Crooked Churches and Saintly Sunrises

James Muirden

The hypothesis that churches in England may have been built to face the sunrise on the day of their patronal festival has been rejected by most researchers. The writer suggests that their fieldwork has been inadequate and their data analysis faulty. Having explained his reasons, he gives examples of individual churches and groups of churches encountered in his Devon survey whose alignment characteristics are consistent with the 'patronal sunrise' theory. Not only is it possible to deduce the date of dedication but the relevant saint, even when the original dedication has been changed or lost; this has potential for understanding more about pre-Conquest churches and for closer dating of buildings. Further work is needed to see whether there are regional variations. An appendix sets out his methodology.

Introduction

The widespread belief that 'churches face east' is not borne out by the churches themselves. Numerous surveys have recorded orientations, ranging across a large arc of the horizon, from north-east to south-east.[1] No medieval church-builders' manuals have been handed down to us, and so we are ignorant of the rules, if any, that determined how the foundations of English churches should be laid out. This means that modern enquiry has tended to consist of looking for correlations within a mass of data.

Terminology:

Orientation is used for the direction a church is facing relative to true north (north = 0°, east = 90°, south = 180°)
Alignment is used to denote the sunrise to which a church is pointing
[The *azimuth* of a point on the celestial sphere is defined as the angular distance measured towards the east, from north, along the astronomical horizon and the intersection of the great circle passing through the point and the astronomical zenith with the astronomical horizon. *Chris Peat, Heavens-Above,* accessed 05/11/05, Ed.]

There are, broadly speaking, four 'umbrella' suggestions:

1. No importance was attached to precise orientation.
2. Churches were aligned on the sunrise on the day when building operations began.
3. Churches were aligned on the sunrise on the day of their patronal festival.
4. Churches were orientated by using a magnetic compass.

Approaches to the subject

This quote from a study by Hinton (2004, 50) of the orientation of almost 1,000 English medieval rural churches is an example of **Approach 1.**

> *'In general, it seems reasonable to conclude that churches were originally vaguely aligned eastwards, but for some reason a more accurate orientation became increasingly important over time, which was realised when the opportunity arose through rebuilding'.*

Approach 2 received some support in an early survey by Cave (1950, 50), who measured the orientation of 642 English churches, and concluded that:

> *'the distribution of orientations would be accounted for if many churches were orientated by the rising sun at the time when their foundations were first laid out, and if others were properly orientated by taking the point of sunrise round about the equinox or by other ways which would be known in the middle ages'.*

On the other hand, Hoare & Sweet (2000, 169), after analysing the orientation of 183 churches dated 7th to 12th century, mainly in eastern England, concluded that:

> *'whilst a very few may have been oriented in accordance with one of the so-called sunrise theories, none of these is widely applicable, nor is it likely that any will ever be associated with certainty with individual buildings'.*

Ali & Cunich (2001) found some support for **Approach 3** – that churches may have been aligned on the sunrise on the day of their patronal festival; they concentrated on cathedrals, large churches, and monastic sites. In the sample of 141 for which a dedication is known, as many as 33 (23%) were orientated according to the sunrise azimuth* on the patronal feast day (p 183). Efforts to explain the wide range of orientations by the wandering of the Earth's magnetic pole (suggestion 4) have on the whole proved unsuccessful. The 'patronal sunrise' theory has as its greatest protagonist, the Revd Hugh Benson (1956). His results were so impressive that his methods have been adopted here, and have been applied to more than a third of Devon's total of almost 500 medieval churches.

Firstly, the reader's attention must be drawn to three vital

shortcomings in the data-gathering methods used in most previous investigations.

1. Failure to take account of the effect of **horizon altitude** when determining sunrise dates.

2. Failure to allow for the errors of the **Julian calendar,** which meant that medieval dates were astronomically different to modern dates.

3. Making no allowance for the fact that the **dedication** of a church may have changed since it was built.

Problem 1:
Determining the 'alignment sunrise' date

None of the surveys mentioned above determined the churches' alignment sunrise dates. They merely recorded the orientation of each church, and assumed that they were facing a zero-altitude horizon. This assumption is not justified, since church horizons can be several degrees high, and an elevated horizon has a most important effect on the date of observed sunrise.[2]

In the course of a calendar year, the sunrise point as seen from England marches along the eastern horizon from approximately south-east (in midwinter) to north-east (in midsummer) and back again. In Devon, assuming that the sun is seen rising above a sea horizon, or over a flat landscape, the range is from a true bearing or azimuth of about 51° in midsummer to about 129° in midwinter, and the orientation of the sunrise on all intervening dates can readily be calculated – BUT, these bearings no longer apply if the horizon is elevated. The effect of hills on the horizon is to shift the sunrise point to the right by approximately 1?° of azimuth for each degree of altitude (Fig 1).

Throughout most of the year, except very near the solstices, the azimuth of the sunrise point changes by slightly more than $^1/_2$° from one morning to the next. Therefore a sunrise date error of about two days is introduced for each neglected degree of horizon altitude. Relatively few churches have a 0° horizon: an eminence a mere 20m higher than the churchyard and a kilometre away will raise the effective horizon by one degree. Taking into account all the likely kinds of terrain in which country churches were constructed, it is obvious that neglecting the horizon effect will make many derived sunrise dates a week in error, and some will be in error by more than this.

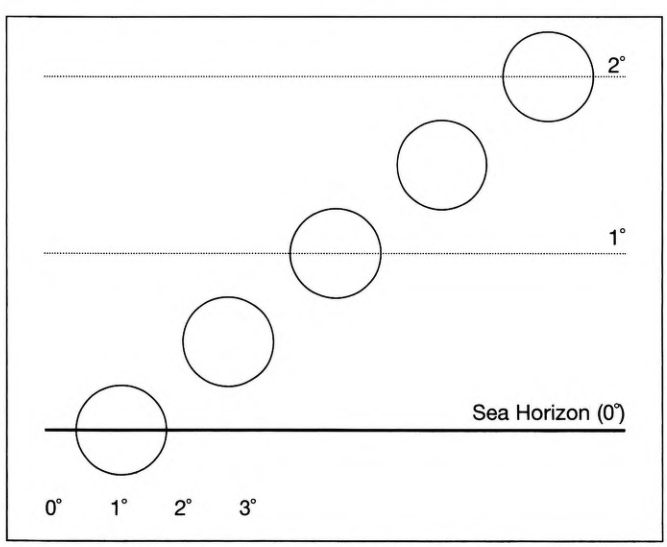

Fig 1 The effect of horizon altitude on sunrise azimuth

If the patronal sunrise alignment theory is to be allowed an adequate test, it must be assumed, initially at least, that the church builders went to great trouble to achieve the best alignment of which they were capable. Errors of more than a week would undermine the whole investigation. Therefore, horizon altitudes had to be measured, and the date of **observed sunrise** calculated. The sun passes through the same sunrise point twice a year. For example, it rises at almost the same orientation (as seen from a given site) on 20th April and on 23rd August. Another shortcoming of the previous research has been a lack of discrimination between the alternative dates. See below.

Problem 2:
Allowing for the Julian calendar error

During the church-building period under discussion, the Julian calendar was in use. The Earth's orbital period contains approximately 365? days, and so this calendar inserted an extra leap day every four years to keep it in astronomical synchronisation. However, this was not a perfect solution. The resulting calendar year was slightly too long, and the date fell behind the true (astronomical) date at the rate of one day every 130 years. The problem was solved by the Gregorian calendar, which modified the allocation of leap days. This was adopted in Britain in 1752, when the Julian calendar was 11 days behind the correct date. Since the medieval ecclesiastical feasts were tied to the Julian calendar, the festival dates do not correspond astronomically to the same dates today. Table 1 shows how the error has steadily increased.

Table 1 – The modern calendar is ahead by approximately

Year AD	Discrepancy
820	4 days
950	5 days
1080	6 days
1200	7 days
1330	8 days
1450	9 days

Taking the feast of St Gregory (12th March) as an example, a church aligned on his sunrise in the 10th century would now be facing sunrise on 17th March (correction five days), and a church aligned in the 14th century would now be facing the sunrise on 20th March (correction eight days). This correction has been widely ignored. Cave considered it 'quite negligible', and it does not appear to have been taken into account by Hoare & Sweet or Hinton, although the former point out that their lack of knowledge of horizon

altitude does in any case limit their ability to investigate the patronal sunrise (Hoare & Sweet 2000, 168). Ali & Cunich did, however, attempt to apply an appropriate correction (Ali & Cunich 2001, 171). A 'sunrise date' that ignores the possible effects of horizon altitude and the certain effects of the calendar correction could, in extreme but not impossible cases, give a modern date that is three weeks away from the original Julian date of alignment and hence the patronal festival. Hunting for any correlations within this mass of fluctuating uncertainty seems doomed to failure.[3]

Problem 3:
Knowing the church's dedication

Many if not most churches were probably founded in Saxon times, even though the structures we see today are almost always the result of rebuilding and extension from Norman times onwards. However, the Norman church may have followed the alignment of the previous church, and even used the same foundations – some evidence is presented below for very ancient sunrise alignments. If this is so, then it is the Saxon dedication that would have determined the sunrise alignment. Fewer than one-fifth of Devon's churches have a dedication record pre-dating 1300, and many were lost at the Reformation; the number that can be traced back to pre-Norman times is tiny. A further complicating factor is that early dedications were probably multiple (Orme 1996, 36). Mary appears in many of them, but a secondary saint was very likely to have been present as well – the importance of relics may have been a determining factor here. Therefore even an ancient dedication may be incomplete.

It follows from this that even if Problems 1 and 2 have been successfully overcome, a 'trawl' of sunrise dates against known dedications is not the way to tackle the problem. The dedication record is too fragile. Since churches cannot move, the problem has been addressed from the opposite direction. First their 'alignment sunrise' dates were determined, to see if the overall data suggested any favoured festivals. Then, on the principle that what applies to some may well apply to others, several churches were examined in more detail to analyse whether the patronal sunrise theory offered any insights into their history. The fieldwork technique and methods of data-reduction used are described in the Appendix.

The derived 'alignment sunrise' dates

Fig 2 presents, in histogram form, the modern 'alignment sunrise' dates of 194 Devon churches so far surveyed. To preserve a reasonable scale, a few extreme values at the left (midsummer) point of the chart have been omitted. The x-axis lists the alternative dates for each alignment sunrise. These are consistent with the movement of sunrise during the year – from right to left from January to May, and from left to right from August to November. The majority of churches are found in the left-hand part of the figure, corresponding to the 'summer' period from spring to autumn. There are a number of well-defined peaks, some containing a dozen or more alignments within a very narrow date-range. To attempt to discover what festivals, if any, are represented by these clusters, it is necessary to deduct the appropriate number of days that represent the Julian calendar error when the churches' foundations were laid out. If the group of 26 churches whose date ranges are 25th 27th March or 17th 19th September are being examined, and it is assumed for simplicity that they are either March or September sunrises and not a mixture of the two, the middle date of each group is taken: 26th March and 18th September, as the target date. Applying the corrections given in Table 1, these dates can be reduced to the equivalent Julian date at different epochs (Table 2).

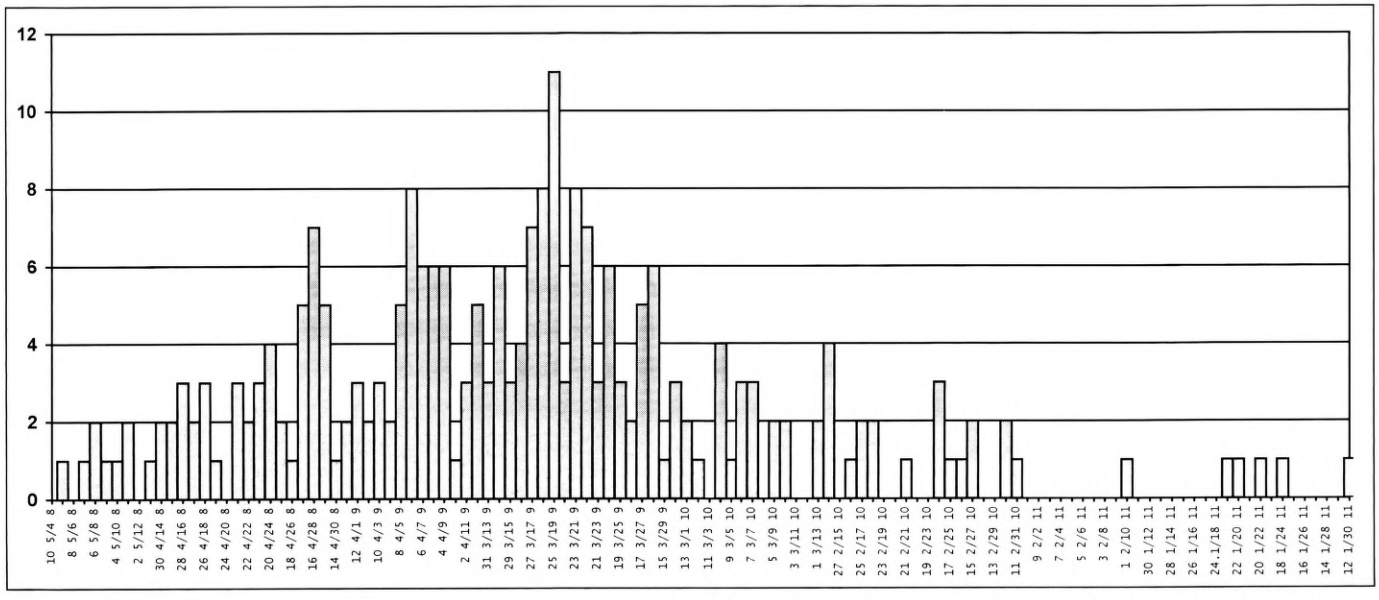

Fig 2 The 'sunrise alignments' of 194 churches in the Devon survey. In the case of crooked churches both alignments are plotted. '10 5/4 8' means 10 May or 4 August, etc.

The range of March Julian dates include St Cuthbert (20th March), a rare modern dedication in Devon, but possibly more common in the past. The September Julian dates fall between two popular festivals – the Nativity of Mary (8th September) and the Exaltation of the Holy Cross (14th September). There is no obvious way of discriminating between these festivals on such vague evidence. Beyond the feeling that this and other narrow groups of sunrise dates in Table 2 ought be significant, plain 'feast-spotting' is likely to be unproductive.

Table 2 – Correcting modern sunrise alignment dates to Julian dates

Church aligned on the sunrise in	Correction	Derived Julian Date
March 26 sunrise		
950	-5 days	21 March
1200	-7 days	19 March
1450	- 9 days	17 March
September 18 sunrise		
950	-5 days	13 September
1200	-7 days	11 September
1450	- 9 days	9 September

Crooked churches

Removing the ambiguity of 'spring' and 'autumn' dates would be immensely helpful. Hugh Benson, the Oxfordshire vicar who studied the sunrise alignment of every ecclesiastical site in that county some 50 years ago, believed that he had discovered a way of overcoming this problem by paying special attention to crooked churches (Benson 1956). Crooked churches are a well-known puzzle. The exemplar of the type has its nave and chancel on different orientations. (This gave rise to the enduring concept of the 'weeping chancel', supposedly a deliberate symbolic allusion to Christ's inclined head on the Cross, which appears to be a *post hoc* Victorian conceit.) However, many other churches have less obvious misalignment, frequently in a single chancel wall or in an aisle added after the initial building phase. A suggested morphology is shown in Fig 3.

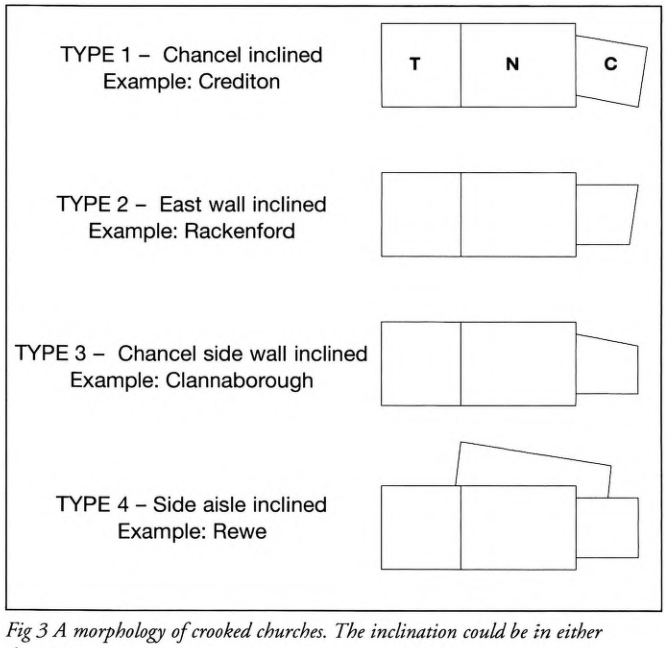

Fig 3 A morphology of crooked churches. The inclination could be in either direction.

The significant point is that virtually all examples of crookedness occur at the junction between building phases. Most church historians therefore put down misalignment to careless setting-out during later building operations.[4] However, as Benson pointed out, crookedness can affect some most important churches, where there would have been no lack of money to pay for the best. He quotes the famous chancel of Adderbury church in Oxfordshire, built at a deviation of 1° to the nave by the celebrated Richard Wynchcombe in 1407, as an example of intentional crookedness by a known master mason.

Benson believed that most crookedness was intentional, and that crooked churches contain, within their realignment, a record of the sunrise shift between building stages. A third of the churches in his survey of about 240 buildings and sites were crooked in one way or another. Out of 189 churches in this Devon survey about 50 show evidence of misalignment or realignment, but the true number is probably greater.[5] If Benson's theory is accepted, a crooked church allows a choice to be made between the 'spring' or 'autumn' alignment sunrise date, if the order of its building stages is known. If, in the year 950, a simple church was laid out facing the sunrise on the Feast of Gregory the Great (12th March), according to Table 1 any part of the visible structure still on this original alignment would now be facing a modern sunrise about five days later – on 17th March – due to the Julian calendar error. If a new chancel were added to the existing nave round about 1350, and realigned on the '12th March sunrise', it would now be facing the sunrise eight days later – on 20th March, because of the increased calendar error. The axis of the chancel will therefore be pointing to the left of the nave axis.

The formula

If the deviation of the later structure is to the *left* (north), the alignment sunrise is in the *first half* of the year.

If the deviation of the later structure is to the *right* (south), the alignment sunrise is in the *second half* of the year.

The difficulty lies in knowing the order of construction – or rather the order in which the foundations were laid, which may not be quite the same thing if a church has been substantially rebuilt. Benson professed some knowledge of church architecture, but even he complained of spending hours in some churches trying to decide their building history. Until a church archaeologist comes to the rescue,

Table 3 – The range of sunrise alignments within 53 crooked churches in Devon. Dates in tone signify preferred sunrises. The entries under 'Type' use the morphology in Fig 3

No	Parish	Modern alignment date range		Type
		1st half year	2nd half year	
1	Upton Hellions	15-23 Jan	20-28 Nov	3 & 4
2	Shute	18-23 Jan	19-24 Nov	1
3	Rackenford	20 Jan-1 Feb	10-22 Nov	2
4	Templeton	15-17 Feb	24-27 Oct	1?
5	Clannaborough	15-18 Feb	24-27 Oct	3
6	Morchard Bishop	21-25 Feb	17-21 Oct	1
7	Holsworthy	5-9 March	5-9 Oct	4
8	Cadeleigh	10-13 March	30 Sept- 3 Oct	1?
9	Bramford Speke	10-17 March	27 Sept-3 Oct	3N
10	Axmouth	12-16 March	28 Sept- 2 Oct	1
11	Woolsery (W)	16-22 March	22-27 Sept	2 & 3
12	Crediton	17-19 March	25-27 Sept	1
13	Membury	17-22 March	22-26 Sept	N
14	Coldridge	18-21 March	23-25 Sept	1
15	Widworthy	20-29 March	14-24 Sept	N
16	Mariansleigh	20-30 March	13-23 Sept	N
17	Loxbeare	22-25 March	18-21 Sept	3
18	Nymet Rowland	22-27 March	17-22 Sept	3
19	Clayhidon	23-25 March	19-20 Sept	N
20	Bishop's Nympton	23-25 March	19-21 Sept	N
21	Hemyock	23-26 March	17-21 Sept	1?
22	Uplyme	25-26 March	18-19 Sept	1
23	Clovelly	25-28 March	16-18 Sept	2
24	Talaton	26-30 March	14-18 Sept	1?
25	Broadclyst	26 March-1 April	12-17 Sept	N
26	Rewe	27-29 March	15-17 Sept	4
27	Merton	31 March- 4 April	9-13 Sept	3
28	Ashreigney	2-6 April	7-10 Sept	3
29	Sidbury	3-7 April	6-9 Sept	1
30	Puddington	5-7 April	5-7 Sept	3
31	Zeal Monarchorum	5-8 April	4-7 Sept	3
32	Netherexe	5-?10 April	?2-8 Sept	2
33	Inwardleigh	5-11 April	1-7 Sept	2?
34	Sampford Peverell	8-10 April	2-4 Sept	3
35	Spreyton	9-17 April	27 Aug-3 Sept	3 & 4
36	Colebrooke	10-12 April	31 Aug-2 Sept	2
37	Buckerell	14-17 April	26-29 Aug	1?
38	Jacobstowe	16-19 April	24-27 Aug	3
39	Washford Pyne	16-20 April	24-27 Aug	2 & 3
40	Bradworthy	17-20 April	24-27 Aug	2 & 3
41	Chulmleigh	19-23 April	20-24 Aug	N
42	Burrington	20-24 April	19-23 Aug	3
43	Mamhead	21-25 April	19-22 Aug	3N
44	Winkleigh	22-25 April	18-21 Aug	1
45	Bridestowe	23-26 April	17-20 Aug	1
46	Bridford	26-28 April	16-18 Aug	1
47	Willand	27 April-3 May	10-16 Aug	1
48	George Nympton	28 April-1 May	12-15 Aug	4
49	Uffculme	?29 April-3 May	10-?14 Aug	1 & 4?
50	Thurlestone	29 April-?4 May	?9-14 Aug	2
51	Christow	7-9 May	4-6 Aug	1?
52	Walkhampton	3 June-midsummer-10 July		2N
53	Modbury	7 June-midsummer-7 July		1N

many of these crooked churches will remain undated. The rest have been analysed according to the following principles:

Persuasive evidence that part of the structure is relatively recent (this very often applies to an aisle).

A single inclined wall (almost always in the chancel) is likely to be on an earlier alignment than the body of the church.

Table 3 presents a summary of all the crooked churches whose alignment sunrise dates have been noted, with the deduced date order underlined where the evidence is strong. For convenience, they are arranged in order of their first 'spring' alignment date.

Some grouping is suggested, especially churches 17-22, which cover the period 22nd to 27th March or 17th to 22nd September. Three of these have already been assigned the autumn sunrise window, which is consistent with the festival of Holy Cross (14th September) with a Julian correction of between three and eight days. Another group of churches 28-31 have all been assigned an autumn sunrise window, with an overall date range of 4th to 10th September. The intended alignment could be the feast of St Giles (1st September), with a Julian correction of between three and nine days. Churches 4 & 5, 15 & 16, 38 - 40 and 41 - 43 may also share a common history of dedication. This kind of observation is no great improvement on the 'feast-spotting' using Fig 2. A useful analysis must draw on more than coincidence of date. The following five case studies will show a deeper investigation into the alignment significance of some churches in the survey.

Crediton church (12)

Crediton is a Type 1 crooked church. A visitor standing at the west end of the nave can see that the centre mullion of the great east window is displaced to the right of the line of the nave and the two tower arches that mark the crossing. This church has an exceptionally well-documented history. A monastery was founded there in the 8th century, and the church was in effect the diocesan cathedral until 1050, when a bishop's seat was established at Exeter. The pre-1050 structure was then replaced by the building and upgrading that we see today.

Orme (1996) gives a summary of its dedication as follows:

934-953 *Mary (alleged)*
1237 *Holy Cross and Mary*
1386 *Holy Cross alone in most subsequent sources*

However, he quotes Leland (c 1540): 'The olde chirch was dedicate to S. Gregory', evidently referring to the pre-1050 cathedral. As mentioned above, it is possible, or even likely, that early dedications were to Mary plus another saint. The tentative 10th century-dedication to Mary could have included a secondary dedicatee.

Measurements of the external walls confirm the visual impression that the eastern part of the building is inclined to the right. The following modern 'sunrise alignment' dates were derived:

Nave + crossing *19 Mar or 25 Sep*
Choir + Lady Chapel *17 Mar or 27 Sep*

The Julian correction for the earliest known existing structure (the central tower arches of c 1150, with which the later nave appears to be in line), is about seven days. This means that when the crossing was built, its axis was aligned on the sunrise on or very near 12th March (19th March minus 7 days) and 18th September (25th September minus 7 days) in the calendar in use at the time. Significantly, Gregory's feast is on 12th March. This coincidence is encouraging but no more, since the September sunrise fits the alignment equally well. Can the relative dates of the foundations of the crooked sections be derived? If so, the sunrise can be fixed. The first clue is the amount of crookedness - about a degree, equivalent to about two days of Julian calendar correction, or two to three centuries of sunrise drift. This means (since the crossing contains Norman elements and the nave is in line with it) that the choir and Lady Chapel could have been aligned on Gregory's sunrise some two and a half centuries earlier or later than the 1150 structure. Which is more likely? Since Pevsner dates some elements of the Lady Chapel to the 13th century, the earlier alignment is indicated. In this case, the chapel is assumed to be on, or built parallel to, foundations that were laid out round about the year 900, a date that agrees in round terms with the likely date of the Saxon minster church.

Slader (1968, 24) wrote:

'Devon was incorporated in the see of Sherborne in AD 705 and though a minster had been founded at Crediton in 739... Bishop Ethelgar (934-53) collected funds for the building of St Mary's Minster at Crediton. Tradition has it that the foundations of this vanished Saxon cathedral lie beneath the present churchyard, and during the restoration of the lady chapel between 1876 and 1877 some ancient masonry laid bare did indeed suggest an archway leading to a crypt, but unfortunately no further investigation was made'.

If this was indeed the crypt belonging to the lost church, it is where the 'sunrise theory' predicts that church to have been, and leads conveniently to the next case study - the church at Sidbury.

Sidbury church (29)

This celebrated church is very noticeably crooked, and it has a Saxon crypt beneath the chancel – one of only six known in the whole of England, although Crediton may conceal a seventh. The church proudly announces its '7th-century crypt' on notices and in its guide. But is this supported by the evidence? Orme (1966) has not found a pre-Reformation

dedication , and suggests that its subsequent association with St Giles was based on one of its parish feast days, held on St Giles' Monday (St Giles' feast is 1st September).[6]

The church is of Type 1; the modern sunrise alignment dates are:
Nave – 7th April or 6th September
Chancel – 3rd April or 9th September

The orientation of the crypt, noted from a surveyor's plan, is slightly to the left of the nave itself, suggesting a modern alignment date of perhaps 8th April / 5th September for the Saxon church. This site may therefore be a miniature of the one at Crediton, enshrining the efforts of builders over an interval of more than a thousand years. The chancel post-dates the nave; the date of the crossing, which also defines the orientation of the nave, is given as about 1000. The west end of the chancel is dated to about 1140, with a Decorated eastern extension. Therefore the September dates are the relevant ones, since the correction is to the right. Applying Julian corrections based on the suggested dates, the following alignment sunrise dates are derived in Table 4:

Table 4 – Sidbury; modern date, correction & Julian date			
Sidbury	**Modern date**	**Correction**	**Julian date**
Crypt	5 September	3 days	2 September
Nave	6 September	5 days	1 September
Chancel	9 September	6-7 days	2-3 September

These dates coincide with St Giles' feast within the likely limits of error; it is worth noting that the horizon at Sidbury is close to the church, and one of the highest measured (9°), which makes the derived sunrise date slightly more uncertain than is the case with distant horizons. The theory offers an explanation of why the development of the site should have been along three different axes, and the analysis raises the question of the date of the crypt. The year of Giles' death is uncertain, but it is generally believed to have been c 710. So if the Sidbury crypt was part of a Saxon church originally dedicated to him and overbuilt in Norman times, it cannot be dated to the 7th century. If we work backwards, and assume that the Saxon church was aligned precisely on the sunrise on 1st September, the difference from the modern sunrise alignment date is four days. This is the Julian correction for a date around 800. A search of the literature has found no support for the locally-advocated 7th -century date, or indeed for any particular pre-Norman date. As far as it goes, the alignment evidence seems to tell a more convincing story, bringing the date of the crypt, and hence of the previous church, forward to the later Saxon period. The lack of any pre-Reformation 'Giles' dedication is itself interesting; it seems too much of a coincidence, assuming of course that the alignment is significant, to suppose that this particular festival was resurrected by chance. The church of the adjoining parish to the south, Sidmouth, has a record of Giles as a dedication going back to 1310; the sunrise alignment of its other neighbour, at Ottery St Mary (whose second dedicatee, if any, is now lost), is to 4th April / 8th September, the second date being only a day away from that of the Sidbury chancel. These further coincidences could be relevant.

The churches of Willand and Uffculme (47 & 49)

The upper part of the River Culm valley, in east Devon, contains four crooked churches of great interest, because each adjacent pair agree very closely in their sunrise alignments. The March/September alignments of the churches at Clayhidon and Hemyock can be found in Table 3 (19 and 21).

Table 5A – Willand & Uffculme alignments		
Willand	South nave wall	27 April or 16 August
	South chancel wall	3 May or 10 August
Uffculme	Body of church	?29 April or ?14 August
	South aisel wall (+chancel?)	3 May or 10 August

Willand is dated to the 'spring' alignments because the south nave wall is clearly older than the south chancel wall, and therefore the correction is to the left. The building sequence at Uffculme is less clear, but there are certainly two alignments within the structure (Table 5).[7] The histogram Fig 2 shows that these neighbouring churches share a relatively empty sunrise 'window', and it stretches credulity to suppose that these similarities of alignment and crookedness are not significant. If reasonable Julian corrections of five and nine days are applied to the earliest and latest modern alignment dates at Willand, and the same logic to applied to Uffculme, the derived dates are as follows:

Table 5B – Willand & Uffculme alignments		Modern date	Correction	Julian date
Willand	South nave wall	27 April	5 days	22 April
	South chancel wall	3 May	9 days	24 April
Uffculme	Body of church	29 April?	5 days	24 April?
	South aisel wall (+chancel?)	3 May	9 days	24 April

The Julian dates point to the feast of St George (23rd April). This is not a dedication suggested by many churches in the survey; so why should St George have such status here? The answer may lie just 2½ km away from Willand, in a sacred site known as St George's Well, which could preserve the church's lost dedication. It will be seen from Table 2 that the church at George Nympton (No 40) also belongs to the 'George' group, and its dedication to this saint is recorded back as far as 1281 (Orme 1996). However, in view of what has been said about the dedication record, this evidence will rightly be called special pleading!

Two lost Celtic dedications?

The list of crooked church alignments in Table 2 contains only a few in the very early and late months of the year. Therefore coincidences of date are particularly striking. The

churches at Templeton and Clannaborough (4 & 5, Table 6) stand in this rather deserted part of the alignment calendar, but their sunrise alignments are extremely close.

Table 6 – Templeton & Clannaborough alignments		
Templeton	Body of church	15 February or 27 October
	Chancel	17 February or 24 October
Clannaborough	Body of church	18 February or 24 October
	North chancel wall	15 February or 27 October

Clannaborough, an aisleless Type 3 church, is dated by its single inclined chancel wall, which is assumed to pre-date the rest of the structure. The correction is to the left, and therefore a 'spring' date is indicated. Templeton is another small aisle-less church, which appears to be Type 1; Pevsner & Cherry (2002) do not help in distinguishing the relative ages of nave and chancel, but the coincidence of dates is so striking that it would be more remarkable if the two were not related and share a common history of realignment. Clannaborough was measured quite early in the survey. Deducting a reasonable Julian correction from the dates of its two parts suggested an original alignment sunrise on about 8th 10th February; this does not suggest any likely festival in the Norman calendar (Wormald 1934)' and stimulated further investigation. Glimmers of light have been found in Frances Arnold-Foster (1899), who gives the date of 8th February as the feast of St Kew. Her note on the *'perplexing patron of St Kew in North Cornwall'* contains the following information:

'According to the Exeter martyrology, S. Kew's Day was February 8, and the saint is there described as "S. Kywe, virgin;" but the date of the actual parish feast is the Sunday nearest to July 25, that is, S. James's Day. In old documents the parish appears, not as "St. Kew," but in the more ancient form of Lanow, still pointing, however, to the same origin (Vol. 2 p. 281).'

This raises the intriguing possibility that the name of Clannaborough might be derived from *'Lanow'* and not from *'Cloenesberg'*, as the nearby Barton is called in Domesday. A Celtic connection with this site is suggested by a much better-known Celtic saint, Petroc, being associated with Clannaborough since the 13th century. Orme (1996, 21) comments:

'Four plausibly ancient Celtic dedications in a county of 482 medieval churches is not many, considering that Devon passed to the Saxons at a relatively late date when they were Christians... As time went on and the Celtic population of Devon became anglicised, it is a fair assumption that Roman Christianity and its favourite saints became dominant, replacing earlier Celtic cults.'

Although Clannaborough retained its Celtic link, Templeton did not, its pre-Reformation dedication (15th century) being to Margaret. Is this an example of Orme's Romanisation process? If these two churches were aligned upon the sunrise on St Kew's Day around 1200 (Julian correction 7 days), the saint may have been celebrated at both places for some time before then.

The 'Spreyton trio' – Spreyton, Colebrook & South Tawton

The churches of three adjacent parishes just to the north of Dartmoor share interesting alignment links. The middle of the three is at Spreyton (35) which is a markedly crooked church of Type 3, with a south chancel wall at an angle of 4½° to the main body of the church. This gives very widely-spaced modern sunrise alignment dates:

Table 7A – Spreyton alignments		
Spreyton	Body of church	9 April or 3 September
	South chancel wall	15 February or 27 October

A deviation of this amount is not to be explained by the drift of the Julian calendar, and suggests a change of dedication. In this case, identification of building stages is no help in identifying the relevant sunrise, since it is, effectively, two straight churches built on the same site at different dates and to different patronal sunrises. What is interesting about Spreyton is the way it relates to its neighbours: to the east is Colebrooke (36), and to the south lies its other neighbour, South Tawton, a straight church (Table 7). Their modern sunrise dates are as follows:

Table 7B – Colebrooke & South Tawton modern sunrise dates		
Colebrooke	Body of church	10 April or 2 September
	East chancel wall	12 April or 31 August
South Tawton		16 April or 27 August

The sunrise alignment of the body of Colebrooke agrees to within a day with the body of Spreyton, and that the alignment of South Tawton agrees to within a day with the south chancel wall of Spreyton. Assuming that the inclined chancel walls represent an earlier stage of each building, an attempt can be made to construct phasing:

1. South Tawton shares dedication with first Spreyton church; Colebrooke was built to another dedication. Then
2. Spreyton was rebuilt to dedication of Colebrooke, and Colebrooke was realigned on its own changed patronal sunrise. South Tawton not realigned.

The only firm dating available is that for Colebrooke: since the chancel wall is assumed to be the oldest part, the autumn period is indicated (correction to the right). Deducting the usual five to nine days from 31st August and 2nd September respectively gives a likely alignment sunrise date of 25th-26th August, and the nearest feast in the Norman calendar is St Bartholomew (25th August) who was certainly a major saint, and for whom a vigil was indicated in many calendars of the time. It is certainly possible that

the rebuilt Spreyton church shared this festival with its neighbour Colebrooke.

Assigning a dedication to the previous Spreyton church and South Tawton church is more problematical, as either the spring or autumn date could be correct (Table 8). Assuming that the second building stage happened round about 1200 the previous alignment must pre-date this.[8] Essaying a correction of five days gives the following possible alignment sunrise dates in the Julian calendar:

Table 8 – Julian calendar dates for Spreyton 1st church & South Tawton	
Spreyton 1st church	12 April or 22 August
South Tawton	11 April or 22 August

Fig 2 shows that no fewer than 17 churches or parts of churches fall in the 15th-17th April / 27th–29th August period (modern dates), which includes the alignment dates of these two churches. They share a popular sunrise window, but its significance is still unknown. Benson also found a concentration of churches around this time, and presented a persuasive argument based on his measurements of six crooked churches, that they were aimed at the sunrise on 22nd August – the Octave of the Assumption, though there seems to be no discernible reason why this festival should attract more reverence than the Assumption itself (15th August).

Conclusion

Large and questionable assumptions, and wholesale methods of analysis, may have served to conceal rather than reveal the case for the patronal sunrise alignment of churches. The confident (and on the whole negative) results of much recent and past research have, not surprisingly, made people resistant to the idea, or at least encouraged them to believe that the evidence is beyond recall. If this paper has done no more than show that there are better ways of approaching this intriguing problem, it will have served its purpose. The evidence is by no means beyond recall and is in every churchyard, and it can only become more persuasive as more churches are studied. If churches were carefully aligned on their patronal sunrise, then analysis of their alignment sunrise dates could throw light on matters beyond the scope of present orthodox research, since their original patron saint and their approximate date of foundation could be deduced. Evidence with respect to some apparently well-supported dedications, especially Holy Cross, hints at foundation dates corresponding to Julian corrections of four or even three days - in other words, two or three centuries before the Conquest, opening up an exciting prospect. Much more work is needed before the theory finds itself on a firm footing, and survey results from other counties are needed. Any notable differences (which are already appearing between the Oxfordshire and Devon findings) could throw some light on regional cultic preferences, and perhaps confirm the validity of the hypothesis.

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Table 9 – Notes on ten churches in the survey		
Church No	**Church Location**	**Notes**
9	Brampford Speke	Original chancel north wall turned to south; alignment taken from Victorian documentation
13	Membury	Two chancel walls & two north transept walls all turned to north
15	Widworthy	Exposed foundations of ancient wall (measurement by Peter Bedford)
16	Mariansleigh	Previous church fabric incorporated in south wall
20	Bishop's Nympton	East wall of south aisle turned to north
25	Broadclyst	East wall of north aisle turned to south
41	Chulmleigh	East wall of south aisle turned to north
43	Mamhead	South transept on third (southern) alignment
52 & 53	Walkhampton & Modbury	The probable errors of these dates are ±3 or 4 days, because the sunrise position near the solstice changes so slowly. They could, therefore, have been intended to point towards the same sunrises in June or July

APPENDIX

Collecting the data

When embarking on the Devon survey, the first clear need was for the most accurate possible alignment sunrise information. A constructing a 'solar protractor' was constructed, a device that measured the angle of sunlight falling on the wall of the church. The azimuth of the wall could then be determined. This was used for the first sixty or so churches. It had the obvious advantage of freedom from stray magnetic effects, and the obvious disadvantage that it was weather-dependent and could not directly measure all the walls. Magnetic effects have proved to be very troublesome in the case of city churches, where invisible iron can make consistent readings virtually impossible. But having overcome my prejudice against the magnetic compass, it has proved a much more flexible way of measuring country churches, and all subsequent measurements were done in this way. Four churches, originally measured with the solar protractor, have agreed in azimuth (the angular distance along the horizon between a point of reference, usually the observer's bearing, and another object; the angle measured from north, eastwards along the horizon to the point where a vertical circle through a celestial object intersects the horizon) to within a degree when revisited (in ignorance of the previous alignment) with the compass.

A yachtsman's prismatic compass was used, whose divisions can be read to $^1/_2°$. Instead of applying the predicted local value of the magnetic variation (the difference between magnetic north and true north) several sightings were taken on well-defined distant marks and the magnetic difference derived from an OS map. This automatically allows for any zero error in the compass scale. At least ten external wall readings were usually taken of each church. Reversed readings were obtained wherever possible – the east wall and the west tower wall are almost always reversible, and north walls can often be viewed in both directions as well. Buttresses are often of standard width, and a sighting along these is considered equivalent to a sighting along the wall itself. Interesting sections of wall, or walls with irregular buttressing, were measured using a mirror secured to a piece of wood and held against the wall or a window sill, and taking sightings in the mirror. The reading in this case was of course at 90° to the wall alignment. Readings were sometimes taken inside the church, especially to determine the axis of an arcade or the general deviation of a chancel; when reversed, these readings quite often show a discrepancy of a degree or two due to visible and invisible iron.

Measurements of the tower and chancel walls were analysed separately from those for the body of the church, to look for evidence of crookedness. Towers may be markedly crooked even though geometrically regular - an 'off-axis' tower is not by itself considered significant, since the tower did not constitute part of the celebratory space. It is possible that the need for particularly solid foundations led to the builders ignoring the best line. The horizon altitude was measured to the nearest $^1/_2°$ with a home-constructed device. Frequently, the view from the church is blocked, although a distant view can sometimes be obtained from a neighbouring spot; if the horizon is completely inaccessible, then as a last resort its altitude can be derived with reasonable confidence by studying the contours on an OS map.

The alignment sunrise date was determined using the US Naval Observatory website at
//aa.usno.navy.mil/data/docs/AltAz.html

This gives the azimuth and altitude of the centre of the sun (corrected for refraction) as seen at two-minute intervals on any date from anywhere on the Earth's surface. The 'best-fit' date for each church can be found in a few minutes, but Leap years are best avoided. The question of error and bias is crucial: the alignment of a wall must be judged, and a decision made when the compass marker hovers between two half-degrees. These inaccuracies tend to be smoothed out when a number of measures of the same church are made. Bias through subconsciously judgement is not a problem, because the measurements are meaningless until submitted to the website program. Occasionally it is not possible to judge between two dates when the measured sunrise position falls exactly between them. In this case the 'best-fit' date is found in the opposite six months, and used to obtain its equivalent in the other half of the year. The method is not perfect, since the normal year contains an odd number of days, and there is no universal correspondence between 'spring' and 'autumn' sunrise dates. The error from this cause is always going to be less than a day, and, realistically, this is acceptable.

Footnotes

[2] *It is assumed in all researches made that the observed rather than the theoretical (zero-altitude) sunrise is what matters.*

[a] The word 'orientation' means the **direction** a church is facing relative to true north (N = 0°, E = 90°, S = 180°). 'Alignment' is used when discussing the **sunrise** to which a church is pointing.

1. With respect to Scottish practice, Laurie (1859, 414) states:
'On the evening previous [before the laying out of the foundations], the Patrons, Ecclesiastics, and Masons assembled, and spent the night in devotional exercises: one being placed to watch the rising of the sun, gave notice when his rays appeared above the horizon. When fully in view, the Master Mason sent out a man with a rod, which he ranged in line between the altar and the sun, and thus fixed the line of orientation.'
[Johnson (1912, 209).]

2. This glimpse into early English practice comes from Morris (1997, 208-9):
'It is possible that a desire for greater strictness in orientation arose out of the Benedictine reforms of the tenth century. Dunstan, an ardent reformer, archbishop of Canterbury (959-88) is said to have corrected the alignment of a new church at Mayfield, Sussex, by nudging it with his shoulder. The tale suggests that orientation was a matter upon which the audiences of Dunstan's vita would expect him to have held firm views.'

3. This possibility had attracted the interest of earth-scientists, who saw church orientations as a way of tracking changes in the direction of the Earth's magnetic field. Ali & Cunich (2001,183) state that *'in only a limited number of cases is it possible that a compass was used for orientating the buildings'.*

4. Friar (1996, 326) presents the popular view:
   '...such deviations [in crooked churches] are entirely due to medieval masons not caring too much about geometrical niceties when altering or extending earlier building.'

5. Before starting to use a magnetic compass, derived alignments were mainly based on the orientation of the south, east and west (tower) walls. Misaligned northern walls would not have been recorded unless the effect was obvious.

6. In a note to the writer, Orme points out that his suggested pre-Reformation Sidbury dedication to Michael is erroneous.

7. Uffculme church is not easy to measure, as it has been greatly extended, with one north and two south aisles. It is now almost square, and contains the longest screen in Devon. According to Pevsner, the north arcade is the earliest part; as seen from the nave, the axis of the chancel is inclined 1½-2° to the left, which agrees with the alignment of the south aisle wall. This second south aisle is a Victorian addition, but the builders appear to have followed the line of the previous south wall in order to keep the aisle rectangular. As an individual church, Uffculme would be difficult to analyse with confidence; but its sunrise alignments, despite their uncertainty, are so close to those of Willand that some close connection is hard to deny.

8. The north wall at Spreyton appears to be older than the body of the church, and is on an alignment of 76°, equivalent to a sunrise date about two days earlier – in other words, a building date about 2½ centuries earlier. If most of the surviving building is Perpendicular, this is consistent with c 1200 for the 'first rebuilding' phase, of which the north wall remains.

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