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THE STONE ROWS OF SOUTH-WEST IRELAND: A FIRST RECONNAISSANCE

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1. INTRODUCTION

In order to derive meaningful evidence on prehistoric astronomy, it is necessary to collect field data according to well-researched methodological constraints and to subject the data obtained to appropriate statistical analysis.[1] During the last twenty years this author has undertaken extensive fieldwork on the possible astronomical significance of prehistoric monuments, mainly in western Scotland.[2] This has shown that many of the short rows of standing stones found in this region appear to be oriented upon the southerly limit of the rising or setting moon,[3] and recent work in the island of Mull, Argyll, has indicated that terrestrial features such as prominent hilltops may also have played a key role in the symbolism underlying the siting and orientation of these sites.[4] A similar conclusion has been reached with regard to the recumbent stone circles (RSCs) of north-eastern Scotland.[5]

South-western Ireland is clearly an important area in which to extend this line of research and to undertake comparative studies. The area is extremely rich in free-standing megalithic monuments: there are over 80 rows comprising three to six standing stones,[6] over 100 stone pairs[7] and numerous single menhirs;[8] about 50 'axial-stone circles' of seven or more stones[9] together with 45 five-stone circles;[10] and 6 'four-posters'.[11] In addition, there are some one hundred burial monuments known as 'wedge tombs'.[12] There are clear morphological similarities between the axial-stone circles and five-stone circles of south-west Ireland on the one hand and the north-eastern Scottish RSCs on the other,[13] and the concentrations of stone pairs[14] and the presence of four-posters[15] in both Perthshire in Scotland and south Munster in Ireland reinforce the idea of some form of linkage, direct or indirect, between the two areas. Concentrations of short stone rows are found in western Scotland, south-western Ireland, and between the two in mid-Ulster, and some continuity of tradition is evident.[16] A difference between Scotland and south-west Ireland is that in the latter the short stone rows and stone circles are found in close association and evidently are closely related elements of a single tradition.[17]

For the archaeoastronomer, one of the most intriguing features of the sites in south Munster is that despite their diversity of form, they demonstrate a quite remarkable overall consistency in orientation, with a highly significant concentration around NE–SW. Of 69 rows whose orientations are plotted by Ó Nualláin,[18]

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all but eleven fall between 20°/200° and 75°/255°, and all without exception fall between 350°/170° and 100°/280°. Of 60 stone pairs, all but two fall between 6°/186° and 88°/268°.[19] Even the single menhirs are often slabs and generally follow the pattern of NE–SW orientation.[20] The azimuths of the axial stones of the stone circles lie between S and WNW, corresponding closely to the azimuths of the recumbent stones in the RSCs of north-eastern Scotland.[21] Finally, all wedge tomb entrances face the western arc of the horizon.[22]

Despite their obvious similarities to the Scottish free-standing megalithic sites and the great archaeoastronomical interest in the latter over the years, there have only been two substantial archaeoastronomical investigations of the south-western Irish monuments. The first, Barber's computerized study of 30 axial-stone circles, concluded that twelve of them were oriented upon the sun or moon,[23] but this result is not statistically significant.[24]

The second investigation is Lynch's study of 37 short stone rows, undertaken between 1973 and 1976.[25] In Lynch's approach, careful attention was paid to defining row orientations, taken as the line of best fit to the centroids through still-standing stones, and these are quoted to a precision of 0°·1. The north point was, however, determined from magnetic measurements rather than by more reliable means such as timed observations of the sun.[26] The declinations indicated by each row in both directions were then deduced, also to a precision of 0°·1, and compared with the solar solstices and equinoxes and the lunar standstills. Following a probability calculation Lynch concluded that significantly many astronomical targets were indicated to within an accuracy of somewhat under 2°. However, the just-about-equal mix of solar and lunar targets worried the author, who was unhappy about "the diverse events indicated within such a homogenous group of sites".[27]

In view of more recent developments in archaeoastronomy, an approach which is limited to quoting the precise declinations of alignments in the exact direction of orientation as defined by some predetermined means from the present-day placement of the stones seems likely to be of very limited value. There are a number of reasons for this view. First, as already mentioned, the Scottish evidence strongly suggests that natural horizon features such as prominent hilltops may have been significant, and this possibility should be explored at the south-west Irish sites. A prominent mountain located a few degrees off the apparent present-day mean alignment of the site may be more closely related to its intended symbolic function than the horizon in the actual direction of alignment. Second, it does not seem that the alignments were intended to be precise: "The stones are not set with their long axes in precise alignment and indeed in many cases serious deviations occur."[28] Third, we must avoid the outdated paradigm that simply concentrates on the theoretical extremes and means of the solar and lunar motions. Instead, we need to let the distribution of indicated declinations speak for itself,[29] and to admit the possibility not only of symbolism associated with the solstices, equinoxes and standstills but also broader, lower-precision alternatives.[30]

With these considerations in mind, a survey programme was initiated by the present author in 1991. This programme has three main aims: (i) to investigate the oriented sites of south-west Ireland in a systematic way in the light of new ideas and approaches within archaeoastronomy; (ii) to accumulate data for meaningful comparative studies with the better-studied Scottish sites; and (iii) to suggest possible areas where broader and more extensive research efforts, in the manner of the North Mull project,[31] might valuably be concentrated.

During the first season of fieldwork, attention was focused upon the four- to six-stone rows, for the simple reason that these provide a sample of sites at which orientation evidence is likely to be relatively well preserved.

In this paper we describe the methodology of data acquisition, present the data, and undertake exploratory data analysis in order to formulate ideas that can be tested using the data obtained in later seasons.

2. METHODOLOGY OF DATA ACQUISITION

2.1 *Selection of Sites*

The starting point for our sample was all sites with four or more stones in the list of stone rows published by Ó Nualláin.[32] This list includes descriptions, plans and drawings. Another list has also recently been published by Burl as part of a new corpus of the stone rows in Britain and Ireland.[33] In addition, Ó Nualláin (1991, priv. comm.) has supplied the author with a list of updates to his own list, which includes four unpublished sites, and some corrections to Burl's.[34] We have included the site at Eightercua, included in Burl's list[35] but excluded from Ó Nualláin's on the grounds that the stones may be associated with a stone fort.[36]

The final list of sites is given in Table 1, ordered from grid north to grid south. Discrepancies between Ó Nualláin's and Burl's lists are detailed there, as are changes (such as partial destruction) that have taken place since visits by the Ordnance Survey of Ireland in the 1970s. A map showing the distribution of the sites is given in Figure 1.

For the purposes of discussion and subsequent analysis, we adopt certain conventions and nomenclature. Thus, for convenience, we refer throughout to the 'NE' and 'SW' directions in the context of individual rows (e.g. 'the NE-most stone'), even though the rows in question may actually be oriented NNE–SSW, ENE–WSW, or even N–S or E–W. The actual orientation data are given in Table 2. For referring to the stones within a row, we always use the label *a* for the SW-most stone (in the above sense), labelling subsequent stones towards the NE as *b*, *c*, etc.

2.2 *Selection of Horizon Indications*

The author visited all of the 31 sites listed in Table 1, with the exception of two (Barrahaurin and Derrymihin West) which were known to have been destroyed,

TABLE 1. Rows of four or more stones in Counties Cork and Kerry.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Ke	57	Beal Middle	Q885475	5	6	6		NE		D	Y		A	N		910419	
Ke	U1	Feavautia	R065235	3	4	4		U	E	D	Y		B	N		910419	D
Co	1	Cloghvoula	R158143	3	4	4		SW		C	N		A	N		910419	
Ke	58	Cloonsharragh	Q511128	3	4	4	G	NE		D	N		C	Y		910419	
Co	2	Knocknanagh East	R227057	1	4	4	C									910419	x
Co	5	Garrane	W478912	3	4	4		NE		D	Y		A	N		910414	
Co	12	Beenalaght	W483874	5	6	6		N	f	A	N		C	N		910416	g
Co	8	Tullig	W318872	4	4	4		SW		A	N		D	Y		910414	
Co	13	Barrahaurin	W454830	0	0	5	e										i
Co	16	Cabragh A	W278798	4	4	4		NE		C	Y		A	N		910413	b
Co	17	Cabragh B	W278793	4	6	6		U	d	C	N		D	Y		930519	c
Co	20	Coolgarriff	W407776	2	4	4	h	SW		A	N	j	D	Y		910415	A
Ke	65	Gortacloghane	V759738	3	4	4		U		D	N		C	N		910421	
Co	22	Reananerree	W204728	6	6	6		SW		D	N		D	Y		910413	
Ke	U2	Derrineden	V572716	6	6	6	L	SW	F	A	N		D	Y		910421	DI
Ke	64	Doory	V546710	4	5	5	O	NE		D	Y		B	N		930522	
Co	25	Rooves Beg	W450702	1	5	6		NE	k	C	N	l	A	N	m	910415	x
Ke	U3	Dromkeare	V540684	4	4	4		SW		B	N		D	Y		910421	DJ
Co	28	Dromcarra North	W278681	5	5	5		U		D	Y		A	N		920512	
Ke	U4	Eightercua	V512646	4	4	4		SW		D	Y		D	Y		910421	M
Ke	67	Kildreelig	V408637			4											K
Ke	68	Garrough	V558608	2	4	4		SW		A	N		D	Y	N	910421	
Co	36	Castlenalacht	W486608	4	4	4		NE		C	N		C	Y		910415	
Co	35	Farrannahineeny	W214607	4	5	5		SW		A	N		D	Y		910417	
Co	37	Piercetown	W690593			5	a										n
Co	33	Maughanasilly	W044585	4	4	5	p	NE	o	C	Y		A	N		910416	P
Co	117	Behagullane	W275567	2	4	4		U	v	A	N		A	N	S	910417	uw
Co	41	Dromdrasdil	W171557	3	4	4	s	SW		A	N	t	C	Y	Q	910416	R
Co	40	Ardrah	W069544	4	4	4		SW		B	N		D	Y	q	910416	r
Co	U5	Derrymihin West	V696461	0	0	5	B										iD
Co	55	Gurranes	W174315	3	5	5		NE	y	D	Y	z	D	Y	T	910417	

COLUMN HEADINGS:

1 County (Co=Cork/Ke=Kerry)
2 Catalogue no. in Ó Nualláin, "Stone rows in the south of Ireland"
3 Site name
4 Irish National Grid Reference
5 No. of stones still standing
6 No. of stones remaining (standing or prostrate)
7 Estimate of original no. of stones in row
8 Notes on number of stones
9 Probable direction of stone height gradation, if any (tallest at NE end / SW end / N(neither) / U(unknown))
10 Notes on stone height gradation
11 (Most distant) horizon distance category to NE
12 Highest point exists within the horizon profile indicated to the NE? (Y/N)
13 Notes on horizon to NE
14 (Most distant) horizon distance category to SW
15 Highest point exists within the horizon profile indicated to the SW? (Y/N)
16 Notes on horizon to SW
17 Date of survey or visit
18 General notes

KEY TO NOTES ON NO. OF STONES (Column 8)

a Ó Nualláin lists this as a four-stone row, but a survey team from the Cork Archaeological Survey visited the site on 9 May 1983 and noted a fifth stone, 0·37m high, located 1·4m to the SW of the SW-most stone shown by Ó Nualláin (P. Walsh, 1993, priv. comm.). The fifth stone had also been noted by Ó Riordáin in 1931.[55]

e The site, now destroyed, consisted of five stones, three of which were prostrate, in 1916.[56]

h Stone *b* has fallen since Ó Nualláin's visit, and prostrate stone *c* has been shifted.

p Stone *c*, which was split in two and half of which is shown fallen on Ó Nualláin's plan,[57] has been reconstructed since Lynch's excavation.[58] The northernmost stone *e* was not located.

s The NE-most stone has fallen since Ó Nualláin's visit. The SW-most, largest stone is threatened by a substantial bush growing immediately adjacent to it and may soon be pushed over.

B This site, now destroyed, consisted of five stones. A plan in the Somerville papers at University College, Cork shows a row of four standing stones oriented ENE–WSW. The fifth stone was removed and is now incorporated in a fence to the north (S. Ó Nualláin, 1991, priv. comm.).

C Only the largest stone shown in Ó Nualláin's plan[59] now remains standing. The others have been pulled down and dragged into a heap by the side of it.

G Ó Nualláin lists this site but shows a large prostrate stone in his plan[60] and now feels that it represents the remains of a four- to six-stone row (1991, priv. comm.). Burl lists the site twice, once[61] as a three-stone row and once[62] as a four- to six-stone row. We found three large standing stones together with a large prostrate stone to the SW, in accordance with Ó Nualláin's figure.

L While there appear to be six stones at this site (see general notes), the status of stones *b* and *d* is in some doubt. There are no other cases of contiguous stones in the stone rows of the area,[63] and it is the opinion of the Archaeological Branch of the Ordnance Survey in Dublin that *b* and *d* are likely to be later or recent additions (P. Walsh, 1993, priv. comm.).

O Ó Nualláin lists this site as a 'three stones with a fourth ... set roughly in line', as does Burl,[64] rather than a four-stone row. The reason is that if the site is considered to be a single row, it is anomalously long (some 23m). However, it is considered to be a single row for the purposes of this analysis. In his diagram, Ó Nualláin[65] shows a further fallen stone or outcrop, also roughly in the alignment, but does not comment on it. This appears to be a possible candidate for a fallen stone, but its status is uncertain.

KEY TO NOTES ON STONE HEIGHT GRADATION (Column 10)

f There is a tall stone at each end.

d Stones *a*, *c*, and *d* appear to be broken off.

k This is inferred from the sizes of the prostrate stones.

o Uncertain, as all stones appear broken off, but the NE-most is currently the tallest.

v Stones *c* and *d* have been reduced to stumps.

y This is suggested by menhirs *a*, *b* and *c*; *d*, however, is low.

E Uncertain. Prostrate stone *a* appears intact, but stone *d*, although shorter, is broken off.

F *e* is the tallest and most substantial stone and *f* is obviously broken, which suggests a height gradation in this direction.

KEY TO NOTES ON HORIZON TO NE (Column 13)

j This is uncertain owing to a forestry plantation adjacent to the site. It is possible that a more distant profile is visible beyond the local horizon.

l Uncertain because the exact orientation is unknown.

m The horizon in this direction is probably local, but obscuration by trees and buildings make this uncertain.

t It is not clear whether a more distant horizon, about 5km away, might be visible behind the local one about 30m away, currently covered by a copse. The more distant horizon does not, however, contain any prominent features.

z Distant horizon, including the hill which achieves the highest apparent altitude, can currently only be seen at the very left-hand end of the indication. Further to the right is a low bluff some 300m from the site, which is covered in tall vegetation. Behind this, it is possible that more distant horizon would be visible in the absence of vegetation, although the distant horizon in question is low and featureless.

Table 1 — continued]

KEY TO NOTES ON HORIZON TO SW (Column 16)

q The distant horizon is obscured by field walls and buildings some 100m to the SW of the site. Measurements on site by magnetic compass showed that the summit of Seefin (29 km) is within the indicated range. This is calculated from maps to have an azimuth of 238°·2, which compares with the alignment azimuth of 237°·1 quoted by Lynch.[66]

N The row is not oriented upon a horizon peak but upon a solitary island in the middle of the bay visible from the site. Although the whole island is below the sea horizon, its highest point provides a good indication of a point on the latter, which is taken as the 'highest' horizon point for the purposes of this analysis.

Q Although no accurate determination of the orientation of the row could be obtained (see general note *R*), the summit of Nowen Hill (4·1 km) is at least close to the general direction of indication. This summit was measured to have an azimuth of 226°·6, although the alignment azimuth quoted by Lynch[67] is somewhat higher (234°·0).

S It is possible that the summit of Milane Hill would just be visible on the horizon in the indicated direction behind the point where a tree-covered hill little more than 500m distant meets much closer outcroppings. Certainly it would be visible from uphill behind the site to the NE. For this reason, the hill is included tentatively in Table 3.

T The peaks of more distant hills on the peninsula SW of Skibbereen are just visible behind the right-hand slope of the hill (531ft) 2km to the WSW of Castletownshend, 2·6km from the site. However, it is the latter that achieves the highest apparent altitude.

KEY TO GENERAL NOTES (Column 18)

b This site is listed twice by Burl: once as 'Cabragh A'[68] and also, erroneously, as a 3-stone row ('Cabragh B')[69] (S. Ó Nualláin, 1991, priv. comm.).

c This site is not listed by Burl.

g Not surveyed as both indicated horizons are obscured by forestry trees.

i Not visited as site has been destroyed.

n Not found. Ó Nualláin, apparently on the basis of site visit in the mid-1970s, states that the site is overgrown with gorse. Much of the area is now under forestry plantation.

r Not surveyed as the distant horizon to the SW is obscured by field walls and buildings some 100m to the SW of the site.

u This site is erroneously listed by both Ó Nualláin and Burl[70] as a stone pair. Clearance of vegetation has revealed two low stumps to the NW of the NW stone giving a four-stone alignment 6·6m long. There is also a radial-stone cairn some 16m to the SE (S. Ó Nualláin, 1991, priv. comm.).

w Not surveyed as the horizon is less than 50m distant to the NE, and less than 1km distant and tree-covered to the SW.

x Not surveyed as only one stone remains standing and the original orientation is highly uncertain.

A This site is not listed by Burl, although the nearby pair[71] is.[72]

D This site, though not included in Ó Nualláin's published list, is included in a list of updates provided by Ó Nualláin in 1991 (priv. comm.). It has been assigned a number preceded by 'U'.

H This site consists of a row of three standing stones, all broken off, together with a fourth prostrate stone, now partially incorporated in a field wall. *a*, the prostrate stone, is 2·3m long × 1·2m wide. 0·6m to the NE is *b*, a block 1·1m high × 0·8m × 0·6m; *c*, 1·2m from *b*, is the stump of a slab 0·6m high × 2·2m wide × 0·15m thick; and *d*, 1·3m from *c*, is a broken-off slab 1·5m high × 0·85m wide × 0·3m thick. They would have formed a row approximately 8m long.

I This site consists of a row of six stones, as follows: *a*, 0·9m × 0·3m × 1·6m tall; *b*, 0·7m × 0·35m × 0·95m tall; *c*, 0·55m × 0·45m × 1·1m tall; *d*, 0·8m × 0·4m × 0·45m tall; *e*, 2·1m × 0·6m × 2·7m tall; and *f*, 0·6m × 0·35m × 1·3m tall. *a*–*b*, *b*–*c* and *d*–*e* touch each other. *c* and *d* are 0·45m apart. *e* and *f* are 1·0m apart.

J This site consists of a row of four stones: *a*, 2·0m × 0·85m × 2·4m tall; *b*, 0·5m × 0·3m × 0·5m tall; *c*, 1·4m × 0·8m × 1·75m tall; *d*, 0·7m × 0·4m × 1·2 tall. *a* and *b* are 1·05m apart; *b* and *c* are 0·8m apart; *c* and *d* are 0·95m apart.

K Not found. A small standing stone, some 1·3m tall, and an adjacent stump were found in the approximate location, with ground close by having been dug and quarried out, suggesting that the site might have been destroyed. However, these remnants do not appear to fit any part of

Ó Nualláin's description, and the identification is far from certain.

M A clear stone alignment, albeit incorporated into a later stone fort.[73] There seems no objective reason to follow Ó Nualláin[74] and exclude it from the sample on these grounds, and we follow Burl by including it. It has been assigned a number preceded by 'U'.

P Burl[75] gives an erroneous grid reference for this site.

R This site is currently located in a thicket of holly and brambles. The horizon could be surveyed from an adjacent position, but no accurate determination of the orientation of the row could be obtained.

and two (Kildreelig and Piercetown) which were searched for but not found. The visits all took place in 1991, except for Dromcarra North and Doory. Cabragh B was revisited later in order to correct an earlier survey hampered by poor horizon visibility.

Surveys were undertaken at 22 of the 27 sites visited. In the remaining cases (Knocknanagh East, Beenalaght, Rooves Beg, Behagullane, and Ardrah) surveys were rendered unproductive by one or more of the following factors: (i) obscuration of the horizon by adjacent forestry trees, other high vegetation or buildings;[37] (ii) the close proximity of indicated horizons (closer than, say, 500m); and (iii) large uncertainty in original orientation, owing to the fact that only one stone remained standing at a site. The reasons are listed in detail in Table 1. At Dromdrasdil, no accurate determination of the orientation of the row could be made because the site is currently located in a thicket of holly and brambles and so no indicated horizon range data were obtained.[38]

At eight of the remaining 21 sites (Beal Middle, Garrane, Tullig, Cabragh A, Coolgarriff, Derrineden, Dromcarra North, and Castlenalacht) surveys in one direction of indication were rendered unproductive for reasons (i) or (ii) above. Thus, in all, 34 horizon indications were measured at 21 sites.

2.3 *Survey Procedure*

Survey procedure followed that of previous work by this author.[39] The range of possible indications was estimated subjectively but, since the data were not reduced on site and their astronomical potential was unknown, this should not have given rise to any overall bias in favour of particular astronomical interpretations. The extent of the range was determined by reference to identifiable points on the distant horizon, which were then surveyed. The north point was determined by timed observations of the sun. The azimuth limits of the range, together with mean altitudes and declination limits, are listed to an appropriate accuracy in Table 2.

In an attempt to determine whether one or other direction of indication might be the important one, or at least the one of greater importance, the author examined possible stone height gradation at each site. The potential value of doing this is suggested both by the fact that the tallest stone is usually at one end of the row[40] and by the apparent importance of height gradation in the axial-stone circles,[41] as well as in many of the RSCs of north-eastern Scotland.[42] Where possible,

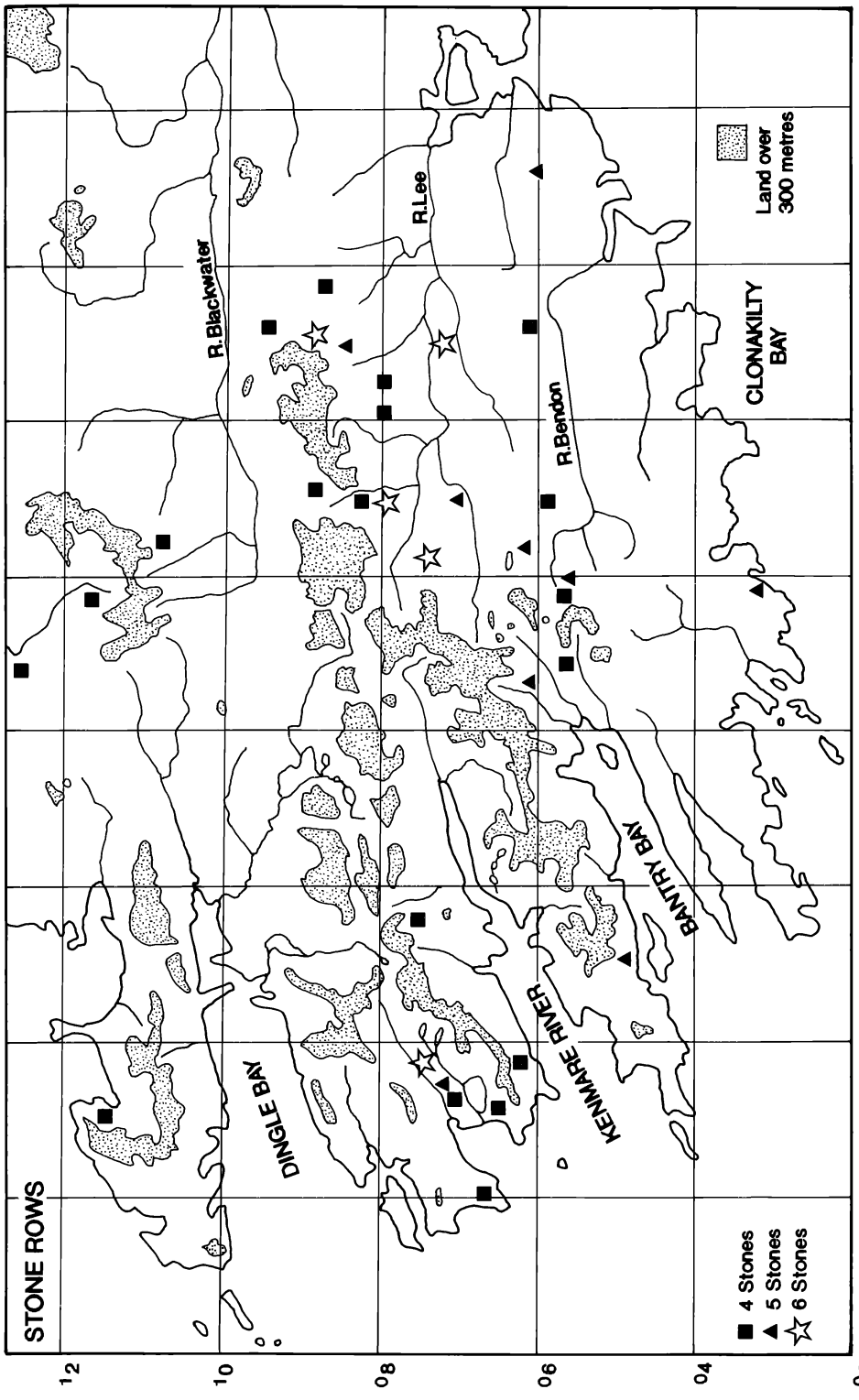

FIG. 1. Map of the stone rows of between four and six stones in Counties Cork and Kerry. The six-stone row at Beal Middle is off the map to the north. Three sites that have come to light recently[34] are also shown, although they are not considered in the paper. Source of information: Archaeological Branch, Ordnance Survey, Dublin.

a probable direction of gradation is identified in Table 1.

In view of recent work suggesting that prominent hilltops may be an important factor in the symbolism of these sites (see above), an attempt was made to identify prominent hills falling within the indicated azimuth ranges, and to measure the azimuths and altitudes of their summits. However, we sought a methodology that avoids the subjective determination of prominence. We believe we have achieved this by examining the point of highest altitude within each indicated range. Where this point is one or other end of the range, i.e. the indication is upon the side of a hill, or the altitude variation within the entire range is very small (smaller than, say, 0·4 degrees), then we consider that no high-point of possible interest exists. Whether or not a highest point exists within the indicated range is listed in Table 1. Where such a point exists, the hill summit is identified and its azimuth, altitude and declination are quoted in Table 3 to an accuracy of 0·1 degree. This is well within the practical limits that, according to recent work,[43] day-to-day variations in refraction place upon azimuthal indications at the latitude of the British Isles.

Finally, 'horizon scans' were produced at each site in an attempt to determine whether there is a preference for more distant horizons in particular directions (absolute or relative to the orientation of the site).[44] This consisted of dividing horizon distances into four categories — 'A' (up to 1 km), 'B' (1–3 km), 'C' (3–5 km) and 'D' (over 5 km) — and noting the azimuths of the junctions between different categories. Such a procedure enables us to divide the horizontal circle into 1° intervals and then, for each interval, to examine the percentage of horizons falling into each category. The results are shown in Figure 2(a). Where a 'preferred direction' could be estimated from the stone height gradation — quoted to the nearest degree in Table 2 — the procedure could be repeated using azimuths relative to the preferred direction rather than absolute azimuths. The results are shown in Figure 2(b).

3. THE RESULTS

3.1 *Preferred Directions of Indication*

The stone height gradation in the Cork-Kerry stone rows is not always monotonic, and in many cases most or all of the stones are evidently broken off, so that attempting to identify the original height gradation is little more than pure guesswork. However, a probable 'preferred direction' was identified from the stone height gradation at 20 of the 26 sites examined (see Table 1). These probable directions of indication (taken to be from the smallest to the tallest stone) are almost evenly split between NE and SW, with 9 and 11 instances respectively. One site, Beenalaght, is a six-stone row where the stones are graded up to a high stone at each end.[45]

In the great majority of cases this determination of the apparent direction of indication is reinforced by the horizon distance in the two directions. This is most obvious at the seven sites — Beal Middle, Garrane, Tullig, Coolgarriff,

TABLE 2. Table of indicated horizon ranges.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
57	35	40	0·2	+29·4	+27·6			–	–	–	–	–	38–218	a		38	
U1	36	40	0·2	+29·4	+27·6		N	216	220	1·2	−28.6	−27·4	38–218		N	–	
1	355	5	0·2	+37·4	+37·2		N	175	185	3·0	−35·0	−34·8	0–180		N	180	
58	58	63	−0·2	+18·2	+15·4	g	j	238	243	7·4	−13·2	−9.8	60–240		j	60	
5	33	38	0·2	+30·8	+28·6		k	–	–	–	–	–	36–216	b		36	
8	–	–	–	–	–	a		241	243	1·8	−16·2	−15·0	62–242		l	242	
16	42	44	2·8	+29·6	+28·6		m	–	–	–	–	–	43–223	a		43	
17	54	57	1·4	+22·4	+20·2		n	234	237	0·4	−21·4	−19·4	55–235		n	–	
20	–	–	–	–	–	c		216	222	0·0	−30·4	−27·8	39–219		N	219	
65	35	41	4·2	+35·2	+30·2		N	215	221	2·6	−28·6	−25·4	38–218		N	–	
22	32	35	0·6	+31·6	+30·4			212	215	0·6	−31·8	−30·0	33–213			213	
U2	–	–	–	–	–	a		213	216	0·4	−31·2	−30·2	34–214		N	214	
64	32	48	2·0	+33·4	+25·6		o	212	228	2·4	−28·8	−23·4	40–220		p	40	i
U3	20	26	4·2	+40·0	+37·0			200	206	2·0	−33·8	−32·4	23–203			203	
28	41	46	0·6	+28·2	+25·4		q	–	–	–	–	–	44–224	a		–	
U4	45	49	1·0	+26·2	+24·6			225	229	0·8	−25·8	−24·0	47–227			227	
68	40	43	11·4	+38·2	+36·8	h	N	220	223	−0·3	−29·2	−27·8	42–222		N	222	
36	–	–	–	–	–	d		233	241	0·2	−22·0	−17·8	57–237		N	57	
35	39	44	2·0	+30·6	+26·8			219	224	1·2	−28·6	−25·8	41–221		r	221	
33	42	49	1·6	+28·4	+25·4		s	222	229	1·2	−26·6	−23·4	45–225		s	45	
55	53	72	0·2	+21·8	+10·6	ef	t	233	252	0·4	−21·6	−11·6	63–243	e		63	

COLUMN HEADINGS:

1 Catalogue no. in Ó Nualláin, "Stone rows in the south of Ireland"
2 Minimum Azimuth (to NE), quoted to the nearest degree
3 Maximum Azimuth (to NE), quoted to the nearest degree
4 Mean altitude (NE indication), quoted to the nearest 0·2 degrees
5 Maximum Declination (NE indication), quoted to the nearest 0·2 degrees
6 Minimum Declination (NE indication), quoted to the nearest 0·2 degrees
7 General notes (horizon to NE)
8 Notes on Lynch's result where significantly different (horizon to NE)
9 Minimum Azimuth (to SW), quoted to the nearest degree
10 Maximum Azimuth (to SW), quoted to the nearest degree
11 Mean altitude (SW indication), quoted to the nearest 0·2 degrees
12 Minimum Declination (SW indication), quoted to the nearest 0·2 degrees
13 Maximum Declination (SW indication), quoted to the nearest 0·2 degrees
14 Mean axis, quoted to the nearest degree
15 General notes (horizon to SW)
16 Notes on Lynch's result where significantly different (horizon to SW)
17 'Preferred direction' estimated from stone height gradation, quoted to the nearest degree
18 Notes on 'preferred direction'

KEY TO GENERAL NOTES ON HORIZONS (Columns 7 and 15)

a Horizon less than 500m distant, so not surveyed.
b Horizon local and obscured by a forestry plantation adjacent to the site, so not surveyed.
c Horizon probably local and obscured by a forestry plantation adjacent to the site, so not surveyed.
d Distant horizon obscured by nearby field walls and vegetation, so not surveyed.
e The indicated azimuth range here is very wide, owing to the sinuous nature of the alignment.
f The right-hand end of the indication was not surveyed, owing to tall vegetation on the local horizon (see Table 1). The declination figure quoted is an estimate.
g The NE horizon was not surveyed owing to obscuration by field walls and gorse some 20m from the site. In this direction is land near the tip of the peninsula leading to Rough Point, some 12 km distant. This has an altitude close to that of the sea horizon. Consequently, an altitude of −0°·3 has been assumed in order to provide the declination estimates given.
h Some error is possible owing to large extrapolations between surveyed points.

KEY TO NOTES ON LYNCH'S RESULT WHERE SIGNIFICANTLY DIFFERENT (Columns 8 and 16)

j Lynch appears to have transposed the horizon altitudes in the two directions at this site.
k Lynch quotes a much higher altitude (8°·4).
l Lynch quotes a rather higher azimuth, of 244°·2.
m Lynch quotes a rather higher azimuth (48°·8) and a much higher altitude (9°·4). At azimuths between 45° to 51° we obtain altitudes around 2°·6.
n Lynch quotes a rather lower azimuth (52°·2 / 232°·2) and an altitude of 0°·0 in both directions.
o Lynch quotes an azimuth of 36°·2, corresponding to *acd* (see note on preferred direction) and a rather higher altitude of 3°·0.
p Lynch quotes an azimuth of 216°·2, corresponding to *dca* (see note on preferred direction) and a lower altitude of 0°·0. At azimuths between 215° to 222° we obtain altitudes between 3°·0 and 3°·2.
q Lynch quotes a higher altitude of 2°·0.
r Lynch quotes an azimuth of 222°·4 and an altitude of 0°·2. This azimuth is close to the summit of Nowen Hill (azimuth 222°·5), for which we obtain an altitude of 1°·6.
s Lynch quotes a rather lower azimuth (39°·6 / 219°·6).
t Lynch quotes a rather lower altitude of –0°·6.
N Lynch does not provide data for this site.

KEY TO NOTES ON 'PREFERRED DIRECTION' (Column 18)

i The line *acd* (i.e. from the outlier to the SW-most pair of Ó Nualláin's three-stone row, *b* being the possible fallen stone), yields an azimuth range of roughly 32°–37°, whereas the NE-most pair *de* yield 45°–48°, so the mean figure of 40° may be misleading.

Derrineden, Garrough and Farrannahineeny–where the horizon is over 5km distant (category D) in the apparent direction of indication but local, i.e. closer than 1km (category A), in the opposite direction. In all, 15 of the 20 sites where a probable preferred direction could be identified demonstrated a preference for a more distant horizon in that direction.[46] In four further cases, distant horizons are encountered in both directions.[47] The apparent exception is Cloghvoula.

3.2 *Variation of Horizon Distance with Azimuth*

Figure 2(a) shows the horizon scan for the absolute azimuth data (see Section 2.3 above). Some reasonably large variations are evident, such as the higher proportion of distant horizons at azimuths around 40° — where some 50% of all indicated horizons fall within category D, as opposed to an average of 29% — and the lower proportion of local horizons around azimuth 250°. It is, however, beyond the scope of the paper to present the control data and statistical tests needed to investigate the extent to which such variations (i) are significant, or (ii) might be explicable simply in terms of site location in areas of good settlement potential within the local topography.[48]

For the purposes of exploratory data analysis, the plot of azimuths relative to the 'preferred direction' (Figure 2(b)) is more enlightening. There is a clear and sharp increase in the proportion of distant horizons at relative azimuths close to zero — i.e. close to the 'preferred direction' at individual sites — where it rises to 75%, as opposed to an average of 31%. This strongly reinforces the evidence already obtained (by comparing the preferred direction with the opposite one)

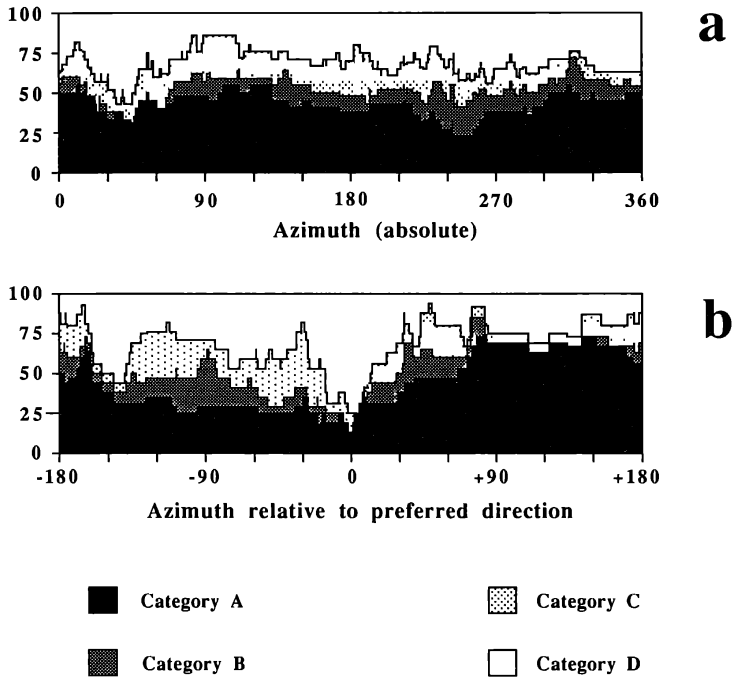

FIG. 2. (a) Horizon scans by azimuth. For each 1° interval in azimuth, we plot the percentage of horizons in category 'A' (up to 1 km, black), 'B' (1–3 km, dark shading), 'C' (3–5 km, light shading) and 'D' (over 5 km, white). Where data could not be measured or estimated on-site, e.g. because of close afforestation, they have been omitted and the average taken over the remaining data for the azimuth interval in question. (b) Horizon scans relative to the 'preferred direction' where this is available (see Table 2). Bins now represent the azimuth relative to the principal direction.

that it was important to the builders of these stone rows to have a distant horizon (generally further than 5km) in the direction of primary interest. The exceptions are Cloghvoula, already noted, and possibly Gurranes, where we have assumed that local ground, currently covered in vegetation, would obscure a distant horizon beyond; however, this not certain (see Table 1). At sites such as Eightercua and Reananerree a single distant hill appears in the direction of indication very close to the direction of indication, disappearing behind local ground a mere two degrees or so on either side.

3.3 *Indicated Declinations*

The indicated declinations obtained from the data tabulated in Table 2 are presented in Figure 3. For the purposes of visualization and exploratory data analysis, each range is simply plotted with equal weighting assigned to all declinations between the limiting ones, a lower weighting per bin being used for wider ranges. Because of the NE–SW orientation of all the sites, all southern declinations are setting declinations and all northern declinations are rising ones.

Even with this small data set, concentrations in declination are clearly evident in Figure 3, the main ones being around −31° to −26° (peaking at −28°) in

the south and +25° to +30° (peaking around +28° to +29°) in the north. These concentrations correlate roughly with the southern and northern lunar standstills (–30° and +28°), and suggest that a lunar explanation should be pursued, in line with the findings in Scotland. Certainly there is no evidence here of any particular interest in the solar solstices.

A comparison of these general conclusions with those of Lynch[49] illustrates the effect of the paradigm shift away from emphasizing precise indications (however objectively defined) and theoretical extremes of the solar and lunar motions. We have also undertaken a direct comparison of our data with those of Lynch,[50] who considered many indications in common with those considered here. Of those 34 horizon indications that we have measured and listed in Table 2, she measured 23, obtaining one hit upon a major standstill (Doory, SW) and one upon a solstice (Eightercua, SW). The Eightercua line is evident in Figure 3, but is the only solstitial line in our sample. We obtain a higher range of declinations at Doory owing to the fact that our measured altitude is some 3 degrees greater than that quoted by Lynch.

There are, in fact, a number of specific discrepancies between our field data and Lynch's. In Table 2, we list cases where Lynch's azimuth falls more than 1 degree outside the range quoted by us, or her altitude differs from ours by more than 1 degree. The discrepancies in azimuth may be due, for example, to our subjective determination of the indicated azimuth range or to her magnetic determinations of plate bearing-to-azimuth correction. The altitude discrepancies are more serious, amounting to as much as 7° in some cases. We are not told how horizon altitudes were determined by Lynch. It is clear that the earlier results must be treated with caution for a number of reasons.

3.4 *Prominent Hills*

The idea that prominent hills were of importance to the builders of the stone rows is borne out subjectively by the simple observation that a number of the

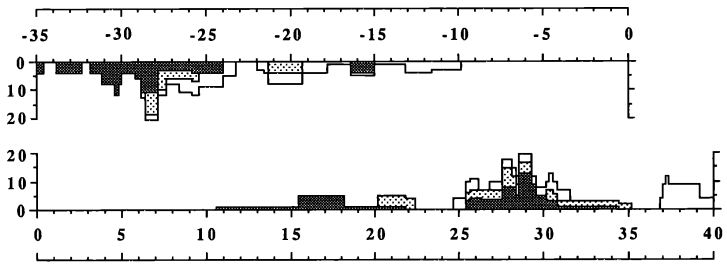

FIG. 3. Indicated declinations. Each range is plotted with equal weighting assigned to all declinations between the limits given in Table 2. The weight is 4 vertical units for ranges up to 2 degrees, 3 units for ranges 2–3 degrees wide, 2 units for ranges 3–4 degrees wide, and 1 unit for ranges over 4 degrees wide. Dark shading denotes a range in the preferred direction, lighter shading a range at a site where the preferred direction in unknown, and no shading a range in the direction opposite to the preferred one. All negative declinations are for setting objects, all positive declinations for rising ones.

TABLE 3. Table of highest points in the indicated horizon ranges.

1	2	3	4	5	6	7	8	9
57	NE	Y	Slievecallan (NW peak)	40	38·5	0·3	+28·2	
57	NE	Y	Slievecallan (SE peak)	40	39·7	0·3	+27·7	
U1	NE	U	Hill, 883ft, at R188397	20	36·2	0·2	+29·2	
U1	NE	U	Hill, 916ft, at R197387	20	40·0	0·2	+27·6	
58	SW	O	Point on ridge between Brandon Peak and Brandon Mountain	4·8	242·7	8·0	−9·8	
5	NE	Y	Coolfree Mountain	32	37·4	0·3	+29·0	
8	SW	Y	Mullaganish	11	241·8	1·8	−15·7	
16	NE	Y	Musherabeg	4·5	43·3	2·8	+28·9	
17	SW	U	Knockboy	32	237·1	0·7	−19·4	
20	SW	Y	Milane Hill	36	220·1	0·1	−28·6	a
22	SW	Y	Douce Mountain	15	214·6	1·0	−30·0	
U2	SW	Y	Knockstooka	14	214·9	0·7	−30·2	
64	NE	Y	Colly	14	45·5	2·4	+27·4	
U3	SW	Y	Beenarourke	9	204·5	2·2	−32·4	
28	NE	U	Hill, 1250ft, 0·5km SE of Lacknahagny	15	40·9	0·9	+28·2	
U4	NE	O	Knocknacusha	22	48·6	1·3	+24·9	
U4	SW	Y	Reenearagh	6	227·5	1·1	−24·1	
68	SW	Y	Two-Headed Island	7	221·4	−0·3	−28·5	f
36	SW	O	Hill, 550ft, at W447582	4·7	234·2	0·3	−21·4	
35	SW	Y	Nowen Hill	11	222·5	1·6	−26·1	
33	NE	Y	Hill 1017ft, at W099632	7	49·0	2·1	+25·5	e
117	SW	U	Milane Hill	13	236·9	1·1	−19·2	d
41	SW	Y	Nowen Hill	4·1	226·6	5·5	−20·5	c
40	SW	Y	Seefin	29	238·2	0·2	−19·4	b
55	NE	Y	Hill, 531ft, 2km WSW of Castletownshend	2·6	237·5	1·0	−19·1	
55	SW	O	Hill, 565ft, 2km ENE of Glandore	8	54·0	0·4	+21·3	

COLUMN HEADINGS:

1 Catalogue no. in Ó Nualláin, "Stone rows in the south of Ireland"
2 Direction (NE/SW)
3 Stone gradation in this direction? (Y/O(opposite direction)/N(neither)/U(unknown))
4 Name of peak
5 Distance (km)
6 Azimuth of summit, to the nearest 0·1 degrees
7 Altitude of summit, to the nearest 0·1 degrees
8 Declination of summit, to the nearest 0·1 degrees
9 Notes

NOTES

a Calculated owing to poor visibility at time of survey.
b Calculated owing to obscuration of the distant horizon (see Table 1).
c Whether Nowen Hill is within the indicated azimuth range is uncertain because no accurate determination of the orientation of the row could be obtained (see Table 1).
d Whether Milane Hill is in fact visible is uncertain (see Table 1), and this entry must be regarded as tentative.
e Small error possible. Extrapolated between surveyed points.
f The value quoted corresponds to that point on the sea horizon directly above the highest point of Two-Headed Island.

rows point directly at the highest or most distant summit visible in a wide stretch of closer horizon. Amongst the best examples are Reananerree (Douce Mountain), Eightercua (Reeneragh), Cabragh North (Musherabeg), Tullig (Mulliganish), and Farrannahineeny (Nowen Hill). Variations on this theme are also evident: the row at Garrough is aligned upon Two-Headed Island, an isolated islet in Darrynane Bay which appears just below the sea horizon.[51]

The procedure outlined in Section 2.3 provides an objective way of assessing whether a prominent hill is likely to be present in an indicated range of horizon, while avoiding the need to invent and apply specific measures of prominence. An examination of Table 1 reveals a strong correlation between the presence of a highest point within the indicated horizon range and the directionality of a site. There are twenty sites for which relevant horizon data are available and a preferred direction could be determined. At fourteen of these, a highest point occurs in the preferred direction but not in the opposite direction (in nine cases the preferred direction is the SW; in the other five it is the NE). In a further two cases suitable highest points occur in both directions. Only at two sites does a highest point occur in neither direction and at a further two (Cloonsharragh and Castlenalacht) in the opposite direction but not in the preferred direction.

The declinations of the relevant hill summits are listed in Table 3 and illustrated in Figure 4. Leaving aside those opposite to the preferred direction at a site, there is a remarkable concentration of the north-easterly summits at seven sites between +26° and +29°, i.e. around and just within the northern lunar standstill. In addition, nine of the thirteen south-westerly summits fall within one degree of the major or minor lunar standstill, with another two near the centre of the range of the southerly monthly limiting moon. This pattern is consistent, for example, with an interest in the setting full moon nearest to midsummer, since over the 18·6-year cycle this phenomenon will occur most often towards the edges of the relevant declination range (−30° to −19°). Just two hill summits fall somewhat outside the latter.

This clustering of sixteen out of twenty hill summits about three of the four lunar standstills reinforces the lunar pattern evidenced by the indicated horizon ranges in general, and seems to provide some of the strongest evidence yet from a small, coherent group of sites for a common symbolic interest in the moon.

4. DISCUSSION

This first reconnaissance of the oriented sites of south-west Ireland has uncovered remarkably strong indications of the importance of prominent hilltops in conjunction with the horizon rising and setting position of the moon. This much is consistent with recent results from the stone rows of western Scotland and the RSCs of north-eastern Scotland, but there is one important difference. In the case of the RSCs, the directionality was always towards the SW,[52] as evidenced by the position of the recumbent stone and flankers, stone height gradation, cup markings, and the distribution of horizon distance with azimuth.[53] Similarly, the

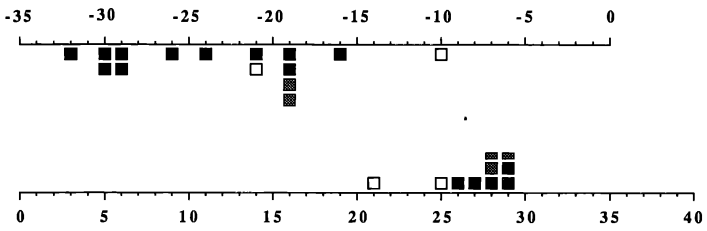

FIG. 4. Declinations of highest points in the indicated horizon ranges. Each square represents a single hill summit, plotted to the nearest degree. Where two summits of equal altitude occur in the same range, half squares are used. Dark shading denotes hills summits in the preferred direction; no shading denotes those in the opposite direction. Light shading is used at sites where no preferred direction has been identified.

lunar pattern discerned amongst the stone rows of Argyll and Mull concerns only southern declinations, although sometimes it involves risings in the SE as well as settings in the SW.[54] In Cork and Kerry, however, the orientations of all forms of free-standing megalithic monuments are NE–SW, and amongst the four- to six-stone rows at least, there is no evidence for a predominant interest in south-westerly direction; on the contrary, the 'preferred direction' as evidenced by stone height gradation — and reinforced by horizon distance data, the presence of prominent hills, and the astronomy — is as often NE as SW. This leads to a fundamental, and as yet unnswered, question: why should a lunar interest be confined to rising phenomena in the north and setting phenomena in the south? Evidence pointing to solar orientations in one direction and lunar in the other would make more obvious sense, forming pairwise symbolic associations such as the setting sun and the simutaneously rising full moon near midwinter. However, the evidence from the four- to six-stone rows quite definitely points to lunar alignments in both directions.

Further fieldwork is in progress to clarify these and other issues, and to examine whether the trends apparent at the four- to six-stone rows extend to other forms of related monument in the Cork and Kerry area. The 1992 and 1993 seasons have focused upon three-stone rows where all three stones remain standing.

ACKNOWLEDGEMENTS

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2. For a summary of the work up to 1984 see C. L. N. Ruggles, "Megalithic astronomy: The last five years", *Vistas in astronomy*, xxvii (1984), 231–89. More recent work is summarized in C. L. N. Ruggles, "Two approaches to the study of possible astronomical symbolism in prehistoric stone rows: Recent fieldwork in western Scotland and south-west Ireland", in C. Jaschek and P. Erny (eds), *Proceedings of the European meeting on archaeo- and ethnoastronomy* (Strasbourg, in press).
3. C. L. N. Ruggles, "The linear settings of Argyll and Mull", *Archaeoastronomy*, no. 9 (1985), S105–32; see also Ruggles, "The stone alignments of Argyll and Mull" (ref. 1).
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6. S. Ó Nualláin, "Stone rows in the south of Ireland", *Proceedings of the Royal Irish Academy*, lxxxviii C (1988), 179–256, lists 73 rows of between three and six stones in Counties Cork and Kerry (69 in the main list, pp. 231–40, plus four in an additional list, p. 252). In addition, several more sites have come to light since Ó Nualláin's publication (S. Ó Nualláin and P. Walsh, priv. comms.). H. A. W. Burl, *From Carnac to Callanish: The Prehistoric stone rows and avenues of Britain, Ireland and Brittany* (New Haven, 1993), p. 211, lists over 80 sites.
7. Ó Nualláin, "Stone rows in the south of Ireland", lists 103 pairs of standing stones in Counties Cork and Kerry (85 in the main list, pp. 241–50, plus twelve as 'anomalous', pp. 250–52, plus six in an additional list, pp. 252–3). In addition, several more sites have come to light since Ó Nualláin's publication (S. Ó Nualláin and P. Walsh, priv. comms.).
8. There is no single list covering the whole study area, but the *Archaeological inventory of County Cork*, i: *West Cork* (Dublin, 1992) lists 344 standing stones and possible standing stones in West Cork alone, and J. Cuppage, *An archaeological survey of the Dingle Peninsula* (Barryferriter, 1986), lists a further 69 extant stones, together with 23 cases reported but now

destroyed, in the Dingle peninsula.

9. S. Ó Nualláin, "A survey of stone circles in Cork and Kerry", *Proceedings of the Royal Irish Academy*, lxxxiv C (1984), 1–77, pp. 11–30, lists 48 circles of between seven and nineteen stones. The term 'axial-stone circle' is used here to denote stone circles with an 'axial stone' as defined by Ó Nualláin (*ibid.*, 3). It is used in preference to the term 'recumbent stone circle' (*cf.* H. A. W. Burl, *The stone circles of the British Isles* (New Haven and London, 1976), 213–24) so as to avoid prejudging the issue of a possible link with the RSCs of north-eastern Scotland (see below).
10. Ó Nualláin, "A survey of stone circles in Cork and Kerry" (ref. 9), 30–45, lists 45 five-stone circles. These appear to represent a degenerate case of the axial-stone circles.
11. S. Ó Nualláin, "Grouped standing stones, radial-stone cairns and enclosures in the south of Ireland", *Journal of the Royal Society of Antiquaries of Ireland*, cxiv (1984), 63–79, pp. 63–65; H. A. W. Burl, *Four-posters: Bronze Age stone circles of western Europe* (B.A.R. British Series 195; Oxford, 1988).
12. Ó Nualláin, "Stone rows in the south of Ireland", Table 5, incorporates data from 99 wedge tombs in Counties Cork and Kerry.
13. The Irish sites, like the Scottish RSCs, include a single 'axial' or 'recumbent' stone placed on its side. However, at the Irish stone circles a pair of standing 'portals' were placed on the opposite side to the axial stone, and there was a tendency for height gradation towards the portals. At the Scottish sites, two upright 'flankers' were placed on either side of the recumbent stone and there was a tendency for height gradation towards the flankers. See S. Ó Nualláin, "The stone circle complex of Cork and Kerry", *Journal of the Royal Society of Antiquaries of Ireland*, cv (1975), 83–131, p. 115; Burl, *The stone circles of the British Isles*, 213.
14. M. E. C. Stewart, "Excavation of a setting of standing stones at Lundin Farm, near Aberfeldy, Perthshire", *Proceedings of the Society of Antiquaries of Scotland*, xcviii (1966), 126–49; Ó Nualláin, "Stone rows in the south of Ireland", 198.
15. Burl, *The stone circles of the British Isles*, 191–5; Ó Nualláin, "Stone rows in the south of Ireland", 198–9.
16. H. A. W. Burl, "The sun, the moon and the megaliths", *Ulster journal of archaeology*, I (1989), 7–21; Burl, *From Carnac to Callanish* (ref. 6).
17. Ó Nualláin, "Stone rows in the south of Ireland", pp. 191–4.
18. *Ibid.*, Fig. 2a. A few examples from outside Cork and Kerry are included.
19. *Ibid.*, Fig. 2b. The two exceptions *are* oriented NW–SE, but may be the remains of other types of monuments (*ibid.*, 190).
20. See S. Ó Nualláin, "Stone circles, stone rows, boulder-burials and standing stones", in M. Ryan (ed.), *The illustrated archaeology of Ireland* (Dublin 1991), 89–92, p. 91.
21. For an orientation plot see Ó Nualláin, "A survey of stone circles in Cork and Kerry", Fig. 24. For a comparison with the Scottish RSC orientation data see H. A. W. Burl, "Pi in the sky", in D. C. Heggie (ed.), *Archaeoastronomy in the Old World* (Cambridge, 1982), 141–69, p. 148 and Fig. 1.
22. See Ó Nualláin, "Stone rows in the south of Ireland", 190, where it is stated that this is true of all 460 or so wedge tombs in the whole of Ireland. For an orientation plot of 81 sites in Counties Cork, Kerry, Limerick and Tipperary see R. de Valera and S. Ó Nualláin, *Survey of the megalithic tombs of Ireland*, iv: *Counties Cork, Kerry, Limerick, Tipperary* (Dublin, 1982), Fig. 36.
23. J. Barber, "The orientations of the recumbent-stone circles of the south-west of Ireland", *Journal of the Kerry Historical and Archaeological Society*, vi (1973), 26–39.
24. P. R. Freeman and W. Elmore, "A test for the significance of astronomical alignments", *Archaeoastronomy*, no. 1 (1979), S86–96, pp. S90–93; see also Heggie, *Megalithic science* (ref. 1), 182–4.
25. A. Lynch, "Astronomy and stone alignments in S.W. Ireland", in Heggie (ed.), *Archaeoastronomy in the Old World* (ref. 1), 205–13.
26. A. Thom, *Megalithic lunar observatories* (Oxford, 1971), 120–1.
27. Lynch, "Astronomy and stone alignments in S.W. Ireland" (ref. 25), 212.

28. Ó Nualláin, "Stone rows in the south of Ireland", 180.
29. This was actually the approach taken in Thom's early work, e.g. A. Thom, "A statistical examination of the megalithic sites in Britain", *Journal of the Royal Statistical Society*, A cxviii (1955), 275–91. It is also the approach taken by this author in Ruggles, *Megalithic astronomy* (ref. 1) and subsequent work.
30. For example, the western Scottish stone rows appear to indicate a range of directions associated with the moon at its southern monthly limit, i.e. between declinations −30° and −19°, rather than just the limits of this range. See C. L. N. Ruggles, "The linear settings of Argyll and Mull", *Archaeoastronomy*, no. 9 (1985), S105–32.
31. For the aims and objectives of the North Mull project see C. L. N. Ruggles and R. D. Martlew, "The North Mull project (1): Excavations at Glengorm 1987–88", *Archaeoastronomy*, xiv (1989), S137–49.
32. Ó Nualláin, "Stone rows in the south of Ireland". Although Ó Nualláin's list includes a few sites in neighbouring counties, our sample was restricted to the counties of Cork and Kerry for logistical reasons.
33. H. A. W. Burl, "A county concordance: The stone rows of Britain, Ireland and western Europe", in A. Thom, A. S. Thom and H. A. W. Burl, *Stone rows and standing stones* (B.A.R. International Series 560; Oxford, 1990), 421–540. This has now been updated in Burl, *From Carnac to Callanish* (ref. 6), 214–69 (for four- to six-stone rows see pp. 245–9), but the updated list was not available at the time of site selection.
34. Three further sites in County Cork have come to light even more recently (P. Walsh, 1993, priv. comm.) and are not considered further in this paper, although they are shown in Figure 1. They are a five-stone row at Derrynacaheragh (W181553), a three- or four-stone row at Leadawillin (W395773), reported to be incorporated into a field wall and probably not surveyable, and a four-stone row, now destroyed, at Pluckanes North (W536845).
35. Burl, "A county concordance" (ref. 33), 499.
36. Ó Nualláin, "Stone rows in the south of Ireland", 200. For a counter-argument in favour of Eightercua's inclusion, see Burl, *From Carnac to Callanish* (ref. 6), 169.
37. Offset surveys were not attempted in this first reconnaissance, in order to enable the largest possible number of sites to be examined in the time available.
38. However, a survey *was* carried out in order to measure a hill summit in the general direction of indication (see Table 3).
39. See, e.g. Ruggles, *Megalithic astronomy* (ref. 1), 69–70.
40. Ó Nualláin, "Stone rows in the south of Ireland", 180.
41. Ó Nualláin, "A survey of stone circles in Cork and Kerry" (ref. 9), 3.
42. H. A. W. Burl, "The recumbent stone circles of north-east Scotland", *Proceedings of the Society of Antiquaries of Scotland*, cii (1970), 56–81, p. 63.
43. See B.E. Schaefer, "Basic research in astronomy and its applications to archaeoastronomy", in C. L. N. Ruggles (ed.), *Archaeoastronomy in the 1990s* (Loughborough, 1993), 155–77, pp. 162–4.
44. This was done in Ruggles, "A new study of the Aberdeenshire Recumbent Stone Circles, 1" (ref. 5), where the method is described in detail (p. S63). For the results see *ibid.*, Figs. 1 and 4.
45. Ó Nualláin, "Stone rows in the south of Ireland", Fig. 29. H. A. W. Burl (priv. comm.) suggests that the site may represent two conjoined three-stone rows.
46. The horizon distance categories in the direction of and opposite to the preferred direction are: D/A (7 cases); D/B (3 cases), D/C (1 case) and C/A (4 cases).
47. D/D (3 cases); C/C (1 case).
48. For such an exercise in the context of the stone rows of Mull and Argyll, see C. L. N. Ruggles, R. D. Martlew and P. D. Hinge, The North Mull project (2): The wider astronomical potential of the sites, *Archaeoastronomy*, no. 16 (1991), S51–75.
49. Lynch, "Astronomy and stone alignments in S.W. Ireland" (ref. 25), 212.
50. *Ibid.*, Table 1.

51. The point on the sea horizon directly above the highest point on this island is such a clearly defined point that its parameters have been included, as for a hill summit itself, in Table 3.
52. Interpreted, as elsewhere in this paper, to encompass a wider range: actually about 90° centred upon WSW. See Ruggles, "A new study of the Aberdeenshire Recumbent Stone Circles, 1" (ref. 5), Table 2.
53. Ruggles and Burl, "A new study of the Aberdeenshire Recumbent Stone Circles, 2" (ref. 5).
54. Ruggles, "The linear settings of Argyll and Mull" (ref. 3); Ruggles, "The stone alignments of Argyll and Mull" (ref. 1).
55. S. P. Ó Riordáin, "The place names and antiquities of Kinalmeaky Barony, Co. Cork (continued)", *Journal of the Cork Historical and Archaeological Society*, xxxvi (1931), 57–68, p. 65.
56. Ó Nualláin, "Stone rows in the south of Ireland", quoting J.P. Conlon, "Rude stone monuments of the northern portion of Cork County", *Journal of the Royal Society of Antiquaries of Ireland*, xlvi (1916), 58–76, 136–62.
57. Ó Nualláin, "Stone rows in the south of Ireland", Fig. 23.
58. A. Lynch, *Man and environment in south-west Ireland, 4000 B.C.–A.D. 800* (B.A.R. British Series 85; Oxford, 1981), 69–74.
59. Ó Nualláin, "Stone rows in the south of Ireland", Fig. 12.
60. *Ibid.*, Fig. 18.
61. Burl, "A county concordance" (ref. 33), 482.
62. *Ibid.*, 499.
63. Ó Nualláin, "Stone rows in the south of Ireland".
64. Burl, "A county concordance" (ref. 33), 482.
65. Ó Nualláin, "Stone rows in the south of Ireland", Fig. 31.
66. Lynch, "Astronomy and stone alignments in S.W. Ireland" (ref. 25), Table 1.
67. *Ibid.*
68. Burl, "A county concordance" (ref. 33), 497.
69. *Ibid.*, 479.
70. *Ibid.*, 451.
71. Ó Nualláin, "Stone rows in the south of Ireland", no. 96.
72. Burl, "A county concordance" (ref. 33), 452.
73. Ó Nualláin, "Stone rows in the south of Ireland", p. 200 and Fig. 62.
74. *Ibid.*, 200.
75. Burl, "A county concordance" (ref. 33), 498.