THE ORIENTATION OF CISTERCIAN CHURCHES IN WALES: A CULTURAL ASTRONOMY CASE STUDY

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The union of sun, landscape, and architecture contribute collectively to the siting of Welsh Cistercian abbeys. By taking into account the topography rather than a symbolic horizon[1] to identify the exact sunrise point, and by using the sky as one of its primary sources, this paper proposes that there was a deliberate intention to orientate Welsh monasteries by embracing their individual landscapes. Landscape itself, Belden Lane argued, has agency when story emerges through the blend of culture, sky, and earth, for

> the human role in completing the task for jointly perceiving a given landscape is to tell its story, to weave a narrative that embraces the energies of land and sky in suggesting common meanings only discovered together.[2]

It is this story that we sought to find in our research, albeit in this case a monastic one. Our team consisted of an anthropologist (Brady), a medieval art historian (Gunzburg), and an archaeologist (Silva), all of whose training overlaps within the field of cultural astronomy. In order to investigate the sun's role in the building of these monastic centres, between August 2014 and March 2016 the orientation of twenty-three Welsh monastic sites, as well as the elevation of their surrounding landscapes, was surveyed and measured. We will first discuss the dilemma that the direction east posed to scholars in the ancient world when orientating sacred buildings. A detailed discussion of the methodology used and related astronomical terms follows. The findings are then presented and examined with regards to the orientation of these Welsh Cistercian abbey churches. From our research four common themes emerge: the importance of the landscape in understanding the orientations of the abbey churches; the emphasis on sunsets and the west; the focus on the astronomical equinox rather than that of the Julian calendar equinox; and the solar position on Michaelmas (September 29th) and/or Saint David's Day (March 1st).

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[1] That is, a theoretical flat horizon.

[2] Belden C. Lane, *Landscapes of the sacred: geography and narrative in American spirituality* (Baltimore, MD/London 2001), p. 58.

I. The Dilemma of East

On a flat horizon the sun rises due east and sets due west at the time of the equinoxes, which occur in March and September when the sun is on the equator; on these days there is a balance of day and night hours. Additionally, the sun on these days will rise and set on the local horizon at the midpoint of the span defined by its rising or setting positions at the two solstices.

The equinoxes were key dates in early Christian doctrine. In 221, Sextus Julius Africanus proclaimed that Christ was conceived on the vernal equinox, 25 March in the Roman calendar.[3] In creating the cult of *Sol invictus* in 274, the Emperor Aurelian established a theological approach to the four key solar dates of the year. The cult of *Sol invictus* taught that the conception of John the Baptist occurred at the autumnal equinox, 24 September, and that of Christ six months later at the vernal equinox, 25 March; hence John the Baptist was born at the summer solstice, 24 June, while Christ was born on the winter solstice, 25 December.[4] Three hundred years later, Isidore of Seville (560-636), in his *Etymologiae*, spoke of the idea of balance that the equinox offered. He stated that sacred buildings needed to be oriented towards the equinoctial east so that when the congregation was facing the altar, 'the line from the east to the west would make the right and left parts of the sky equal'.[5] This was echoed in the thirteenth century by the French bishop, William Durandus (1230-1296) who commented on the orientation of a church by stating,

> 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.[6]

This is the balance that Isidore of Seville referred to as, 'the right and left parts of the sky [are] equal' and why Durandus proclaimed it as the day of balance and 'moderation, both in prosperity and adversity'. Sunlight, according to Otto von Simpson, was the 'most noble of natural phenomena, the least material, the closest approximation to pure form' and fundamental to the 'Platonizing metaphysics of the Middle Ages'.[7] Thus if a church or abbey was seeking this balance and wanted to be concerned with a theologically-defined equinox, the builders would have marked the place on the horizon of the rising or setting sun on 25 March in the

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[3] Frank C. Senn, *Christian Liturgy : Catholic and Evangelical* (Minneapolis, MN 1997), p. 114.

[4] Stephen C. McCluskey, *Astronomies and Cultures in Early Medieval Europe* (Cambridge 1998), p. 27.

[5] Isidore of Seville, *Isidore of Seville's etymologies : the complete English translation of Isidori Hispalensis Episcopi Etymologiarum sive Originum Libri XX*, trans. Priscilla Throop (Charlotte, VT 2005), XV 4.7.

[6] William Durandus, c. 1230-1296, *The Symbolism of Churches and Church Ornaments: a translation of the first book of the Rationale Divinorum Officiorum*, with introductory essay, notes, illustrations by John M. Neale and Benjamin Webb (Leeds/London/Cambridge 1843), p. 21-22.

[7] Otto Georg von Simpson, *The Gothic Cathdral* (New York 1956), p. 51.

Julian calendar. Over the centuries, however, this date of 25 March would have drifted further away from the true, or astronomical, equinox when the sun is on the equator and rises due east, and the day and night are almost equal in length. The consequences of this drift between the Julian calendar's view of the equinox (25 March) and the true equinox (21 March Gregorian calendar) would have resulted in the orientation of the later churches or abbeys drifting north of due east. Contemporary researchers have questioned whether this orientation has been interpreted in churches as the solar position at the astronomical equinox or the Julian calendar date of the equinox.[8]

In English churches, this argument has been complicated by the observation of William Wordsworth who, in 1822, wrote that a church was aligned to the sunrise of the feast day of the saint to whom the church was dedicated:

> Our churches, invariably perhaps, stand east and west, but *why* is by few persons *exactly* known; nor, that the degree of deviation from *due* east often noticeable in the ancient ones was determined, in each particular case, by the point in the horizon, at which the sun rose upon the day of the Saint to whom the church was dedicated.[9]

In 1956, Hugh Benson took into consideration Wordsworth's claims when looking at the orientation of churches. While acknowledging the difficulties of establishing the founding patron saint, he discovered that only a minority of churches aligned with the patronal feast day sunrise but may, however, share its alignment with other nearby churches.[10] More recently, Peter Hoare and Caroline Sweet in 2000, and Jason Ali and Peter Cunich in 2001, investigated the orientation of churches and abbeys taking Wordsworth's assertion into account but also looking for other possible reasons for the alignments.[11] Hoare and Sweet measured 181 and Ali and Cunich measured 143 English churches and abbeys. Their research explored the church's or abbey's orientation to a symbolic sunrise, a sunrise on a flat terrain, and ignored the influence of landscape. This disregard for landscape – as will be discussed below – is important, for a mountain or even a small hill can alter the visual sunrise or sunset. Neither group of researchers could find any reason for the deviations around due east in the orientation of the churches and abbeys. In 2015, however, Hoare challenged their earlier assumptions and commented that it was possible that the altitude of the horizon to the east should be considered.[12]

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[8] Antonio Cesar Gonzalez-Garcia and Juan Antonio Belmonte, 'The Orientation of Pre-Romanesque Churches in the Iberian Peninsula', *Nexus Network Journal* 17 (2015), p. 353-377.

[9] William Wordsworth, *The Poetical Works of William Wordsworth* (London 1846). p. 400.

[10] Hugh Benson, 'Church orientations and patronal festivals', *The Antiquaries Journal* 36 (1956), p. 205-213.

[11] Peter G. Hoare and Caroline S. Sweet, 'The orientation of early medieval churches in England', *Journal of Historical Geography* 26 (2000), p. 162-173; Jason R. Ali and Peter Cunich, 'The Church East and West: Orienting the Queen Anne Churches, 1711-34', *Journal of the Society of Architectural Historians,* 64 (2005), p. 56-73.

[12] Peter G. Hoare, 'Orientation of English Medieval Parish Churches', in *The Handbook of Archaeoastronomy and Ethnoastronomy,* ed. by Clive L. N. Ruggles (New York 2015), p. 1711-1718, here p. 1715.

II. Methodological Considerations

The study of the orientation of buildings with respect to celestial objects is the purview of archaeoastronomy, which has recently been defined by Fabio Silva as 'the study of how people have understood, conceptualized and used the phenomena in the sky and what role the sky played in their cultures, by analysing their material remains.'[13] Traditionally, at least in Europe, its focus has been on the study of prehistoric and megalithic monuments, such as Newgrange in Ireland and Stonehenge in Britain, that contain alignments of architectural features such as passages, entrances, and central axes to celestial objects as they rise and set.[14] Archaeoastronomy is but one of the fields that comprise Cultural Astronomy, the study of the relationship between the sky and human societies, which also encompasses more traditional historical and anthropological methodologies. Art historians, such as Giuliano Romano and Hans Michael Thomas, and Manuela Incerti, amongst others, have used such interdisciplinary techniques to examine the role of sunlight in medieval Italian duomos, baptisteries, and private chapels in connection with the astronomical or liturgical calendar, and found that sunlight fell on relevant frescoes in connection with saints' feast days.[15]

To explore the connections between the positions of sunrise and sunset on any given day, and the orientations of an architectural feature, one needs to take two important elements into consideration.

1. The Position of the Sun

The sun does not rise or set in the same position every day; by observing the position of sunrise every day for a period of a year one would see that it changes like the swing of a pendulum (Fig. 1). There are two extreme positions, in the north-east and south-east octants, where the sun's pendular movement seems to come to a rest before changing direction, and a mid-point (in the east), which is crossed twice, where this movement is at its maximum speed. The same occurs for the position of sunset, but on the western horizon.

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[13] Fabio Silva, 'The Role and Importance of the Sky in Archaeology: An Introduction', in *Skyscapes: The Role and Importance of the Sky in Archaeology,* ed. Fabio Silva and Nicholas Campion (Oxford 2015), p. 1-7, here p. 2.

[14] Clive L. N. Ruggles, *Astronomy in Prehistoric Britain and Ireland* (New Haven, CT/London 1999); Fabio Silva and Nick Campion, *Skyscapes: The Role and Importance of the Sky in Archaeology* (Oxford 2015).

[15] Manuela Incerti, *Il Disegno della Luce Nell'architettura Cistercense: Allineamenti Astrologici nelle Abbazie di Chiaravalle Della Colomba, Fontevivo e San Martino De'bocci* (Florence 1999); Manuela Incerti, 'Solar Geometry in Italian Cistercian Architecture', *Archaeoastronomy, the Journal of Astronomy in Culture* 16 (2001); Romano Giuliano and Hans Michael Thomas, 'Sul Significato Di Alcuni Fenomeni Solari Che Si Manifestano Nella Cappella Di Giotto a Padova', *Ateneo Veneto* 178 (1991), p. 213-256; Hans Michael Thomas, 'Sonneneffekte in der Giotto-Kapelle in Padua', *Sterne und Weltraum* 34 (1995), p. 278-285.

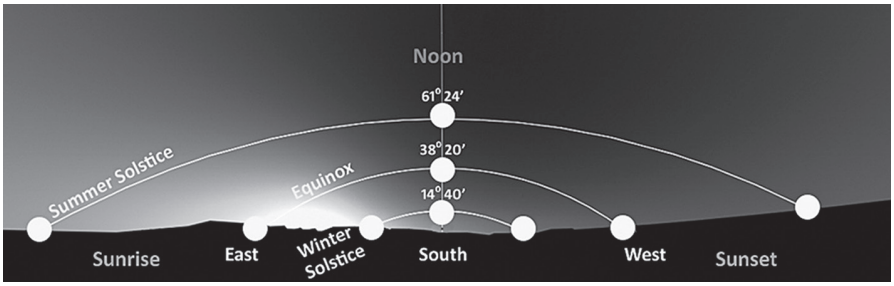

Fig. 1. The annual passage of the sun for latitude 52° north (mid Wales).

Additionally, the sun's highest altitude in the sky varies throughout the year. Figure 1 was calculated for the latitude of mid Wales, which is about 52° N and shows the annual passage of the sun against a generic horizon. At the summer solstice, the sun rises in the north-east, and culminates at noon as high in the sky as it can reach at an altitude of 61° 24' and then sets in the north-west. At the equinox, the sun rises due east, culminates at an altitude of 38° 20' and sets due west. At the winter solstice the sun rises in the south-east and only gains an altitude of 14° 40' before setting in the south-west.

These four horizon points mark the sun's moments in the year where the seasons start in the Gregorian calendar: the two solstices and two equinoxes. For a given orientation that falls between the solar extremes, an alignment with the sun will be observed four times in the year: twice for its rising (once in the spring/autumn and another in summer/winter), and twice for its setting.

2. The Landscape

The second important element is the landscape, in particular the horizon line. A raised horizon can change the position of sunrise and sunset significantly on any given day, and hence influences the dates when the rising or setting sun will shine its light down the length of the building. Figure 2 shows the impact of the landscape on the Cistercian abbey church at Valle Crucis (founded 1201), which has quite high hills immediately to the west of the main church door. If these hills are ignored, then the researcher would conclude that the church is aligned to sunset around the Julian dates of 2 April and 11 September (Fig. 2 left). This would, however, only be a symbolic sunset, as the actual experience of sunset – with the light of the western sun shining directly into the abbey church – would have occurred on the Julian dates of around 20 April and 10 August (Fig. 2 right). This combination of orientation and landscape is an individual relationship that each abbey church has to its surroundings, and to ignore this relationship is, we argue, an oversight that dismisses the role of sunlight in the narratives of these abbey churches.

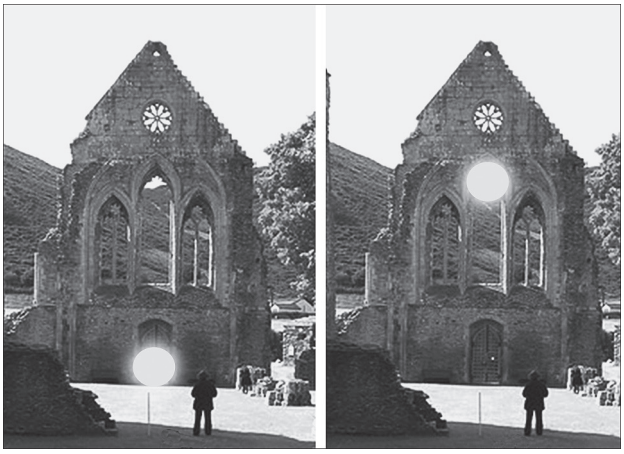

Fig. 2. Valle Crucis abbey church looking towards the west door, showing symbolic (left) versus actual (right) sunset. (Image: WMS team)

In 2015 Stephen McCluskey observed how, when analysing the orientation of churches, it was best to work with large samples that could be statistically tested.[16] This was in contrast with the work of Benson,[17] who approached the problem by embracing elements of a local or cultural nature that influenced the orientation of a community's church. With our starting premise being informed by Lane's view that story emerges from place, each monastery then needed to be examined as a unique case study. We therefore adopted Benson's approach, a case-study methodology, rather than McCluskey's methodology of statistics. We built our case studies by considering the measurements of the orientation for each church, which included elevations of the local east and west horizons, the founding history of the abbey, and the rhythm of the liturgical year. Additionally, we broadened our focus and took into consideration the placement of the western door and any *in situ* rose windows, both of which could contribute to the uniqueness of the church's orientation. In summary, we approached each church as if its orientation was a reflection of a complex mixture of the abbey's founding history, liturgical calendar, and timekeeping, blended with its unique landscape.

3. The Eleven Welsh Cistercian Abbeys in our Data Set

A final consideration was the question of what abbeys to include in our data set, as Basingwerk (c. 1150) and Neath Abbey (founded 1130) were established as a part of the Savigniac Order. This order was founded by Vitalis of Mortain (c.1060-1122),

[16] Stephen C. McCluskey, 'Orientation of Christian Churches', in *The Handbook of Archaeoastronomy and Ethnoastronomy,* ed. Clive L. N. Ruggles (New York 2015), p. 1703-1710, here p. 1709.
[17] See n. 10 above.

canon of the collegiate church of Saint-Evroult. In the years 1095-1096 Vitalis resigned his prebend for the solitude of the eremitic way of life of the Desert Fathers at a place named in a letter attached to his mortuary roll as *Domini Petra (Dompierre* 'Rock of the Lord') in the north-west of France.[18] A potent preacher calling people to conversion meant that he became surrounded by an ever-growing group of disciples. Recognising the need for the stability and religious discipline that a monastery could bring, by 1113 Vitalis had established the monastery at Savigny with the aid of donations, and the authorisation of King Henry I of England (1068-1135).[19] Within this structure, Vitalis drew up a modest rule based on the Rule of St Benedict and with the same theological intent as the Cistercians.[20] Neath in south Wales and Basingwerk in north Wales were two daughter-houses established and populated with monks from Savigny.[21] By the mid-twelfth century, Neath and Basingwerk suffered from the lack of central control from Savigny that was so essential to the success of the Cistercian network of abbeys, and both abbeys were in serious survival difficulties. Savigny, as Janet Burton has noted, was 'a monastic experiment which had failed.'[22] The inability of the then-head of Savigny, Abbot Serlo, to maintain his authority over the Savigniac congregation, coupled with the close theological intent with the Cistercian worldview, saw him take the unprecedented action of petitioning for his entire congregation to become part of the Cistercian Order. The petition was accepted in a privilege given from Pope Eugene to Serlo on 19 September, 1147, and all Savigniac houses were reformed according to Cistercian principles.[23] Based on this theological closeness of the Savigniac Order to that of the Cistercians, we have included Basingwerk and Neath in this study.

By the thirteenth century there were sixty monastic sites in Wales, sixteen of which were Cistercian or Savigniac. Of these sixty sites, thirty-four still have churches or other buildings visible in the landscape, either as ruins, in varying states from lines of foundation stones to full archways, or preserved as parish churches. Of the original sixteen Cistercian or Savigniac monastic sites, eleven churches retain visible traces which enable their orientations to be measured, and are the focus of our research.[24]

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[18] Jaap Van Moolenbroek, *Vital L'ermite, prédicateur itinérant, fondateur de l'abbaye normande de Savigny*. trans. Anne-Marie Nambot (Assen/Maastricht 1990), p. 148-211.

[19] Ibid., p. 257-263.

[20] Ibid., p. 267.

[21] David M. Robinson, *The Cistercians in Wales : architecture and archaeology 1130-1540* (London 2006), p. 27.

[22] Janet E. Burton, *The monastic and religious orders in Britain, 1000-1300* (Cambridge 1994), p. 69.

[23] Terrence M. Deneen and Francis Swietek, 'The Date of the Merger of Savigny and Cîteaux Reconsidered', *Revue d'histoire ecclésiastique* 101 (2006), p. 547-574, here p. 558-560.

[24] Of the original sixteen abbeys, those with no visible remains are Strata Marcella (Powys, f. 1170); Llantarnam (Torfaen, f. 1179); Llanllŷr (Ceredigion, f. pre-1197); Grace Dieu (Monmouthshire, f. 1226); Maenan (Conwy, also known as Aberconwy 2, f. 1283/4).

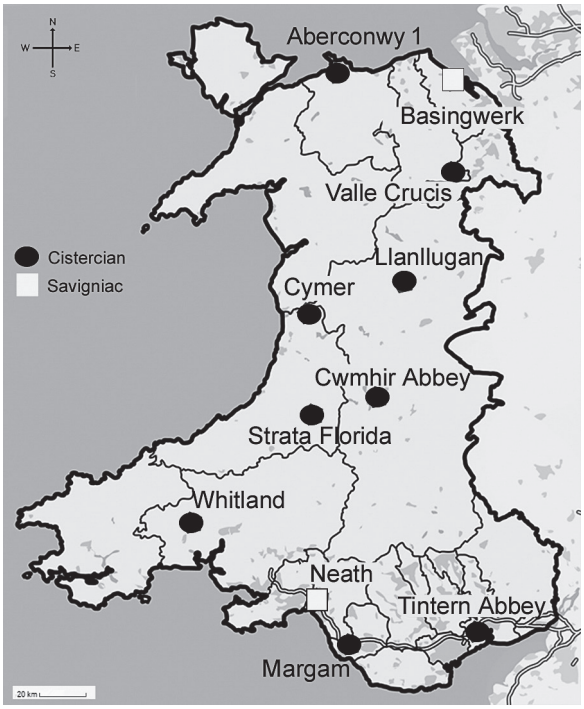

Fig. 3. The location of the eleven Cistercian and Savigniac churches in this study, chosen because of visible architectural remains.

4. Surveying Methodology

The two key elements surveyed were the orientation of the church and the influence of the landscape in which the monastery was located. The two measurements that encapsulate this information are the azimuth and the horizon altitude.[25] The azimuth is an angular distance between True North and the orientation of interest, measured on the horizontal plane. It is measured in degrees, with 0°, 90°, 180° and 270° corresponding respectively to north, east, south and west. Horizon altitude, on the other hand, is measured on the vertical plane, and is the angular distance between the horizon line and the horizontal plane. It is also expressed in degrees, but here 0° means that the horizon lies at the same elevation above sea level as the observer's location. Positive values indicate a higher horizon. These two values can be measured directly *in situ* using a compass and clinometer respectively.

Azimuth measurements were taken using Suunto KB-14 compasses (with an advertised precision of 0.33°). The altitude measurements were taken using Suunto

[25] RUGGLES, *Astronomy in prehistoric Britain and Ireland*, p. 164-171.

PM-5 clinometers (precision of 0.25°). Previous scholars have measured the orientation of early medieval Anglo-Saxon churches by holding a magnetic compass against the side of the church's wall and averaging out the different measurements caused by variations to the surfaces of the stones.[26] We have found this method to be inaccurate, however, with a variation of up to 5° due to the roughness of the stones in our sites. Instead, a different approach was employed by sighting 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 there was an obstruction such as a corner, a ranging pole was used to increase contrast and allow a more accurate compass reading. If the walls were in such ruins that only foundations were available, ranging poles were used to raise the foundations to eye level. If none of the above were possible, the nave's axis of symmetry was identified with a surveyor's tape and the axis marked with ranging poles to allow measurements to be taken.

As a way of minimising both user and instrument error, three different sets of instruments were employed with three different users. Measurements were only recorded when agreement to within half a degree was reached among all three users. Magnetic anomalies were checked, as recommend by Clive Ruggles, by measuring orientations with the compass in both directions.[27] In the presence of anomalies – which were common in structures either still being used, or those containing iron or other magnetic materials – we searched for alternative viewing positions. All compass measurements were corrected for True North using the International Geomagnetic Reference Field model for magnetic declination,[28] which was calculated for the structure's location and day of measurement using the online tool provided by the National Geophysical Data Center.[29]

With regard to horizon altitudes, in a few cases modern buildings or tree canopies covered the view so that we could not accurately measure the horizon altitudes. Virtual horizon panoramas that use digital elevation models to reconstruct horizon altitudes are, however, available.[30] For the cases where we did have field measurements, a direct comparison of such virtual measurements with clinometer readings showed virtual measurements to be accurate to within half a degree, falling in line with other studies that show this approach to be sufficient for the present purposes.[31] Given all of the above, our measurement uncertainty has been estimated to be equal to or less than 0.5°.

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[26] For example, Hoare and Sweet, 'The orientation of early medieval churches in England', p. 164.

[27] Ruggles, *Astronomy in prehistoric Britain and Ireland*, p. 165.

[28] Magnetic declination is the difference between True North and Magnetic North.

[29] National Geophysical Data Center (2015) Magnetic Field Calculators [online], accessed August 2014, http://www.ngdc.noaa.gov/geomag-web/#declination.

[30] Michael Kosowsky, 'HeyWhatsThat' [online], accessed August 2014, http://www.heywhatsthat.com, (2013).

[31] Victor Reijs, 'Comparing programs that calculate the skyline profile [online]', *http://www.archaeocosmology.org/eng/skylineprofilescomparing.htm,* (2015), accessed November 2015.

III. Results and Discussion

Azimuths and altitudes were converted to declination using the formula for conversion of horizontal to equatorial coordinate.[32] This conversion takes into account latitude (geographical location), true azimuth (orientation) and altitude of the horizon (local landscape). The resulting values were compared to a table of daily declinations for the sun to determine when the sun rises or sets in alignment with the structure.[33] The calendar dates provided by these tables, which are calculated for the Gregorian calendar, were converted to the Julian calendar using the conversion factor appropriate to the century in which the monasteries were built. For the monasteries in question this was an adjustment of six days.

It is important at this stage to ensure that measurement uncertainty is taken into account. Using the declination conversion equation, an uncertainty of 0.5° in the horizontal measurements converts to an uncertainty of about 1° in declination. To this uncertainty one must add two other components: uncertainty due to the size of the solar disc, and uncertainty due to atmospheric refraction near the horizon. As we have no way of knowing what limb of the sun's disc, the right or left side of the sun, the builders may have used, and given that this disc has a diameter of about 0.5°, we allowed for a further uncertainty of 0.25° to either side. Furthermore, because the sun's light is heavily refracted near the horizon, causing its colour to change to orange/red and its visual position to shift slightly, we further increased the uncertainty for horizon events by 0.5° as suggested by Bradley Schaefer.[34]

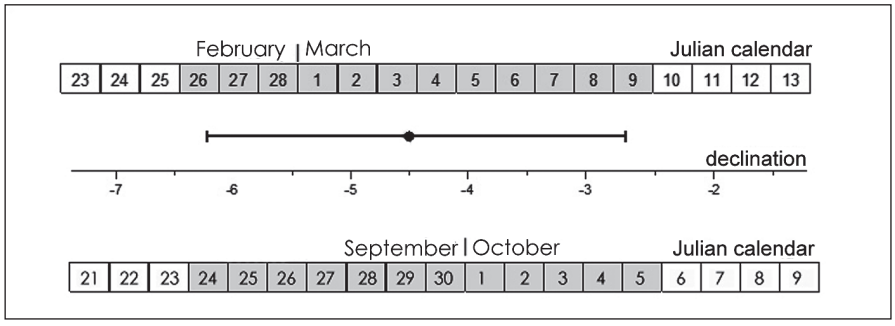

Fig. 4. Strata Florida's western axis. The black dot represents the calculated western declination; the length of the line on which it sits is the margin of uncertainty of ±1.75°. The line directly beneath it is the declination scale. The grey shaded boxes above and below are the corresponding dates in the Julian calendar when the sun sets in alignment with the west door of abbey church (grey shaded boxes). The top set of dates indicate sunset in the earlier part of the year (February-March); the lower set is for the return of the sun when it is setting to the same position at the later part of the year (September-October).

[32] Ruggles, *Astronomy in prehistoric Britain and Ireland*, p. 22.

[33] Such as the one available at: www.wsanford.com/~wsanford/exo/sundials/DEC_Sun.html

[34] Bradley Schaefer, 'Refraction near the horizon', *Astronomical Society of the Pacific,* 102 (1990), p. 796-805.

In sum, our estimates of uncertainty for comparing our measurements to solar dates are 1.75° for horizon events (sun rise or set) and 1.25° for non-horizon alignments (since refraction does not occur when the sun is rising or setting behind a hill). As an example, Figure 4 shows Strata Florida's western axis for the time of year when the sun sets, on a distance horizon, through the western door, using the Julian calendar. The span of grey shaded dates is the reflection of the uncertainty in declination.

We initially undertook a statistical analysis of the data as advocated by McCluskey,[35] but found no significant patterns in orientation; this was to be expected due to the limited number of samples. Since we have surveyed every available Cistercian or Savigniac church in Wales this should be understood as a limitation of statistical methodologies to deal with archaeologically-realistic (i.e. small) sample sizes.[36] Because of this circumstance, as mentioned earlier, we have opted for a case-study approach, looking at each structure as an individual entity and drawing comparisons only when there are common liturgical dates.

With this approach in mind, Figure 5 represents the data for all the abbey churches where their east and west declinations have been translated into Julian calendar dates. These dates represent the days when the churches would receive the light of the rising or setting sun directly through the eastern windows or western doors, the actual sunrise or sunset, rather than the symbolic sun as used by previous researchers working with English churches and abbeys. In considering Tintern Abbey church, for example, Figure 5 visually displays how the abbey church would

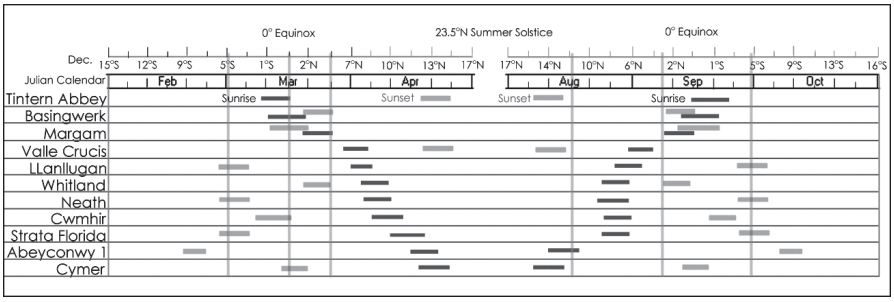

Fig. 5. Sunrises (short horizontal black lines) and sunsets (grey lines) for each of the abbey churches. The length of these lines reflects the range of days on which the eastern or western orientation of the abbey church would receive the direct light of the sunrise or sunset. The vertical lines, from left to right, using the Julian calendar, are for Saint David's Day (1 March), the astronomical equinox (15 March), the Annunciation or the theological equinox (25 March), the Assumption (15 August), the Nativity of the Virgin (8 September) and Michaelmas (29 September). The churches are arranged from the earliest sunrise at Tintern Abbey in mid-March to the latest at Cymer Abbey in mid-to-late April.

[35] See note 16 above.

[36] See Fabio Silva, 'A Tomb with a View, New Methods for Bridging the Gap between Land and Sky in Megalithic Archaeology', *Advances in Archaeological Practice: A Journal of the Society for American Archaeology* 1 (2014), p. 24-37.

receive the light of the sunrise through its eastern windows between 9-16 March as well as from 16-24 September, while through its western door the sun would set between 18-25 April and 6-14 August (all dates Julian calendar).

1. The Divinity of the Astronomical Equinox Sun[37]

It was evident in our results that the sentiment expressed by Isidore of Seville of an equal division of the sky, combined with Durandus' comment of 'moderation, both in prosperity and adversity', held significance for the Welsh Cistercians independent of their geographical location in Wales and their own unique founding histories.

Tintern Abbey – the first Cistercian house in Wales and only the second in Britain – was established in 1131 in the south-east of the country. Its founder was Anglo-Norman magnate, Walter Fitz Richard de Clare, Lord of Chepstow (died 1137 or 1138). It is evident in the foundations that the builders sought the grace of the astronomical equinox sun for their new church which was located in difficult terrain. Figure 6 is part of the horizon profile of Tintern Abbey where it can be seen that if the builders aligned the axis of the church to a symbolic sunrise at due east, the rising sun would have been invisible. Instead they took the landscape into account, and shifted the axis of the abbey to enable the east window to receive the light of the rising sun on the morning of the astronomical equinox sun.

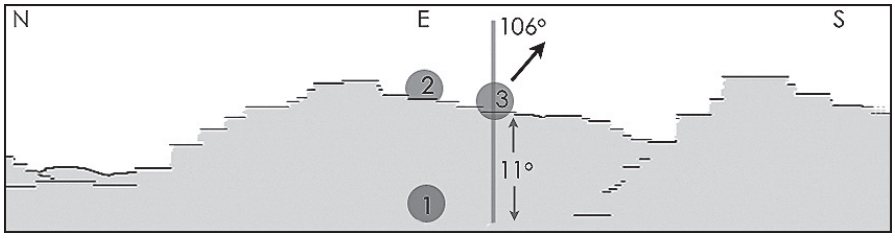

Fig. 6. The easterly horizon profile of Tintern Abbey (generated by HeyWhatsThat horizon profile copyright © 2013 Michael Kosowsky and used with permission). The grey vertical line marks the orientation of the church to the true azimuth of 106°. To the east the church looks at a slope with an elevation of 11°. If the church pointed true east it would not see the sunrise at the astronomical equinox, for that was blocked by the hill (position 1). Instead the abbey church would experience the sunrise at position 2, between 3-9 April (Julian calendar). Only by shifting the orientation to 106° does the abbey church get the light of the rising astronomical equinox sun (position 3) shining directly through its east window.

[37] Figures 7 – 17 provide the plan and context for the abbey churches, each shown in its landscape represented by a contour map. Below that is a 360° image of the horizon when viewed from the church, with its eastern and western azimuth orientation marked on the line of its local horizon. Plans are reproduced with permission from David M. Robinson, *The Cistercians in Wales: Architecture and Archaeology 1130-1540* (London 2006). The contour map and horizon elevation images were generated by HeyWhatsThat horizon profile and used with permission, © 2013 Michael Kosowsky.

A century after the completion of the first church at Tintern, construction of a much larger church was undertaken. A common practice in this situation was for builders to incorporate one of the walls and foundations of the older structure into the new one. At Tintern, however, this potentially labour-saving step was ignored in favour of shifting the entire orientation of the new church about 0.9° to the north, thus moving the axis from a bearing of 105.3° to the current orientation of 106.2°.[38] One can only wonder if this was an attempt to gain a sharper alignment to the disk of the rising astronomical equinox sun over the ridge east of the abbey church.

This theme of the astronomical equinox continues with Basingwerk Abbey (Fig. 7). Although originally located in Flint at Hen Blâs at Colehill, it was finally located c. 1131 overlooking the Dee estuary.[39] It was founded by Ranulf 'de Gernon', Earl of Chester (1129-1153), and was planned as a settlement of monks from Savigny in the disputed borderland in the northeast of Wales.[40] This abbey's easterly vista looks out over a flat horizon and with its true azimuth of 90.6° it looks to the rising sun at the time of the equinox. Basingwerk Abbey church conforms perfectly to Isidore of Seville's and Durandus' thinking about the role of the equinox and balance. In contrast to this is Margam Abbey (Fig. 8) founded 1147, located in South Wales on the opposite coast to Basingwerk, and which recruited its monks largely from the Anglo-Norman areas of the Marches or from the border English shires.[41] It, too, has a coastal vista, but this time the sea sits to the west of the abbey. In this instance the Cistercian builders orientated their abbey church so that the light of the setting sun shone through the west door on the day of the astronomical equinox, Julian calendar date 14 March. The eastern end of the abbey church points to some low hills which shifts the actual sunrise that shone into the eastern window to a date later in March. This later date, Julian calendar 19-25 March, could be the intentional alignment to theological equinox or the feast of the Annunciation. The western orientation of other abbey churches, however, suggests that this tight western alignment of Margam to the astronomical equinox should not be ignored.

This apparent willingness to swap east for west, sunrise for sunset, is also evident in the orientation of Cwmhir Abbey church (Fig. 9). Founded in the year 1176, and colonised by monks from Whitland Abbey, the abbey was located in a valley with high ridges to the immediate north and south. In this landscape the abbey church was orientated nearly 12° away from true east at an azimuth of 78.7° which enabled the builders to find an east/west line towards the lower hills in the west in such a way that the abbey church's western door pointed to the place on the horizon of

[38] The calculations of the orientation of the earlier abbey at Tintern are based on the plans held by the National Monuments Record of Wales (NMRW), CGM20.086.

[39] Janet Burton and Karen Stöber, *Abbeys and Priories of Medieval Wales : Abbeys and Priories of Medieval Wales* (Cardiff 2015), p. 46.

[40] Robinson, *The Cistercians in Wales*, p. 27.

[41] Ibid., p. 31.

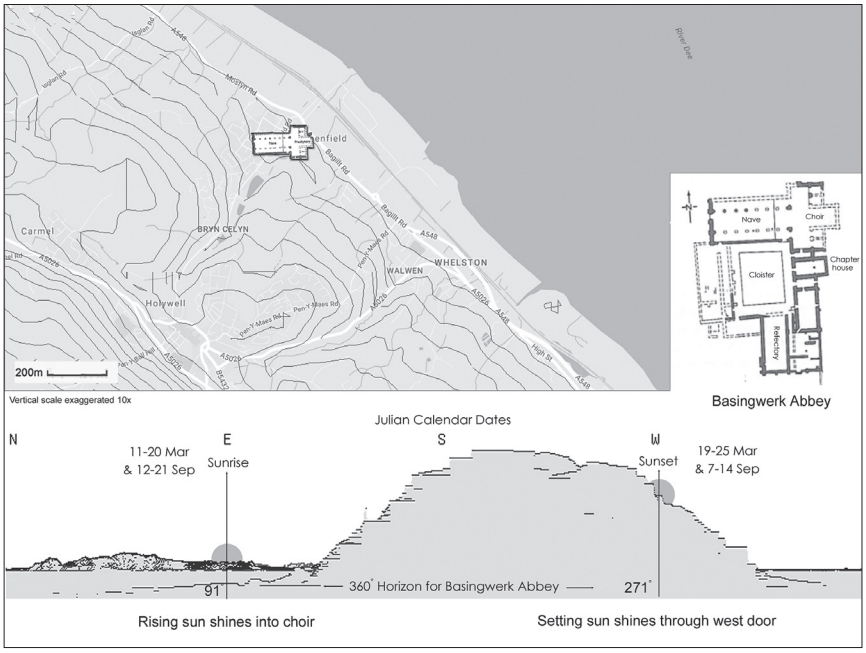

Fig. 7. Basingwerk Abbey.

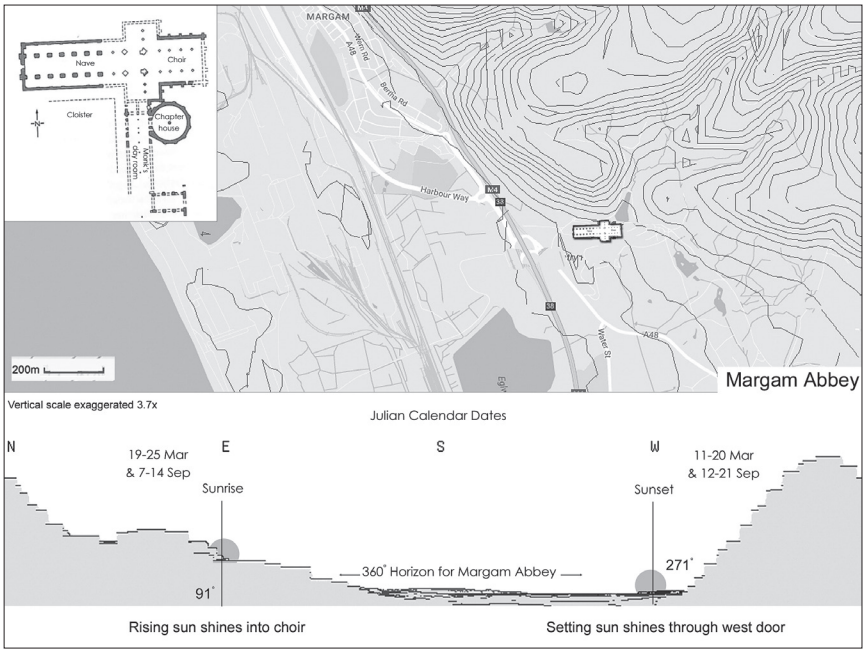

Fig. 8. Margam Abbey.

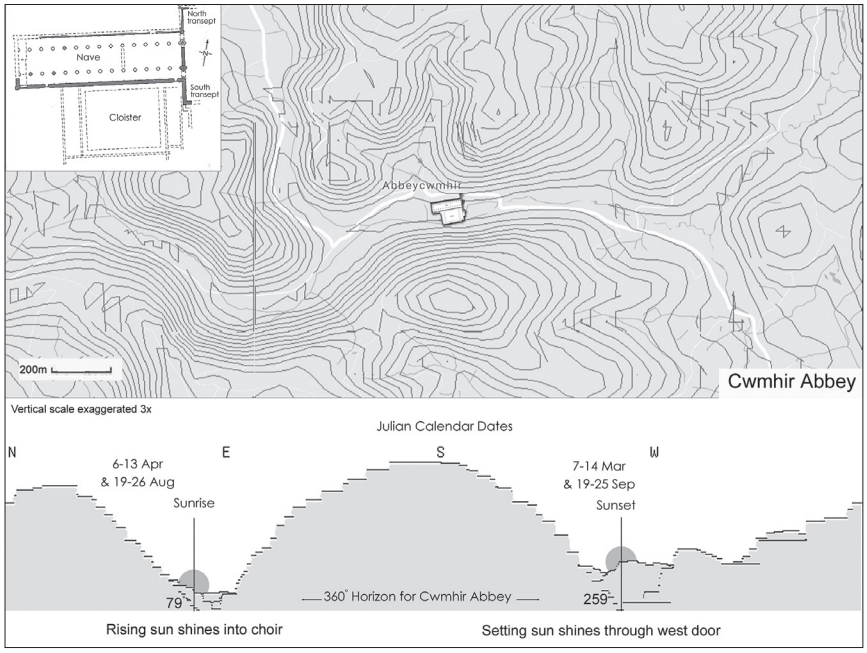

Fig. 9. Cwmhir Abbey.

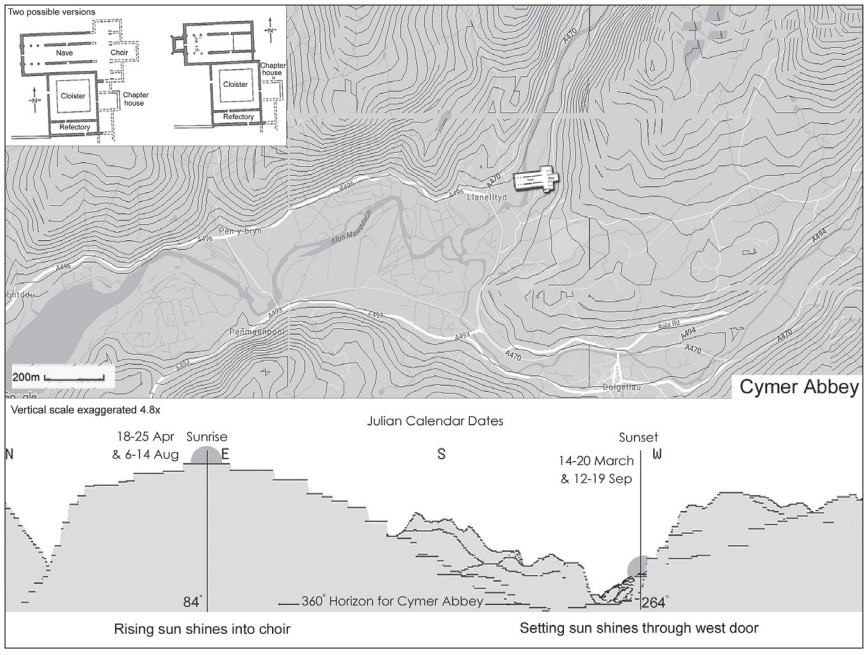

Fig. 10. Cymer Abbey.

the setting astronomical equinox sun. What is curious with Cwmhir is that the builders may have actually had a preference for the western setting sun, as it would have been just as possible to arrange the eastern end of the abbey to face the rising astronomical equinox sun. They had a choice and it appears they favoured the west.

Another abbey set in a mountainous landscape is Cymer Abbey (Fig. 10), a daughter abbey of Cwmhir and founded 1198/99. For the builders of this abbey, true east looked directly into a hill with an elevation of 12°-13° and true west towards lower hills with an elevation of 5°. Thus, to capture the light of the astronomical equinox sun, the builders adjusted the axis of the abbey church to the north of east to an azimuth of 84.5°. This did not allow it to capture the rising sun in the east but it did take advantage of the mouth of the valley to the west of the abbey church where a break in the hills provided a far lower terrain visually. With this axis, the abbey church was able to be orientated so that it captured the astronomical equinox setting sun through its western door.

2. The Stars and the Horizon

At this juncture it is useful to pause and consider how the Cistercian builders might have looked at a mountainous terrain in Wales and known the places on the horizon where the sun would rise or set for the key times of the year. One could observe the sun on the horizon over a few years, but as has been noted by many scholars, the observation of the exact position of the disk of the equinox sun on a real horizon can be quite difficult to determine.[42] A far easier, more reliable and quicker method is to watch the movement of the stars.

In fact, there is evidence which supports the use of star watching to aid the rigors of timekeeping in a medieval Christian monastery. In the sixth century, Gregory of Tours (c. 538-c. 594) in his *De cursu stellarum* stated that the sky needed to be watched for the rising or setting of stars to have knowledge of the length of time between a set of prayers and sunrise.[43] This link to the heavens was also discussed by Rachel Poole in her consideration of the personal notebook of an eleventh-century French Benedictine monk. This small scrap of scribbled notes reminded the owner which stars would rise over different parts of the monastery's roofs, arches, or windows at the key times required to wake the other monks for prayer. The timing of this nightly alarm system was considered vital for what might be termed the theological health of the monastery, as there was a proscribed number of prayers that needed to be timed and be completed by sunrise.[44]

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[42] Clive L. N. Ruggles, 'Whose equinox?', *Journal for the History of Astronomy – Archaeoastronomy supplement* 28 (1997), p. S45-S50.

[43] Gregory of Tours, *De cursu stellarum sive de cursibus ecclesiasticis*. ed. F.G.H.C. Hasse (Wrocław 1853).

[44] Rachael Poole, 'A monastic star time table of the eleventh century', *The Journal of Theological Studies* 16 (1915), p. 98-104, here p. 102.

Apart from timekeeping, however, the night stars can also act as markers on the horizon of key solar events. If one knows the line of stars which mark due east when they rise or set on the horizon, then this is the line of stars that mark the equator. Thus the place where this line of stars touches the horizon will be the location of the rising or setting sun for the equinox sun. For example, at the time of the building of the Cistercian abbeys in Wales, this star line could have been visually drawn through the constellations starting from just above the belt of Orion, through the mouth of Cetus the Whale, along the line of the western fish of Pisces, through the body of Aquila the Eagle, through the left hand of Ophiuchus, through the left wing of Virgo, under the head of the Hydra, and back to the belt of Orion. Finding any section of this line of stars in a night sky allowed the builders to project the line down to either the western or eastern horizon. These points so identified on the ridges and hill-tops would be the places where the astronomical equinox sun would be seen to rise or set.[45] This is the method suggested by these abbey church alignments, as they were focused on the actual astronomical event of the equinox, as expressed in their landscape, rather than the theological equinox as discussed earlier.

3. Michaelmas and St David's Day

Two abbeys, Neath and Strata Florida, favour another pattern. They sit in similar landscapes and have similar orientations. Neath (Fig. 11) in South Wales, was, like Basingwerk, originally a Savigniac house, founded directly from Savigny around 1130. It sits in rolling hills that dip away in the south-west to an elevation of around 2°. This is similar to the landscape of Strata Florida (Fig. 12), a daughter house of Whitland Abbey, founded some years later in 1164, and located in the Cambrian Mountains of mid-Wales. It also faces hills to the east and has a wide vista to the west with distant hills at an elevation of 2°. Both these abbey churches could, with little effort, have aligned their western doors to the theological or astronomical equinox setting sun. The builders, however, shifted the axis of the abbeys over 10° north of this point to allow their western doors to align to two possible sunsets, that of Michaelmas on 29 September and Saint David's Day on 1 March. These churches were not alone in this orientation. Later when Llanllugan Abbey (Fig. 13), a Cistercian women's monastery, was founded c. 1200 in mid-Wales, the nuns adopted a parish church for their abbey church.[46] By chance or by design, this parish church also held in its footprint the same alignment to Saint David's Day or Michaelmas, achieved by the arrangement of the church within a bowl of low hills.

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[45] For a more detailed discussion on star-lines see Bernadette Brady, 'Star-Paths, stones and horizon astronomy', in *SEAC 2011 Stars and Stones: Voyages in Archaeoastronomy and Cultural Astronomy,* ed. Fernando Pimenta, *et al*. (Oxford 2015), p. 58-63.

[46] Tim McCormick, *The cathedrals, abbeys & priories of Wales* (Little Logaston 2010). p. 172.

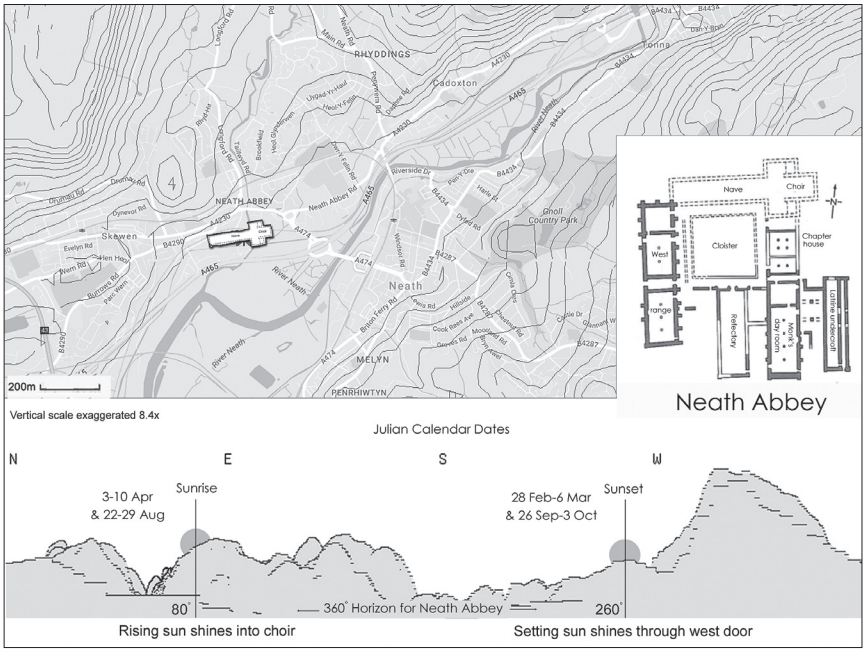

Fig. 11. Neath Abbey.

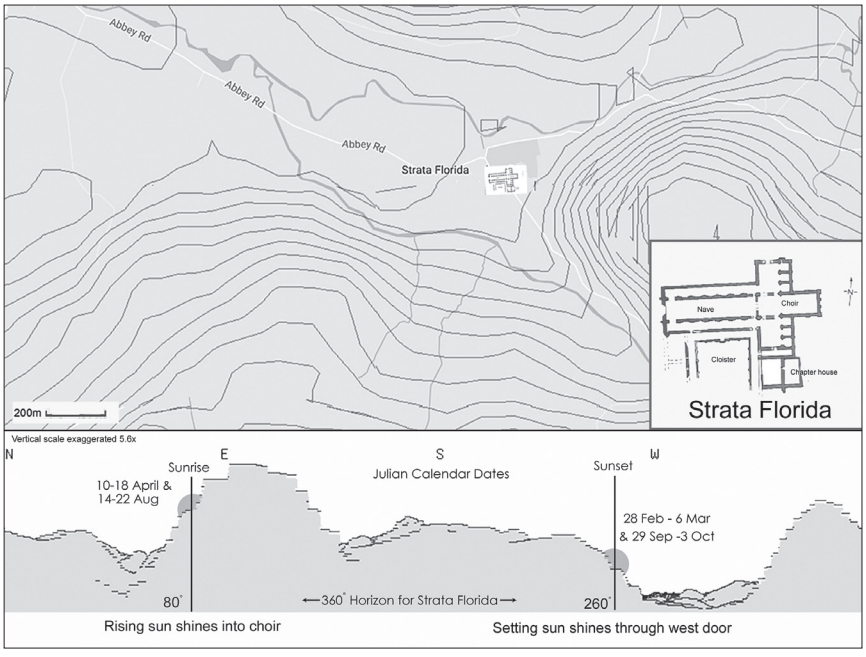

Fig. 12. Strata Florida Abbey.

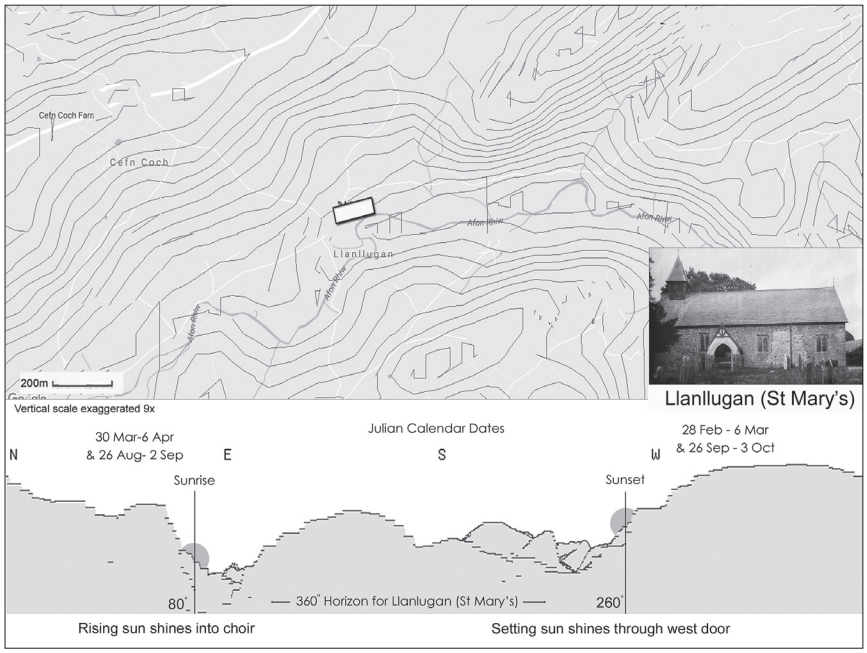

Fig. 13. Llanllugan Abbey.

Saint David or Dewi Sant (c. 462/512-c. 589/601) is the patron saint of Wales. He was the son of Sant, king of Ceredigion, and he lived in the Age of Saints, the time after 500 CE, which saw the emergence of a regionalised form of Christianity and Church.[47] David was one of three principal saints of southwest Wales (the other two being Teilo and Padarn) and allegedly the only Welsh saint to have been canonised around 1120 by Pope Calixtus II (1118-1124). J. W. James has argued that David escaped the rigors of what was believed to be necessary for a medieval man to be sainted due to his recognition in the calendars and martyrologies of England, Ireland and Scotland, along with his *vitae*.[48] Indeed J. Wyn Evans has maintained that no evidence for such canonisation has yet been identified.[49] What has been evidenced by William of Malmesbury (1080-1143) was Pope Calixtus II equating two journeys to St David's in south Wales as the equivalent of one to

[47] RHYGYVARCH, 'Vita Sancti David per Ricemarchum/Rhygyvarch's Life of Saint David', ed. Arthur W. WADE-EVANS, (Stow-on-the-Wold 1914), p. 29, 73.

[48] J. W. JAMES, *Rhigyfarch's Life of St. David. The Basic Mid Twelfth-Century Latin Text*, with intro., trans., critical apparatus by J. W. JAMES (Cardiff 1967), p. vii.

[49] J. Wyn EVANS, 'St David and St Davids', *Celtic Hagiography and Saints' Cults,* ed. Jane CARTWRIGHT (Cardiff 2003), p. 10-25, here p. 17.

Rome for English pilgrims, thus elevating St David's as a major pilgrimage destination in rank comparable to Jerusalem and Santiago de Compostela.[50]

David's identification with Britain was emphasised in the tenth century vaticinatory poem *Armes Prydein* (the Prophecy of Britain) from the *Book of Taliesin*.[51] The poet incited the Welsh, together with their 'prophesied allies from Ireland, Scotland, Cornwall and Brittany along with their Scandinavians of Dublin, to rise against the English and drive them from the land'.[52] David was identified as an active saviour and a leader of warriors, defender of the land and a bringer of peace. In legend, even the land endorsed David's divine nature and entitlements as chief saint of the island when the ground beneath him was said to have risen up as he preached so that those at a distance could hear him speak.[53] The struggle for an independent Welsh Church fighting for dominance against Canterbury created the politically correct atmosphere for the emergence of Rhygyvarch's *Life of St David* (c. 1090). Bernard, the first Norman bishop of St David's (1115-1148), used this *vita* in his effort to strengthen the significance of his see and establish David as patron saint of Wales. Two other *vitae* followed: Geoffrey of Monmouth's (1110-1155) *Historia Regum Britanniae* (c. 1136), and *Life of St David* written by Gerald of Wales (c. 1146-c. 1223) at the end of the twelfth century. Although for most of the medieval period the northern kingdom of Gwynedd dominated the land, by the late eleventh/early twelfth centuries David was celebrated as the patron saint of Wales, protector and hope of the nation, perhaps intensified by the fact that, as Elissa R. Henken pointed out, major conflicts on both religious and secular grounds between St David's and the Anglo-Normans took place in the south.[54] There are more than fifty Welsh parish churches dedicated to St David and more than thirty wells, but as Graham Jones has noted, these dedications only occur south of the line from Aberystwyth to Oswestry and are generally located in the diocese of St David in the south-west of Wales.[55] This St David's Day orientation, however, also aligns to sunset on Michaelmas.

The cult of Saint Michael the Archangel also grew in importance in Wales in the tenth and eleventh centuries, and he was seen as second in popularity only to the Virgin Mary.[56] This popularity is reflected in the frequent naming of Welsh churches as Llanfihangel (St Michael's church).[57] Michael is mentioned in the Book of Daniel (10:13, 10:21, and 12:1) as an intercessor, guardian and protector

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[50] William of Malmesbury, 'Gesta Regum Anglorum/The History of the English Kings', ed. R. A. B. Mynors, Rodney M. Thomson, and Michael Winterbottom (Oxford 1998), p. 778-781.

[51] Elissa R. Henken, 'Welsh Hagiography and the Nationalist Impulse', *Celtic Hagiography and Saints' Cults,* ed. Jane Cartwright (Cardiff 2003), p. 26-44, here p. 33.

[52] Ibid., p. 33.

[53] Rhygyvarch, 'Vita Sancti David per Ricemarchum/Rhygyvarch's Life of Saint David', p. 65.

[54] Henken, 'Welsh Hagiography and the Nationalist Impulse', p. 37.

[55] Graham Jones, *Saints in the Landscape* (Stroud 2007), p. 36, 161.

[56] Owen Chadwick, 'The Evidence of Dedications in the Early History of the Welsh Church', *Studies in Early British History,* ed. H. Munro Chadwick (Cambridge 1959), p. 177.

[57] Emrys G. Bowen, *The settlements of the Celtic saints in Wales* (Cardiff 1954), p. 2.

of Israel, 'great prince who standeth for the children of thy people', in Jude (9) struggling with the devil over the body of Moses, and in the Book of Revelation (12:7-9) leading God's armies and battling and slaying the dragon, a common representation in medieval art. He was also frequently portrayed as the psychostasis, the one who weighed souls. Although this iconographic motif has no scriptural source, Richard Freeman Johnson argued that Michael's contention for the body of Moses 'sanctioned the belief that Michael could defend men at the moment of death from the attack of the devil'.[58] In Assumption texts, such as Gregory of Tours *Libri miraculorum I*, *De gloria beatorum martyrum* 4, Michael was the one who was given charge of the Virgin Mary's soul as she crossed into heaven.[59] His feast day of 29 September marked the beginning of autumn, the entry into the dark part of the year, and for medieval communities the end of the financial year.[60] Saint Michael always maintained his pre-eminent position as a cosmological agent, an angel of transitions who governed fire as well as healing water. He stood between the two worlds, heights and depths, entrances and exits, guarding and guiding the departing souls of the dead to the comfort of salvation. According to Jones, his popularity in Wales was concentrated in a wide arc across the country, only becoming scarce in the southern area of Glamorgan under direct Norman control.[61]

The abbeys of Neath, Strata Florida, and Llanllugan have different founding histories but their churches are all aligned to this important sunset. The question that these orientations raise is whether the monks and nuns were emphasising the Welsh national saint David, or the healing and protective energy of Saint Michael. Alternatively, they may have been aware of the solar syncretism of the two dates. Effectively these abbey churches receive the light of the setting sun down the length of their nave on both days. Preliminary research into English Cistercian abbey churches also shows the same strong emphasis on this axis, suggesting that, rather than favouring the Welsh saint of Saint David, the emphasis is on the more universal Saint Michael. The possibility of whether this could be a Cistercian footprint is one we will explore in future research.

The penultimate Welsh Cistercian abbey to be built was that of Valle Crucis (Fig. 14).[62] Valle Crucis was a daughter-house of Strata Marcella (not included in this study as it has no above ground remains), itself a daughter house of Whitland Abbey. Valle Crucis was founded in 1201 in a steep valley in North Wales with high hills to the north-east and the south-west. In this mountainous landscape the

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[58] Richard F. Johnson, *Saint Michael the Archangel in Medieval English Legend* (Woodbridge 2005), p. 87.

[59] *PL* 71, 708, cited in Luigi Gambero, *Mary and the Fathers of the Church : the Blessed Virgin Mary in Patristic Thought* (San Francisco 1999), p. 353.

[60] Richard H. Britnell, 'Minor Landlords in England and Medieval Agrarian Capitalism', *Past & Present* 89 (1980), p. 3-22, here p. 4, n. 6.

[61] Jones, *Saints in the Landscape*, p. 14, 68-70.

[62] See note 24. Grace-Dieu had a later foundation but its precise location is unknown.

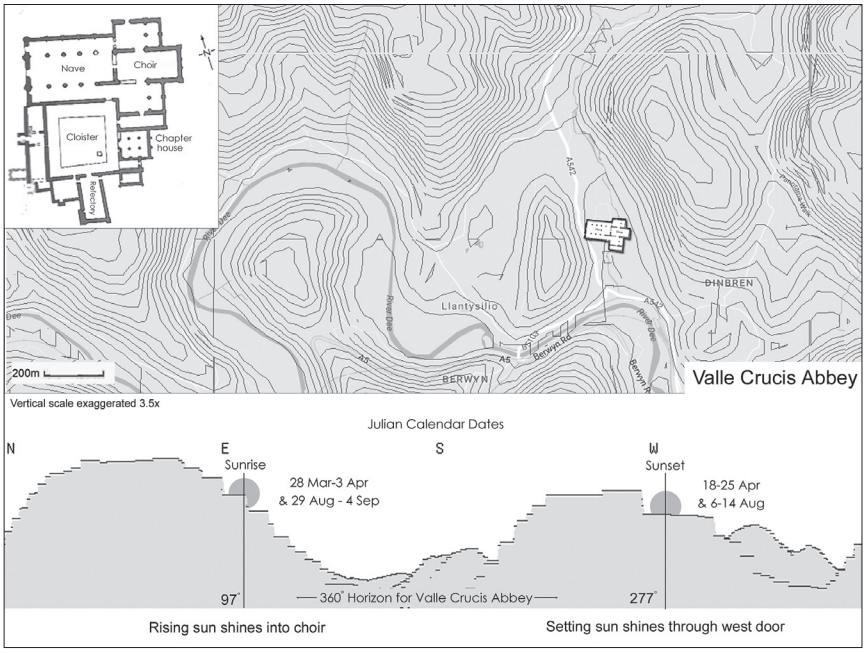

Fig. 14. Valle Crucis Abbey.

church was orientated at a true azimuth of 97.1°, and no real clue is revealed for this orientation until one considers the rose window, which is still *in situ* (Fig. 2).

The Cistercian architectural vocabulary is distinctive for its sparseness. From 1150, however, the rose window was rapidly incorporated by the Cistercians in Britain and they became the first order to adopt it outside France. Indeed the classic Cistercian configuration of placing the rose above lancet windows with their Trinitarian symbolism, Maximilian Sternberg noted as the 'defining traits of the order's architecture' and architectural indications of the Cistercian inclusion of sunlight into their theology.[63] The orientation of the church at Valle Crucis in this steep valley is such that the rose window in the western end of the abbey church is filled with the orb of the sun in the late afternoon of 15 August (The Assumption, Julian calendar). This phenomenon only occurred on the Virgin Mary's important feast day of the Assumption around the local time of 18:00, the beginning of Vespers.[64] This phenomenon is dependent on the exact combination of the orientation of the abbey church, the height of the rose window and the length of

[63] Maximilian STERNBERG, *Cistercian architecture and medieval society* (Leiden/Boston 2013), p. 67.

[64] BURTON, *The monastic and religious orders in Britain, 1000-1300*, p. 161.

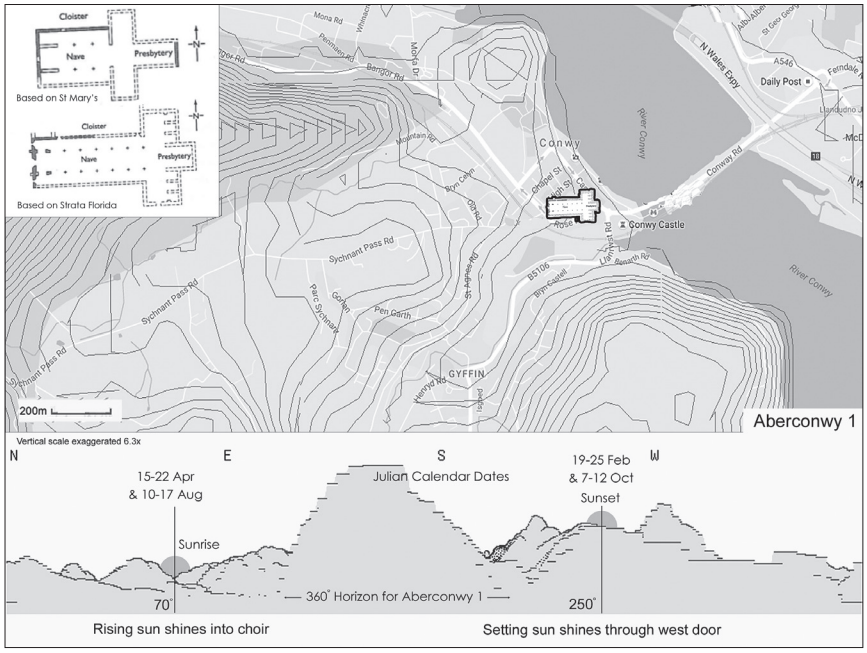

Fig. 15. Aberconwy 1 Abbey.

the abbey church to the high altar. This focus on the Assumption is also evident in Aberconwy 1 (Fig. 15), founded in 1186 by monks from Strata Florida and first located at Rhedynog Felen, then moved to Aberconwy by 1192. It has a wide vista to the east towards the sea and with its orientation of 70° – a shift of 20° from true east – the light of the rising sun radiates into the abbey church on the morning of the Assumption.

One abbey that appears to pay attention to the sunset on 25 March is Whitland (Fig. 16), founded pre-1145 and, like Margam Abbey, established directly from Clairvaux. Once again, the western sun was stressed by the builders, but unlike Margam – that aligned to the astronomical equinox – Whitland's church is aligned to the theological equinox. The intention, however, may not be an orientation to the theological equinox, but instead to one of the three important feasts of the Virgin Mary, that of the Annunciation. With no rose windows *in situ,* no other orientations can be considered.

4. The Role of the Landscape

The true azimuths of the eleven abbey churches range from 70° to 106°, a range of over 36°. Nevertheless, this seemingly diverse set of measurements falls into

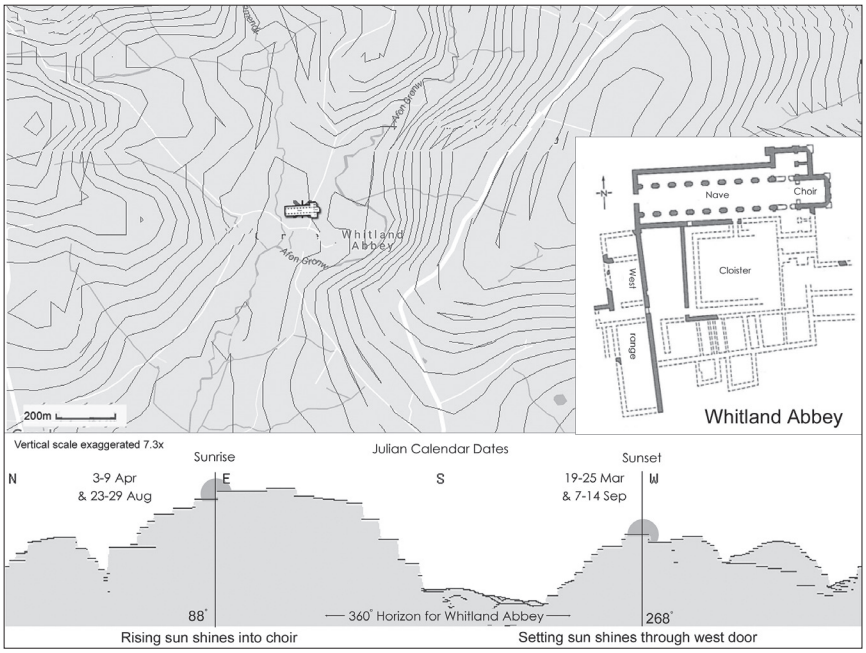

Fig. 16. Whitland Abbey.

three groups when the landscape of each abbey church is brought into account: orientation to the astronomical equinox; orientation to Michaelmas/St David's Day; and orientations to the feast days of the Virgin. Importantly for our research, these groups appear to be independent of the founding narratives of the abbey, with all appearing to honour the same liturgical calendar. Furthermore, our research indicates that the builders of these abbeys churches embraced the landscape when situating and aligning their churches so that they received the physical light of the sun at significant theological days: the feasts of the Virgin; or the astronomical equinox, the time of the equal division of the sky; or Michaelmas/Saint David. A good example of this phenomenon is Tintern (Fig. 17), where the azimuth shows the widest deviations from east at 26°, yet its eastern end aligned to the disk of the rising astronomical equinox sun. Such deviations from due east underline both the desire to align to the equinox and the role played by the landscape in the decisions about location and orientation of the abbey church.

Previous work on English abbeys and churches has focused on the eastern orientation of the structure. Repeatedly, however, we found that the churches showed alignments to sunsets. Indeed, seven abbeys – Margam, Llanllugan, Whitland, Neath, Cwmhir, Cymer, and Strata Florida – all hold alignments to astronomical equinox or Michaelmas/Saint David's Day via their western doors. In the

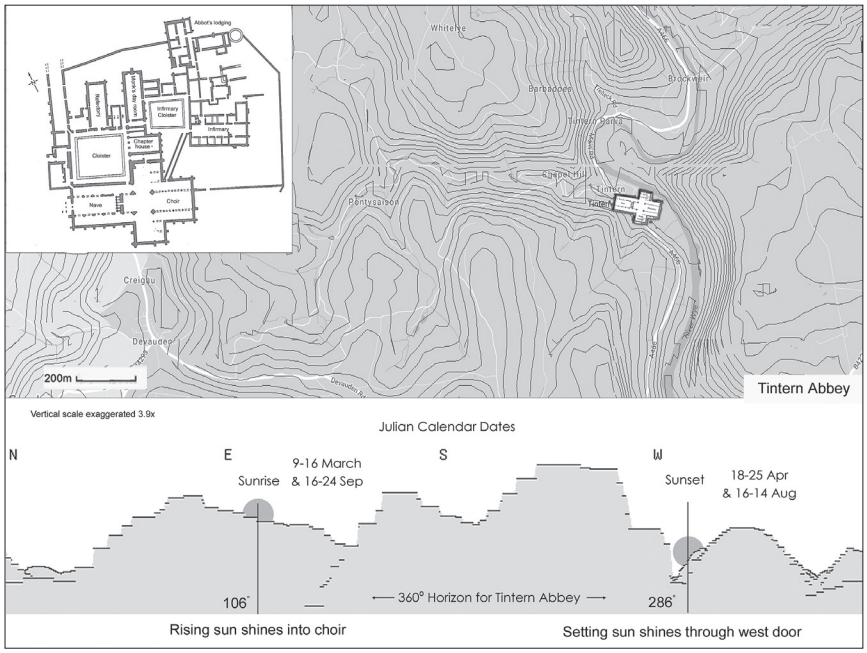

Fig. 17. Tintern Abbey.

case of Valle Crucis, whose western door was over-shadowed by a hill, a rose window on the western façade was aligned to the Assumption (15 August). Only Tintern Abbey in the south, and Basingwerk and Aberconwy 1 on the north coast overlooking the sea, revealed orientations to the astronomical equinox to the east.

There are two other points to draw from our research. The first is in regard to the planning of Cistercian monasteries, of which several lines of enquiry are currently under consideration. David Robinson has noted that the Cistercian order adopted the Benedictine claustral model that materialised in the late eighth or early ninth centuries with the Carolingian monastic reforms which by the mid-1130s were deeply embedded in Europe. This model has the cloisters laid out first and allows the church and the three principal ranges of conventual buildings to be situated around this centralising focus.[65] Terryl N. Kinder has argued that although the Benedictine model was adopted by the Cistercians, no two identical abbeys have yet been found. Instead, there is great diversity in how the sites and their structures were organised.[66] Kinder suggested that plan designs revealed changes resulting

[65] Robinson, *The Cistercians in Wales : architecture and archaeology 1130-1540*, p. 150.

[66] Terryl N. Kinder, *Cistercian Europe: Architecture of Contemplation* (Grand Rapids, MI/Cambridge UK 2002), p. 108.

from decisions made on-site. Given the precision with which these eleven Welsh Cistercian abbey churches have been aligned to engage with the landscape in a theological manner, we argue that these on-site decisions were at least partly dictated by the sun and the horizon. The abbey church was probably not built first. Its planned orientation, however, indicates that it would have been the principal concern and the determining factor for the layout of the cloisters, around which the other monastic buildings were then laid out.

The final point is one made by Kinder regarding architecture and light. She observed how the aim of Cistercian architecture and its décor was to aid the process of interiorization, to turn it away from colour and external excitement. 'The building,' she wrote, 'was not meant to take one's breath away; quite the contrary it was intended to bring back the breath slowly and evenly to an internal quietude, just as the valley site itself invited this slow process of interiorization.'[67] It was the light of the sun, the light of God, which animated the inside of the abbey church and its slow procession during the day aided this process of internal reflection. It is a given that sunlight and daylight hours and the amount of light reaching into an abbey of course differ through the year. Nevertheless, our research adds to Kinder's argument that this animating effect of sunlight was captured through the orientation of each abbey church, all of which were set in different landscapes, yet all of them set to capture God's animating light to emphasise theologically significant days.

IV. Conclusions

In drawing these case studies together some common themes have emerged: the importance of the landscape in understanding the orientations of the abbey churches; the emphasis predominantly on sunsets and the west; the focus on the astronomical equinox rather than that of the theological equinox; and the solar position on Michaelmas or Saint David's Day. Additionally, the balance, moderation, and unity of God's light at the time of the equinox dominated the solar discourse in five of the abbey churches, while the light of the Annunciation or Assumption sun created a space where the abbey church could be particularly illuminated by God's light on those days. The wider implications of this research suggest that the seemingly planned orientation of the church would then have determined the layout of the rest of the monastery. Additionally, these orientations seemed to be independent of the founding history of the individual abbey, as the planners at each site appear to have taken location into account and, within the limits of the landscape, to then find a suitable theological relationship to the sun's light.

[67] Ibid., p. 143.

Lane recognised that a story emerges when culture, sky, and earth are seen as a single entity. In our research the story we have found is that each Welsh Cistercian abbey sought to structurally form a theological and liturgical relationship to the sun's light. They did this by intentionally orientating the abbey church to make use of the local topography to engage with the sun on theologically significant days. Thus when the abbey builders were faced with the mountains of Wales, their on-site decisions encompassed a solar discourse to help the abbey church become a liminal space where monk could meet God, through prayer and the divine light of the sun.

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L'orientation des églises cisterciennes au pays de Galles : une étude d'astronomie culturelle

Cet article montre comment l'association du soleil, du paysage et de l'architecture contribue à l'étude du site des abbayes cisterciennes galloises. D'août 2014 à mars 2016 les auteurs ont examiné tant l'orientation de toutes les églises cisterciennes des fondations encore existantes au pays de Galles que l'altitude des paysages d'alentour. A l'aide de méthodes tirées de l'astronomie culturelle, l'analyse de ces données révèle qu'à travers l'orientation voulue de l'abbaye dans la topographie locale chaque église est en relation avec la lumière du soleil aux jours théologiquement importants. D'autres observations remarquables concernent la prise en compte du coucher du soleil et de l'ouest, la préférence de l'équinoxe astronomique à celui du calendrier julien et la position du soleil pour la Saint-Michel et/ou pour la Saint-David. Les implications de ces résultats pour des débats plus larges dans le domaine des études cisterciennes sont ensuite discutées.

The Orientation of Cistercian churches in Wales: a cultural astronomy case study

This paper considers how the union of sun, landscape, and architecture contributed to the siting of Welsh Cistercian abbeys. From August 2014 to March 2016 the authors surveyed and measured the orientation of all Cistercian churches with extant foundations in Wales, as well as the elevations of their surrounding landscapes. Using methodologies drawn from cultural astronomy, analysis of this data revealed that through the intentional orientating of the abbey within the local topography, each church formed a relationship to the sun's light on theologically significant days. Other notable observations include the emphasis on sunsets and the west, the focus on the astronomical equinox rather than the Julian calendar equinox, and the solar position on Michaelmas and/or Saint David's Day. The implications of these results for wider debates in the field of Cistercian studies are then discussed.

Die Ausrichtung zisterziensischer Kirchen in Wales: eine kulturastronomische Fallstudie

Dieser Artikel untersucht, inwieweit Sonne, Landschaftsraum und Architektur zur Anlage walisischer Zisterzienserabteien beitrugen. Von August 2014 bis März 2016 untersuchten und vermaßen die Autoren die Ausrichtung aller Zisterzienserkirchen mit noch erhaltenen Fundamenten in Wales ebenso wie die Bodenerhebungen der sie umgebenden Landschaft. Unter Anwendung der Methoden der kulturellen Astronomie ließ die Analyse der Daten erkennen, dass jede Kirche durch die gezielte Ausrichtung der Abtei an der örtlichen Topographie einen Bezug zu dem Licht der Sonne an theologisch bedeutsamen Tagen herstellte. Andere bemerkenswerte Beobachtungen betreffen die Gewichtung des Sonnenuntergangs und des Westens, den Focus auf die astronomische Tagundnachtgleiche mehr als auf diejenige des julianischen Kalenders sowie die Position der Sonne an Michaeli und /oder am *Saint David's day*. Die Folgerungen aus diesen Ergebnissen für eine weiterführende Auseinandersetzung im Bereich der Zisterzienserstudien werden im Anschluss diskutiert.