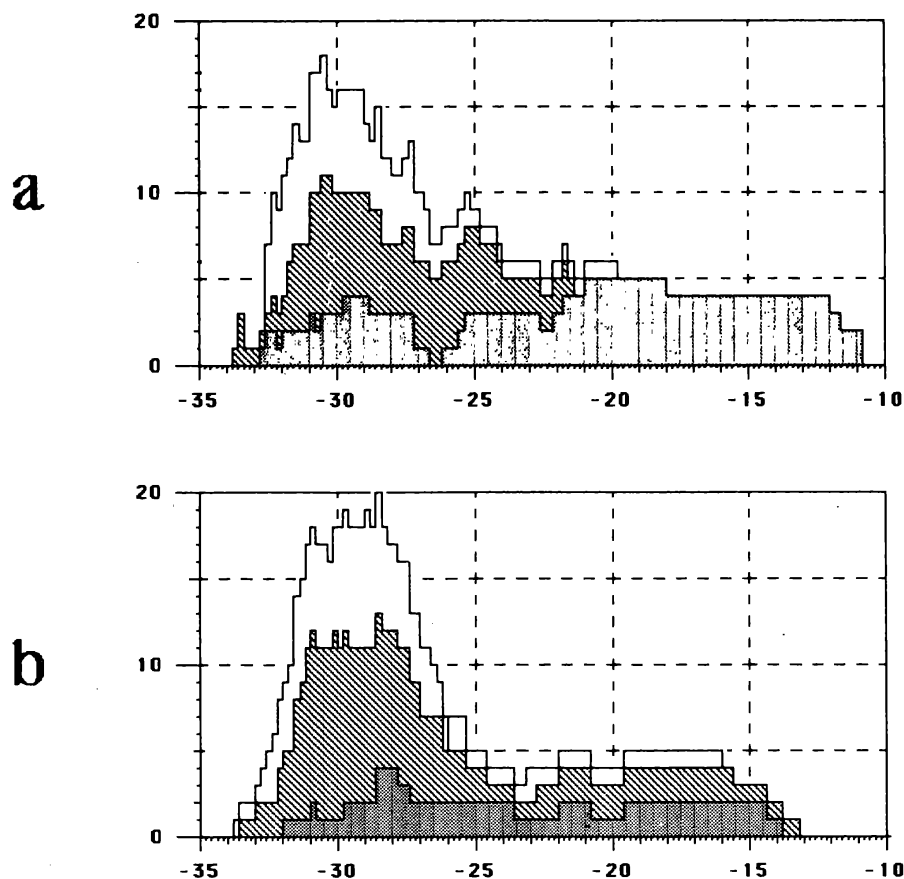


FIG. 15. Histogram of declinations within the indicated horizons. Declinations within each i.h. are weighted uniformly, so that the y -value indicates at how many sites a given declination is within the i.h.

a: Centre Line, from P_6 ;

b: Perpendicular Line, from P_{10} .

The three divisions of Tables 3 and 4 are represented by differential shading, Division 1 (first-hand data from reliably preserved sites) being the darkest.

Thus observations of the rising and setting major or minor standstill Moon may explain an overall trend evident amongst the indicated declinations for the Perpendicular Line, but they do not account for the construction and orientation of every site in the sample. Similarly a desire to construct the circle stones so that the recumbent was due south of the ring may partially explain an overall trend evident amongst the indicated azimuths for the Centre Line.

14. *Prominent Hilltops within the Horizon above the Recumbent*

In Section 10 above we dismissed the idea that orientations upon particular types of terrestrial feature were a contributory factor of the overall RSC orientation trend. However, we might ask whether such orientations, say upon prominent hilltops, notches or distant mountains, might have influenced the precise orientation of individual sites within the WSW-SSE sector, and whether they themselves had a particular astronomical significance.

During the surveys of 1981 it was noted that the horizon above the recumbent

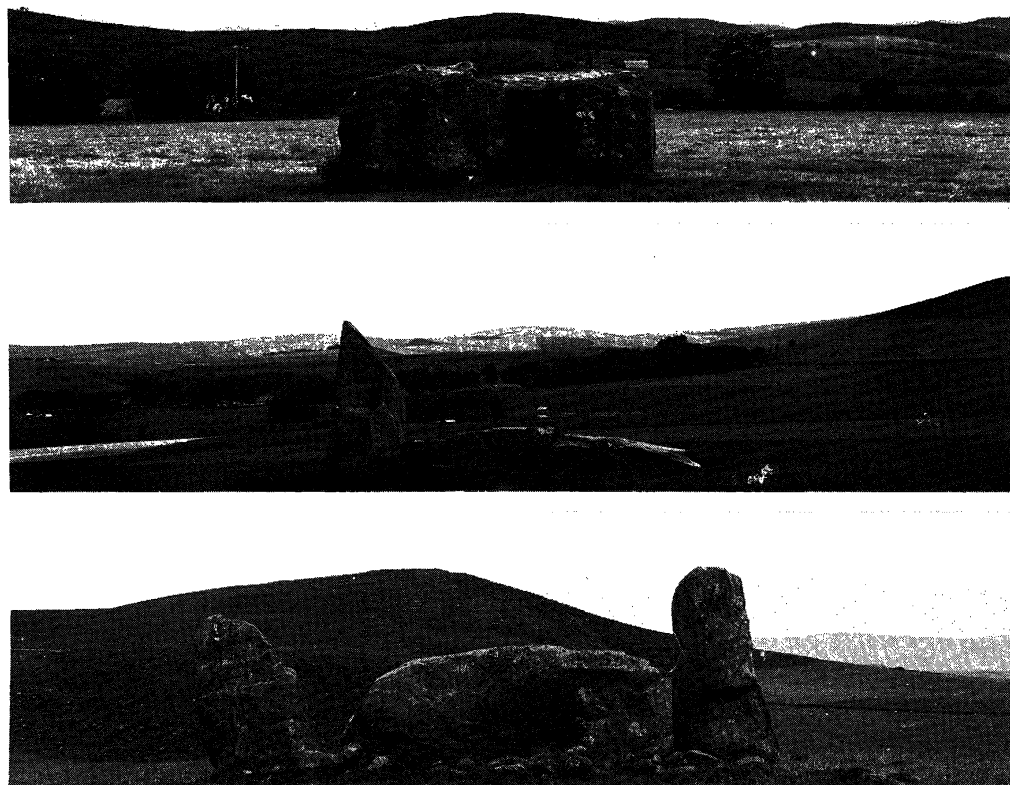


PLATE 6. Examples of single conspicuous hilltops contained in the horizon above the recumbent. Top: Hillhead of Avochie from Rothiemay (RSC23). Middle: Satter Hill from Inchfield (RSC40). Bottom: Hill of Flinder from Stonehead (RSC41). Photographs by CR.

very often contained a single conspicuous hilltop. This is sometimes a prominent nearby summit rising above lower, more distant hills to either side, as at Rothiemay (RSC23), Stonehead (RSC41) and Midmar Kirk (RSC71). Sometimes it is a hilltop at moderate distance, rising sharply amongst gentler hills, as at Inchfield (RSC40), Sunhoney (RSC72) and Dyce (RSC83). At other sites it is a distant peak rising above flatter local ground, as at Old Keig (RSC49) and New Craig (RSC58), or else showing in a gap between more local hills, as at Corrstone Wood (RSC33). Three examples are illustrated in Plate 6. At other sites there appears to be one prominent summit, but the interpretation is rather more subjective. Examples are Ardlair (RSC37) and Loanhead of Daviot (RSC59). At relatively few sites is the horizon featureless, or else undulating with no peak of particular prominence appearing within the range.

A full list of unique hilltops contained within the indicated horizon is given in Table 6. It should be noted that (i) there is inevitably an element of subjectivity, as rigid criteria for their selection have not yet been developed; and (ii) hill identifications and distances quoted in the table are unchecked and should be treated as provisional, since they were not measured as a primary part of the 1981 project. Seventeen further sites were rejected from further consideration because their indicated horizon contained no single obvious peak. Ten of these (RSC6, 7,

12, 48, 56, 67, 75, 78, 84 and 86) have flat-topped recumbents, four (RSC5, 26, 47 and 61) have uneven-topped recumbents, and three (RSC39, 68 and 94) have recumbents the shape of whose top is indeterminable.

In columns 7 and 8 of Table 6 we note for each site the difference between the azimuth of the hill summit concerned and the Centre Line and Perpendicular Line orientations. Of the eighteen entries in the table for which both axial orientations are determinable, the conspicuous hilltop occurs nearer to the Perpendicular Line orientation in twelve cases. It was noted during the 1981 fieldwork how the Perpendicular Line axis often pointed to a conspicuous hilltop whereas the Centre Line axis seemed to avoid it. The best examples are Rothiemay (RSC23), Arnhill (RSC24), Ardlair (RSC37), North Strone (RSC54), Whitehill Wood (RSC73), Garrol Wood (RSC91) and Raes of Clune (RSC92). In contrast, the hilltop is nearer to the Centre Line axis in only three cases.

After the list of hilltops had been drawn up their azimuths and altitudes were determined (from theodolite surveys where available, and by calculation from Ordnance Survey maps otherwise) and their declinations were calculated. The relevant values are listed in Table 6 and illustrated in Figure 16. The preferred declinations are -30° and -29° , but the spread about these values is wide. The same is true when only those hilltops occurring within 3° of the Perpendicular Line azimuth (shaded squares) are considered. Thus there is no stronger indication of observations of the major standstill Moon than was obtained from the analyses of the previous section.

We provisionally conclude that conspicuous hilltops were not used within the indicated horizon to pick out particular astronomical events (notably the major moonrise or set). However, the presence of such hilltops in the majority of indicated horizons, generally near to the Perpendicular Line, does provide evidence that such hilltops were deliberately sought and included within the horizon above the recumbent in many cases.

Several authors have suggested that groups of sites were preferentially oriented upon prominent landmarks. A. L. Lewis was the first to suggest that the builders of stone rings might have thought hills to be sacred, and built the rings in sight of conspicuous summits.⁸⁶ In recent years Harding,⁸⁷ for example, has suggested that the Milfield henges in Northumberland were oriented so as to allow distant horizon views through the entrance; and Barnatt⁸⁸ has suggested that some of the stone rings on Bodmin Moor in Cornwall incorporated orientations upon visually impressive tors. This idea is corroborated by several ethnographic examples such as the En tribe of northern Burma.⁸⁹

In the case of the RSCs, there is also evidence that conspicuous hilltops were sought. However, at present, lunar orientation and the presence of a conspicuous hilltop seem to be separate goals, which could often be achieved together. It may be that at sites such as Berrybrae (RSC5), where a conspicuous hill (Mormond

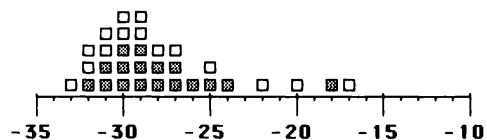


FIG. 16. Declinations of conspicuous hilltops within the indicated horizon, plotted to the nearest degree. Shaded squares represent sites where the azimuth of the hilltop is within 3° of the Perpendicular Line azimuth.

TABLE 6. Sites with single conspicuous hilltops contained within the indicated horizon.

<i>Column headings</i>	<i>Key to column 3 (shape of top of recumbent)</i>
1 Site reference.	F Flat top.
2 Site name.	U Uneven top.
3 Shape of top of recumbent.	X Fallen or broken, shape of top indeterminate; or removed.
4 Status of measurements.	? Determinable but unknown.
5 Name of hill.	<i>Key to column 4 (status of measurements)</i>
6 Distance of hill in km.	s Surveyed profile.
7 Difference between azimuth of hill summit and Centre Line azimuth, in degrees.	p Part survey, with large parallax errors, together with calculated profile.
8 Difference between azimuth of hill summit and Perpendicular Line azimuth, in degrees.	c Calculated profile.
9 Azimuth of hill summit.	v Profile surveyed, but distant hill suspected and calculated.
10 Altitude of hill summit.	
11 Declination of hill summit.	

1	2	3	4	5	6	7	8	9	10	11
RSC11	Loudon Wood	F	c	Hill of Dens	4	4	1	191.0	1.0	0
RSC17	Corrydown	F	c	Hill of Rothmaise	11	3	7	189.0	0.8	-31.2
RSC19	Pitglassie	?	c	Hill of Rothmaise	10	?	7	177.5	0.4	-31.7
RSC20	Mains of Hatton	F	c	Gordonstown Hill	3	9	?	156.0	0.4	-32.5
RSC23	Rothiemay	F	s	Hillhead of Avochie	2	14	0	202.5	1.6	-29.6
RSC24	Arnhill	F	v	Tap o'Noth	17	7	0	195.5	1.4	-28.6
RSC25	Yonder Bognie	F	v	Hill of Foudland	13	4	5	178.5	1.6	-30.1
RSC33	Corrstone Wood	F	c	Morven	27	?	1	209.5	1.2	-31.2
RSC37	Ardlair	X	s	Knock Saul	6	9	3	150.5	1.6	-27.2
RSC40	Inschfield	X	c	Satter Hill	8	?	1	201.0	1.4	-26.7
RSC41	Stonehead	U	s	Hill of Flinder	1	?	2	212.0	1.4	-29.2
RSC43	Wantonwells	U	c	Satter Hill	5	?	2	203.5	3.8	-23.6
RSC44	Braehed	U	c	Knock Saul	3	?	3	205.0	1.8	-28.1
RSC46	Loanend	F	c	Spur of Satter Hill	1	?	7	217.5	4.2	-25.4
RSC49	Old Keig	F	c	Mount Keen	37	3	0	209.5	4.2	-21.7
RSC52	Druidsfeld	X	s	Benaquhallie	9	?	8	162.5	2.0	-27.5
RSC54	North Strone	X	s	Mill Maud	7	9	2	189.5	1.2	-29.3
RSC55	Old Rayne	X	c	Oxen Craig	5	2	?	197.0	4.2	-31.6
RSC58	New Craig	X	p	Mount Battock	49	?	1	203.0	0.6	-27.2
RSC59	Loanhead of Daviot	F	s	Hill at NJ 733219	7	9	4	191.0	0.6	-31.8
RSC63	Easter Aquorthies	X	p	Hill of Fare	20	1	1	196.5	0.8	-30.8
RSC66	Castle Fraser	F	s	Hill of Fare	10	2	2	201.0	2.0	-28.8
RSC71	Midmar Kirk	F	s	Hill to south	1	14	9	217.0	6.0	-20.2
RSC72	Sunhoney	F	s	Blackyduds	3	5	2	226.0	4.8	-17.9
RSC73	Whitehill Wood	F	c	Green Hill	4	12	4	191.0	3.4	-29.0
RSC77	Tomnaverie	U	s	Lochnagar	30	2	?	234.0	1.8	-17.3
RSC83	Dyce	U	c	Brimmond Hill	4	6	6	184.5	1.6	-31.4
RSC89	Esslie the Lesser	X	p	Shillofad	3	3	?	180.5	3.0	-30.2
RSC90	Esslie the Greater	F	p	Shillofad	3	5	12	171.0	4.0	-28.8
RSC91	Garrol Wood	F	s	Spur at NO 738886	3	8	1	150.0	2.4	-26.1
RSC92	Raes of Clune	U	c	Strathgyle	2	12	3	171.5	3.2	-29.6
RSC96	Colmeallie	X	s	Craig of Shanno	2	9	?	193.0	6.8	-25.4

TABLE 7. Sites from which measurements of Mither Tap were made.

Column headings

- 1 Site reference.
- 2 Site name.
- 3 Azimuth of Mither Tap (brackets indicate calculated, rather than measured, value).
- 4 Centre Line azimuth (see Table 2 for status of determination).
- 5 Perpendicular Line azimuth (see Table 2 for status of determination).

1	2	3	4	5
		°	°	°
RSC54	North Strone	49	180.0	191.5
RSC52	Druidsfield	65	—	170.0
RSC37	Ardlair	113	159.0	147.0
RSC39	Candle Hill	132	163.5	—
RSC40	Inschfield	139	—	202.0
RSC56	Hatton of Ardoyne	152	219.5	236.5
RSC55	Old Rayne	(177)	195.0	—
RSC58	New Craig	221	—	202.5
RSC59	Loanhead of Daviot	(225)	200.0	187.0
RSC61	Kirkton of Bourtie	258	—	199.0
RSC63	Easter Aquorthies	287	195.5	195.5
RSC67	South Ley Lodge	317	—	197.0
RSC68	South Fornet	318	—	183.5

Hill) occurs to the WSW of the site, at an azimuth some 30° greater than that of the principal axes, the two goals could not be simultaneously achieved and a compromise was reached. It would clearly be of great interest to investigate conspicuous hilltops occurring within the indicated horizon more thoroughly and objectively than has been done here.

A notable candidate for preferential orientation is Mither Tap, the “Old Mother Mountain”, a particularly conspicuous peak at the eastern end of the Bennachie Hills, whose name suggests that it was regarded as a holy mountain in more recent times. The Bennachies, northeast of Alford, are a range of hills rising amidst the central concentration of RSCs, and are surrounded by such sites (see Figure 7). In Table 7 we list some of the sites from which Mither Tap is particularly conspicuous, giving its azimuth together with the Centre and Perpendicular Line orientations of the sites as available. Despite the presence of such rings as Old Rayne (RSC55), New Craig (RSC58) and Loanhead of Daviot (RSC59), from which Mither Tap falls in the WSW-SSE sector, it is remarkable that not a single recumbent stone was set in line with the crag — almost as though it was considered undesirable to have the mountain silhouetted between the flanking stones of the ring. Thus despite its physical prominence Mither Tap itself was not a summit upon which RSCs were aligned, although many lower hills apparently were. Clearly there is no simple explanation of alignments upon conspicuous hills, any more than there is a simple explanation of the astronomy of the RSCs.

15. Regional Variations in Orientation

Despite the clear architectural uniformity amongst the RSCs there are noticeable regional variations in style, size and orientation. From a diagnosis of seventeen architectural features such as diameter, length of recumbent, height of flankers,

and including the dates of artefacts discovered in the rings, a provisional typology for the RSCs was constructed by one of the authors (AB).⁹⁰ It was suggested that rings such as Loanhead of Daviot (RSC59), Sunhoney (RSC72) and Cothiemuir Wood (RSC48) were early whereas small and somewhat unimpressive sites like the shrunken ring at Garrol Wood (RSC91) were late in the series. Some confirmation for this scheme emerged from the observation that generally the 'early' sites were in the central regions unlike those thought to be later which were at its edges.

It is clearly of interest to see whether regional variations are evident in the site orientations and, if so, whether they are correlated with typological variations. A diagram of the distribution of RSC orientations has been given by Burl.⁹¹ Updated and more extensive diagrams, based on the data of Part One of this paper, are given in Figures 17 and 18, for the Centre and Perpendicular Line orientations respectively.

There is no overriding orientation trend amongst the central concentration of sites around the Bennachie and Correen Hills of central Aberdeenshire, although many of them are oriented SSW, at azimuths between 190° and 205° (RSC55, 58, 59, 61, 62 and 63). A general absence of sites in this area which are oriented around due south, at azimuths between 170° and 190° , may also be worthy of note. Immediately to the north of the central concentration, by contrast, there was a tendency to orient sites towards the south. In the far northeast, in the Buchan district, there are three sites oriented between 185° and 190° (RSC6, 11 and 12), but we also find the extremes of Strichen (RSC7) which faces SSE and Berrybrae (RSC5) which faces southwest.

Immediately to the south of the central concentration is a scatter of sites situated around the Hill of Fare, between the rivers Don and Dee. Those sites in the north and east of this group are oriented south and SSW, but those to the south and west, including the more far-flung sites at Balnacraig (RSC76) and Tomnaverie (RSC77), tend to be oriented southwest. Finally, in the far south, in Kincardineshire south of the River Dee, there is a marked concentration of azimuths towards the SSE, between 150° and 183° (sites RSC86, 89, 90, 91 and 92).

Thus while there is some evidence of regional orientation preferences, it is not at all clear-cut. Analyses of indicated declinations in different regions provide no clearer a picture. In the absence of extensive excavation we may never be able to provide any totally convincing evidence about regional variations, simply because of the paucity of the data. However, by focusing upon particular areas we can make some observations of interest, as well as some speculative interpretations.

There is, for example, an interesting dichotomy in the Buchan district of northeast Aberdeenshire between those rings which are circular and those which are elliptical in shape (Table 8). The builders of the three circular sites seem to have had a decided preference for recumbents in the south, whereas the two elliptical RSCs have recumbents facing SW and SSE.

It is noteworthy that at Strichen the axis through the recumbent is aligned with the longer axis of the ellipse, whereas at Berrybrae it is aligned with the shorter. Thus an apparent astronomical orientation is provided by one or other axis of the ellipse. This is also a feature of the egg-shaped cromlechs of Brittany which are the French counterparts of the British stone circles. Thus at Ménéac, near Carnac,

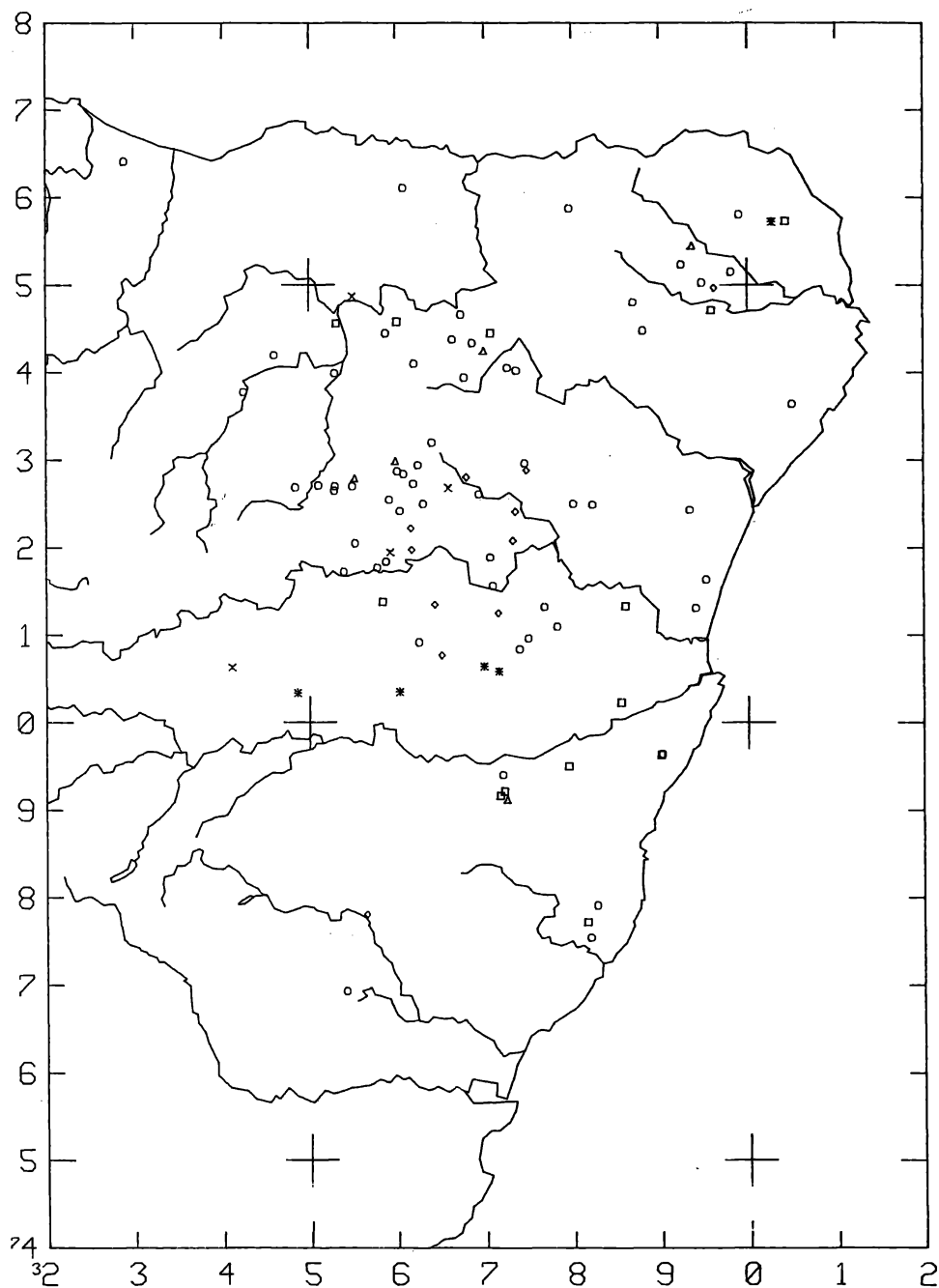


FIG. 17. Regional preferences in Centre Line orientation. Each symbol represents an RSC, with Centre Line azimuth A coded as follows:

Triangle	$A < 170$
Square	$170 \leq A < 190$
Diamond	$190 \leq A < 205$
Cross	$205 \leq A < 220$
Star	$220 \leq A$

RSCs whose Centre Line azimuth is unknown are represented by a circle. The figure includes all sites listed in Table 1.

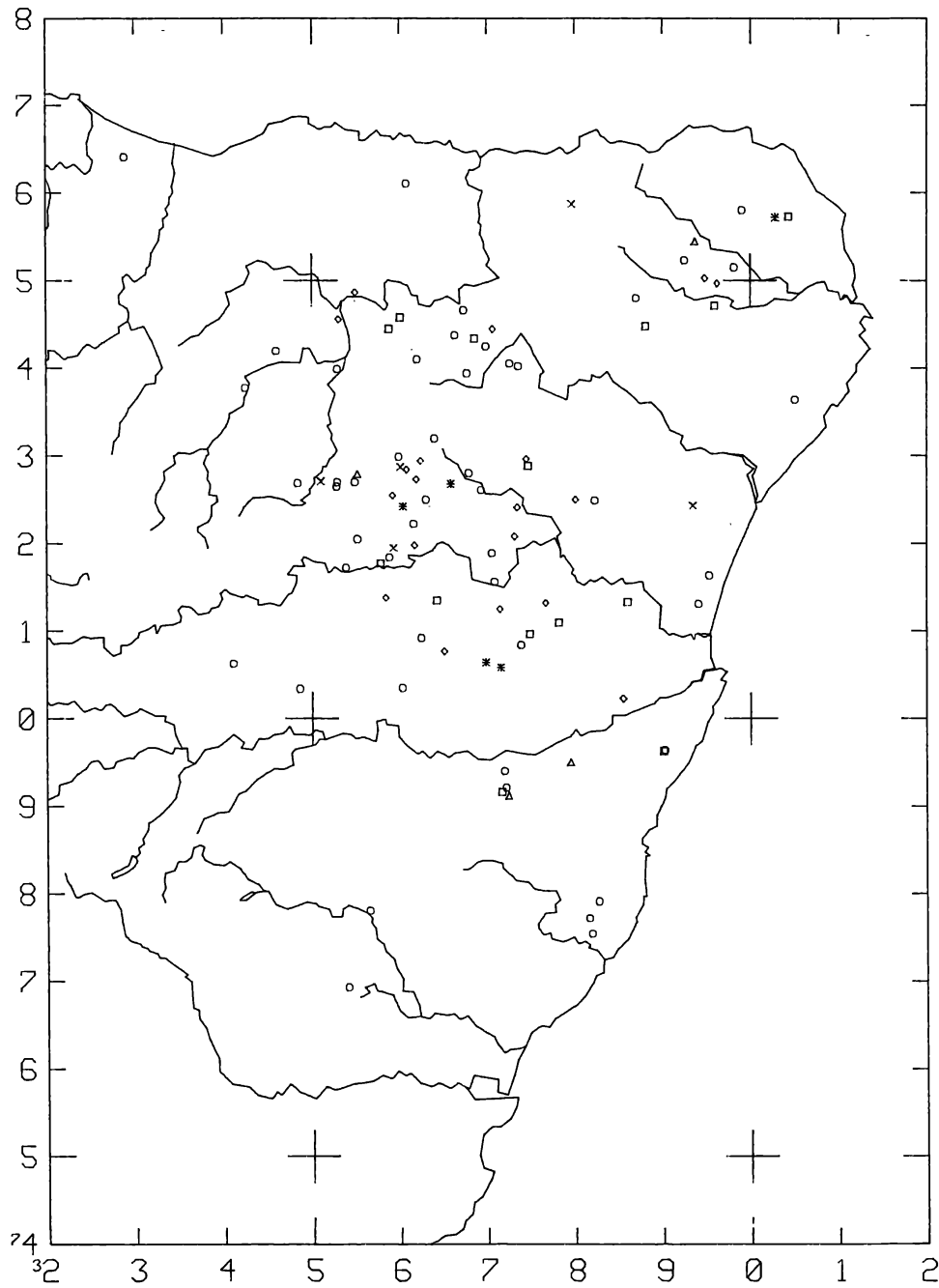


FIG. 18. Regional preferences in Perpendicular Line orientation. Symbols have the same significance as in Figure 17.

there are two cromlechs in which the short axis of the eastern and the long axis of the western indicate solstitial events.⁹³

The same appears to apply to several ovals and ellipses in Wales.⁹⁴ Should further investigation show this to be generally true, it would provide an explanation for non-circular rings other than the geometrical interpretations of

TABLE 8. Diameters and axial azimuths for RSCs in the Buchan district. The quoted diameters are from AB's notes (recently updated) as opposed to those values quoted in Table 1 which were taken from data compiled some ten years ago.⁹²

Column headings

- 1 Site reference.
- 2 Site name.
- 3 Diameter(s) in metres.
- 4 Orientation of the longer axis (non-circular sites).
- 5 Centre Line azimuth (see Table 2 for status of determination).
- 6 Perpendicular Line azimuth (see Table 2 for status of determination).

1	2	3	4	5	6
RSC7	Strichen	12.1 × 11.0	NNW-SSE	161.0	158.0
RSC6	Netherton	16.6		185.0	185.0
RSC12	Aikey Brae	14.4		185.5	185.5
RSC11	Loudon Wood	17.6		194.0	190.0
RSC5	Berrybrae	13.0 × 10.7	NW-SE	231.0	231.0

Thom.⁹⁵ Certainly at Cultoon on Islay the long axis of the oval was directed towards midwinter sunset;⁹⁶ and the midsummer sunrise alignment of the Woodhenge ellipses in Wiltshire has been recognized since 1929.⁹⁷

An apparently perplexing variation on the general regional orientation trend can be seen at the fine rings, only 1.5 km apart, of Midmar Kirk (RSC71) and Sunhoney (RSC72). Sunhoney was constructed on the southern outskirts of the RSC distribution and this may have restricted the builders' choice of a suitable location. They needed good soil, nearness to water, a local source of stones and an elevated level site with a good view to the south. All these were available in the valley near Echt but a distant horizon to the south was not. Instead, the hills rose so sharply there that the Moon at its southerly maximum never appeared above them. At Sunhoney there may have been a compromise. Instead of aligning upon the extreme southerly Moon, which would have been impossible in that situation, the people set the richly cupmarked recumbent stone in line with the Moon at its minor standstill. The resulting azimuth of 224°.5 might account for the similar azimuth of 226° at neighbouring Midmar Kirk if that ring were erected some years afterwards. (Midmar was reconstituted in A.D. 1914, but we are assured that the recumbent was not moved.⁹⁸)

More generally, regional variations in orientation might be explained to some extent by the idea, mooted in Section 9, that neighbouring groups co-operated in the initiation of a new ring. Such neighbours, already using sites many years old, would have known when the Moon would move between the flankers of their own ring. If they passed this information on this could account for the broadly similar orientations in certain areas that have been noted above.

16. *Sites with Cupmarks*

A question that has perplexed archaeologists for many years is whether cupmarks, known on many megalithic tombs, stone circles and standing stones, had an astronomical significance. Recumbent Stone Circles may provide the

beginnings of an answer. In these rings such carvings are found only on the recumbent, its flankers or on the stones immediately adjacent to them. Plate 7 shows an example at Balquhain (RSC62).

Cupmarks occur at a dozen RSCs, mostly distributed in the central regions on a north-south line to the north of the River Dee, but with one, Potterton (RSC81), on the east coast. Generally they have no more than one or two cupmarks but Loanhead of Daviot (RSC59), Balquhain (RSC62), Sunhoney (RSC72) and Rothiemay (RSC23) have far more.

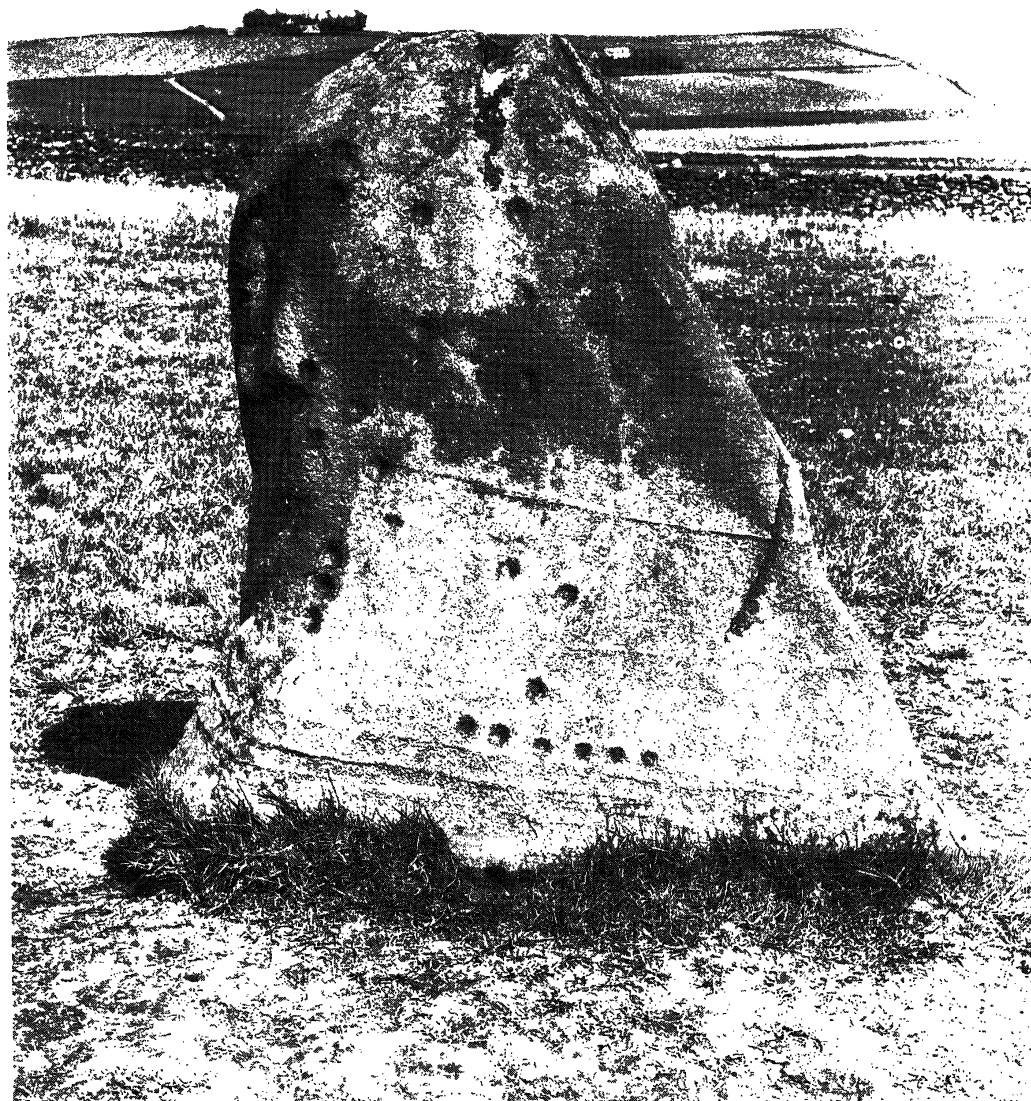


PLATE 7. The cupmarked stone west of the west flanker at Balquhain (RSC62). Photograph by RCAHM(S).

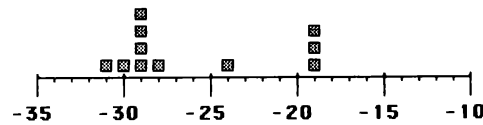


FIG. 19. Declinations of the horizon directly above cupmarks, as viewed from the centre of the ring. Values are plotted to the nearest degree.

Estimates of the azimuths of the cupmarks from the centre of the ring have been obtained at eight of the sites, and these are listed in Table 9. At the other four sites — Balnacraig (RSC76), Pitglassie (RSC19), Potterton (RSC81) and Nether Corskie (RSC69) — such figures are unobtainable because the centre of the ring is unknown. Horizon altitudes and the corresponding declinations are also given in Table 9.

The eleven declination values obtained reveal a most interesting distribution (Figure 19). Seven of them are clustered between $-31^{\circ}.0$ and $-28^{\circ}.4$, within 2° of the rising or setting major standstill Moon; indeed, six are clustered between $-29^{\circ}.6$ and $-28^{\circ}.4$. Three of the remainder fall between $-19^{\circ}.1$ and $-18^{\circ}.8$, within 1° of the minor standstill Moon. At Balquhain we appear to have cupmarks lying beneath the setting position of the Moon at both standstills. Only a single declination, that of $-24^{\circ}.2$ obtained at Loanhead of Daviot, does not appear to have a simple explanation in terms of the lunar standstills.

Thus at this stage cupmarks perhaps provide the strongest evidence of all for a lunar motivation amongst the RSCs. Direct surveys of the relevant azimuths and declinations are clearly desirable in order to verify the results of this section. If, as it appears, cupmarked stones (at least in the RSCs) do have an astronomical significance, then we should undoubtedly undertake investigations of cupmarks elsewhere.

17. Discussion

With their clear-cut orientations between SSE and WSW the RSCs form at present the most promising of all megalithic groups in the British Isles for astronomical analysis. It is from the study of such large, integral groups, rather than from individual monuments, that the most persuasive evidence is likely to come in the early stages of archaeoastronomical research.¹⁰³

The evidence provided in the two parts of this paper implies that astronomical considerations influenced the siting and orientation of the RSCs. We conclude that astronomy was undoubtedly a factor, perhaps an important one, in the function of the sites. At the same time, it is clear that the sites were *not* 'observatories'. Their relatively small diameters and wide recumbents imply that they were not sites of great astronomical precision. From the archaeological evidence it seems likely that the sites had a simple ritual significance amongst small egalitarian groups living in co-operation.

Although the top of the recumbent always lay below the natural horizon the flankers usually projected above it. This may have been an attempt to reproduce an astronomical 'letterbox' like those at Newgrange in Ireland¹⁰⁴ and Maes Howe in the Orkneys.¹⁰⁵ In these passage-graves the entrance stone and the blocking stone respectively, both of them horizontal, have their tops well below the skyline and the midwinter Sun appears in a narrow rectangle defined by the skyline, the

sides of the passage and the lintel stone at the entrance. With the likelihood that the RSCs had an Irish connection¹⁰⁶ it is quite possible that their builders were following this tradition of creating a megalithic 'window' whose base was formed by the horizon, its sides by the inner edges of the two flankers but whose top was omitted perhaps because an RSC was an open-air site unlike the enclosed passages and chambers of megalithic tombs. In such an interpretation the cupmarks on some recumbents might be considered in the same light as the lavish decoration on the entrance stone at Newgrange.

In terms solely of axial indications there seems to be no simple, direct interpretation of the pattern of indicated declinations in terms of observations of the Sun and Moon. Burl's original suggestion¹⁰⁷ that sites might have been oriented so that the major standstill Moon would pass above the axial line is ruled out by the large number of declinations somewhat *above* $-30^{\circ}.0$. There are some indications, both archaeological and astronomical, that the east flanker was of particular importance, but there is no simple explanation of all the data, and to

TABLE 9. Azimuths of cupmarks from the ring centres, together with declinations of the horizon above them.

Column headings

- 1 Site reference.
- 2 Site name.
- 3 Number of cupmarks on the circle stone east of the east flanker.
- 4 Number of cupmarks on the east flanker.
- 5 Number of cupmarks on the recumbent stone.
- 6 Number of cupmarks on the west flanker.
- 7 Number of cupmarks on the circle stone west of the west flanker.
- 8 Azimuth of the cupmarks from the ring centre.
- 9 Horizon altitude above the cupmarks.
- 10 Declination of the horizon above the cupmarks.
- 11 Comments.

Key to column 11 (comments)

- a *Rothiemay*. The ring centre has been determined from Thom's plan⁹⁹ on which no absolute azimuth is given. The azimuth was determined during fieldwork in 1981.
- b *Arnhill*. It is not certain that these are man-made cupmarks.¹⁰⁰
- c *Braehead*. The cupmarks are on a chockstone under the east end of the recumbent.¹⁰¹
- d *Cothiemuir Wood*. The cupmarks are at the extreme western end on the outer face.
- e *Loanhead of Daviot*. The azimuth is taken from Thom's plan.¹⁰² It is the azimuth of his line *BC*; although *B* and *C* are spurious the line fortuitously goes through the relevant circle stone.

1	2	3	4	5	6	7	8	9	10	11
RSC23	Rothiemay			119			202.5	1.4	-28.4	
RSC23	Rothiemay					2	167.0	0.5	-31.0	a
RSC24	Arnhill			2			195.5	1.6	-29.6	b
RSC44	Braehead			4			193.0	2.6	-29.1	c
RSC46	Loanend			2			225.0	3.6	-19.1	
RSC48	Cothiemuir Wood			3-4			204.0	0.8	-29.2	d
RSC59	Loanhead of Daviot	12					140.0	0.2	-24.2	e
RSC62	Balquhain					25	232.0	0.5	-18.9	
RSC62	Balquhain			1			190.0	3.0	-29.4	
RSC62	Balquhain		4				172.0	3.0	-29.3	
RSC72	Sunhoney			31			224.5	5.0	-18.8	

postulate an exclusive interest in the east flanker begs the question of why a complete stretch of horizon, rather than a single point, was demarcated.

When the whole horizon above the recumbent is considered, there are more definite indications of an interest in the rising or setting major standstill Moon (and occasionally the minor standstill Moon). However, even this does not explain all the sites. Evidently there is no simple, all-embracing astronomical explanation for the Recumbent Stone Circles. Instead we must bear in mind that it is very unlikely that the positioning of the recumbent stone was exclusively astronomical. We find evidence of conflicting concerns: orientation upon the major or minor standstill Moon; the presence of conspicuous hilltops within the horizon above the recumbent; a recumbent stone facing due south. These separate goals would rarely have been achievable simultaneously, and we surmise that compromises were often reached. It remains the opinion of AB, however, that the evidence strongly supports the belief that an orientation upon the southern Moon was of major importance to the RSC builders.

The azimuths of cupmarked stones seem to corroborate the idea of an interest in the major or minor standstill Moon: indeed, they do so in a rather spectacular way. Our results require checking by renewed surveys. If they stand, then in addition to aiding our interpretation of the RSCs they might give us a valuable insight into the function of cupmarks more generally.

Some regional variations are evident in the orientation of RSCs, but their interpretation must at present remain speculative. We mentioned in Section 15 that a provisional typology had been proposed for the RSCs. Astronomically, there are no obvious changes between the hypothetically earlier and later rings, and indeed it would be unwise to place great confidence in a chronology which must at present be conjectural.

No rigorous statistical tests have been presented in this paper. We have tried instead to present the new data and to give some initial, general interpretations which integrate the astronomical and archaeological evidence rather than concentrating upon the astronomy alone. Hopefully further fieldwork and more rigorous statistical analyses can now begin to investigate these ideas further.

Several directions have emerged for future work. At the RSCs themselves it would be of great interest to investigate conspicuous hilltops occurring within the indicated horizon more thoroughly and objectively than has been done here. Such data might be augmented from sites in a poorer state of repair than those considered in these papers, even those where both the Centre Line and Perpendicular Line orientations are unknown. Excavation, should adequate resources become available, may be able to clarify many of the apparent overall trends and regional variations deduced from the surface evidence. The idea that the recumbent and flankers were set up before the other stones of the ring might be testable by excavation. Studies of related groups of sites, such as the Clava cairns of Inverness-shire or the Recumbent Stone Circles of south-west Ireland, would be of the greatest interest. The results of Section 16 suggest that studies of cupmarked stones, not only at the RSCs but elsewhere, might also prove valuable.

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