

The Dual Alignments of the Solstitial Churches in North Wales

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Abstract: In the north of Wales, there are 105 churches that have stonework dated to the thirteenth century or earlier. Of these, only 12 are oriented to face the summer solstice sunrise. Additionally, all of these solstitial churches are located in the northernmost counties of Wales, near or around the valleys which flow beside the Snowdonia Mountains or to the east of them. The 12 solstitial churches take their landscape into account and, thus, vary considerably in their azimuths in order to align to the actual sunrise of the summer solstice. In such terrain, one would expect a wide and diverse collection of western declinations, yet these 12 churches fall into three distinct regional bands of western declination. The 12 solstice churches have western declinations that align them either with the winter solstice sunset (this is the natural alignment) or with the period of early February and early November. With all the churches fitting into these declination patterns, this paper presents an argument for the origin of this apparent intentionality, based on the history of the region. The Isle of Anglesey, in the Roman period, was one of Europe's major Druidic centres of learning and the Druids' naked-eye astronomy skills are evident in artefacts such as the Coligny Calendar. Based on this background, this paper suggests that the original fifth- or sixth-century churches, which were later rebuilt in stone, appropriated pre-existing sacred sites. Thus, today, these Welsh historical churches appear to have preserved, in their medieval walls, older non-Christian orientations.

Keywords: churches; North Wales; pre-Christian orientations; solar alignments; solstice

Introduction

There are, according to John Potter (2013, 53–72), a total of 411 historic churches in Wales, identified as historic because they contain pre-thirteenth or thirteenth century stonework. Since 2014, I have been measuring these churches, by methods which will be described later in this paper, in order to build a database of each church's east and west declinations. At this stage, all of the 105 historic churches in the counties of the Isle

of Anglesey, Caernarfonshire, Denbighshire and Flint (Figure 1) have been measured. Of these churches, 12 have been discovered as being aligned, in their landscapes, to the summer solstice sunrise. Further south, I have also measured an additional 175 churches (about 57% of the total) identified by Potter and, at this stage of the research, only four other such solstice churches have been located (see Table 2).

Past researchers have approached investigation into the orientation of medieval churches by tending to work with large datasets, consisting primarily of azimuth measurements, in order to find commonality. Peter Hoare and Caroline Sweet (2000) worked with the true azimuth of churches in England but found little similarity. Jason Ali and Peter Cunich (2001) investigated the relationship between magnetic and true azimuth for 143 English churches but found insufficient evidence to support the use of a compass for their alignments. Ian Hinton (2012) also considered azimuth and worked with over 2000 churches throughout the United Kingdom and discounted the role of the landscape in a church's orientation but drew conclusions about local harvest dates. Recently, Sassan Allen (2015) presented an overview of past methods and suggested that there were many factors that could influence the orientation of a church in its local landscape.

In terms of methodology, Stephen McCluskey has recommended using large datasets but commented that "we should expect the patterns of church orientation to vary with local circumstances" (McCluskey 2015, 1709). He showed how churches in the English Midlands could yield different results from, for example, churches in the English West Country over a similar-sized area. My research follows McCluskey's thinking but reduces the area of the "local circumstances" considerably to the kingdoms and *cantrefi* – the major administrative units within a kingdom (Jones 1953, 66) – of medieval Wales. Considering the diversity or similarities of declinations of the historical churches within a single *cantref* is one of the larger aims of this research. Based on this micro rather than macro approach, the research project draws on the methodologies of anthropology, which allow for each church to be "interviewed" with consideration of its community role and its relationship to the landscape and its own history, as well as to the larger historical narrative of the region.

For this reason, the research project focuses on the declination of the churches, thereby exploring the actual sunrises or sunsets experienced by the church rather than the symbolic sunrise found by a consideration solely of azimuth, true or magnetic. This idea is driven by the fact that, in the mountainous landscape of North Wales, the difference in dates between actual and symbolic sunrise can be considerable. Drawing on the thinking of Thomas Csordas (1999, 172) concerning the anthropological role of the body in cultural studies, one can consider the actual sunrise or sunset to be an event of the body, while a hypothetical sunrise or sunset to be an event of the mind. Hence, this project takes the position that the phenomenon of the actual sunrise was a more culturally significant event for the medieval parishioner.

The expectation of the larger research project is that the declination of these churches will not conform to a single pattern across all of Wales, or even across all of North, Mid- or South Wales, but instead may share commonality or patterns of declinations with other churches in

their area, whether this be within the same *cantref* or some other, as yet unknown, geographical or cultural grouping. Hugh Benson (1956) defined such small groups of churches which had commonalities in orientation as “clusters”, and this term has been adopted in this project. It is hoped that this continuing investigation into such clusters will be the subject of later papers; however, in the journey required to fulfil this larger aim, an apparently disproportional number of solstice churches located in the north of Wales compared to elsewhere in Wales has been discovered, and are the focus of this paper.

Welsh Christianity and Its Roots in Place

It is widely accepted that the Christian faith entered Wales through individual missionaries from Ireland, with different missionaries arriving in the north and south parts of Wales (Bowen 1954, 31). These missionaries settled into the Welsh landscape in accord with the custom of Celtic churches of the fifth century and, as Bowen (1954, 2) noted, their communities followed “a primitive Christian custom as in Rome itself of naming meeting places for worship after their founders”. There was also the custom of the Welsh churchyard, which was “God’s sacred acre” called a *llan*, the Welsh word for an enclosure or place (Bowen 1954, 1; Friar 1996, 267). Churches were thus established by lone missionaries, who would be given a site or who would select a site and establish a *llan* (Bowen 1954, 31, 103).

These Welsh customs produced what can be today considered a high level of *hagiotoponym*, which is when a settlement takes on a local saint’s name (Morris 1957, 6; Jones 2007, 28). Oliver Padel (2002, 306), in discussing *hagiotoponym* in Cornwall, argues that such an association between place and saint can have great durability. For example, the Church of St Rhychwyn, on the edge of Snowdonia Mountains, is near the modern town of Llanrhychwyn, the “place of Rhychwyn”, and it may have carried that name from as early as the sixth century with Saint Rhychwyn’s arrival in the area. This relationship between a saint and a place is frequently unique, in that there are around 600 dedicatory names found among Welsh churches and over 300 of these occur only once (Jones 2007, 29). Thus, commonly, a Welsh saint is often locally rather than nationally recognised.

The hagiographies give the manner of selection of the initial place. Elissa Henken (2003, 29) comments that a site for the church was often marked by the miraculous appearance of building materials or by an animal. These animal guides were often white and, frequently, appeared as a boar, sow or swan (Jankulak 2003, 276, 280). Such narratives, written later in the twelfth and thirteenth centuries, are a convenient tale for acknowledging the agency of the place while ensuring that such agency, sacredness, had its origins with the saint. But, regardless as to the source of this sacredness of place, it is evident that the place itself chose the saint. Possession of a place which held agency was deemed an essential component of the saint’s authority. The saint was a powerful figure who, like a king, was deemed responsible for the fertility of the land and the spiritual and material welfare of the people in his or her community (Henken 2003, 27). The sacredness of the *llan*, its ability to be the real estate of the Divine and, thus, offer salvation through burial within its parameters, was a part of that power. In this way, in the fifth and sixth centuries in Wales, place, saint and people were bonded together in a spiritual and material union.

It is questionable, however, that the sacredness of a place was only activated by the arrival of the saint. A source closer to the time and free of the need for the glorification of the saint gives a different view of how the place was selected. In the sixth century, Abbot Mellitus in Britain received a letter from Pope Gregory I (540–604 AD) in which the Pope gave instructions on how Christian missionaries should proceed in converting the people of Britain. As quoted in Bede's *Ecclesiastical History*, Gregory urged the missionaries to respect the pagan temples and sites, stating:

[T]he idol temples of that race should by no means be destroyed, but only the idols in them. Take holy water and sprinkle it in these shrines, build altars and place relics in them. For if the shrines are well built, it is essential that they should be changed from the worship of devils to the service of the true God. When this people see that their shrines are not destroyed they will be able to banish error from their hearts and be more ready to come to the places they are familiar with, but now recognizing and worshipping the true God.

(Gregory, *Epistles*, Book 11, Letter 76, quoted in Bede, *Ecclesiastical History* 1.30, trans. Colgreave, p. 57)

Gregory was discussing the conversion of the Anglo-Saxon peoples in England, but this letter shows the general methodology of carrying Christianity to new lands. A second source, in terms of material evidence, is found in the research conducted by Ian Hinton (2012, 109). He found that a large proportion of all churches in England and Wales are built on sloping land that faces east which, he argued, was indicative of a site selected as sacred before the arrival of Christianity.

By the time of the arrival of Saint Augustine on the east coast of England in 597 AD with instructions to convert the British Isles, Wales already had a thriving Celtic Christian community of bishops and monasteries (Morris 1989, 6). These monasteries consisted of a small number of buildings or huts with a church in the centre, all sitting in a circular or oval *llan* (McCormick 2010, 3). The Welsh clergy held other forms of Christianity in disdain and, according to Richard Morris (1989, 10), saw themselves as the *cathari*, “pure ones”, *pura Wallia* (see map Figure 1). Any travelling Christian from Saxon England needed to spend 40 days in penance before the Welsh clergy would accept them into their community. Commenting on the high incidence of *hagiotoponym* in Wales, Jones (2007, 30) points to this Welsh loyalty to Celtic Christianity as the motivation for resisting the later English push to rededicate churches to the universal saints of the Roman version of Christianity.

The early post-Norman Conquest years of 1066–1150 AD are considered by Morris (1989, 165) to be the time of the “great rebuilding”, when almost all the wooden churches of England and Wales were reconstructed in stone. There was a revival of interest in the orientation of churches and cathedrals at this time: the great cathedrals of Exeter, Wells and probably York, were, according to Morris (1989, 208), “not only rebuilt but also reoriented after the Conquest”, and he suggests that this practice may have spread down to the village level. This Norman practice of reorientation was, according to Sassan Allen (2015, 23), designed to align the church to a street plan or some other feature, such as a road to a castle or even to underlying Roman orientations.

Sassin Allen adds, however, that with the lack of Welsh pre-Norman settlements of urban status, apart from Pembroke, this practice of reorientation did not spread into Wales, and thus many Welsh churches not only potentially retain their original Welsh saint's name, but may possibly also still hold their original orientations that had been laid down in the fifth or sixth century, in the period known as the Age of the Saints. Additionally, these founding saints would have appropriated, if possible, a local pagan temple for the location of their church.

The Solstitial Orientation of a Church

In the thirteenth century, the French bishop William Durandus commented on the proper orientation of a church:

The foundation must be so contrived, as that the Head of the Church may point due East; that is, to the point of the heavens, wherein the sun ariseth at the equinox; to signify, that the Church Militant must behave Herself with moderation, both in prosperity and adversity: and not towards that point where the sun ariseth at the solstices, which is the practice of some.

(Durandus, *Rationale Divinorum Officiorum* 1.1.8, trans. Neale and Webb pp. 21–22)

Hence, the equinox sunrise alignment was considered balanced – which, of course, the solstice, in terms of light or location of the Sun on the horizon, was not. The summer solstice did mark the feast of Saint John the Baptist, who as Christ's first cousin was allocated this solstice to balance the birth of Jesus in the winter. Celebration of this day, though, was discouraged, as it was deemed to lead to impious behaviour. John Mirk, a fourteenth-century monk in Shropshire in the Marches of Wales, condemned the celebration of Midsummer's Eve and claimed that the lighting of "bone fires" (bonfires) on that night was dangerous as it could encourage dragons to emerge from the fire (Powell 2009, 167).

This Welsh approach to church activities at the summer solstice is also evident in the history of a particular nineteenth-century church in mid-Wales: the Church of St John the Baptist at Ysbyty Cynfyn, Ceredigion, Wales. It is a reconstruction undertaken in 1827 of an earlier church and, as such, is not considered an historical Welsh church. The church, a chapel of ease, is named for the Order of Saint John, and *ysbyty* (hospital) indicates a hospice for pilgrims; C. S. Briggs (1979, 139) notes that in 1755 Lewis Morris had composed a manuscript commentary for the Society of Antiquaries (eventually published in the *Gentleman's Magazine* in 1791), in which he had referred to "some Knights-hospitallers, instituted by one Cenwyn", who would "once a year [...] remain all night in the chapel and try their activities in wrestling, all the benches being removed, and the spectators generally young women and old champions, who are to see fair play" (quoted in Briggs 1979, 139).

In visiting the church in June 2016, it was found that its eastern declination was +23.93° (Az E 63.5°, Alt E 10°, at a latitude of 52.39565°), all of which draws a connection between the feast of Saint John the Baptist with the summer solstice and the nature of the Welsh celebration of that solstice. As noted above, John Mirk frowned upon the

behaviour exhibited at this celebration, and although Morris' 1755 description of the wrestling matches in front of young women does not give the date for when this once-a-year event took place, the church's name and its orientation suggest that this night of wrestling was held on Midsummer's Eve. This commentary, provided before the current structure was built, also supports the notion that the church built in 1827 maintains a loyalty to the orientation of an older structure – at least, in this example, to a church on the site in 1755.

It is rare to find archaeological evidence to support the idea that a Welsh stone church is still on the same orientation as its original structure, primarily due to the lack of excavation conducted on these still-active churches. There have been a few cases in England where a Saxon church has been excavated, and some do show a consistency of alignment from an earlier wooden church to the current stone building (Hinton 2012, 75). Finally, in this curious example of the nineteenth century Church of St John the Baptist, there are also links to a pre-Christian stone circle. Inside its *llan*, there are some standing stones as well as five stones incorporated into the wall of the *llan*. These have been moved and re-appropriated as building material, but it is generally considered that one large menhir could still be in its original position (Briggs 1979, 145).

Such an example, although attracting differing opinions that argue that the *llan* was a nineteenth-century addition, adds support to the evidence that Pope Gregory's directive to missionaries that pagan sacred sites be converted to Christianity was enacted. It also indicates that a church's name, location and past orientation in relation to the heavens may be significant in ways that have been forgotten by its community.

The Research

This paper emerged from building a database of the declinations of Welsh historic churches. In the ongoing work of virtually surveying all of the 411 historic churches in Wales, 14 solstice churches have been identified with 57% of the survey work completed, 12 located in a loop in the northernmost parts of Wales. Thus, there appears to be a disproportional number of solstice churches in this northerly part of Wales.

As noted above, this northern area of Wales holds a total of 105 historic churches, located in the counties of the Isle of Anglesey, Caernarfonshire, Denbighshire and Flint (Figure 1). In exploring this high number of solstice churches in the area, I conducted virtual fieldwork (VF, method clarified below) on all of these historical churches and later supported this with live fieldwork (method clarified below) on 33 of them, including the churches which are the focus of this paper. For a full listing of the 105 churches and the detailed findings of the fieldwork, see Table SF1 in the Online Supplementary Material (see end of text for link).

Methodology and the Measure of Uncertainty

All churches were measured primarily using the virtual measuring tools of Google Earth. Fortunately, Google Earth images over the northern parts of Wales are of sufficient reso-

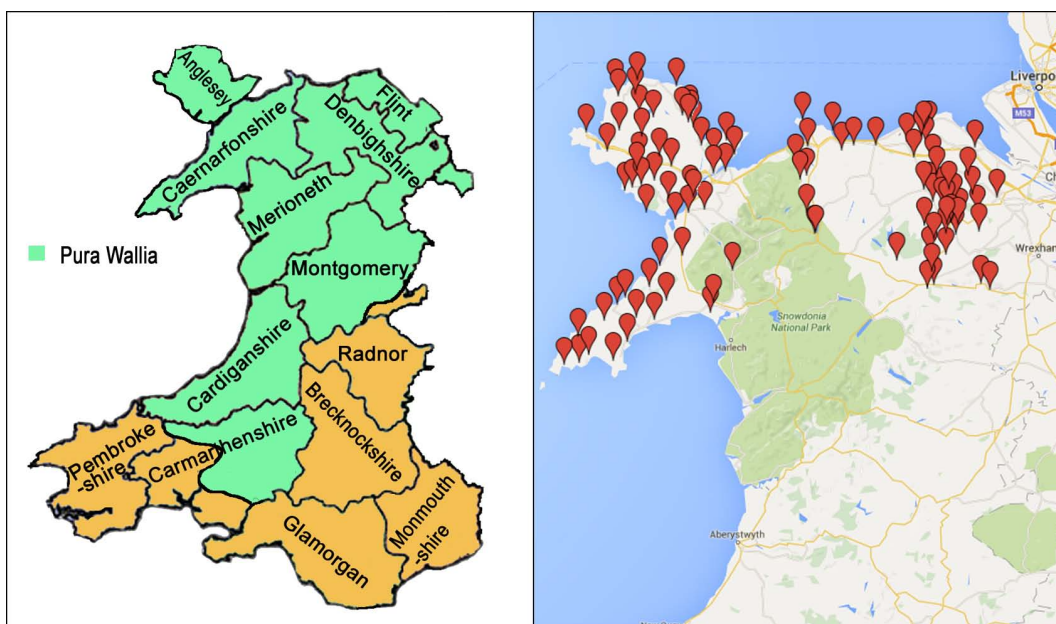


FIGURE 1. Left: The counties of Wales, showing in green the areas of Independent Wales, *pura Wallia*, in 1234 AD. Right: The location of the 105 historical churches in the northern area of Wales in the counties of Anglesey, Caernarfonshire, Denbighshire and Flint (image generated by Google Maps).

lution to allow close work for measuring the centre beam of a church's roof (Figure 2). For the landscape measurements, the virtual panorama service of HeyWhatsThat (HWT, Kosowsky 2013) was used to find the altitude to which the church's easterly–westerly axis is aligned. This tool was used with the awareness that small variations in elevation can occur in HWT depending on factors such as the observer's distance from the raised horizon as well as from the contours of the local terrain. The measure of uncertainty imposed on the VF is, however, within the same level of uncertainty as the LF discussed later and, therefore, is incorporated in the final results. These virtual tools enabled the eastern and western declinations to be calculated for each church.

To verify this VF approach, a sample of these churches was measured against LF, which confirmed that any difference between the VF and LF fell within the margin of uncertainty being employed. The LF work was conducted by myself and Darrelyn Gunzburg using a Garmin 12 XL to find the longitude and latitude, and a Suunto KB-14 compass (with an advertised precision of 0.33°). The altitude measurements, the number of degrees of elevation above the horizon, were taken using Suunto PM-5 clinometers (with a precision of 0.25°). Where possible, we sighted the axial orientation of the building along its length, standing back from the wall and aligning the compass to the point where the side of the wall disappeared from view. If this was not possible, we used a coloured ranging pole to sight into a corner of a transept or buttress. All readings were checked for local magnetic anomaly by taking readings in the opposite direction. With

most of the churches being active, drain pipes or other obstacles often made sighting along the walls difficult. In these cases, we took a different approach.

In Britain, older churches are often closely surrounded by graves. From the medieval period, parishioners had the right to be buried inside the churchyard – in Wales, the *llan*, the sacred earth. This practice continues today. Part of the fieldwork preparation was to examine aerial images from Google Earth to ascertain whether it was possible to see the graves, and, if so, whether they were aligned to the church (Figure 2). The graves largely date to the nineteenth and twentieth centuries and are thus in good condition and, in many cases, are substantial structures above ground level. In cases where we could not measure the building, we measured a number of graves and, if these all gave a consistent figure, we then used this as the azimuth of the church, with the backup of Google Earth's virtual measuring tools to support the LF. Readings were only recorded when both fieldworkers found measurements that were within 0.5° of each other. All compass measurements were corrected for True North using the International Geomagnetic Reference Field model for magnetic declination, which was calculated for the structure's location and day of measurement using the online tool provided by the National Centers for Environmental Information (2014).

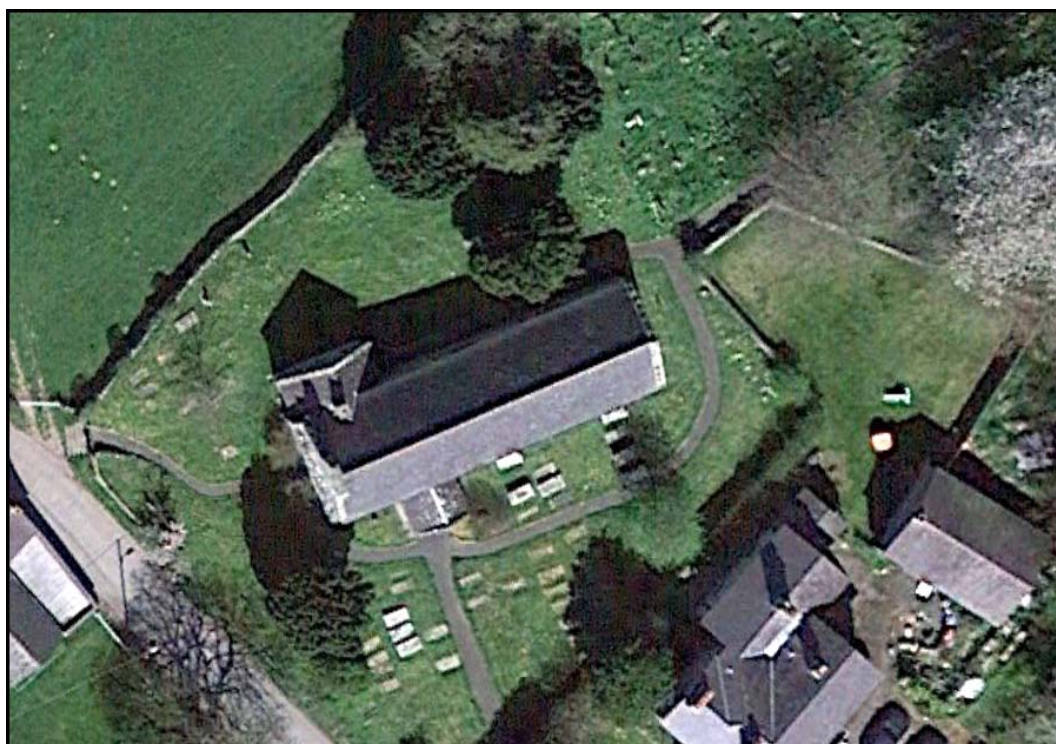


FIGURE 2. An example of the quality of the Google Earth images available for North Wales: the Church of St Mael and St Sulien (HC177), showing the clear line of the roof's central beam, which could be measured using the ruler tool. In addition, it can be seen from this image that some graves close to the church align to the line of the building.

With a level of uncertainty of 0.5° applied to both instruments, a declination level of uncertainty was $\pm 1^\circ$. Additionally, because I was working with the phenomena of sunrise or sunset, if this occurred on a distant horizon Bradley Schaefer's refraction uncertainty formula was applied to the resulting measurements (Schaefer 1990, 804). This added a further error margin of 0.5° to the declinations. Finally, the disk of the Sun measured 0.5° in diameter, and so, with no way of knowing what limb of the Sun's disc the original builders may have used, an additional level of uncertainty of 0.25° was factored in to the final figures. Thus, the level of uncertainty in declination for the Sun on a distant horizon was $\pm 1.75^\circ$ but, for solar events on a raised horizon, such as a nearby ridge, then refraction was not an issue and the level of uncertainty was $\pm 1.25^\circ$.

Given that the summer solstice is for a solar declination of $+23.43^\circ$ then applying the level of uncertainty produced a range of declinations as shown in Table 1.

TABLE 1. The two different declination ranges (with or without refraction) used to determine if a church is oriented towards the summer solstice sunrise.

Altitude of horizon	Uncertainty margin	Min. declination	Max. declination
$\leq 1^\circ$	$\pm 1.75^\circ$	21.68°	25.18°
$> 1^\circ$	$\pm 1.25^\circ$	22.18°	24.70°

Findings

In considering the western declinations of the churches, it can be seen that the 12 solstice churches fall into three clusters (Figure 3). Cluster 1 churches are all located on the eastern side of the country in Denbighshire and Flint. This cluster shares western declinations within a band of 2.5° between -14° to -16.5° . Cluster 2 churches are located in the mountains or on the Isle of Anglesey. These churches have their western declinations also within a band of 2.5° , from -17.5° to -20° . Cluster 3 churches, located on the coast between the mainland and the Isle of Anglesey, have western declinations ranging from -22.3° to -23.6° .

Table 2 lists the longitudes, latitudes, true azimuth, horizon altitude for east and west, and the eastern and western declinations for all 16 solstice churches found in the fieldwork: the 12 solstice churches in the northern area of Wales and the other four solstice churches that fall outside the region. Some of these churches are perched on ridges: the Church of St Mael and St Sulien, and the Churches of St Cwfan and of St Rhychwyn. Others stand on the coast, with the sea to the east (the Churches of St Deiniol, of St Beuno and of St Dwywnwen), or west (the Church of St Michael and All Angels). Some sit in bowls, surrounded by low hills (the Churches of St Garmon and of St Trillo). The Church of St Tyrnog sits across a valley. Their true azimuths range from 48° through to 65.5° (Table 2), yet all of them face the summer solstice sunrise and have only three bands of western declinations.

With regard to the group "Other", these are the four solstice churches located in the research which are outside the region. St Michael's Church in Llanfihangel-y-Pennant (HC120) is in the foothills of Cadair Idris in the county of Merioneth; in the east is the Church of St Aelhaiarn (HC121) in Guilsfield, which could be included in Cluster 2 but

Table 2 continued

Code/Church	Long. W	Lat. N	T.Az. E	Alt. E/W	Dec. E	Dec. W
SSSR / Cluster 3						
HC185 St Beuno's Church	4.46624	53.1907	48	0.3/1.5	23.89	-22.32
HC190 St Dwynwen's Church	4.4129	53.1375	48	0.7/0	24.27	-23.67
HC233 St Michael and All Angels Church	4.20395	53.1444	50	1.5/0	23.97	-22.68
SSSR / Other						
HC120 St Michael's Church	3.9658	52.6611	68	13.5/2	23.98	-11.49
HC121 St Aelhaiarn's Church	3.1567	52.6968	50	0/4	22.92	-19.45
HC100 St Michael's Church	3.1013	52.1494	49	1/4	24.59	-20.27
HC211 St Tetti's Church	3.2679	51.8738	121	4.2/7	-15.04	24.29

which is located out in the county of Montgomeryshire; in the south are the Church of St Michael, Michaelchurch-on-Arrow, in the county of Radnor, and the Church of St Tetti, in Llanddetty in Brecknockshire, which uniquely faces west to the summer solstice setting Sun. Both these churches in the south are located in the Marches outside the area of the *pura Wallia*. The completion of the survey work over the forthcoming year may place these churches into some context. For the moment, however, they are added here for the sake of completeness.

Eastern Declinations of the Solstitial Churches

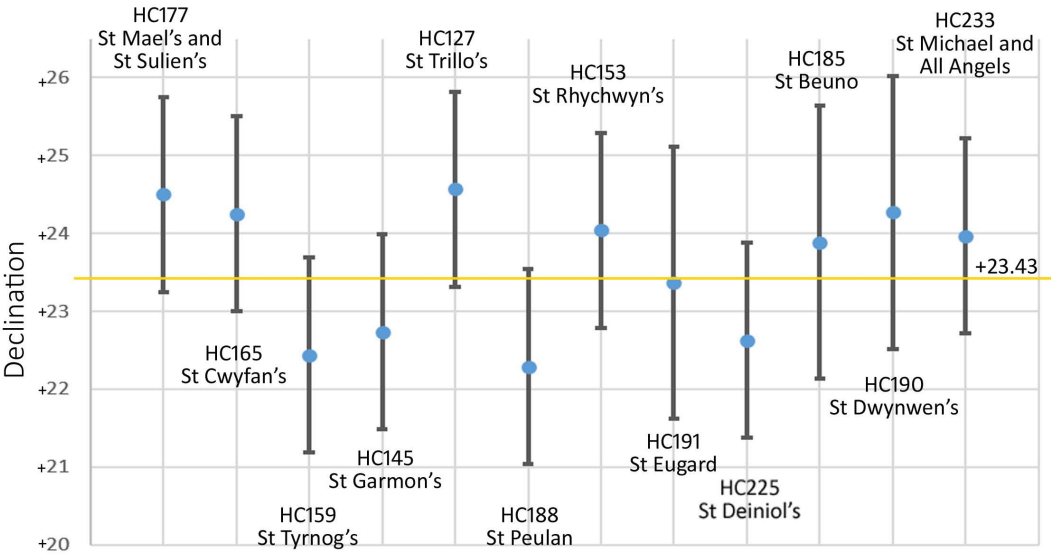


FIGURE 4. The eastern declinations of the 12 solstice churches (blue dot), with their levels of uncertainty indicated by error bars. The declination of the summer solstice is indicated by the yellow line.

The solstice alignment of these groups is displayed in Figure 4. All the churches have eastern declinations which align them to the summer solstice sunrise within the levels of uncertainty. The western declinations of these churches are displayed in Figure 5. The five churches in Cluster 1 (white icons in Figure 3) are all in Denbighshire or Flint and have a shared western declination of -15.4° , indicated by a green line. The four churches in Cluster 2 (blue icons in Figure 3) are all in Caernarfonshire and Anglesey and display a second shared western declination of -18.4° , indicated by a blue line. The three churches in Cluster 3 (yellow icons in Figure 3) are all in the west and in flat coastal landscapes with their western end aligned to the winter solstice sunset. The Church of St Tyrnog (HC 159) in Denbighshire is the only church that fits into Cluster 1, right on the edge of its level of uncertainty, but it just misses out being in Cluster 2.

Western Declinations of the Solstitial Churches

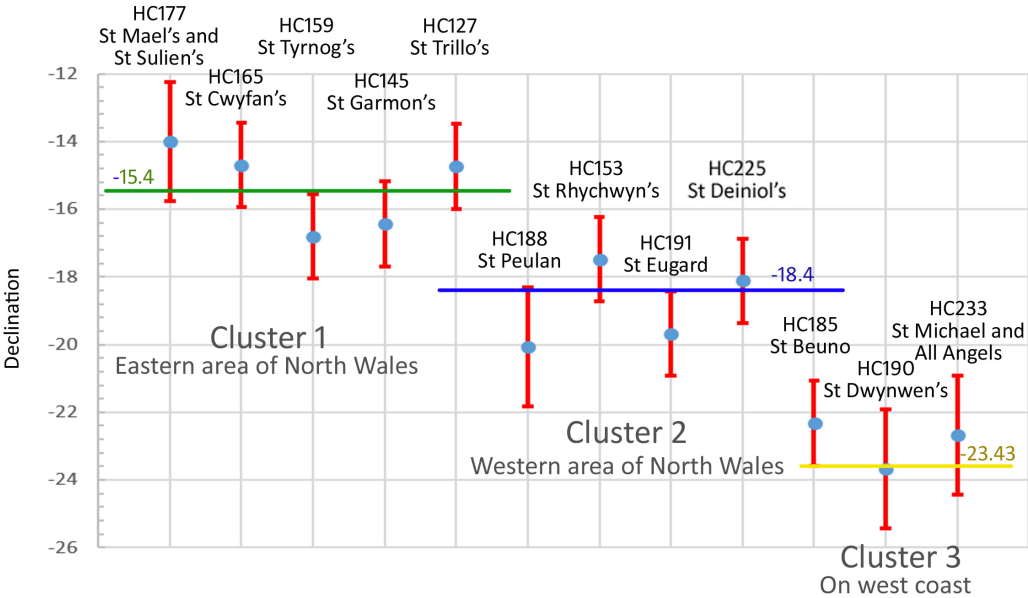


FIGURE 5. The western declinations of the 12 solstice churches (blue dot), with the levels of uncertainty indicated by error bars. The common shared declination in the individual clusters is indicated by the horizontal lines.

As can be seen from Figure 5, there are, given the levels of uncertainty, other ways of forming these clusters. St Tyrnog's (HC159) could be linked with St Garmon's (HC145) and combined with St Rhychwyn's (HC153) and St Deiniol's (HC225), producing a cluster with a shared declination of around -17° . However, this grouping, although possible, would need to ignore the geographical elements and combine churches in the east with those in the west. Additionally, it would annex St Peulan's (HC188) and St Eugard's (HC191) into their own cluster yet, by their level of uncertainty, they could just as easily be combined into Cluster 2. Thus my approach, particularly after visiting all the churches, has been

to respect the geographical element, which just so happens to also create the smallest number of clusters.

Case Studies

In order to appreciate the varied landscape settings of these churches, it is worth considering four of these churches in detail: the Church of St Rhychwyn and the Cathedral of St Deiniol in Caernarfonshire, in Cluster 2, with their shared western declinations of -17.5° to -18.1° , and those of St Cwyfan and St Trillo in Denbighshire, in Cluster 1, with their shared western declinations of -14.7° .

St Rhychwyn's Church and St Deiniol's Cathedral

The Church of St Rhychwyn (HC153) is considered to be the oldest church building in Wales. It sits on the edge of the Snowdonia Mountains looking out to the east over the Conwy Valley into the hills located five miles in the distance (Figure 6). The church itself stands upon a wide-sloping stretch of land that falls away to the east, offering a panorama of the valley below. It is considered partly eleventh but mainly twelfth century in its stone construction, and is a double-aisled rectangular building. Its western end is dug into the natural rise of the land. The western end of the church is, in effect, "pushed" back into this slope. Inside, there is a stone slab floor formed on three levels which slopes down to an altar situated in front of a pair of small windows in the east. With no windows in the west end, the only other windows are small side windows. Bright sunlight does not really penetrate into the church. Even on the morning of the summer solstice sunrise to which the church is aligned, the influence of the Sun's beams would be minimal. In its isolated position on the edge of the Snowdonia Mountains, it required the faithful to make a hard climb every week into the mountains. In fact, this became such an issue that later, another church was built lower down in the village of Trefriw.

Founded by Saint Rhychwyn in the sixth century, the church's very remoteness shows that his motivation in choice of a location was not influenced by a desire to be close to the people whom he wished to convert. Instead, he appeared to follow the dictates of Pope Gregory, which was to first convert a sacred place to Christianity and then, from that "conversion", the people would follow. The current church, on its eastern slope overlooking the valley and wedged into the land on the western side, appears to be loyal to an older footprint. With the ridge offering a wide vista overlooking the valley to the east, Rhychwyn, and/or the later builders who rebuilt the church in stone, had the choice of a complete range of eastern solar events, yet from that vista, they chose the summer solstice sunrise. Additionally, there is land to the east of the church, so one wonders why the structure was set back into the raised land to the west.

In contrast, in terms of azimuth and landscape, is St Deiniol's Cathedral (HC225) in Bangor just opposite the Isle of Anglesey (Figure 7). Saint Deiniol was one of the earliest Welsh saints (Dalton *et al.* 2011, 108–109). His cathedral, according to Coflein (2017), is believed to have been founded c. 525 AD as a Celtic *clas*, a Celtic monastic

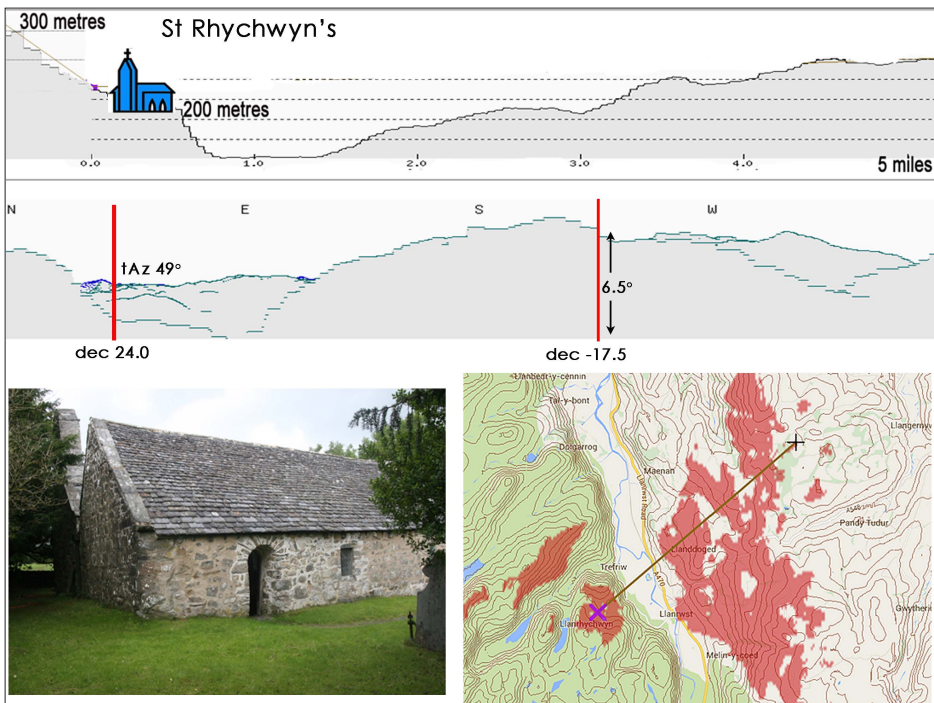


FIGURE 6. St Rhychwyn's Church (HC153). Top: Side elevation of the church. Middle: 360° landscape. Bottom right: the contours of the landscape. The church is marked with a purple cross and its wide easterly vista is shown by the red shaded areas. The line across the valley is the direction of its eastern orientation (horizon and elevation images generated by HeyWhatsThat; horizon profile © 2013 Michael Kosowsky, used with permission). Bottom left: South wall and western end of St Rhychwyn's Church, showing how it is embedded into the hillside (photograph by author).

site and place of learning, and today the cathedral sits in the busy city of Bangor near the coast and next to the university. The cathedral itself is located on a wide piece of land that gently slopes to the east towards the sea (Figure 7, lower right), which means that, to its west, the cathedral is set below the level of the streets. To the northeast, if the modern buildings were cleared away, there would be a view out to the sea, yet this view is too far to the north and does not align to any solar events. If alignment was not an issue, the natural orientation would have been out to this wide sea view. However, the cathedral builders appeared to have been sympathetic to orientation, since the building's eastern view is directed to the edge of a low headland with an altitude of 2° , which is the location of the summer solstice sunrise.

About 100 m to the west of St Deiniol's, there is another low ridge, with an altitude of 2.5° . The cathedral thus sits between two low ridges of similar altitude and, with its azimuth of 55° , shares a dual alignment with St Rhychwyn's with its azimuth of 49° – both church and cathedral face east to the point of the summer solstice sunrise and both carry the same western declination of -17.5° or -18.1° .

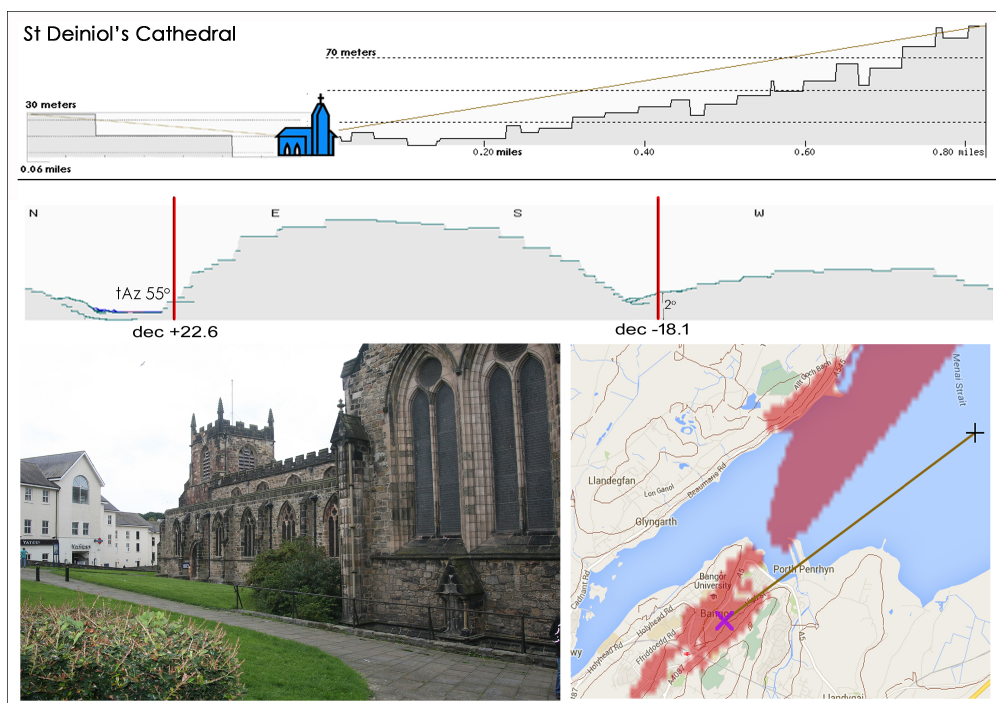


FIGURE 7. St Deiniol's Cathedral, Bangor (HC225). Top: Side elevation of the cathedral. Middle: 360° landscape. Bottom right: the contours of the landscape. The cathedral's orientation avoids the obvious sea vista (the red shaded area) and, instead, is directed to the edge of a small headland (horizon and elevation images generated by HeyWhatsThat; horizon profile © 2013 Michael Kosowsky, used with permission). Bottom left: The western end of St Deiniol's Cathedral, showing the way the land slopes down to the east (photograph by author).

Although these two churches are in very different landscapes and locations, they both share the same eastern and western declinations.

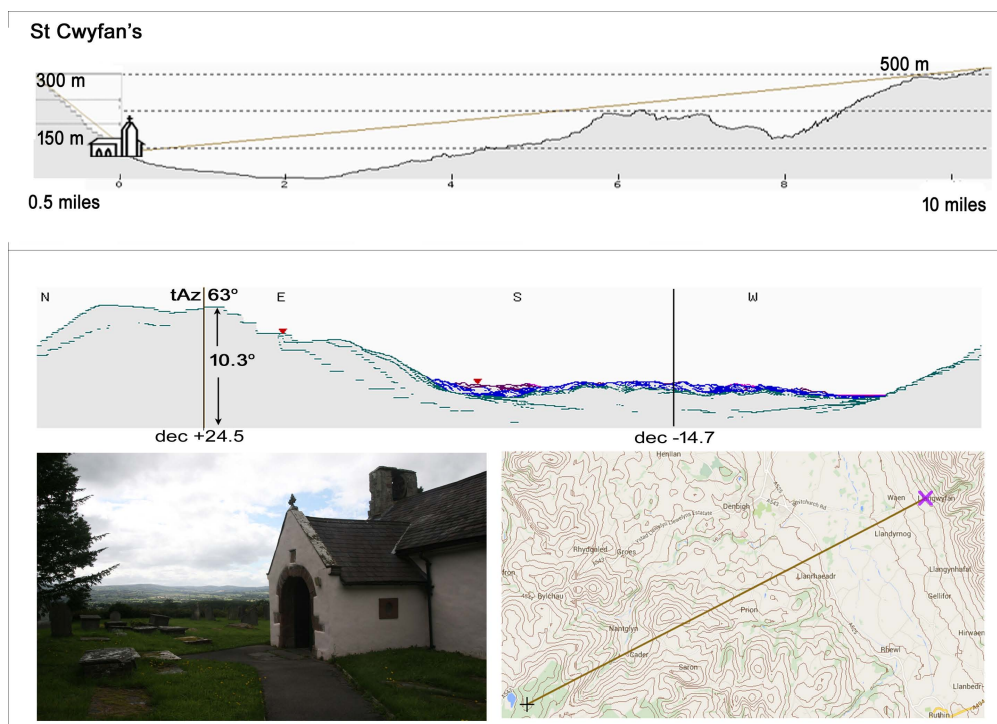
St Cwyfan's Church and St Trillo's Church

Two churches from Cluster 1 are located in Denbighshire: St Cwfan's is in Llangdynrog and St Trillo's is in Llandrillo-yn-Edeyrn.

Saint Cwyfan's Church (HC165) (Figure 8) is on the side of the Clwydian Hills and is built next to a steep lane leading up into the mountains. The church is perched on a ridge in a similar way to St Rhychwyn's but, in this case, the vista and the slope of the land is to the west as it looks out onto the full panorama of the Vale of Clwyd. A small stream runs past its *llan* on the north side and the land itself slopes gently from the east towards the west. The church was noted in the "Norwich" taxation of 1254 AD (a description of clergy revenues compiled by the Bishop of Norwich, at a time when the Pope Innocent IV [c. 1195–1254 AD] granted a tenth to King Henry III [1207–1272 AD] for three years) but offers no architectural evidence of an earlier structure on the site (Clwyd-Powys Archaeological Trust 2017a). The church orientates its eastern end into

the side of the mountains, approximately only 300 m in front of the church, offering a horizon altitude of 10° , but nevertheless, at the very point where the summer solstice Sun breaks over the ridge. Its western view is towards the distant peaks on the other side of the valley and its western declination is -14.7° . Thus, it falls into the same band of western declination as the other solstice churches in the same region.

St Cwfan's place on the ridge of the valley does set it apart from the local community, particularly in the medieval period, suggesting that the location was selected more for its importance rather than for convenience. Finally, the location itself, with its raised position and its full view of the valley to the west, implies an allegiance to an older culture than that of Christianity. Indeed, if the saint had wished for a church orientated to the east for the summer solstice, there were more convenient locations down in the valley, closer to the community, rather than a site that required the eastern end of the church to look directly into a ridge with an altitude of 10° .



St Trillo's Church sits on a small raised circular area clearly defined by its *llan* (Figure 9). It is located to the west of the Afon Ceiriog and occupies the centre of the village. With its circular *llan*, there is a sense that the village has grown around the church, rather than it being implanted into its centre. A church was named in this village in the 1254 AD "Norwich" taxation records, but the actual building, including a majestic tower from the nineteenth century, shows little, if any, medieval architecture (Clwyd-Powys Archaeological Trust 2017b). Standing in the church's *llan*, on the raised area, one finds oneself in the centre of a bowl of low hills which provides a raised horizon and offers a clear 360° view of the sky. It is, in fact, the perfect location for sky watching. From this vantage point, the builders could have selected any desired eastern or western solar event. The church sits at a true azimuth of 54°, which points it directly to the place where the disc of the summer solstice sunrise cuts the hills. Due to the nature of the hills, it has the same western declination as St Cwyfan's, with its westerly views of -14.7°.

Both these churches, St Cwyfan's and St Trillo's, have very different landscapes and locations in terms of local settlements, and both have different azimuths, yet they share the same east and west declinations: to the east, the summer solstice sunrise and, to the west, the sunset at a declination of around -15°.

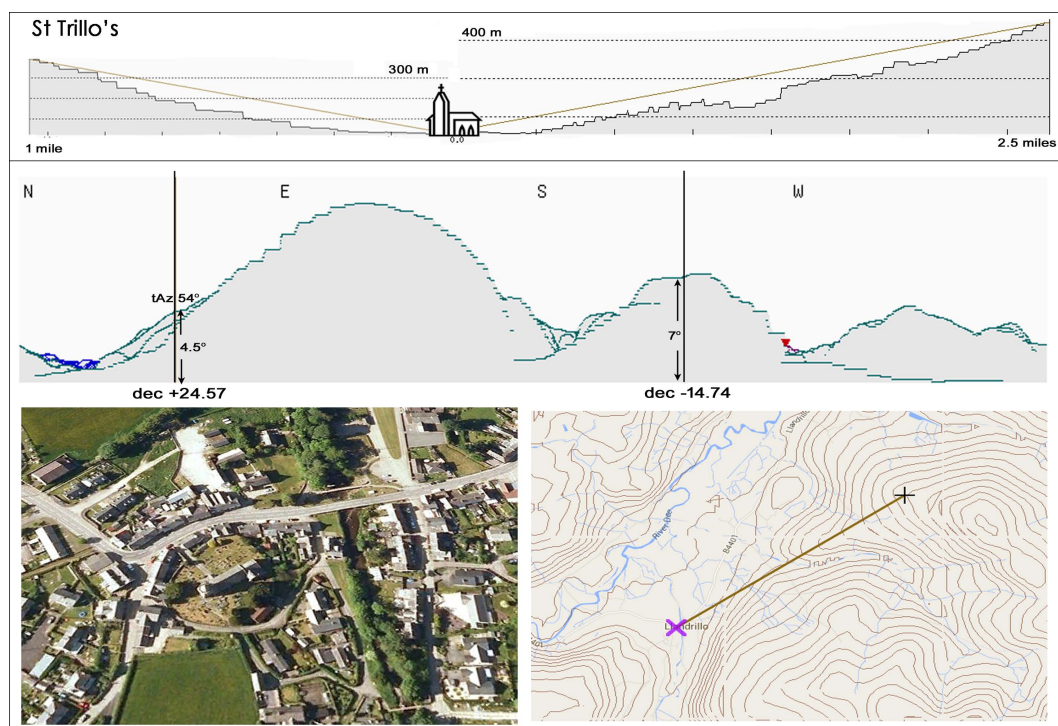


FIGURE 9. St Trillo's Church (HC127), Llandrillo, Denbighshire. Top: Side elevation of the church. Middle: 360° landscape. Bottom right: the contours of the landscape; the church is the purple cross and the extended line is its easterly orientation toward the low hills, 2.5 miles away (horizon and elevation images generated by HeyWhatsThat; horizon profile © 2013 Michael Kosowsky, used with permission). Bottom left: Aerial image of St Trillo's Church showing its raised circular *llan* in the centre of the village (image from Google Earth).

Discussion

These case studies are just four from a total of 12 solstice churches located in the northern coastal counties of Wales. The 12 churches sit in varying terrains, yet all contain common features in their western declinations. The three churches of Cluster 3 are on flat terrains, and are thus aligned to the rising Sun at mid-summer and the setting Sun at mid-winter. In such cases, however, it is unclear which solar event would have been deemed more important. The other nine churches, in their markedly different landscapes, reveal only two bands of western declination: one around -18° and the other around -15° (Figure 5).

Intentionality or Chance?

The question, of course, is of intentionality. It is unlikely, from the points already raised, that the Christian saints who founded these churches would have intentionally sought these particular western declinations for their solstice churches; indeed, they may not have even sought the initial summer solstice sunrise alignment. In this regard, if it were the Christian saints who accidentally established these dual alignments, then one is looking at simple coincidence.

In considering the possibility of such a coincidence on a flat terrain, a summer solstice sunrise orientation will automatically be aligned in the west, to the winter solstice sunset. This accounts for the three solstice churches – St Beuno's, St Dwywnwen's and the Church of St Michael and All Angels of Cluster 3 – on or near the Isle of Anglesey.

In turning to the other nine solstice churches – the remaining solstitial churches in North Wales – these sit in varying landscapes and thus the western declinations could realistically have ranged from a declination of -23.5° , as with the Cluster 3 churches, through to a declination of -5° , depending on the elevation of the landscape to the west. For example, a mountain with an altitude of 20° would produce a western declination of around -5° for a church orientated to summer solstice sunrise and, therefore, a random western declination could fall anywhere within a band 18.5° wide. With the level of uncertainty, as shown in Table 1, then the nine remaining solstice churches of North Wales have their western declinations falling into a range of degrees of declination which is either 2.5° or 3.5° wide (i.e. $2 \times 1.25^\circ$ no refraction, or $2 \times 1.75^\circ$ with refraction).

There are five churches in Cluster 1 which are all in the same geographical area of the eastern part of North Wales and which all lie within one band of declination, -15.4° . The remaining solstitial churches in North Wales, Cluster 2, all lie in the western area of the region and fall into the band of declination, -18.4° . As can be seen from Table 3, the probabilities of all five solstitial churches in the eastern region is roughly $1:25000$ ($4.5e-5$) or, with refraction, $1:5000$ ($2.42e-4$), while to have all four solstitial churches in the western area sharing the same western declination is roughly $1:3000$ or, with refraction, $1:1000$. Finally, to have all the solstitial churches in North Wales which do not align to the winter solstice sunset aligning to just these two declinations is roughly $1:1$ trillion ($9.849e-12$) or, with refraction, $1:5$ million ($3.105e-7$).

TABLE 3. The probabilities of random orientation.

Probabilities	Single church having a western dec -15.4°	All five churches in the eastern region sharing this declination	Probability of random chance		
No refraction	$(2.5^{\circ}/18.5^{\circ}) = 13.5\%$	$(2.5^{\circ}/18.5^{\circ})^5$	4.50 e-5	or	0.000045%
Refraction	$(3.5^{\circ}/18.5^{\circ}) = 18.9\%$	$(3.5^{\circ}/18.5^{\circ})^5$	2.42 e-4	or	0.000242%
	Single church having a western dec -18.4°	All four churches in the western region sharing this dec.			
No refraction	$(2.5^{\circ}/18.5^{\circ}) = 13.5\%$	$(2.5^{\circ}/18.5^{\circ})^4$	3.33 e-4	or	0.00033%
Refraction	$(3.5^{\circ}/18.5^{\circ}) = 18.9\%$	$(3.5^{\circ}/18.5^{\circ})^4$	1.3e-3	or	0.0013%
All nine solstitial churches falling into either cluster					
No refraction	$(2.5^{\circ}/18.5^{\circ})^4 \times (2.5^{\circ}/18.5^{\circ})^5 = (2.5^{\circ}/18.5^{\circ})^9$				9.849e-12
Refraction	$(3.5^{\circ}/18.5^{\circ})^4 \times (3.5^{\circ}/18.5^{\circ})^5 = (3.5^{\circ}/18.5^{\circ})^9$				3.105e-7

This regional difference from the eastern area to the western area of North Wales is the subject of ongoing research; however, independent as to this regional pattern, it can be assumed that these dual alignments do carry intentionality.

Christian or Pre-Christian

The actual dual alignments of all the solstitial churches of North Wales consist logically of an orientation to the summer solstice sunrise and, to the west, they are aligned to the following Gregorian calendar dates:

- Cluster 1 in the east of North Wales, Declination -15.4° = 8th February and 3rd November.
- Cluster 2 in the west of North Wales, Declination -18.4° = 29th January and 14th November.
- Cluster 3 on the west coast, Declination -23.43° = winter solstice.

If these orientations carry Christian intentionality then one would need to consider the Julian calendar adjustments for the fifth, twelfth and thirteenth centuries (the periods of rebuilding), and this would push these dates forward either by one day (fifth century) or seven days (thirteenth century). With this in mind, one can see some Christian correspondence with Candlemas Day in early February, and All Saints Day on 1st November, as well as with the summer solstice, which the churches all share and which is allocated to Saint John the Baptist. The winter solstice is, of course, the birth of Christ. Any Julian calendar correction for the thirteenth century would move even further away from these dates. It is questionable, therefore, that the Christian saints in the fifth century sought such dual alignments – a summer solstice sunrise with a western orientation to sunset on Candlemas (2nd February) or All Saints Day (1st November). Ronald Hutton (1991, 286) argues that many scholars consider that these Christian feast days were grafted onto the earlier Celtic feasts of Imbolc (2nd February) and Samhain (31st October); or, if such syncretisation did not occur in North Wales – and Hutton supports this doubt – then, as Stanislaw Iwaniszewski (2015, 12) and Juan Belmonte (Belmonte 2015, 484–486)

independently point out, these cross-quarter dates of 31st October and 2nd February are a consistent theme of any culture that seeks to form a solar calendar. Indeed, when one ignores the issue of the Julian calendar, which assumes Christianity, the churches of Cluster 1 are closely orientated to the western sunset of the cross-quarter day of 31st October, while Cluster 2 is suggestive of 2nd February.

Furthermore, according to Morris (1989, 297), the often small window-slits of these churches allowed for a level of darkness which emphasised the shafts of sunlight through the narrow side windows. Nevertheless, the evidence of these narrow windows along with the total lack of windows in the west wall of some churches indicates that the church builders, at least when building in stone, were not aware of or interested in the light of the rising or setting Sun. Hence, although it is a possibility that the founding saints actively sought to find these dual alignments for their churches, the more likely explanation, particularly in the light of Pope Gregory I's letter to Abbot Mellitus in Britain cited earlier, is that the early church builders followed the assumed sacred orientation of an existing pre-Christian site.

Celtic Calendars and Druid Sky Knowledge

The history of the pre-Christian times in this northerly area of Wales is of a vibrant Druid stronghold, with the Isle of Anglesey a place of Druidic training and the centre of Druid resistance against the Roman invasion into Wales in 55–54 BC (Hutton 1991, 170–171). Hutton reminds us that Julius Caesar (100–44 BC) considered the Isle of Anglesey as the Druids' religious stronghold in Britain, and that Britain itself was the source of the religious instruction for European Druidry, with Celts from Gaul travelling to Anglesey for Druidic training.

The calendar that the Druids used is debatable, although there is one example of a Gaulish Druidic calendar. This is known as the Coligny Calendar, and it was found in bronze fragments at Coligny, France in 1897. It is generally accepted that the Coligny Calendar portrays the Gaulish Celtic approach to the calendar from the third to first century BC (Olmsted 1992, 73–75): the Gaulish solar calendar is based on the light and the dark times of the year, with an emphasis on the darkness (Olmsted 1992, 62; Zavaroni 2007, 18). Caesar related that the Celts counted the nights, rather than the days, to mark their year (*Gallic War* 6.18). The Celtic year started with sunset on the cross-quarter day, on the evening of 31st October. The end of the dark part of the year was 2nd February, known as Imbolc (Hutton 1991, 176). The Coligny Calendar does not, in itself, refer to a month called "Imbolc"; yet, importantly, it does provide evidence of a high level of sky-watching knowledge possessed by these Celtic people.

Such high-level sky knowledge would be required for capturing the dual alignments evident in these churches. The central problem is the necessity of finding the correct landscape in order to achieve a particular dual alignment: sunrise at the summer solstice while, directly opposite that sunrise point on the horizon, the sunset position of either the February or October/November date. A method to achieve this, without spending years moving from site to site, would be to watch the movement of the stars and work with star-paths, linear constellations which are defined by a declination (Lewis 1974).

If one knows the place on the horizon where the summer solstice Sun will rise, then this horizon place can be observed over some nights at different times of the year to learn the 360° circle of stars, and the star-path, that rises over this point; in this example, the circle of stars with a declination of +23.5. Knowing this circle of stars means that in an unfamiliar landscape for any night, any part of that circle of stars can be found and then visually projected down to the horizon to mark the place of the summer solstice sunrise. In this manner, star-paths can be learned and then used to mark any unfamiliar horizon with its key points of sunrise or sunset for any other date of the year. Such star-paths, as I have argued elsewhere (Brady 2015), are both a portable horizon calendar, as well as a compass in unfamiliar landscapes.

Using a set of two or three star-paths, the task of finding the correct location to obtain a particular dual alignment for a row of stones or structure would still require visiting many sites. Nevertheless, as long as one could see the stars, it would only take a single evening of star-watching to ascertain the suitability of any particular location. This is the type of sky knowledge and activity that one can, based on the evidence of the Coligny Calendar, attribute to the Druids. However, as Hutton (1991, 170) argues, the practice of the Druids “did not greatly depend upon monuments and artefacts”, as they preferred to work with timber. A Druidic timber structure may have survived into the Age of the Saints but, more likely, the site could have been marked by a Bronze Age (or earlier) stone structure. It is pure speculation, but still feasible to assume, that any relationship that such a stone monument had to the sky would have been evident to any trained sky-watcher. In this latter case, the Druids in North Wales with their sky-knowledge could have honoured the sacredness of such a stone structure and thus ensured the continuity of the sacredness of a site and its structure into the Age of the Saints.

Location of Churches

An additional support for a pre-Christian origin to these dual alignments is the actual location of the churches themselves. In returning to Figure 3, it can be noted that all the solstice churches are in a wide loop that moves from the Isle of Anglesey, leaps over the Snowdonia Mountains, and then sweeps up through the Vale of Clwyd, ending with the Church of St Mael and St Sullien in the north of Denbighshire. Of interest, and requiring further research, this loop avoids the area of the Llŷn Peninsula (located just below Anglesey Isle, Figure 1), which contains 18 of the 105 historical churches under consideration. This could be meaningless; however, this pattern is more suggestive of a pre-Christian influence as the missionary saints would have viewed the distinct Llŷn Peninsula in much the same way as to any other part of North Wales and thus, if they wished, they could have built a solstice church or two on the open coastal areas of the peninsula.

Conclusion

This work emerged from the building of a database of the east and west declinations of Welsh historic churches. At this stage, 57% of the 411 historic churches in Wales have been surveyed either virtually and/or by visiting the church. So far in this ongoing

work, 14 solstice churches have been identified (Table 2, above). Of these 14, it was noted that 12 are located in a loop in the northernmost parts of Wales. By taking a micro approach to the data and considering each church as a unique unit in its own local area, it was found that these solstitial churches hold western orientations that fall into distinct regional patterns.

In the east, in Denbighshire and Flint, the five solstice churches of Cluster 1 all share the same dual alignment to the summer solstice sunrise and sunset on 8th February and 3rd November and thus, possibly, the Celtic Samhain (31st October). The four solstice churches in Cluster 2, in Caernarfonshire and the Isle of Anglesey, all share the dual alignment to summer solstice sunrise and to the sunset of late January and mid-November, and thus possibly to the Celtic Imbolc (2nd February). Lastly are the three solstice churches in the west, on the coast of the Isle of Anglesey and the adjacent Caernarfonshire coast, in Cluster 3, all holding the naturally occurring dual alignment of summer solstice sunrise/winter solstice sunset. The solstice churches in Cluster 3 may not actually represent a dual alignment, although the evidence suggests, by probability, that the churches of Clusters 1 and 2 do carry intentional dual alignments.

In considering this possible intentionality, the key question was to reflect what skills were required to find such a site in the mountains, and who would possess such skills.

The churches themselves represent the activities of the fifth- and sixth-century saints who brought Christianity to the north of Wales. They established a form of Christianity which resisted the version prevalent in England, and which was later reinforced by the Normans. In this way, the churches of North Wales also resisted the nationalisation of saints and the Norman tendency to reorientate churches in the twelfth century. Thus, these Welsh historical churches have a strong possibility that their original orientations have been maintained. Nevertheless, it is questionable that the missionary saints had the naked-eye astronomical knowledge required to find a dual alignment; instead, they may have simply followed the papal edicts to appropriate pagan temples for their churches.

The Welsh area itself, before Christian conversion, was a stronghold of the Druids. The Isle of Anglesey, the focus of the assault on the Druids launched by the Romans in 60 AD, was a holy island and the place of Druid training, not only for Britain but also for other parts of Europe. That this Druidic European community had naked-eye astronomical knowledge is evident in the Coligny Calendar, a Gaulish calendar which showed the attempt to juggle the solar year with the lunar cycle by observation. The Druids themselves were not builders, however; if there were stone structures which carried alignments to the summer solstice plus the other cross-quarter days of the year, they would have had the skills to recognise the calendrical value of such places. In this way, they could have protected and thus, potentially, turned them into the pagan temples that the Christian missionaries found and converted to Christianity through the construction of a church.

Consequently, my research indicates that the solstitial churches in North Wales hold in their stone walls the cosmology of a far earlier culture, either Druidic or from the period of the stone-monument builders.

Online Supplementary Material

Available at <https://doi.org/10.1558/jsa.34233>

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