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Welcome to the 15th edition of the Welsh Stone Forum *Newsletter*. We would like to thank everyone who has contributed to the Newsletter, to the 2017 field programme, and the planning of the 2018 programme.

Subscriptions

If you have not paid your subscription for 2018, please forward payment to Andrew Haycock (andrew.haycock@museumwales.ac.uk). If you are able to do this via a bank transfer then this is very helpful.

Data Protection

New data protection legislation (GDPR, General Data Protection Regulations) comes into force on 25th May 2018. You will have been sent documentation from the Forum regarding this and a request to return a consent form. If you have not received these documents please contact the Secretary.

PROGRAMME 2018

2018 AGM & Annual Lecture

The 2018 AGM will be held at 11.00 am in the Seddon Room, at the Old College Aberystwyth, (near the pier, SN 580 817), followed at 11.30 by the Annual Lecture. This will be given this year by Forum member Dr Tim Palmer, on the building stones of the Old College and the work around Aberystwyth of J.P. Seddon, one of Wales' leading C19th architects.

For those who arrive early and who want lunch afterwards, there are various cafes and restaurants in Pier Street, adjacent to the Old College.

After lunch there will be an excursion to Llanbadarn Fawr church, where Seddon directed three phases of restoration and improvement in the 1860s - 1880s. We will then be making a visit to Abermad (1870-72), Seddon's principal private house in the district, now a nursing home.

Please notify the Secretary (jana.horak@museumwales.ac.uk) if you will be attending the AGM, lecture and afternoon field excursion. Places are restricted on the excursion so will be allocated on a first come first served basis. Many thanks to those who have already indicated their intentions.

May 12th: Radyr Stone, Cardiff

Leaders: Steve Howe & Mike Statham

Meet: 11.00 am Radyr Station car park (ST 135 803, sat nav CF15 8AA Station Road), and 3pm St Augustine's church, Penarth, (ST 188720, Sat Nav CF64 1BA).

Radyr Stone is a freestone local to Cardiff. The trip will start at Radyr Quarry (disused) to view this lithology in outcrop, and then visit examples of its use; first in Llandaff (village and Cathedral) then in Penarth (St. Augustine's church and Penarth Dock). Lunch is planned at Insole Court, Llandaff. Hard hats are necessary for Radyr Quarry and stout shoes or boots are recommended.

June 2nd: Usk revisited

Leader: Jana Horak

Meet: 11.00 Twyn Square, Usk (SO 377 009, sat nav NP15 1BH).

On the last visit to Usk we were unable to visit the castle, so this is a follow-up trip to include this, and also to another venue in the area (to be confirmed). It is hoped that in the afternoon we will be able to visit the new quarry (Devauden) that sourced the stone for the restoration work. Please contact the Field Secretary nearer to the date to confirm exact detail as there may be changes if we are unable get permission to visit the quarry. A hard hat and stout shoes will be necessary if we are able to visit the quarry.

July 21st Pembrokeshire Slate

Leaders: Peter Claughton & Robin Sheldrake

Meet: 11.00 am car park behind Tafarn Sinc (not the pub car park, but the one on the N side of the pub) Rosebush, Pembrokeshire (SN 075 294, sat nav SA66 7QT).

Having encountered Pembrokeshire slate in the course of our trips both in Pembrokeshire and further a field, it is a great pleasure that Dr Peter Claughton, an historian and archaeologist specialising in the extractive industries (and WSF member), has agreed to lead a Pembrokeshire slate trip. In the morning we will visit the Bellstone and Rosebush slate quarries (<http://people.exeter.ac.uk/pfclaugh/mhinf/slate.htm>). Lunch will be at the Tafarn Sinc. We will then take a reduced number of cars to Llangolman to visit Gilfach Quarry, with its characteristic green slate. Hard hats and stout footwear are necessary.

September 8th & 9th: N. Flintshire & Denbighshire

Leaders: Andrew Haycock, John Davies & Tim Palmer

Meet: Sat 8th 11.15 am. Main entrance to St Margaret's Church, Bodelwyddan (SJ 0038 7546), park in the layby south of church.

Meet: Sun 9th 10.00 am, Greenfield Valley Heritage Park car park (for Basingwerk Abbey), Greenfield Road, Holywell (SJ 1940 7746).

Saturday's itinerary will start at St Margaret's Church (The Marble Church), Bodelwyddan built of Carboniferous Limestone. Inside are numerous ornamental stones used to stunning effect. This will be followed by a visit to Rhuddlan Castle (C13th) and Llanasa village (built almost entirely of Gwespys Sandstone) to investigate the stone's influence in northern Flintshire/Denbighshire. We will be able to compare the Gwespys Sandstone here to that seen on the highly successful trip to the Wrexham area last year. We will also see Triassic sandstone from the Wirral in many of the older buildings.

On Sunday, we will first visit Basingwerk Abbey (C12th), St Winifrid's chapel, Holywell, St Marys (late C19th), Halkyn, where we will view the locally produced Halkyn Marble, and visit a disused quarry where it was produced.

There will be suitable opportunities for lunch on both days, details of which will follow nearer the time of the trip. Please bring stout shoes and a hard hat for the quarry visit.

October 6th: Barry Area.

Leaders: Mike Statham & Steve Howe

Meet: 11.00 am, on the roadside opposite the entrance to Barry Recycling Centre, Atlantic Trading Estate, Sully (ST 134 672, sat nav CF63 3RF).

We will examine the building stones used in the Barry area, focussing on some of the less well-known Triassic sandstones, limestones and conglomerates exploited from Medieval through to Victorian times.

We will start on the beach near Sully to view evidence of early stone quarrying and the adjacent Victorian quarry opened up for the construction of Barry No. 1 dock. A visit to the docks will be the next stop (parking on the north side of dock). Lunch arrangements to be confirmed nearer to the date. Options for the afternoon include Roman buildings at The Knap, Barry Castle (C14th?) and Merthyr Dyfan church (notable for its Medieval Triassic sandstone quoins and internal examples of C18th Bullcliff Marble grave slabs). Stout shoes or boots are recommended.

The Forum holds indemnity insurance for members attending field meetings. To ensure that everyone present is covered, it is essential that you inform the Field Secretary (Michael Statham, stathammichael@hotmail.com) in advance that you plan to attend any of the meetings. Members may bring guests to the meeting provided we have prior notification. You will be asked to sign the attendance list on the day.

James Evans

It is with great sadness that we have to announce the death, at the end of January 2018, of one of our members, Jim (James) Evans. Jim, was a retired facio-maxillary surgeon, but had had a deep interest in geology since a boy. He was a long standing member of the Geologists' Association and a member of the Forum since 2012, his last meeting being the St Maughan's Formation trip in June. Jim also volunteered in the Mineralogy & Petrology Section of the Museum, working alongside Jana and Andrew. Jim will be remembered for his irrepressible enthusiasm, his poignant questions (not all of which we could answer), his kindness and his sense of fun. He will be much missed.



Eric Broadbent

We have also been informed of the death of Eric Broadbent. Eric was a member for many years, and is another member who will be sadly missed.

Reinvestigation of Carboniferous sandstones, northeast Wales (Wrexham and Llangollen)

Andrew Haycock

The Upper Carboniferous Cefn y fedw, Gwespyr, Cefn, Coed yr Allt (Halesowen Formation) and Erbistock (Salop Formation) sandstones of Wrexham and Llangollen have been used as a building stone from at least the late C8th (Gwespyr - Pillar of Eliseg, Llandysilio yn Iâl), through to the C19th to C20th and present day. From the C20th onwards, local brick (Dennis, J.C. Edwards - Ruabon, Davies Brothers - Abenbury etc.) became the dominant building material in the region, though exceptions to this can still be found. The mix of local stone and red brick in buildings are a distinguishing feature of this part of Wales.

Cefn Sandstone is the most widely used in the region. The coarser-grained Gwespyr Sandstone is generally quite easy to distinguish from Cefn, but the finer-grained, more homogenous Gwespyr (e.g. Minera or Flintshire) may be a little more difficult to distinguish visually from Cefn on first inspection. Graham Lott, in his report (WSF Newsletter, 6), described the petrography of these stones using thin section analysis, which is a good reference for their classification. Ray Roberts, Ian Thomas and Graham Lott ran a Forum trip to the region in 2006 (WSF Newsletter, 6) to generate further interest in work on northeast Wales sandstones.

Having been brought up locally, and cutting my 'geology teeth' here, I have been very keen to work on the building stones of this area. Their hand specimen and thin section identification is the subject of ongoing research. The Minera/Coedpoeth region is particularly interesting as Gwespyr Sandstone and Cefn Sandstone outcrop locally and are both likely to have been used there, as well as further afield. Archival research will, hopefully, identify new examples of significant buildings constructed of each stone, as well as those previously identified in error. The following descriptions are not definitive as there are local variations between the sandstones, but it provides a start for their identification in the field.

Cefn y fedw Sandstone Formation

Age: Brigantian to Marsdenian Substage
(late Viséan – Namurain)

This lithology is described by the British Geological Survey (BGS) as 'white and pale grey, fine to medium-grained, planar and cross-bedded, quartzose sandstones, pebbly sandstones and thin beds of quartz conglomerate; with units of calcareous sandstone, sandy limestone and chert. Lithologies are commonly arranged in coarsening upwards cycles'. The sandstones are generally very quartz rich and quartz cemented (quartz arenite >95% quartz). As a product of its hardness, it has not been used extensively in this particular region, as other more workable sandstones are available locally.

Use: Generally used for dry stone walling and buildings local to its outcrop e.g. Ruabon Mountain, Cefn y fedw Farm. Local use where quarried for silica (Bwlchgwyn, Gwynfryn, Wern Minera). The stone has been used more for building in Flintshire (e.g. Caergrwle Castle).

Gwespyr Sandstone

Age: Yeadonian to Langsettian Substage
(Late Namurian – early Westphalian)

Other names: Talacre Stone, Aqueduct Grit, Garth Stone

These are described by BGS as '*Fine-grained, feldspathic and micaceous sandstones, cross-stratified on a variety of scales, with conglomerate-lined scours and intercalated siltstone and mudstone beds*'. Fine-grained varieties of Gwespyr can be found at Minera and further north in Flintshire.

The Gwespyr Sandstone of Trevor and Newtown Mountain (subfeldspathic arenite) is found to vary from medium to coarse-grained, often quite granular or pebbly. Some horizons (along bedding) are very mica-rich. Iron discolouration is common throughout as banding, Liesegang rings and 'nodules' and it weathers to a buff yellow to grey colour with orange/brown iron discolouration. Cross-lamination and pebbly/granular horizons are evident in some worked blocks (e.g. Valle Crucis). A finer-grained variety of the Gwespyr Sandstone can be seen at Berwig Quarry, Minera. This stone has been used at the nearby St Mary's church, Pen y Nant and Minera Hall.

In fresh outcrop the feldspar content of Gwespyr Sandstone can be seen to have largely weathered to a cream-coloured/white clay (kaolinite) between the quartz grains (confirmed by thin section), with distinct orange iron speckling throughout and occasional dark (iron oxide) grains. Thin section analysis of samples confirm that there are very few, if any, lithic grains. In weathered outcrop, the clay content has largely been weathered away leaving pronounced quartz-cemented quartz grains (which may lead to confusion with Cefn y fedw Sandstones). In fresh



Fig.1. Gwespyr Sandstone from Berwig quarry, Pen y Nant, Minera.

outcrop, the colour is pale yellow (approx. Munsell 2.5Y 8/2 and paler to 2.5Y 8/4)

Use: Pillar of Eliseg, Valle Crucis, arches in Llangollen and Vron Bridge; dressings in Castell Dinas Bran, St Mary's church, Minera, Talacre Hall.

Quarried at: Trevor, Garth Trevor, Newtown Mountain, Minera, Gwespyr.

Gwespyr Sandstone use at Valle Crucis Abbey

Gwespyr (dressed stone) has been used for the door arches, windows (mullions and tracery), quoins and capitals, with reuse of distinct (pink/orange) fire-damaged Gwespyr. Morton (1876-78) notes the use of Gwespyr Sandstone at the abbey: *'Aqueduct Grit, the same rock as the Garth Stone, a well-known building material which has been used in the neighbourhood of Llangollen for more than 500 years. Valle Crucis Abbey, Llangollen Bridge, Carnarvon Castle, and docks at Bristol are built of it'*. He is likely referring to the use of local Gwespyr Sandstone for the abbey and bridge, but Flintshire Gwespyr would seem a more likely source for the castle and docks (as they are nearer to sea transport). This deserves further investigation. It is interesting to note that this particular reference seems to have been largely forgotten, and has not been quoted since Morton.

There has since been some confusion over the identification of the dressed stone used at Valle Crucis. Cadw note *'early work on the church is of un-coursed dolerite with Cefn freestone and gritstone quoining'*. However, there appears to be little use of Cefn Stone, and the gritstone can undoubtedly be assigned to Gwespyr. The vast majority of the rubble work is local Silurian, while the 'dolerite' that Cadw refer to may in fact be occasional igneous boulders from the glacial drift. Neaverson (1953) states *'Cefn Sandstone from Cefn Mawr was employed in the C13th for dressings at Valle Crucis Abbey'*. Whilst this may be the case for the some of the (later?) dressed stone, it is almost certainly not for the vast majority of the stone seen there.

G. Vernon Price (1952) notes *'Fine durable freestone, suitable for ashlar work, and for the dressings of doorways and windows was obtainable nearby also. The massive beds of the Coedyrallt sandstone form the escarpments in the neighbourhood'*. It is unclear which Coed yr Allt outcrop he is referring to, as the nearest outcrops are found east of Ruabon, beyond the sources of both Cefn and Gwespyr stone (which would have been nearer to Valle Crucis). It is also unclear if he is alluding to Coed yr Allt use at Valle Crucis, as there is certainly no evidence of the stone at that site. He continues *'and in the proximity of the River Dee, the Cefn Rock, an excellent building stone appears on the surface as a dominant physical feature. There is tradition however that the wrought stone was conveyed from a considerable distance away'*. There

appears to be no physical evidence of any stone being used that was not sourced reasonably locally. The exception to this are occasional blocks of igneous material from the glacial drift.

Cefn Sandstone

Age: Bolsovian Substage (Westphalian)

Other names: Cefn Rock, Cefn Stone, Brynteg Freestone

Described by BGS as a *'massive, quartzose sandstone with subordinate and impersistent beds of mudstone and coal'*. Cefn Sandstone is the most widely used stone throughout the region, with many cottages, chapels and churches from C13th to the early C20th built predominantly of this stone (e.g. Cefn Mawr, Pentre Broughton, Coedpoeth, Wrexham). With the advent of the railway in the C19th, the stone was used much further afield (e.g. Liverpool, Manchester, Birmingham, Aberystwyth, Cardiff). It is a medium-grained, quartz-rich sandstone (lithic or sublithic arenite) with feldspar, dark lithic grains, and often with orange coloured iron speckling throughout. The colour is pale yellow to yellow (approximate range Munsell 2.5Y 8/2 to 7/6) on a fresh surface. The feldspars (cream-coloured to white) often remain intact but where weathered to clay (kaolinite), they tend to remain within the 'footprint' of the original feldspar grain (and not distributed between the remaining pore space as observed in Gwespyr Sandstone). On weathered surfaces, Cefn Sandstone is a darker yellow, buff to brown colour and feldspar is often still visible on the surfaces. Cefn Sandstone seems more susceptible to industrial pollution than Gwespyr Sandstone, with many stones exhibiting a very dark brown to black crust. Iron discolouration, as patches, banding and dark brown concentrations appearing as nodules are common. Parallel lamination is observed in many blocks and lithic mud clasts may occasionally be present, as well as plant fossil material.



Fig. 2. Cefn Sandstone, Saron Chapel, Coedpoeth. (Inset: detail of Cefn Sandstone)

Use: Pontcysyllte Aqueduct; St Giles Church, Wrexham; St Marys Church, Ruabon; Gresford Church; The Walker Art Gallery, Liverpool (1877); University College, Bangor (1908).



Fig. 3. Good quality Coed yr Allt Sandstone at Wynnstay Hall. (Inset: poor quality stone, Park Street, Ruabon).

Quarries: Cefn Mawr, Brynteg, Pentre Broughton, Coedpoeth, Afon Eitha (Garden Lodge).

Coed yr Allt Formation (Halesowen Formation)

Age: Asturian Substage (Westphalian)

This is described by BGS as ‘grey-green, micaceous sandstone (litharenite), and grey-green mudstone, with thin coals and limestone beds known as the ‘*Spirobis*’ limestone, with local intraformational conglomerate, strata may be reddened, locally’. The sandstone is very rich in lithic fragments, feldspar and mica. Its colour is quite different to the Gwespyr and Cefn sandstones. On a fresh surface, it is approximately Munsell colour white (5Y 8/1), light grey to pale yellow (5Y 7/2 - 7/4), while weathered surfaces are a similar colour or darker. Cross lamination can be seen in numerous blocks.

Like Cefn stone, this sandstone seems susceptible to industrial pollution, which creates a dark surface crust. Poorer quality stone in the Wynnstay Estate buildings at Ruabon have weathered quite badly over time, while better quality stone seems to have been reserved for Wynnstay Hall, and is relatively unaffected by weathering. Many blocks at the hall exhibit excellent cross-lamination. This stone only seems to have been used locally to its outcrop, particularly for buildings associated with the Wynnstay Estate.



Fig. 4. Outcrop of Erbistock Beds near Erbistock Mill, Dee Valley. (Inset: stone use at All Saints Church, Pen y Lan).

Use: Park Street, Ruabon; Wynnstay Hall Estate (Hall and cottages); Nant-y-belan Tower; farm buildings near Coed yr Allt, Shropshire.

Quarries: Wynnstay Hall Estate, Pentre Clawdd, outcrops in Dee Valley, Nant-y-belan Tower and Coed yr allt, Shropshire.

Erbistock Beds (Salop Formation)

Age: Asturian Substage to Cisuralian Epoch (late Westphalian to early Permian)

Other names: Abenbury Freestone

This is described by BGS as ‘red and red-brown mudstone, and red-brown (mostly sublitharenite) sandstone containing beds of pebbly sandstone and conglomerate itself containing Carboniferous limestone and chert clasts, and thin ‘*Spirobis*’ limestone beds and caliche in the lower part of the unit’. It is fine grained and red brown (Munsell colour 10R 4/4) to purple in colour with grey green and pale mottling in part. Ashlar blocks at All Saints Church, Pen y Lan, exhibit some excellent cross-lamination. Occasional blocks are quite mud rich, which weather quite badly. Soft mud clasts can be observed in some blocks, with voids where they have weathered out.

The stone at Graig Quarry, Pen y Lan, is slightly coarser-grained than blocks at the church. Fresh surfaces reveal iron stained, red quartz grains with numerous white, pink

and cream/orange grains throughout (Munsell colour 10R 5/2 – 4/3, 4/4 on fresh surface). It is worth noting that the stone is generally very porous and has no reaction to dilute hydrochloric acid (HCl) but, where well-cemented beds are found, there is a strong reaction to dilute hydrochloric acid, providing evidence of a calcium carbonate cement.

Use: All Saints Church and estate buildings, Pen y Lan; St Marys Church, Overton; St Hillarys, Erbistock; Hereford Cathedral restorations.

Quarries: Graig Quarry Wood, Lower Farm Wood, Erbistock Mill Quarry, Morris Wood Quarry, Abenbury Wrexham.

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Font of the Year: the demolished church at Llandygydd in south Ceredigion

Tim Palmer

The C19th church of St Tygwydd in the rural hamlet of Llandygydd, close to the southern border of Ceredigion and 6 km east of Cardigan, was built on the site of an earlier medieval church. It is no longer there. It was demolished in three episodes from the late C19th to the C20th, as the structure became more dilapidated. Now its original floor level stands as a platform about a metre above the ground, and only the stone font, still in its original position in the south-west corner, stands higher.

At first sight the font is fairly unremarkable (apart from it being very unusual to see the original font still standing



Fig. 1. The font in situ.

in situ in a demolished church; Fig. 1), and it is heavily overgrown by moss, lichen and bramble. The lichen in particular obscures petrographic detail of the stone, but a little judicious scraping reveals that it is buff coloured limestone. The bowl and the stem are octagonal, and the eight panels on the sides of the bowl show simple carved vegetation (Fig. 2). At the level of the top and the bottom of the panels, two thin bands of contrasting white (when fresh) oolitic stone encircle the bowl. They are much less well-preserved than the stone of the rest of the bowl and have been badly shattered and eroded by frosty winters in the last few decades, leaving obvious grooves. At first sight the structure looks like a Victorian representation of a late



Fig. 2. Carved vegetation on font panel.

medieval eight-sided font, enhanced by a C19th fashion for stone in contrasting colours. However, a closer study reveals that the bowl, stem, and base are made of Dundry Stone, and the narrow bands of white oolite (probably Painswick Stone) have been added at a later stage by slicing across the original bowl and inserting the new material. Thus it appears that the original late medieval Dundry font was reclaimed from the medieval church and modified by the addition of two Painswick fillets when the new church was built, c.1856. This had the effect of increasing the depth of the bowl by about 5 cm, and updating its appearance to accord with the Victorian taste for contrasting materials.

The age gap between the original Dundry structure and the Painswick inserts is confirmed by small repairs in the bowl, stem and base. As is widely seen in Victorian reuse of medieval stonework, areas of damage have been neatly cut out and accurately-shaped new stone pieces inserted into the holes, using a fine white cement that was probably based on white lead. These inserts are also made of white, oolitic Painswick Stone, identical to the bands in the bowl. Painswick was favoured during the C19th for neat, precise repair jobs of this sort, particularly around the rims of ancient fonts where iron staples may once have been inserted for a locking lid. Other indications that the original font was of late medieval date include the octagonal panelled style, the use of Dundry Stone (widely seen in fonts in south and west Wales from C12th – C15th), slight imperfections in the geometry (Victorian fonts were, in contrast to medieval ones, always very accurately shaped and symmetrical), and the presence on the bowl of two compass-drawn daisy wheels (Fig. 3). These geometric figures are common (and frequently overlooked) on or near to medieval fonts and are widely thought to have been drawn as protection against evil spirits. (See Matthew Champion, 2015, *Medieval Graffiti*, Ebury Press, for a full discussion of various styles of protective symbols in churches across England and Wales.)



Fig. 3. Detail of compass-drawn daisy wheels.

Building stones in churches across Wales: a national map of vernaculars:

Part 5 – Caernarfonshire

John Davies

To date the survey of building stones of the churches in the counties of Wales has been completed for the counties of Breconshire, Carmarthenshire, Ceredigion, Meirionnydd, Montgomeryshire, Pembrokeshire, Radnorshire and Ynys Mon (Anglesey) with the results being published in the Welsh Stone Forum *Newsletter* (Nos.11 - 14). This part presents the results for the churches of Caernarfonshire.

Technique

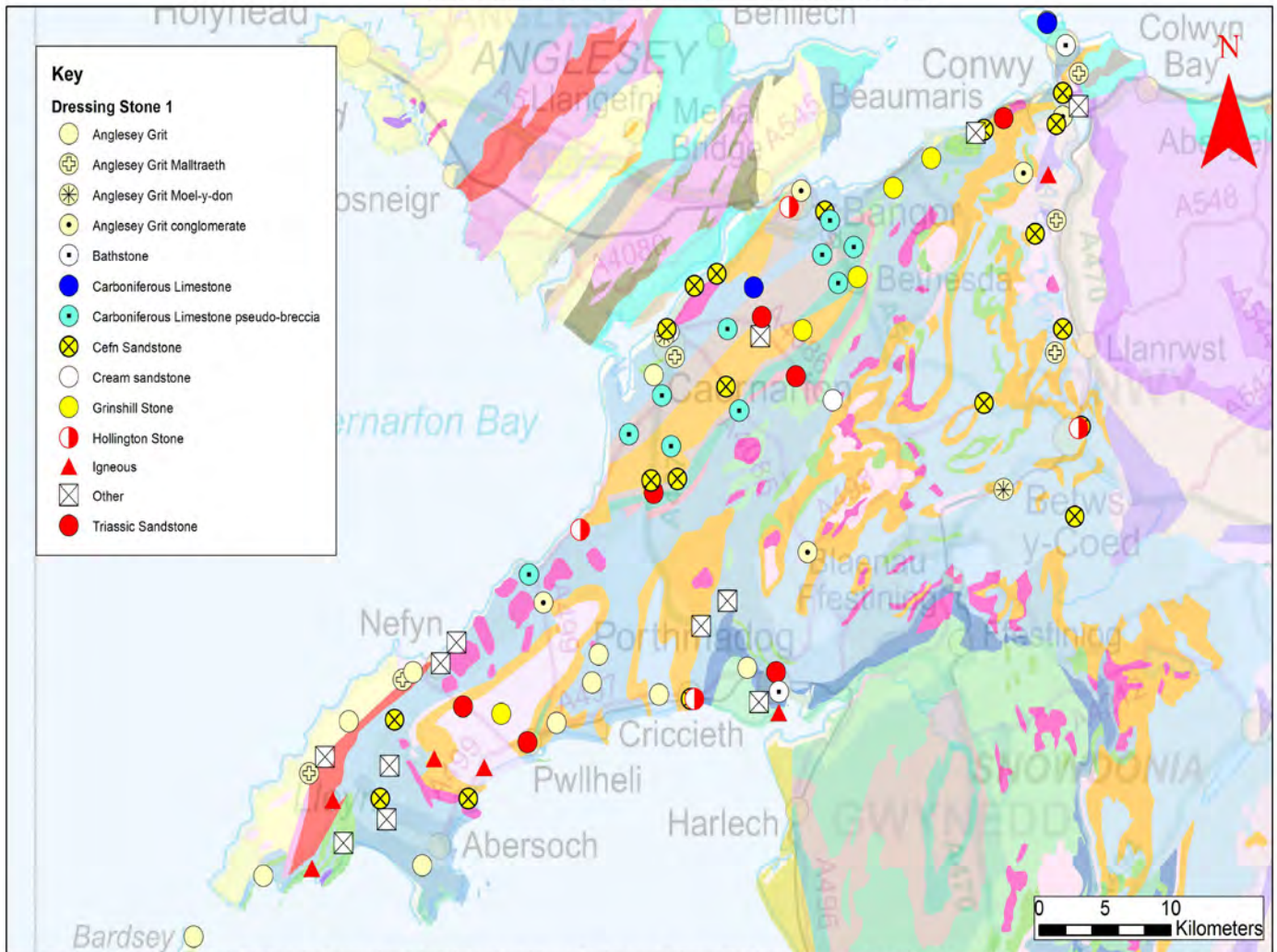
The survey method employed during the survey of churches in previous counties has been continued. The external building stones were examined in order to record the nature and possible source of the materials used. The church interiors were not examined, due to many of the buildings being locked, un-safe or converted into private accommodation. For each church approximately fifteen minutes was spent per building identifying the stone in the external walling and dressings with digital images of doors and windows being made. The resultant maps have the same format as those for the previous counties published.

History of stone use

Many churches use local rubble for walling and, where possible, local stone for dressings. Generally a simple rule applies; a church nearest to the outcrop of a good freestone frequently uses it as dressed stone in the walls, while the further a church is from such a source the less freestone there is in the walling, which is replaced by local rubble stone with the freestone only being used for special dressings. In Caernarfonshire almost no stone is suitable for dressings.

For much of the history of church building in Caernarfonshire the dressing stone was imported by sea but, after the arrival of the railways and improved roads, small amounts of more exotic dressing stone appear from much farther away. Much of this type of stone came from Anglesey. Frequently a building may include three or more different dressings. This is often dependent upon the history of each stone's availability, which produces a chronology of stone use in each building. In the future it may be possible to match such stone use with different architectural styles. However, this creates a problem with regard to deciding which dressing stone to plot on the maps. Here, as in previous papers, the decision was made to plot only the two dominant stones. These are plotted on separate maps (see diagrams, on next page Dressing stone 1 & Dressing stone 2).

Caernarfonshire Overview - Dressing Stone 1



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The building stones of Caernarfonshire churches

There is almost no suitable stone available in Caernarfonshire for dressings. The only exception are bands in the basal Carboniferous quartz conglomerates that occur in a narrow outcrop along the south side of the Menai Strait, between Bangor and Caernarfon. Other quartz conglomerates also occur within the area. However, these are distinctively deformed and do not match those in buildings in Llanbeblig and Caernarfon, where quartz conglomerates are common. The nearest available freestone was obtained from the Lower Carboniferous outcrops in Anglesey. These sandstones and conglomerates have been grouped together as 'Anglesey Grit' for the purposes of this survey. Two varieties of Carboniferous Limestone have also been used.

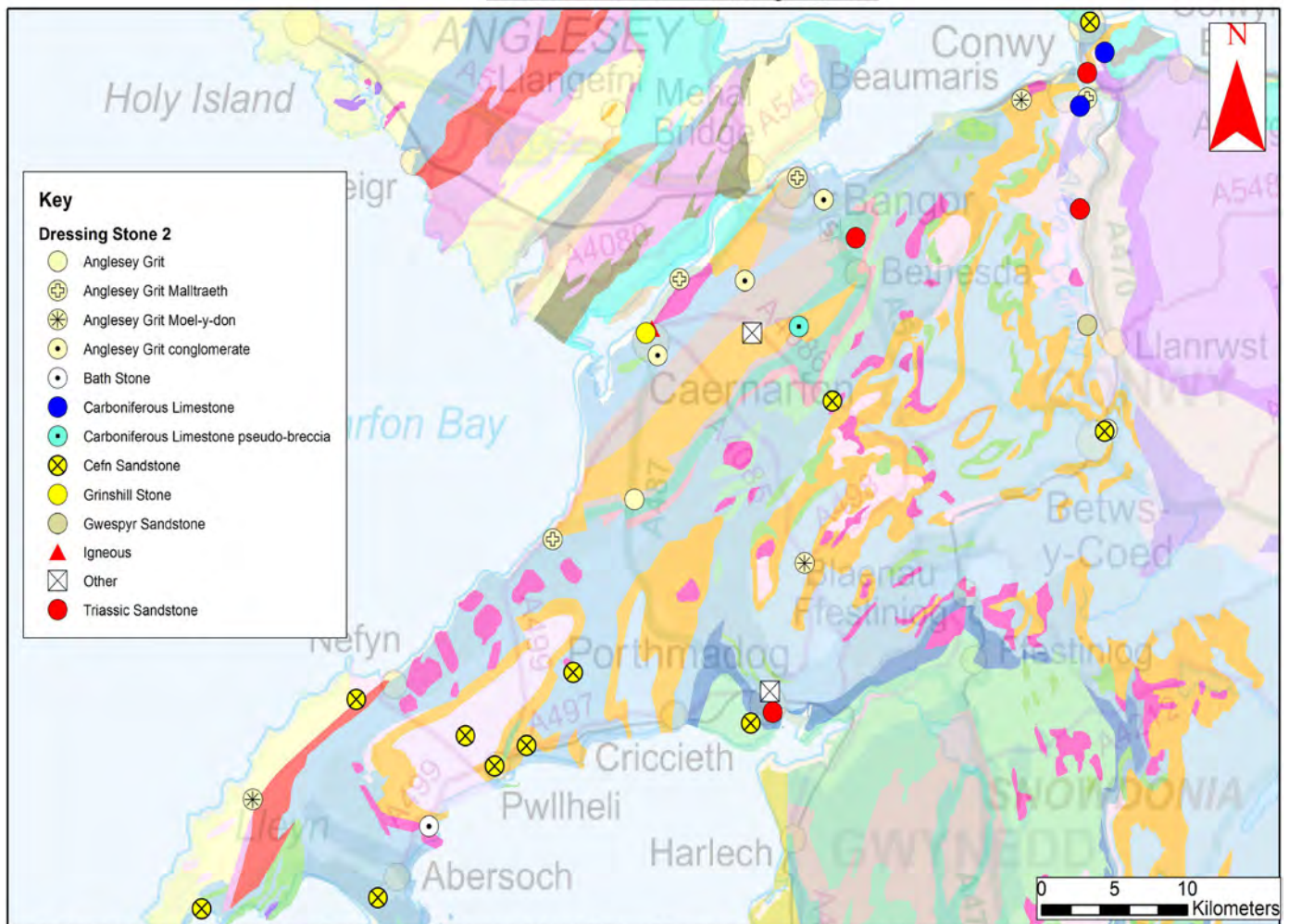
The Anglesey Grit

The Carboniferous Limestone (Clwyd Limestone Group) succession in Anglesey contains a number of bands of conglomerate, quartz sandstones, hard coarse, gritty, quartz sandstones, whitish-cream, coarse, sugary sandstones and yellowish cream, fine dolomitic sandstones. These deposits are referred to as Anglesey Grit and vary in grain size and composition both vertically within the

stratigraphical sequence and laterally. Consequently, it is possible to match lithologies seen in buildings with very small areas of outcrop, which in turn allows for the determination of the likely location of the original stone quarries.

- **Anglesey Grit – conglomerate:** These crop out in the east of the island in Lligwy Bay, around Llanbedr Goch and between Foel and Penmon and also in small cliffs on the Menai Strait on the Plas Newydd Estate. They are probably the same as the conglomerates which crop out on the mainland near the Britannia Bridge and which provided the building material for Llanbeblig church (Fig. 1).
- **Anglesey Grit – hard, grey quartz sandstones:** These hard, white and grey, gritty quartz sandstones outcrop at Creigiau and can be traced southwestwards in strips within the Carboniferous Limestone sequence between Llanbedr Goch and Llangefni.
- **Anglesey Grit – Moel-y-don:** Within the Anglesey Grit there are also reddish to orange coloured sandstones that contain scattered pebbles and have a 'peaches and cream' appearance. These can be readily matched with outcrops on the Menai Strait around

Caernarfonshire - Dressing Stone 2



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Moel-y-don and appear to have been used as far afield as Caernarfon Castle, Beddgelert Priory (with the conglomerates) as well as at Llanbadarn and Strata Florida in Ceredigion.

- **Anglesey Grit – pale cream dolomitic sandstone ‘Malltraeth’:** These white to cream coloured, coarse, sugary sandstones and yellow to cream coloured, fine dolomitic sandstones tend to be distributed in the west and south-west of Anglesey, especially in buildings around Malltraeth (Fig. 2). However, outcrops also occur further to the northeast in an area between Llangefni and Llanbedr Goch. Some can also be seen cropping out in the cliffs around Foel on the east side of the island. All of these varieties of Anglesey Grit can be seen throughout Caernarfonshire, from Conway in the east to Criccieth in the south. Their use is particularly concentrated along the coast.

Carboniferous Limestone

Within the Carboniferous Limestone succession the predominant stone used for ashlar and dressings is a pale, oolitic limestone. This has many minute cracks within its fabric, which has led to it often being referred to as a ‘pseudo-breccia’ (Fig. 5). It was extensively quarried in Anglesey and exported since Victorian times into

mainland Gwynedd, initially probably by rail but possibly also by sea.

Namurian Sandstones

Cefn Sandstone: This is the chief exotic sandstone seen in many of the Caernarfonshire churches. It is a yellow, medium grained, often cross-bedded sandstone that frequently also shows liesegang rings and can also exhibit some soft sediment deformation structures. Cefn Sandstone is typical of the ‘Millstone Grit’ of the north of England Basin, which extends into northeast Wales, around the rim of the Flintshire Coalfield. Compared with the Anglesey Grit it is distinctively yellow to orange in colour and of even grain size. It occurs widely across the county in Victorian age churches.

Cream sandstone: The Namurian succession of Flintshire also contains occasional cream coloured sandstones, which are different from those of the Anglesey Grit and Grinshill Stone. One such paler, quartz sandstone from Flintshire - Gwespys Sandstone - can be coarser grained but in the examples in Caernarfonshire is generally a medium to fine grained, uniform sandstone, which is not difficult to distinguish from Anglesey Grit or Grinshill Stone.



Fig. 1. (top left) Anglesey Grit, Llanbeblig church. Fig. 2. (bottom left) 'Malltreath' pale dolomitic sandstone, Clynog Fawr, Anglesey. Fig. 3. (top right) Pseudo-breccia in Carboniferous Limestone, Trefor. Fig. 4 (bottom right) Red Hollington Stone, Crickieth.

Triassic sandstones

These are usually massive, orange to red coloured, often coarse sandstones with grains up to 5mm in diameter. These have been used for dressings in the county, although the massive, finer-grained, red coloured Shrewsbury Sandstone does not occur. There are several examples of the maroon and green coloured, mottled, Hollington Stone in Victorian churches within the county as well (Fig. 4).

Grinshill Stone: This pale cream to white coloured sandstone occurs in a few churches (Fig.5). It is distinctive in that it is almost always veined with straight veins of coalesced quartz grains. From the architectural style of the buildings it is used in, its use is clearly post railway age.

Jurassic: Bath Stone

Bath Stone is the only Jurassic limestone used within the county and is always in the form that shows weathering-out oolites and calcite veins. It is frequently cross bedded and contains shell debris and weathered-out burrows.

Igneous rocks

Both dolerite and Trefor Granite have been dressed to provide rough door and window jambs in later churches. In most cases where dressed, coursed igneous rocks occur as walling the buildings often have igneous dressings as well.



Fig. 5. Grinshill Stone, Bethesda.

Other materials

There are numerous churches within the county with no dressings at all and wooden windows. Some other churches have brick dressings but neither of these are common.

Conclusions

Within Caernarfonshire the churches have generally used local rubble for walling and imported stone for dressings. The predominant dressing stone, especially along the coast, is Anglesey Grit in all its varieties. Further east, in places such as the Conway valley, Cefn Sandstone is used often as a repair material. There are a few churches which exclusively use Grinshill Stone but it has also been used for repair work. Both Cefn Sandstone and Grinshill Stone occur in buildings erected since the building of the railways. The exceptions to these are igneous rocks that occur in much later buildings after technology had developed to allow them to be sawn easily.

Further Reading:

Davies, J.H. 2003. The use of Carboniferous sandstones and grits from Arfon and Môn as a freestone over a wide area from Llandudno to northern Ceredigion. *Welsh Stone Forum Newsletter*, 1, 6.

Building stones in churches across Wales: a national map of vernaculars: Part 6 - Upland Glamorgan

John Davies

Because of the size and number of communities in Glamorgan, it has been necessary to divide the county into its two main medieval units; Upland Glamorgan (Morgannwg) and the Vale of Glamorgan. In addition, as there are an abundance of churches in Gower, Swansea, Cardiff and Newport, these areas will be published separately.

The churches of Upland Glamorgan fall into two groups; pre-C19th and those built for the needs of the growing mining communities in the 1C9th and earliest C20th. The former group usually occur in old, predominantly hill-top, hamlets and show the largest variety of building stones as dressings were available from the Vale of Glamorgan. Generally these occur in older church fabrics and those that have been rebuilt in the C19th using some of the original materials. The second group are generally built of two main stones; varieties of local Pennant Sandstone for walling and Bath Stone for the dressings. Many of the industrial buildings, houses and churches in the mining communities were built from stone quarried within close proximity of the communities themselves and many quarries are visible along the valley sides.

Walling materials

Upland Glamorgan is underlain almost entirely by rocks of the Palaeozoic era, in particular the Pennant Sandstone Formation (Upper Carboniferous). With a few exceptions these sandstones are generally unsuitable for use as dressing stones because of the frequent inclusion of plant fragments and mica flakes. This gives them a pronounced fine bedding fabric and a preferred fracturing along the bedding surfaces, which makes the stone ideal for course work. In other directions the stone is very hard and difficult to dress and consequently is rarely used for dressings. There are a number of varieties of Pennant Sandstone used in walling that can be identified:

- **Rubble:** Quite often slightly muddy and flaggy sandstones that are incapable of being dressed.
- **Parallel-bedded and lamellar-bedded sandstone:** These often form thin natural beds up to 10-15cm and are often used in course work.
- **Massive Pennant Sandstone:** These usually occur with a rustic-dressed front face and sawn on the other two sides. They occur in course work or stepped course work.

Some Pennant Sandstone walling weathers to give a softer, sugary texture. Where this occurs the sandstones also tend to be a paler grey colour than others. There is scope for further investigation of the Pennant Sandstone lithologies and textures.

Dressings

The age of the dressings used within Upland Glamorgan varies from the Palaeozoic to Mesozoic, but the dominant stone is Bath Stone (Jurassic, Mesozoic). A number of other dressing stones occur. These fall into two groups based upon the age of construction of the church. The older churches, and especially those close to the Vale of Glamorgan, contain Sutton Stone and Quarella Stone from quarries in the Vale, which shows an affinity with the communities of the Vale, and also Dundry Stone imported from Bristol. An exception is Llandeilo Talybont, which was moved from south of Pontardulais to the St Fagans National History Museum. This has dressings of Old Red Sandstone pebbly Brownstones (more lately referred to as Caeras Conglomerate), which was transported down the Llwhwr river from Cil-yr-ychen, near Llandybie, in southeastern Carmarthenshire.

Sutton Stone is used in the oldest buildings. At Margam Abbey the ashlar walling is entirely of this stone as are the dressings at Neath Abbey. Its use for dressings appears throughout south Wales in the earliest church buildings, from Llangyfelach in the west (Fig. 1) to Rhydri in the east. From the quarries near Ogmores-by-Sea the use of Sutton Stone decreases northwards and eastwards but is found in places such as Llandyfodwg, Llanwynno, Eglwysilan and Rhydri. Within the coalfield area Sutton Stone and Quarella Sandstone occur as recycled blocks within the rubble walls of those churches which were rebuilt in the C19th-C20th, indicating that there may well have been an older church on the respective sites from which these dressings were recycled.

Within the Bridgend area Quarella Stone (Fig. 2) is the dominant building stone. It was quarried along its narrow outcrop that stretches from Pyle in the west, through



Fig. 1. (above left) Sutton Stone at Llangyfelach. Fig. 2. (above right) Quarella Stone, Llangynwyd. Fig. 3. (bottom left) Bath Stone, Dowlais. Fig. 4. (bottom right) Forest Pennant Sandstone, Gelligaer.

Quarella itself, to Coychurch, which lies just south of the border between Upland Glamorgan and the Vale. The finest example of the use of this stone is at Pen-y-fai, immediately north of Quarella, and it is the dominant dressing stone at Tondy, Betws and Coychurch, all of which are close to the Quarella quarries. It can also be seen at; Cwmafan, Aberdare old church, Llandyfodwg, Llangeinwyr, Llansawel and Llantrissant. Dundry Stone is quite rare, occurring only in some of the older churches, such as Llangeinwyr and St Illtud, Baglan.

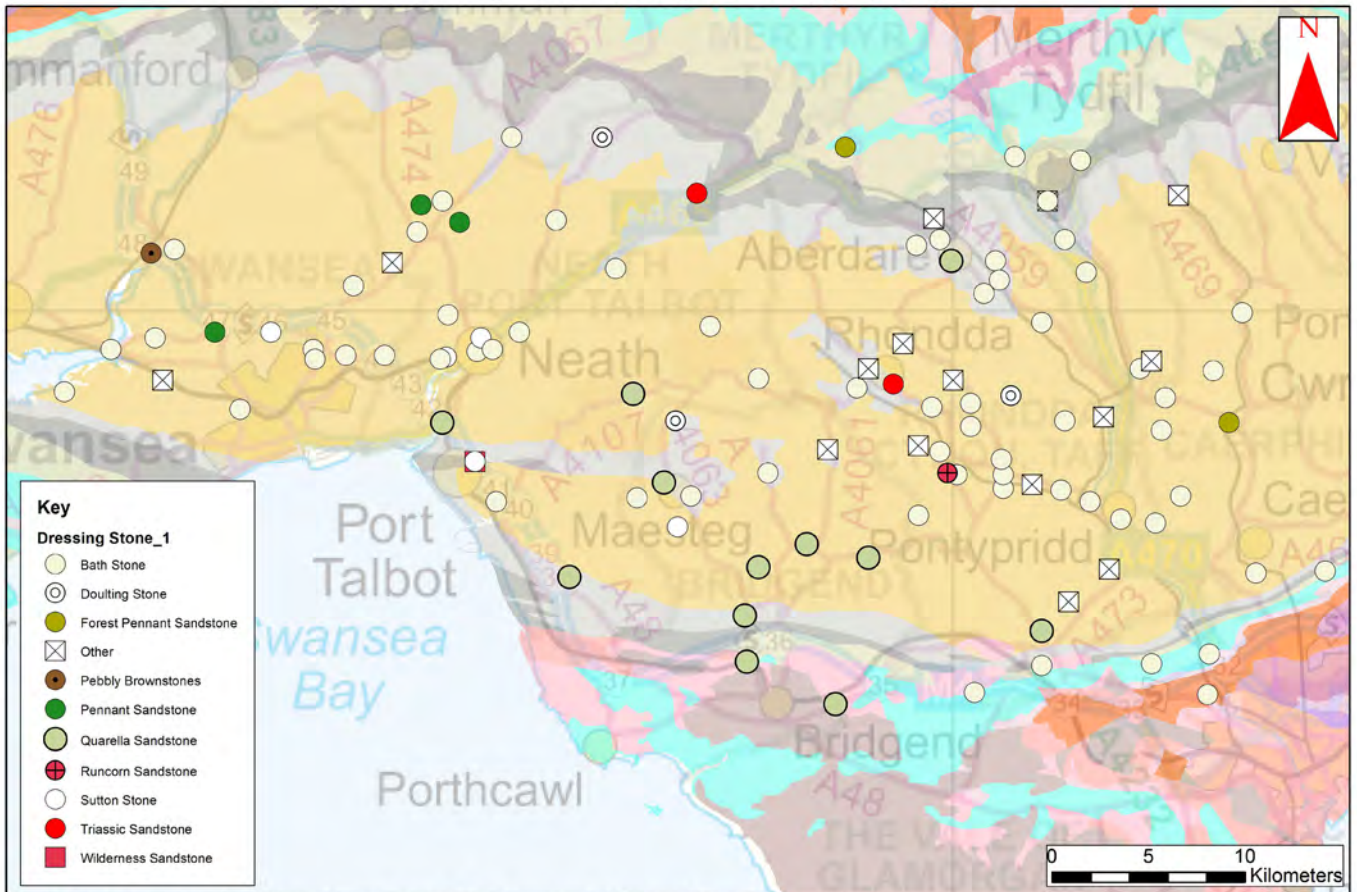
In the older churches the use of these three stones follows a definite age-related pattern; from Sutton Stone to Quarella Stone and then Dundry Stone in chronological order. However, after the mid C19th Sutton and Dundry were replaced as the main dressing stone by Bath Stone, although Quarella Stone continued to be used up to the early C20th. In contrast, dressings in the churches within the coalfield contain more exotic dressing stones, which were imported via the canals and railways, some possibly on coal trains returning empty from the ports. These include, Bath Stone (Fig. 3), Doulling Stone, Cefn Sandstone (from Flintshire) and, later, Forest Pennant Sandstone (from the Forest of Dean, Gloucestershire). Doulling Stone is uncommon but occurs in certain areas. It was used in places such as Seven Sisters, Maesteg, Llanwynno and Cefn-coed-y-cymer.



Fig. 5. Hollington Stone, Llangyfelach.

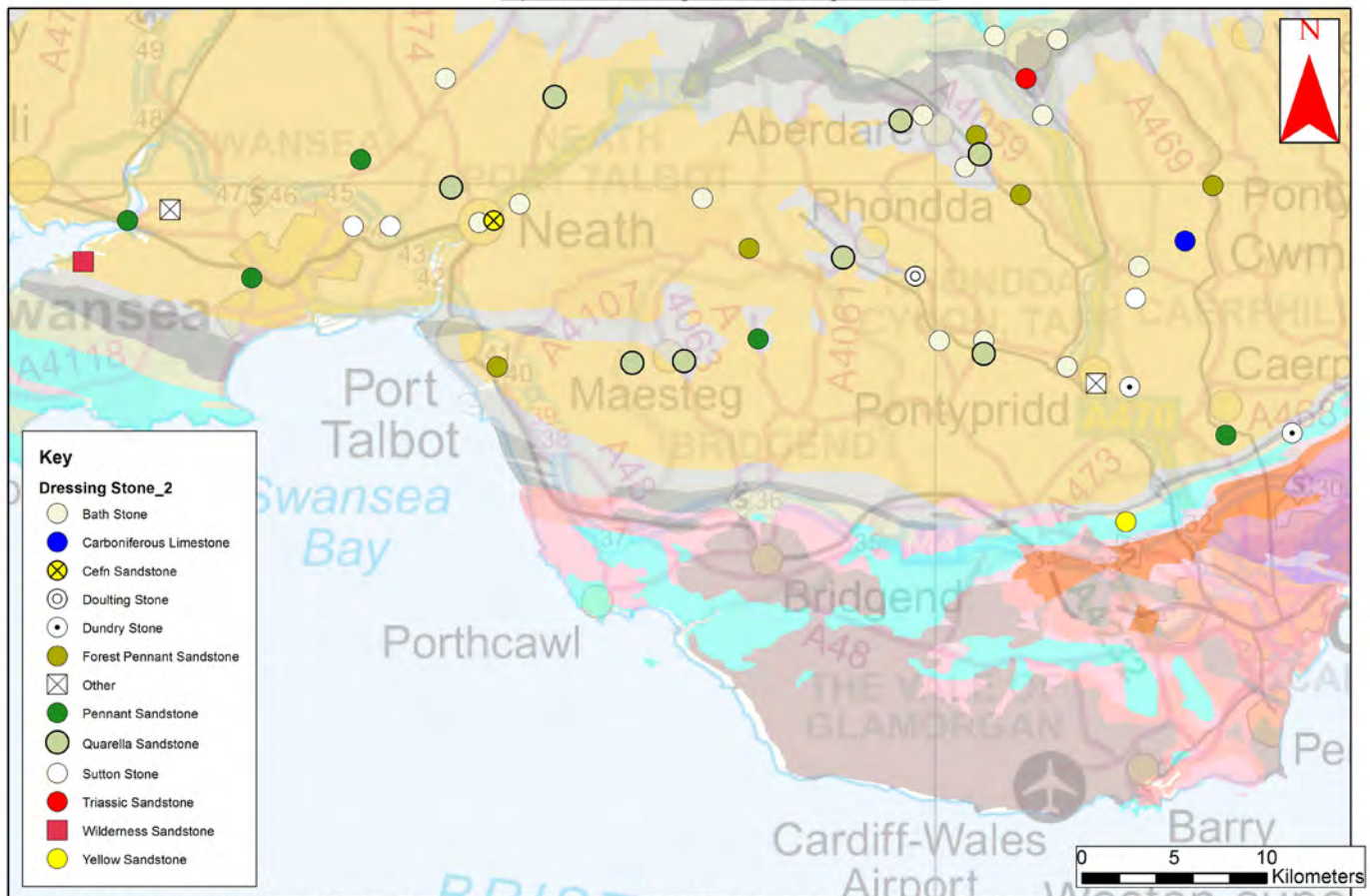
There are a few churches where the dressing stones appear to have been selected for aesthetic architectural reasons, such as Wilderness Sandstone (Old Red Sandstone) and Carboniferous Limestone. Cefn Sandstone and Forest Pennant Stone (Fig. 4) also appear to fall into this category but the latter is frequently used with Bath Stone in recent repairs. A number of churches have used Forest Pennant dressings as a colour contrast to the local 'Blue Pennant'

Upland Glamorgan- Dressing Stone 1



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Upland Glamorgan- Dressing Stone 2



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Sandstone. Forest Pennant has only been used as the primary dressing stone at Penderyn and Ystrad Mynach but was also used in the old church at Aberdare and St Catherine's, Baglan.

Red to green coloured, mottled, sandstone dressings in the churches of Llangyfelach and Pen-y-graig appear to be of the Triassic age Hollington Stone (Fig. 5) whereas red Triassic sandstone has been used in the 'Cathedral of the Rhondda' at Pentre.

Victorian churches in Upland Glamorgan use brick dressings more than in any other area so far surveyed. These vary from red to dark red and yellow and, in a number of instances, have been used in a variety of colours for architectural detail. Such churches occur at Abercynon, Cwm Clydach, Ferndale and Treorchi. Cwmafan has yellow brick dressings while Cwmdare has yellow brick walls with Bath Stone dressings. One church, Maerdy, in Rhondda Fach, shows cast red ceramic dressings.

Conclusions:

Although most C19th churches in this area are predominantly of two building stones, Pennant Sandstone and Bath Stone, the older churches have dressings similar to those found in the neighbouring Vale of Glamorgan from where they were sourced. There are a number of varieties of Pennant Sandstone used in walling which could warrant investigation further.

Alabaster Update

Michael Statham

Since the publication of the book on Penarth Alabaster in January 2017 the following new discoveries have been made.

1. St. Andrew's Church, St. Andrews Major, Vale of Glamorgan

Either side of the north window in the tower of St. Andrew's church, St. Andrews Major, there two Penarth alabaster tablets. I am indebted to the current church warden, Peter Hilary-Jones, for informing me that Chrystal Davies (née Tilney) has recorded the presence of these tablets and transcribed the inscriptions, which are now somewhat difficult to read (Tilney, 1960). The smaller tablet, on the west side of the window, is dated 1725 (Fig. 1) and the larger tablet dates to 1709 (Fig. 2). As they commemorate the death of members of the same family it could be that these two tablets are fragments of a single, larger monument that was present before the church was restored in the C19th. It seems doubtful that they are in their original positions. The tablets are of particular interest as they are the only Penarth alabaster artefacts so far discovered that date to the C18th.

2. Chepstow Castle

In his article on *The Great Tower of Chepstow Castle* Turner (2004) states that Phase Two of the building of the

tower, when it was raised by about 9m, occurred between the late C12th and early C13th. In the description of Phase Two (p. 262), it is stated that *'in the blind archway against the west interior elevation, the Dundry freestone is accompanied by white pink alabaster which forms the lowest block'*. The tower has now been visited to investigate the nature and extent of the alabaster work. On the north side, at the bottom of the arch, there are seven blocks of pinkish-coloured alabaster, three at the base and four on the right side (Fig. 3). The top two blocks on this side are separated by a block of Dundry Stone. The alabaster has suffered some degradation. Figure 4 shows the alabaster work on the south side. Here it comprises seven stones forming a continuous block. These are in a better state of preservation, with the original mason's saw marks being clearly visible, indicating that the stone was never polished.

Turner surmises that the alabaster could have originated either from Aust, just across the Severn estuary from Chepstow, or from the more distant location of Penarth¹. It is also surmised

that this material may have been imported primarily for the purpose of making plaster, some of which also survives in situ in the Great Tower. This is backed up with the statement that an early C14th document records the use at Usk Castle of plaster of Paris made from 'sparstone', shipped from Aust cliff. Whilst it is impossible to determine for certain where exactly the alabaster originated, not least because of its inaccessibility, it appears to be of good quality. The alabaster that currently outcrops in the Aust Cliff is much coarser grained than that of Penarth and tends to be full of flaws containing red or grey mudstone. The deposits are also thinner than those at Penarth. Whereas quality is of little matter if it is to be used for plaster manufacture, it is a material consideration for decorative stonework. The low quality of Aust alabaster was noted by Thomas Rudge (1807) who stated *'Derbyshire alabaster is esteemed of superior value by the marble masons, and is sold at Gloucester Quay, for fifty shillings per ton, while that from Aust, is so low as twenty-two'*. Lewis (1833) noted the occurrence stating that it *'furnishes a plentiful supply for stuccoing, &c., to the masons of Bristol, Bath and other places, but is inferior to that of Derbyshire'*. It is therefore considered less likely that the



Fig. 1. (top left), Fig. 2. (bottom left), St Anmdrew's church.
Fig. 3. (top right), Fig. 4. (bottom right), Chepstow Castle.

alabaster in the Great Tower of Chepstow Castle originated from Aust, Penarth being a more likely location. Notwithstanding its questionable origin, it represents the earliest known use of alabaster in Wales and appears to be the earliest extant secular use of this material in the UK.



3. Ty'n-y-coed, Arthog, nr. Barmouth

Julian Orbach, a co-author of the Pevsner guide for Gwynedd (Haslam *et al.* 2009), informed us that since reading the book on Penarth Alabaster, he had concluded that the 'pink marble arches' carrying the staircase in the hall of Ty'n-y-coed House (colour photograph 95 in the Gwynedd guidebook) were in fact of Penarth alabaster not marble. The house has since been visited. Penarth alabaster is not only present in the arches of the staircase and fireplace in the hall (Fig. 5) but also in various other features within the house, including the dining room the arch over the fitted sideboard (Fig. 6) and an arch in the fireplace over-mantle (Fig. 7) and a small sitting room/TV room (Fig. 8. pilasters in the fireplace over mantle). The house was designed by James, Seward and Thomas c.1875, around the same time as the somewhat similar work they undertook at Insole Court in Llandaff.

4. A Watchet alabaster wall memorial - Monkton Priory, Pembroke

A Watchet alabaster wall memorial has been found in Monkton Priory in Pembroke (Fig. 9). From the style it appears to be C17th. It may possibly have been repaired with Penarth alabaster as both Prichard and Halliday did restoration work here in the C19th. It has not been possible to read the inscription or get a close-up view as it is set high up and not very well illuminated by the existing church lighting.

5. Houses on Newport Road, Cardiff

Several of the houses between numbers 136 (Fig. 10) to 146 on the south side of Newport Road exhibit external elements in Penarth alabaster, including plain blocks, window arch keystones and a cross-like ornamental feature above entrance doorways. We must thank Matthew Williams for this discovery.

Footnote

¹ There remains a further possibility that the alabaster may have originated from Watchet or maybe even Somerton in Somerset as the Great Tower contains stone imported from Dundry in Somerset and Purbeck Marble from Dorset



Fig. 5. (top left), Fig. 6. (center left), Fig. 7.(bottom left), Fig. 8. (right), Ty'n-y-coed House.

FIELD MEETING REPORTS

Nolton Haven and St David's, Pembrokeshire 6th May 2017

John Shipton

On a fine late spring day Forum members assembled at Nolton Haven. Here, we were to view Nolton Chapel that was erected in 1858 using the locally outcropping Coal Measures sandstone.

We made our way onto the sandy beach where we could clearly see where blocks of the Coal Measures sandstones had been won. The colour varies from grey in the lower, older rocks to yellow in the upper, younger rocks. It was not long before Robin Sheldrake found evidence of past quarrying in the form of a drill hole in the beds of stone (Fig. 1). Robin explained that in the past the beach had had another commercial use when ships loaded with limestone were brought into the bay and beached. The limestone would be unloaded at low tide and the boats reloaded with coal from the local drift mines. The limestone was taken by carts to the lime kiln, at the end of the pub adjacent to the car park, to be burned for use in agriculture and building.

We moved on to Nolton chapel (Fig. 2) where we met Franz Nicholas, the conservation architect, and Tom Evans the mason carrying out the repair work. We were shown the quite spectacular cavernous weathering that had afflicted some of the original sandstone ashlars. Robin believed that the original stone had come from the beach and was not very well cemented and therefore wind, rain and frost had caused the grains to pop off. Tim placed a badly eroded block of sandstone on the mason's 'banker' (work bench) pointing out that the surface of the stone was rough and porous allowing moisture, possibly salt-laden, to get into the body of the stone (Fig. 3). In his view, and a theory supported by others, when the stone dries quickly small salt crystals are formed but when the moisture is held longer the salt crystals grow larger forcing the grains of the stone apart resulting in cavernous weathering.

The stone used for repair was another Carboniferous sandstone from the Forest of Dean. Tom Evans placed a block of this on the banker and demonstrated how the margins were dressed with mallet and chisel. After a while he invited others to try their hand and several of the group had a go with varying degrees of success. Following further perusal of the workplace and stone we set off to St David's to visit the cathedral. On the way we stopped to view the brick chimney, between the road and sea, which is the only visible sign left of the Trefrane Colliery. Robin explained that it was from here that the coal was taken by cart to Nolton Haven for shipment.

Following lunch in St David's we assembled outside the porch on the south side of the cathedral. Unfortunately, our



Fig. 9. (above.) Monkton Priory. Fig. 10 (below) Newport Road, Cardiff



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Fig 1. Robin Sheldrake with at old drill hole, Nolton Haven Beach.



Fig.2. Nolton Haven Chapel.

visit coincided with a rehearsal for a concert so we turned our attention to the external elevations of the building and moved round to the recently repaired west front. Although building of the current cathedral commenced in 1181, and was completed soon after, the building has had a



Fig. 3. Tim explaining cavernous weathering.

history of instability and John Nash was commissioned to restore the west front in 1793. However, within a century it needed further structural repair and between 1862 and 1870 the whole building was restored by George Gilbert Scott. Further repair work to the west front was carried out at the end of the C20th.

There was much discussion about the reasons for the surface degradation of the Caerbwdy sandstone ashlar; was it due to natural faults, salt within the stone or possibly a mechanical disturbance caused by the sawing process? The author suggested that the ashlar replaced in the work carried out nearly 20 years ago might suffer the same fate if the degradation was due to mechanical reasons. The quarry in Caerbwdy Bay, used in earlier work at the cathedral, was reopened for this repair project. However, it was reported locally that the stone was won using modern engineering techniques rather than traditional quarrying methods, which may have effected its strength. It is known that stone sawyers cutting the stone into ashlar found their work complicated by drill holes and rock anchors, which it is thought had been inserted into the rock to tear the stone from the quarry face with heavy machinery.

The rehearsal within the cathedral had subsided so we headed inside where the use of Caerbwdy sandstone and limestone created polychromatic features (Fig. 4). We viewed the tombs of medieval clergy before concentrating on a number of memorial plaques. One was a fine example of 'Snowdrop Marble' that it was suggested had come from either Llangynderyn or Marross, both localities

having dark limestone's that contain small brachiopods. Due to rehearsals restarting we decided to spend the rest of the afternoon at the adjacent Bishop's Palace.

The author was fortunate enough to be a member of the Cadw team tasked with a major conservation project at the palace around the turn of the century, much of it carried out using the same sandstone quarried in Caerbwdy Bay and used in work to the cathedral's west front. Another member of the Cadw team was Rick Turner, a former Cadw Inspector, and a paper prepared by him provides much of the background information about the palace in this report.

The Bishop's Palace was almost completely built by Bishop Henry de Gower (1828-47). Although now ruinous it was a remarkable building. The two ranges have arcaded parapets decorated with cut blocks of purple Caerbwdy sandstone and yellow limestone and also contain many carved corbels. Although many are now unrecognisable, due to degradation of the stone, descriptions and recordings of the palace had been carried out by antiquarians from the late C18th and many detailed drawings carried out during C19th show clearly how much erosion has occurred during the last 200 years.

The Bishopric of St David's was not very well endowed and, due to its isolated location, finance dictated that most of the building materials were obtained locally. All the identified building stones used in the palace, with the exception of the oolitic limestone used in Great Hall



Fig. 4. Caerbwdy Stone and limestone used create a polychromatic effect inside the Cathedral.



Fig. 5. Different colour tuffs in the Bishop's Palace walling.
Fig. 6. The Great Hall east gable of the Bishops Palace.

window and rear of the Gate House passage, was quarried near by. Identification of the stone used within the palace was undertaken by Richard Bevins, of the National Museum of Wales.

Precambrian Lower Pebidian tuffs, which are exposed in the Pont-y-Penydd Quarry just north of the Cathedral Close, have been used extensively in the kitchen, alterations to the solar and west gable of the Great Hall (Fig. 5). They are purple and green in colour and are relatively hard wearing.

Precambrian Upper Pebidian tuffs, exposed in the cliffs of Porthlysgi Bay, also occur in a variety of colours, mostly brown and yellow but smaller quantities are pink. These have been used in the undercrofts of the east and south ranges and in the Great Chapel. The yellow and pink rocks have poor weathering qualities and have eroded badly where used in the east range and Great Chapel. The Author pointed out where rendering externally and plastering internally had been employed to try and stop further decay to the eroded stone.

Caerbwly sandstone is the primary freestone used in the palace. It is Cambrian in age and occurs in Caerbwly and Caerfai Bays. It has poor weathering qualities due to the high clay-mineral content but was probably chosen for its local availability. Some Ordovician tuffs were used in the later phases of the work and small amounts of intrusive igneous rocks (i.e. cobbles, boulders or pebbles), are visible around the palace and the surrounding precinct.

The group began by inspecting the undercrofts to the east range below the Bishop's Solar. Although the vaulted ceilings had collapsed they had been rebuilt by Cadw masons using hand picked grey/blue Pembrokeshire slate from Glogue Quarry, near Crymych. Making our way up to the Bishop's Solar, on the first floor, the group had an excellent view through a window of the cathedral's west front where the replaced blocks of Caerbwly sandstone are clearly visible. Walking through the range's rooms we were able to see many excellently carved blocks of Caerbwly sandstone clearly demonstrating the masons skills. Some replacement blocks of stone have been inserted without any attempt to replicate the profile of the original block. The author explained that the reason for this was that Cadw would only carve the stone if they were certain of its original profile. If this was not known, but the stone had to be replaced for structural reasons, the block remained un-carved.

In the south range and Great Hall we were able to view the wheel window in the east gable (Fig. 6). The oolitic limestone, from which all elements of the window were carved, looked to be in very good condition but the author pointed out that, to his knowledge, two major conservation projects had taken place in last 30 years; one in approx 1980 when one of the spokes was replaced with an oolitic limestone as close to the original as was available. Other work carried out at the time was lime mortar repairs to damaged areas and applications of lime-

based shelter coats. During the major conservation project to the palace, around the turn of the century, conservators took advantage of the scaffolding that was in place to repair the masonry of the gable and to inspect the wheel window and apply further shelter coats.

At the west end of the south range is an old latrine block. Here the project team had, respecting all historic floor and roof levels, created a small interpretation facility on the first floor, the ground floor being left as a latrine. The original roof had been covered with a local green slate, fragments of which had been found built into the parapet walls on either side of the roof. These slates were no longer available so Cadw had specified a Westmorland slate as a replacement which, if not geologically correct, was visually very similar and, importantly, was readily available.

Passing through the Great Chapel we viewed further examples of the skills of the Cadw Banker Masons in the door and window jams. Conservation and repair work had also been carried out to a fine Caerbwly sandstone piscine. Although there was still much to see it was getting late so John Davies thanked all those involved in the preparation of the trip and closed the meeting.

The St Maughans Formation of Breconshire, Herefordshire & Gwent

10th June 2017

John Shipton

On a grey overcast morning a large body of Forum and South Wales Geologists Association members assembled at the Parish church of Abbey Dore, what remains intact of the Cistercian Abbey founded in 1147 by Robert Fitz Harold of Ewyas. Construction of the abbey buildings, using sandstones from the local St Maughans Formation, began around 1175 and continued for about 100 years, before the abbey was consecrated by the Bishop of Hereford, Thomas de Cantilupe. Following its dissolution, in 1536, the abbey fell into disrepair but the surviving building was restored in the 1630s with further restoration being carried out between 1700-10.

John Davies explained that the majority of the stone used came from within sight of the abbey from the St Maughans Formation (SMF), which overlies the Raglan Mudstone Formation, the bedrock at the abbey. The sandstones, which are exposed on the higher ground on the valley sides, were deposited in upward-fining sedimentary cycles, with the coarsest material (sandstones and grits) at the bottom of each unit, a process which was repeated many times. It is possible to find a bed of usable sandstone several feet thick.

Many of the blocks of grey grit (from the Conigar Pit Sandstone Member of the SMF), used particularly in the quoins, are pock marked with cavities where pebbles

have been eroded out (Fig. 1). Some blocks exhibit fine bedding and also provide additional information on the depositional setting of the sandstone. For example, one large block showed evidence of a change in current direction with two differently oriented oblique sets of bedding. The block was laid by the mason upside down relative to how it was originally deposited. Some of the dressed stone elements are almost certainly later replacements, most likely Victorian in age, and come from the Brownstones Formation, which lies above the St Maughans Formation. These can be slightly more pebbly, and of red-brown colour (hence the name) as opposed to red-purple of the SMF. These examples however, are probably not local and are thought to come the Wilderness Quarry in the Forest of Dean (see: *WSF Newsletter* No. 8). Further blocks, laid upside down to their original depositional orientation, can be seen in the columns in the south transept. These blocks also show the characteristic striped texture seen in the SMF of cream sandstone with purple-red stripes. John also commented that the SMF can be a good freestone.

Moving into the church Julian Orbach provided background information about the building before



Fig. 1. Cavities in a grey sandstone of the Conigar Pit Sandstone Member. Fig. 2. Coffin made of St Maughan's Formation sandstone.

moving off to view the internal stonework. Features noted included a memorial set high in the wall containing a number of different marbles or polished limestones. Andrew Haycock confirmed that the dark grey limestone with brachiopods was Snowdrop Marble' (see *WSF Newsletter* 14). The altar appeared to be constructed from carved stone blocks, taken from columns in the abbey, topped with a huge sandstone slab. The altar in the southeast chapel also generated considerable interest. Although the surface was heavily waxed, the altar slab appeared to be composed of Bishop's Frome Limestone (see inset box on the Bishop's Frome Limestone). Many present were surprised at this and that this lithology was of sufficient thickness to be extracted and worked in this way. That this identification is correct is supported by other examples of the use of this stone for fonts in the area, confirmed following the trip. Finally, a large stone coffin carved from a block of sandstone from the St Maughans Formation was examined (Fig. 2). The group made a brief visit to the external area of the church, which in the past had been part of the abbey, before moving off to Kilpeck Church.

The medieval church of St Mary and St David, at Kilpeck (Fig. 3), is built using rubble from the locally quarried Raglan Mudstone Formation, in fact so local it may well have come from the land between the church and castle. Some isolated blocks of limestone in the walling were again identified as from the Bishop's Frome Limestone Formation, which outcrops less than 2 km to the NE and NNE of Kilpeck. The dressings are from St Maughans and the Brownstones formations sandstones. Although the church sits on Raglan Mudstone Formation, a NE-SW trending fault to the south of Kilpeck drops down these sandstone-bearing formations. We spent some time inspecting the intricately carved Romanesque south door; and discussion focussed on whether the carvings were original, due to their general near perfect condition (Fig. 4). However, the door had been protected by a wooden porch, until removed in 1868 following major restoration work carried out in 1864. Inside the church a large font (variably described as Norman or Saxon) and a grave slab are cut from a limestone conglomerate, that we were now able to identify as Bishop's Frome Limestone.

Leaving the Raglan Mudstone Formation at Kilpeck, we crossed the fault mentioned previously (the Vale of Neath Disturbance) onto the St Maughan's Formation. Here grits (coarse-grained sandstones) of the Conigar Pit Sandstone Member occur. Much of the stone is grey but some is yellow and flaggy. Our next stop was St David's church at Much Dewchurch (Fig. 5). The building sits on St Maughans Formation from which its walls and dressings are built. However, some elements of the windows, jambs, mullions and tracery have been replaced rather incongruously with a red sandstone, most likely Red Wilderness (of Devonian age) from the Forest of Dean. Yellow limestone tablets found in the exterior

of the east end of the church were not oolitic and Tim thought that they were possibly Caen Stone, a Bathonian (Jurassic) limestone from northern France.

Inside the church John pointed out turbidite structures within the sandstone blocks. This lithology was deposited in a marine environment and the structures showed how the sediment had settled out from the turbidite flow, reflected by coarser sediment at the base of each 'package' but gradually fining upwards. There is also a rather impressive



Fig. 3. St Mary and St David's church, Kilpeck.



Fig. 4. Romanesque doorway, St Mary and St David's church, Kilpeck.

monument to Walterus Pye Miles (1625) worked from white alabaster from the English Midlands, probably Staffordshire or Derbyshire. When the white alabaster started to run out, around the C16th-C17th, veined, brown alabaster, which has been likened to streaky bacon, was then extracted. Large blocks of this have been used in the chancel screen. Another stone of interest are ashlar cut from tufa. This is a lithology the Forum has encountered before on visits to the Wye Valley. It is a porous limestone formed by springs saturated in calcium carbonate. In this area it is known that the occurrence of springs is related to the presence of the Bishop's Frome Limestone.

We had intended to visit Grossmont but, as is so often happens, we had run out of time. John was thanked for organising the trip and he closed the meeting.

Tufa

Not to be confused with tuff (lithified volcanic ash), tufa is another type of non-marine limestone, deposited from calcium carbonate supersaturated water. We have encountered this in the Wye Valley on previous trips. It occurs where limestone overlies less permeable strata, which may be indicated by a line of springs. The precipitation process may be facilitated by plants (through removal of CO₂ during photosynthesis) or microbes. The Bishop's Frome Limestone overlying Raglan Mudstones is the site of a tufa formation. Tufa was popular with both the Romans and with the builders of Norman churches. The stone is porous, therefore light, and easily worked. The peak of tufa formation in southern Britain is thought to be from 5000-2500 BP. It is less likely to form in more recent time as a result of several factors, mainly anthropogenic, such as increased phosphate in ground waters.

See:

H. M. Pedley. Sedimentology of the late Quaternary barrage tufas in the Wye and Lathkill valleys, north Derbyshire. *Proceedings of the Yorkshire Geological Society*, 49, 197-206.

Viles, H.A. 2004, Tufa and travertine. In: Goudie, A.S. (Editor). *Encyclopedia of Geomorphology Volume 2 (J-Z)*, 595-596.

Jana Horak



Fig. 5. St David's church, Much Dewchurch.

What is the Bishop's Frome Limestone?

The Bishop's Frome Limestone (BFL)* differs from many of the other limestones encountered on Forum excursions. Whereas most limestones that we have examined were formed in marine conditions, by the precipitation of carbonate or the accumulation of shelly material, the BFL is of non-marine origin. It is a calcrete, a deposit that forms below the surface of pre-existing sediment or soil by precipitation from calcium carbonate-saturated water within the sediment. Calcretes may form nodular horizons or may develop into more massive deposits. The Bishop's Frome Limestone is the thickest and most persistent calcrete horizon within the alluvial system of the Lower Older Red Sandstone of south Wales and is traceable from the Welsh Borderland to Pembrokeshire. It has a rubbly texture, but towards the top of the unit the nodules coalesce to form a continuous bed of limestone comprising white-grey carbonate nodules in a variegated purple and red matrix. It is this more coherent unit that has been worked as a building stone. Several quarries in the BFL are known from Herefordshire, and many of these were worked for lime (English Heritage, 2012). However, some of these must also have produced stone for use as a building material, and were probably sourced very locally to the buildings in which they are found. We hope to investigate use of the BFL further and report back in the next Newsletter.

*Although referred to as the Bishop's Frome Limestone Member, since the 2015 British Geological Survey revision of Old Red Sandstone stratigraphy, this unit has been termed the Chapel Point Limestone Member.

English Heritage, 2012. *Building stone atlas of Herefordshire*. Strategic Stone Study, pp 20.

Brandon, A. 1989. *Geology of the country between Hereford and Leominster*. Memoir for 1:50 000 Geological Sheet 198.

See also:

The Herefordshire & Worcestershire Earth Heritage Trust project website on 1000 years of building with stone <http://www.buildingstones.org.uk/bishops-frome-limestone/>

Jana Horak

Vale of Glamorgan 8th July 2017

John Shipton

The churches in the Vale of Glamorgan, west of Cardiff, display a great variety of building stones that reflects the varied local geology. We began the meeting at the Plymouth Arms, in St Fagans prior to visiting St Mary's Church next door. Here, over refreshments, our leader, John Davies, told us that the walls of many of the local churches are built primarily of blocks of Carboniferous or Liassic limestone. St Mary's was no exception although the dressings are of a variety of rocks. Moving to the church John chose a small gothic arched doorway to illustrate the characteristics of Bath Stone, an oolitic limestone where, on cut surfaces, the ooliths tend to fall out leaving little holes. It also often contains calcite veins

and/or burrows. When used on protected elevations it tends to take on an orange colour but on those subjected to prevailing weather it may degrade.

A large Gothic window in the gable end (Fig. 1) has dressings to the lower jambs, mullions and cills of Bath Stone but the tracery at the top is Ham Hill Stone, according to the quarry's sales literature. This is a honey-coloured, well cemented limestone from Somerset from the Jurassic Toarcian (late Lower Jurassic). Nearby, John and Michael spotted a large square block of fossiliferous limestone built into the rubble wall, which, upon inspection, was identified as an oyster-rich, lower Liassic limestone. The block had been laid face-bedded providing an opportunity to observe abundant fossils on the bedding surface.

Nearby, a small door also has dressings from a variety of stone (Fig.2). The jambs at the bottom are of Sutton Stone (Liassic age conglomeratic limestone from the marginal facies of the Blue Lias) which outcrops on the coast between Ogmores-by-Sea and Southerndown. This is one of a few freestones to be found in Wales and was widely used in south Wales during medieval times. Other jambs in the doorway are of Ham Hill Stone. Although the walls are predominantly built using Carboniferous Limestone rubble, odd blocks of Sutton Stone have been used and, in the porch, blocks of Old Red Sandstone (Devonian) and Triassic age Radyr Stone. Inside the church dressings in a pale limestone were thought to be Dundry Stone while a dressed stone screen created some discussion as to whether or not it was Liassic: a job for Tim Palmer perhaps.

At Peterstone Super Ely the walls of the porch of St Peter's church are predominantly of random blocks of Liassic limestone with some from the Upper Old Red Sandstone, which outcrops nearby, while dressings to a doorway are of Sutton Stone. Some early, possibly original window dressings, cut from Dundry Stone, still exist in the jambs but other elements, i.e. mullions, have been replaced with Bath Stone probably during the extensive rebuild that occurred in the last decade of the C19th. Although the oldest surviving part of the church is the C14th chancel arch, the chancel itself was rebuilt in 1890-91. Further use of Dundry Stone was found in door jambs on the south elevation.

St Peter's is noted for its C15th perpendicular style west tower (Fig. 3). This has corbelled battlements and gargoyles, which were probably added when the west elevation of the tower was rebuilt or refaced with sawn Lias blocks. John suggested that these were probably local as they contain a higher clay content than the usual Blue Lias. Dressings and string courses are of Sutton Stone and Quarella Stone, a Triassic marginal facies sandstone which was quarried near Bridgend.

At St Nicholas we examined the war memorial which stands outside the churchyard. This takes the form of a celtic cross, which Michael Statham informed us was cut



Fig. 1. (top left) Gothic window at St Fagans church with tracery in Bath Stone at the bottom and Ham Hill Stone at the top. Fig. 2. (bottom left) Side door at St Fagans composed of various stone types. Fig. 3. (top right) The C15th tower at St Nicholas church. Fig. 4. (bottom right) Block of Blue Lias limestone full of oyster shells, St Nicholas.

from Portland Stone by Clarkes of Llandaff. Moving on to the parish church we examined the west tower. At the base is a door arch of Blue Lias limestone with clearly visible oyster shells, indicating that the stone probably came from the oyster-rich beds near the base of the Blue Lias (Fig.4). The quoins and string courses are of Sutton

Stone while the rubble walls are of Blue Lias. A window adjacent to the church porch has jambs of Quarella Stone but the mullions and tracery are of Jurassic limestone.

Inside the church the ornate pulpit is carved in a fine pale-yellow limestone, possibly Caen Stone, with inset columns of green marble which Andrew suggested was



Fig. 5. (top) St Peter's church, Dinas Powys.

Fig. 6. (bottom) Re-used blocks of Carboniferous Limestone inside St Peter's church, Dinas Powys.

Verde Antico from Larissa, in Greece. The ancient font has the upper elements cut from Quarella Stone but the base is Sutton Stone. A large memorial, in the form of a column, is of a yellow/red stone resembling the Spanish Broccatello that Tim identified at Abbey Dore.

We moved on to Dinas Powis to visit St Peter's church, which was built between 1929 - 1930 using recycled stone reportedly taken from Cyfarthfa Ironworks at Merthyr Tydfil. The external walls are of coursed Pennant Sandstone blocks with large Carboniferous Limestone quoins (Fig. 5). The Bath Stone window dressings had not been reclaimed. Internally the walls, columns and arches are all of large blocks of Carboniferous Limestone (Fig. 6), some reclaimed but others from quarries nearby at St Andrew's Major. Some of the reclaimed blocks have streaky lenses of chert on the cut surfaces. Although there is no doubting the skill and ingenuity of the designers and tradesmen the author did feel that what they had created was quite hard and industrial, a view not shared by all.

The final visit of the day was to St Michael's and all Angels church at Michaelston-le-Pit. The church was reportedly built at the end of the C13th, predominantly of local Blue Lias limestone and, like the other churches visited, with a few odd blocks of Old Red Sandstone and red Triassic

sandstone. The quoins are of a very shelly form of Sutton Stone, with replacement windows of Bath Stone. A brief visit inside revealed an ancient font tentatively identified as Dundry Stone. Returning outside a modern boundary wall to the churchyard is built of random rubble containing blocks of Blue Lias, probably from Somerset as there are currently no quarries supplying Lias limestone for building purposes in South Wales. As time was getting on we decided to call it a day and John closed the meeting.

The Carboniferous Sandstones of Northeast Wales: 16th & 17th Sept 2017

John Shipton

A two day trip in September to north Wales, with Andrew Haycock and David Roberts, gave us the opportunity to have a detailed look at the Upper Carboniferous Cefn y fedw, Gwespyr, Cefn, Coed yr Allt (Halesowen Formation) and Erbistock (Salop Formation) sandstones that have been used extensively in the area around Llangollen and Wrexham.

We met at Valle Crucis where Andrew Haycock told us that although the bulk of stone used in north Wales was Cefn sandstone in this area other interesting rocks have also been used. In this region the rocks become progressively younger from west to east with Silurian and Ordovician rocks occupying the area west of Llangollen. Andrew and David pointed out blocks of recycled Gwespyr Sandstone from the abbey in nearby outbuildings. Andrew mentioned that Gwespyr generally contains more feldspar (and clay) than Cefn. The Cefn y fedw sandstone is very hard and quartz dominated, composed of sediment derived from the south, contrasting with Gwespyr, Cefn and other Coal Measures sandstones which generally contain sediment derived from the north. David, from his experience of working these different stones, acknowledged that as a product of its hardness Cefn y fedw has been used little compared to Cefn and Gwespyr.

Before visiting the abbey we viewed the pillar of Eliseg (Fig. 1), which Prof. Howard Williams (Dept. of History and Archaeology, University of Chester) explained had been erected by King Cyngen ap Cadell in honour of his great grandfather Elisedd ap Gwylog, and which stands on a mound whose origins date back to the early Bronze Age. The pillar is a carved piece of Gwespyr Sandstone, sitting on a base of the same stone, the nearest quarries of which are 5.2 miles away in the Dee valley. The pillar and base are made of coarse-grained, cross-bedded sandstone with pebbly horizons with iron staining at the base. Andrew showed the group a sample of the same stone from the National Museum's collections for comparison.

At the abbey, which sits in an abandoned meander of the River Dee, Howard informed us that this Cistercian house was founded in 1201 and rebuilt in 1330 by Abbot Adam. Andrew explained that the bulk of the original



Fig. 1. (top) The Pillar of Eliseg. Fig. 2. (middle) The west front of Valle Crucis Abbey. Fig. 3. Cefn Sandstone blocks, Pontysyllte Aqueduct. Fig. 3. (bottom) Cefn Sandstone blocks, Pontysyllte Aqueduct

dressed building stone is Gwespyr Sandstone but there are also some pieces of Cefn Sandstone that are possibly replacements. The rubble stone walling is from the local Silurian and Ordovician strata, probably from the nearby outcropping Elwy Formation mudstones and sandstones. Also within this fabric cobbles from the river, and acid volcanic rock from north of Llangollen, were identified. Howard explained that in the 1850s the abbey grounds were cleared which reduced the ground to the C13th levels. It was clear from the level of the surrounding land how much material had been removed.

The C13th abbey church is the most prominent surviving building and it was in its west front (Fig. 2) where we first identified banded, gritty Gwespyr Sandstone, used in the door and window dressings and also in the quoins and capitals of the church. There is some reuse of a distinct pink/orange coloured stone, identified as fire damaged Gwespyr Sandstone burnt in the fire that afflicted the abbey around 1236. Time was spent inspecting grave slabs in the monks' dormitory. As the natural light was not good and all the visible surfaces were heavily coated with years of grime, it was unclear whether they were of Gwespyr or Cefn Sandstone. One slab contained clasts, possibly of chert and similar clasts are also present in the Gwespyr Sandstone used in the west front.

Andrew and David pointed out that there were a number of Gwespyr quarries above Trevor. Topographically the highest quarry was near Mount Pleasant above Garth, descending to Garth Quarry then Garth Trevor Quarry and finally Trevor Quarry. After lunch we visited the fenced and overgrown quarry at Garth Trevor. Although access was not possible we could see outcropping blocks of Gwespyr Sandstone and Andrew passed around a sample from the Museum collection that purportedly came from this quarry. Walking back David drew our attention to a rubble wall that was built when the road at the back of the Aussie Rooster pub was widened. It was thought that the rubble stone came from Trevor Quarry, that lay behind the wall, but which is now inaccessible. The stone was coarse-grained, cream in colour and rich in feldspar/clay, much like the Gwespyr seen at Valle Crucis.

At Pontysyllte aqueduct we were able to observe Cefn Sandstone used on a large scale. Below the cast iron channel sections of the aqueduct, in the bank side pier and buttress, we found blocks of Cefn Sandstone displaying cross-bedding and laminations (Fig. 3). It was thought that this had come from the nearby Tyn y Craig Quarry at Cefn Mawr and had been transported to the site by a horse-drawn tramway. We strolled across the aqueduct and came across a large piece of artwork illustrating local history and items associated with the area, which had been mounted on a large slab of Cefn stone. On the back of the slab was a large area of iron banding created by fluid passing through the rock post-deposition.



Fig. 4. (top) Gateway to Wynnstay Hall. Fig. 5. (bottom) York Stone replacements, St Mary's Church, Wynnstay.

There are many disused quarries in the area and on our way to Rhosymedre Quarry, at Cefn Mawr, we stopped for a brief look at it from afar adjacent to the Jolly Mason pub. I think that we can assume that there is a connection between the quarry and pub! Although late to arrive at our final visit, Rhosymedre Quarry, our guide had graciously waited for us and provided access to the quarry through the Cefn Druids football ground, which now occupies the area below the quarry face. Although it was obvious that large amounts of rock had been removed from the quarry the remaining face still exhibited some impressive beds of stone, which would have been ideal for building. It is reported that stone from this quarry was used to construct the railway viaduct over the River Dee. Our host showed us some historic photographs of the quarry that adorned the walls of the clubhouse, including one showing the Ruabon to Barmouth railway line, that cut through the corner of the quarry, and which closed in 1965 as part of the Beeching closures. This completed a very full first day and following a vote of thanks to our hosts we made our way to our overnight accommodation.

Day two found us on the east side of Ruabon Mountain where most of the Carboniferous sandstones can be found. We assembled at a large arched gateway leading in to Wynnstay Hall (Fig. 4). This is built of stone from the Coed yr Allt Formation (Halesowen Formation), which the British Geological Survey describes as a grey-green micaceous sandstone and grey-green mudstone. It was most likely quarried from the estate quarry that we would visit later. Some weathering had occurred to the stone in the arch and replacement ashlar stood out clearly, the blocks being sandstone possibly from Yorkshire. Cottages close by were also built in Coed yr Allt sandstone with an obvious lithic fragment, feldspar and mica content.

The walls of the nearby St Mary's Church are predominantly built of Cefn Sandstone rubble but also contain some river cobbles in the early phase of building, the later Victorian building being much more 'blocky'. We spotted a door blocked with masonry where the dressings appeared to be of an early date and were of Cefn Sandstone. Inside the church there are a number of early (possibly C14th) Christian monuments. It was suggested that one of them displayed weathering typical of Cefn Sandstone but surface oil prevented a definite identification. Some of the blocks of Cefn Sandstone in the aisle columns display red bedding. Outside, the C14th west tower, largely remodelled in 1870-72, displays the dark surface crust brought about by industrial pollution. Some recently replaced blocks of York Stone were already degrading, their dressed surface crumbling on the edges (Fig. 5).

Close to the old church stands the church hall, built in 1982 of local Cefn Sandstone, some of which had been recycled (as evidenced by surfaces bearing limewash) from an unknown source. The building also contains the odd 'exotic'. The entrance to the hall has recycled Cefn Sandstone door jambs, the age and origin of which is also unknown but is probably Victorian as the jambs were cut from blocks of stone cut on six sides, suggestive of mechanical cutting. On the way back we passed a small round building built in Cefn Sandstone that David Roberts informed us was originally the town 'lock up' for drunks but was now used by the nearby Vaults Pub for storage. Before lunch we visited the Coed yr Allt Quarry on the Wynnstay Estate. Wynnstay Hall was damaged by fire in 1858 and the quarry was reportedly opened for the rebuilding works. Although now largely overgrown thick beds of green-white coloured Coed yr Allt (Halesowen Formation) sandstone are still visible. Well-preserved tool marks are also still visible on the quarry face and the flaggy beds that occasionally occur are also exposed. A sample of rock found on the floor of the quarry was seen to contain fragments of coal and mica on bedding surfaces.

Lunch was taken at the Cross Foxes pub at Overton, the car park and garden of which overlook a road bridge over the river Dee. Andrew told us that the reddish stone used



Fig. 6. Wynnstay Hall.

to build the bridge was sandstone from the Erbistock Beds (Salop Formation) which was worked from a number of quarries in the area. This is a Carboniferous sandstone that becomes redder in colour towards the top of the Carboniferous succession.

The afternoon began at Wynnstay Hall (Fig.6) which has a chequered history. Damaged by fire and rebuilt in

the C19th it was requisitioned during World War 2 and suffered the fate of many other great houses requisitioned for military use. After the war, although in fairly poor condition, it became a school but has now been converted to luxury apartments. Moving around the perimeter of the house we came to the Tattershall stable block. Built in 1738-39 it was repaired from 1970-80 by Cleggs Yard Masons using sandstone from Yorkshire.

Making our way through the extensive gardens, designed by Lancelot 'Capability' Brown, we found a considerable pile of Tufa. Why it was there none of us knew. At the edge of the formal garden, in the adjacent wooded area, stands the Grade 2 listed dairy. Originally free standing it now has a C19th extension to the rear. The part used as the dairy is a single storey rendered building with a slate roof adorned with a Doric tetrastyle temple front. With its sandstone ashlar and columns it is like no other dairy that I have ever seen.



Fig. 7. All Saints Church, Pen-y-Lan.

All Saints Church at Pen-y-Lan (Fig.7) was built at the end of the C19th for the Ormrod family entirely of stone from the Erbistock Bed (Salop Formation). This fine-grained sandstone is from a poorly documented quarry near Lower Farm Wood and Graig Quarry at Quarry Wood. David confirmed that a local developer recently acquired stone for a replacement cross at the west end of the church, from a loose block from Graig Quarry. He was told by Peter Charles Ormrod that some of the stone for the original church came from the quarry near Lower Farm Wood. It is likely that both quarries also provided stone for the houses in the village. Externally some of the stone is showing signs of surface degradation. Inside the

church we examined a font, thought to be of Caen Stone and serpentinite. David informed us that the floor tiles were made locally to the Pen-y-Lan Estate.

The last visit of the day was to Graig Quarry at Quarry Wood where the Erbistock Beds were quarried. Here, a long, very overgrown, quarry face displays stone of varying qualities and thicknesses. Some large blocks lay at the base of the quarry and along the trackway on which the stone was hauled out. Here Andrew and David were thanked for organising an interesting and informative trip before we started, what was for some, a long drive home.

Kidwelly, 7th October 2017

John Shipton

The Forum first visited Kidwelly Castle in March 2007 following a request from Dr Rick Turner, former Cadw Inspector, to assist with his research into the building of the Great Gatehouse during 1402. Rick needed to identify the building stones used in the gatehouse to help inform which part was constructed during 1402. So it was that on a very wet day at the end of September 2016 Jana, John Davies and the author met Rick at Kidwelly Castle. As a result of this research it was agreed that it would be worthwhile the Forum revisiting Kidwelly, which we did as the last meeting of 2017.

Before venturing inside the castle John and Jana explained the surrounding geology, which is Palaeozoic in age. The country to the north and west is underlain by Old Red Sandstone, with the Senni Beds producing a green-grey sandstone building stone. Just north of the castle the Carboniferous Limestone outcrops, with the castle itself built on a ridge of Millstone Grit, which contains quartz-rich sandstones (arenites). To the southeast the Coal Measures occur, including Pennant Sandstone. Looking up at the castle we could see pebbly Old Red Sandstone used for corbels, a rock type that John informed us outcrops to the northeast.

Inside the castle John gave a brief history of the structure, explaining that it had been originally built to assist the invasion of Wales and not as a defensive structure. The inner ward, the earliest part of the castle, is similar in plan to other Edwardian castles; square with a tower at each corner. The C13th towers are of Twrch Sandstone (also known as Millstone Grit) and other Carboniferous sandstones, with dressings to doors and arrow loops of Sutton Stone (Fig. 1). Three towers were raised in height in the late C14th so that the occupants could see over the outer curtain walls that were built in the early C14th. At the top of the towers the original castilations, constructed from pebbly Old Red Sandstone (Brownstones Formation) containing pre-ORS pebbles and rock fragments were still visible. Corbels, mostly in Carboniferous sandstone, had been used to support further construction. The northeast tower had not been raised as there was no outer curtain here to impede line of sight.



Fig.1 Arrow loops dressed with Sutton Stone, Kidwelly Castle

Within the inner ward John pointed out that the corbels are of Carboniferous Limestone and not the pebbly Brownstones used elsewhere. The different phases of work in the curtain walls are clearly reflected in the use of different rock types, a feature replicated in the towers where the structures were revised around the same time.

In the Great Gatehouse the dressings are of Sutton Stone, Quarella Sandstone (although fine-grained this identification has been confirmed in thin-section examination by Jana) and in the later works Carboniferous sandstone. These sandstones have degraded far more than the Sutton Stone, which had led to a major conservation project being carried out 10 years ago, the author pointing out some of the repairs that were carried out at that time. From the upper, accessible levels of the gatehouse, we could see the vaulted roof of the Sacristy that is covered with sandstone tiles, provisionally identified by John Davies as Carboniferous flags from the Coal Measures. Leaving the castle through the gatehouse we looked at the large dressed, green sandstone blocks in the door jambs (Fig. 2). Once again these have been confirmed by Jana as Quarella Sandstone, although it is finer-grained than much of this stone seen elsewhere. The political patronage of the castle fits with the use of Quarella.

Heading into Kidwelly for lunch we passed through the main town gateway, built of local rubble stone. Jana pointed out a number of granite cobbles within the fabric (Fig.3). Discussion then followed as to whether these were derived from the local glacial drift deposits or originated as medieval ballast. At present the specific provenance to these granite cobbles has not been substantiated, as this requires extraction and destructive analysis. The most likely option is that they come from Ireland. Both the



Fig. 2. (top) Badly weathered Quarella Stone in the gatehouse, Kidwelly Castle. Fig. 3. (bottom) Granite boulder in the town wall, Kidwelly.

exact geographical provenance and method of transport require further investigation, so watch this space!

After lunch we visited the C13th church of St Mary's in Kidwelly. This is built of local rubble, similar to that in the castle, plus a variety of external stone dressings. The porch contains Devonian sandstones from the pebbly Brownstones, and also sandstone dressings to the entrance doorway with a tentative provenance of the Senni Beds (Senni Formation, Lower Old Red Sandstone) (Fig. 4). The replacement limestone window dressings exhibit crustacean burrows typical of Bath Stone, as well as surface patches of a yellow/orange lichen that is commonly found on limestones. Tim identified some original Dundry Stone dressings in the windows and curiously there is a

square block of Dundry Stone built into the wall, adjacent to a Victorian replacement cill cut from Bath Stone. Tim explained that when identifying Dundry Stone it should be remembered that Doulling Stone is also made up of fragments of broken crinoids, which tend to be a bit coarser than those typically found in Dundry Stone. A grave slab in the wall, probably taken from the floor inside the church, and containing fossil brachiopods, closely resembled Snowdrop Marble. Andrew not being present we suspended a definitive prognosis. It was pointed out that due to the effects of the Carreg Cenen Disturbance a similar stone was quarried locally.

On the south elevation, dressings to a window are cut from a pale limestone containing cavities where clasts have weathered out, a feature characteristic of Sutton Stone. On the southeast corner of the church are Forest Pennant Sandstone replacements in a string course, which replace earlier local sandstone elements. On the east elevation, a large window with original Sutton Stone jambs, has a replacement cill, mullions and tracery in a limestone identified by Tim as Doulling Stone. On the north elevation we found a window, of the same style and size as one on the south elevation, where a small square block of Dundry Stone was built into the adjacent wall. This window, like the one on the south elevation, has Victorian Bath Stone dressings and a small square block of Dundry Stone built into the wall fabric next to the cill. This was obviously no accident as it occurs on opposite sides of the building and the only conclusion that we could come to was that this was the architect or masons way of indicating that the window was a replacement and that the original stone used was Dundry Stone. At the base of the C15th tower John pointed out a yellowish, pebbly, Brownstone in the buttress.

Inside the church the masonry columns were found to be of Old Red Sandstone and Dundry Stone, giving a rather attractive polychromatic effect (Fig.5), while replacements at the bottom are probably Forrest Pennant Sandstone. A screen to a side chapel, off the transept, is cut from a closely compacted oolitic limestone as is an altar, both of which Tim suggested were probably stones with a French provenance. The church has two piscinas, the bowls of both being cut from pebbly Brownstone sandstone.

Finally, we inspected some very badly eroded dressings above a low Gothic arch in the north aisle. These are sandstone, probably from the Senni Beds, but there was no obvious explanation for the decay although it looks like the effects of salt crystallisation. John thought that if the stone had been obtained from the Old Red Sandstone outcrops on the shore at Ferryside then it might well have contained dissolved salt from the marine environment.

We had intended to visit St Iltyd's Church at Pembrey on this trip but once again we had been too ambitious so at 3.45pm Jana thanked John and he closed the meeting.

Stone use at Kidwelly Castle

Jana Horak

Kidwelly Castle originates from the early C12th, although, the stone structures mainly range from late C13th to the second quarter of the C15th. The patterns of stone use can be mapped through these phases. The fabric of the walls is locally derived, with some local stone (Pennant Sandstone and Old Red Sandstone) dressings. Earlier phases of building use Sutton Stone (limestone) and Quarella Stone (quartz sandstone) freestones for dressings.

Geology

Kidwelly sits on the north edge of the South Wales Coalfield (Fig.1). To the northwest lie Devonian rocks (pinky-orange and brown on the map), while immediately to the northeast lie Lower Carboniferous limestones and mudstones (Pembroke Limestone Group - greens and blues), overlain by sandstones of the 'Millstone Grit' (Twrch Sandstone Formation - yellow) and then mudstones, sandstones (and coal) of the Coal Measures strata (grey and olive) and finally the Upper Coal Measures Pennant Sandstone Formation (gold).

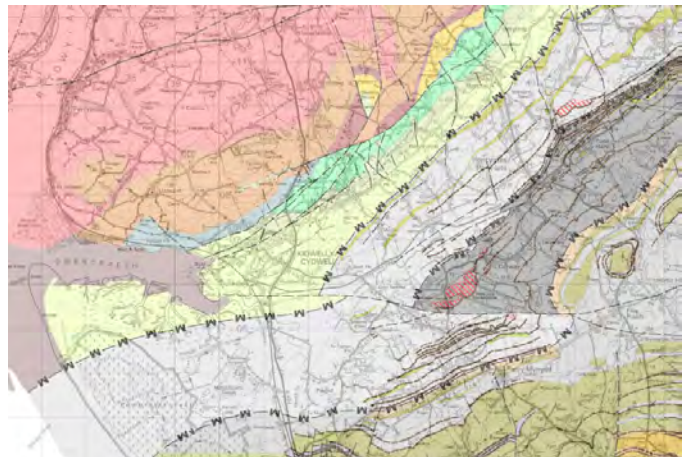


Fig. 1. Geology of the area around Kidwelly. Copyright BGS (2018).

Sutton Stone & Quarella Stone

These two valuable freestones come from the Bridgend area. They are both geographically restricted, forming the local marginal facies of the Triassic (Quarella Stone) and Lower Jurassic (Sutton Stone) formations, which were deposited around islands of Carboniferous Limestone. The lower part of the Sutton Stone succession is generally more conglomeratic than that higher in the succession. Quarella Stone occurs within the Westbury Formation of the Upper Triassic Penarth Group. It is the upper of two sandstone units, which at its greatest thickness reaches 7-11m, which thins to just 5m and 1 m to the southeast of Bridgend. It is characteristically brown, buff or green in colour (this being imparted by clay minerals) and medium to fine grained (0.5 mm – 0.125 mm grain size) (Wilson *et al.* 1990).

Chronology of building

The plan of the castle (Fig. 2) indicates the phases of building. Although visually useful it does not reflect



Fig. 4. (top) Entrance porch, St Mary's church, Kidwelly.

Fig. 5. (bottom) Old Red Sandstone and Dundry Stone pillars, St Mary's church, Kidwelly.

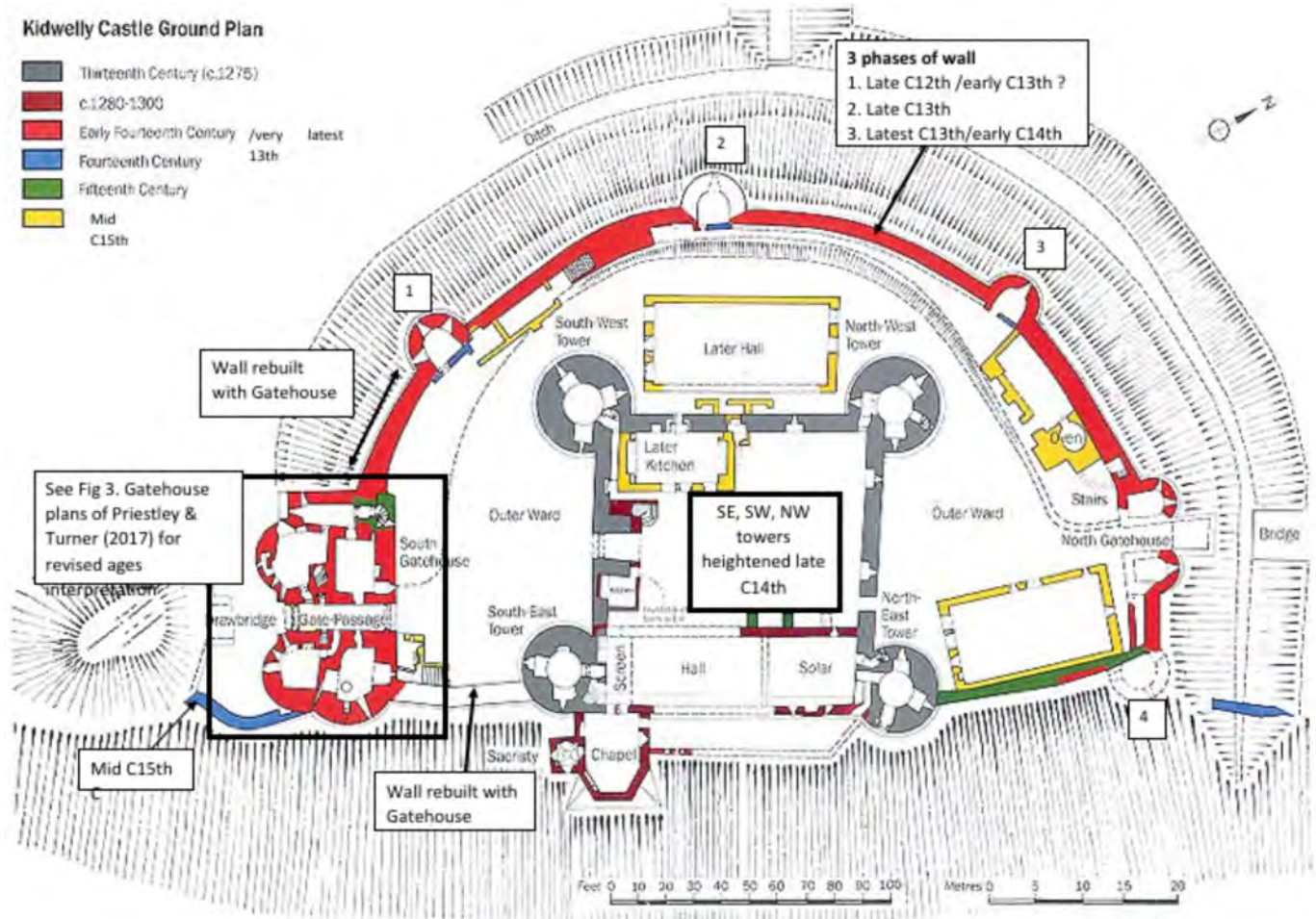


Fig 2. Plan of Castle (Cadw, pre -2002), coloured-coded for this article by date of construction. Annotations indicate alternative interpretations to the colours presented (using data from Priestley & Turner, 2017 and Kenyon, 2006), in particular note difference in attributed age of Gatehouse fabric here, and in Table below, also note the three distinct phases of construction of the outer wall not referred to in the Cadw coding.

Phases as on Castle Plan (Fig. 2)	Main 1 Late C12th/ early C13th	Main 2 1275	Main 3 1283-1303	Main 4 Early C14th	Main 5 Late C14th		Main 6 Early C15th		Main 7 Mid C15th
Gatehouse phase from Priestley & Turner (2017)	GH 1?				GH 2 (1388-9)	GH 3 (1395-99)	GH4 (c. 1403)	GH 5 (1407- 25)	
Boulders		X							
Carboniferous Sst	X	X	X	X	X	X	X		X
Pennant Sandstone							X	X	
Carboniferous Lst		X			X				
Pebbly Brownstones				X		X			
Sutton Stone		X	X		X			xR	
Quarella Stone						X			
Pennant Sandstone								X	

Table 1. Phases of construction indicating stone type used. Phase 1 not shown in Fig. 2. but derived from interpretation of age of outer wall (Kenyon, 2006). Phases 2-7 as on Fig. 2, GH = gatehouse phases from Priestley & Turner (2017).

current knowledge and the annotations indicate changes recorded in Kenyon (2008). The excellent research of Preistley & Turner (2017), from which the data in Fig. 2 is also derived, provides details of the construction phases of the Great Gatehouse over the period 1388-1422, and also of the people who built it. Table 1. attempts to rationalise

this data with the stone types used.

- Main Phase: Late C12th / early C13th. First outer curtain wall (not shown on castle plan)
- Main Phase 2: c. 1275. Inner ward, outer curtain wall and towers.
- Main Phase 3: 1280-1300. Chapel, buildings within

the Inner Ward, rebuilding of the curtain wall, raising the height of Inner Ward southeast, southwest and northwest towers.

- Main Phase 4: Early C14th. Earthworks /possible curtain wall work listed under 3.
- Main Phase 5: 1388 -1422. Great Gatehouse in 4 phases (GH 2-5, after Preistely &Turner, 2017).
- Main Phase 6: Mid C15th. Late addition of hall and kitchen; rebuilding of bakery

By the early C17th the castle was reported as decayed and ruined.

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Welsh Stone Forum visit to Tredegar House near Newport

John Shipton

In August, 2017 the Forum made an informal visit to Tredegar House, in Newport, to view the conservation and repair work being undertaken by the National Trust. This followed an initial visit by Jana in July, to provide assistance with building stone identification. The primary function of the visit was to view the limestone used on the external elevation of the house.

On the 24th August Tim Palmer, Jana Horak, Andrew Haycock, Johnathan Morgan, Michael Statham and John Shipton were met by National Trust staff and, after being kitted out with PPE and receiving a health and safety briefing, were taken on to the working platforms of the scaffold (Fig. 1). Our visit was timed to coincide with the construction workers' lunch break, so time was of the essence. After viewing the replacement slate roof (black north Wales Ordovician slate) we were shown the extent of the degradation to the original limestone window dressings.

Tim explained that the house was built during the 1670s, which predates the early development of the use of Bath (Combe Down) Stone and, in places, the stone used looked like Michinhampton Stone. We were informed that the replacement stone was Monks Park Stone, another Bath Stone. Tim felt that this was a suitable candidate considering the current availability of such limestones.

Inspection of the moulded details over the windows found that some had been cast in a hard, concrete like mortar, with inset details in a fine-grained artificial stone. Whilst on the scaffold we also noticed a slab of dark limestone, set in the wall, that Andrew agreed that this was probably



Fig. 1 (top). Members on the scaffolding. Fig. 2. (bottom) Snow-drop Marble, Tredegar House.

Snowdrop Marble (Fig. 2). Further such marble, rich in Productid brachiopod fossils, was spotted in a fireplace in the main house. Our time slot was now up and the Trust staff needed to return to their public tours so we thank them for facilitating our visit and retired to the café.

Provenancing 'The Smiling Abbot' sandstone

Andrew Haycock

In September 2017, I was invited to Llangollen Museum by Professor Howard Williams (Dept. of History and Archaeology, University of Chester) to inspect the Smiling Abbot, a medieval effigial sandstone slab from the early C14th, that had been rediscovered in the grounds of Wynnstay Hall Wrexham, and subsequently sold to Meryl and Jerry Butler at an auction of building stone at Lindisfarne College (Wynnstay Hall) in the 1980s (Fig. 1). Thought to depict an abbot of the Cistercian house of Valle Crucis, near Llangollen, it was most likely removed from the site during the C19th clearance of the abbey ruins (Williams *et al.* 2017).

On the day, we were joined at the museum by Maddie Gray, David Roberts and Mike Statham, all of us keen to see the stone 'in the flesh'. If we could determine the provenance of the stone as local to Valle Crucis, it would



Fig 1. The Medieval effigy.

help provide further weight to evidence that the stone originated from the site. If so, it will be the only known effigial slab commemorating a Cistercian abbot from Wales, and a rare example from Britain.

During the initial visual inspection (Fig.2), it could be determined that the stone was undoubtedly of a local origin, but it was difficult to say definitively whether it was Cefn or Gwespyr Sandstone due to surface weathering. By contacting the owners, I was able to take two discreet chips from the back of the specimen, so a formal examination of the lithology could be undertaken once two standard thin sections were prepared at Amgueddfa Cymru-National Museum Wales.



Fig.2 Examining the slab.

The lithology of the sandstone was found to closely match Cefn Sandstone, the nearest available significant source of which, to Valle Crucis, can be found just over 6 miles away to the east at Cefn-mawr. The sandstone outcrops extensively on the east side of Ruabon Mountain in this region, so it is therefore reasonable to conclude the stone has a source in this local lithology.

Reference

Howard Williams, Gillian Smith, David Crane & Aaron Watson (2017): The Smiling Abbot: Rediscovering a Unique Medieval Effigial Slab, *Archaeological Journal*, DOI: 10.1080/00665983.2017.1366705

SHORT NOTES

Two unusual stones identified

Blue John. Only found in the Castleton area of Derbyshire an example of Blue John, a purple/white banded variety of fluorite (CaF_2), has been found in a fireplace at Insole Court, Cardiff. The current owners of Treak Cliff Cavern, where Blue John is still mined, were sent the photograph (Fig. 1, below) and identified that the stone came from the Winnats One Vein of Old Tor Mine. A piece of Blue John from this vein and of this size and quality would cost well over £100 today.



Fig. 1. Blue John (fluorite) in fireplace at Insole Court.

Michael Statham

Cotham or Landscape Marble. Cotham or Landscape Marble is a Triassic age limestone containing fossilised algal growths and worm burrows which, when polished, look like a miniature landscape. It is only found in the Cotham Member, of the Lilstock Formation (Penarth Group), of Rhaetian (Triassic) age, of southwest England and south Wales. It is still used to produce small decorative items of jewellery but larger pieces are present in museum collections. However, a rare and possibly unique architectural example of its use has been found in a fireplace in Plas Newydd House, Anglesey (Fig. 2).



Fig. 2. Cotham Marble from Plas Newydd House, Anglesey.

Michael Statham

Machynlleth War Memorial

Machynlleth War Memorial (Figs 4 & 5) is principally made of a Triassic dolomitic conglomerate from Somerset. This stone was quarried at several localities around Draycot and Westbury-sub-Mendip where it was widely used for rubble-stone walling, gateposts and lintels. There are columns made from this material in Wells Cathedral. When used ornamentally it is referred to as Draycot Marble and is somewhat similar to Radyr Stone. The memorial was designed by London architect James Leonard Williams and constructed by A S Gilliam of Bryscom Quarries, near Draycot. As well as the main



stone there are columns of polished Aberdeen granite with caps of polished slate. Information about the men listed on the memorial can be found at <http://www.historypoints.org/index.php?page=Machynlleth-war-memorial>.

Michael Statham

A Fine Example of the use of Douling Stone in Wales

The Builth War Memorial, shown in the photograph (Fig 1), is made of three different stones. Tim Palmer has identified them as; a locally sourced greywacke (the basal steps), Portland Stone Whit Bed (the figures) and the rest Douling Stone.

Michael Statham



Fig. 3. (above) Machynlleth war memorial. Fig. 4 (top right) Close up of dolomitic conglomerate.



Fig. 5. Builth Wells war memorial.

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