STRATEGIC STONE STUDY

A Building Stone Atlas of NORTH-WEST YORKSHIRE

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NW Yorkshire Bedrock Geology

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Introduction

The underlying geology of north-west Yorkshire and the impact of its subsequent palaeoclimatic history has defined the character of the current landscape and the building materials that typify the area. Much of the area lies in the Yorkshire Dales National Park and consists largely of upland, dissected by numerous valleys which drain to the south and east which gives 'the Dales' its name. The word dale originates from the Nordic word dalr and old English word dael meaning valley. The Dales here, is taken to mean all the valleys in North Yorkshire draining the Pennine moorland. These include Wharfedale, Airedale, Ribblesdale, Swaledale, Wensleydale, Coverdale, Arkengarthdale, and many other smaller dales. It also includes Nidderdale which is the only major 'dale' outside the Yorkshire Dales National Park.

The solid geology of the area is dominated by Carboniferous strata, but the **LITHOLOGICAL** nature of this succession changes both from north to south and west to east, controlled by major fault systems associated with the intrusion of the deeply buried **GRANITE** that forms the core of this uplifted area, known as the Askrigg Block. The oldest rocks at **OUTCROP** are of Lower Palaeozoic (Silurian and Ordovician) age and underlie the Carboniferous succession, which is exposed over most of the area. They crop out only on the western fringes of the area in small inliers around Ingleton, Austwick and Ribblesdale, along the North Craven Fault, and in the extreme north-west, in the Sedbergh area, where they are brought to the surface by the Dent Fault. In the southern part of the Askrigg Block massive, early Carboniferous limestone beds of the Great Scar Limestone Group (Lower Visean) form spectacular vertical escarpments along the Craven Fault System or where eroded by glacial action (for example at Kilnsey Crag in the top right image) or by meltwater as at Gordale Scar.

In contrast, in the northern part of the block, the Upper Visean rocks are typified by rhythmic, cyclic sequences of **SANDSTONES**, fissile **MUDSTONES** and **LIMESTONES**, and comprise the Yoredale Group. Sandstone was usually the building stone of choice but in some areas the crinoidal limestones could be just as easily dressed into square blocks and were also used for building stone.

The mudstones were generally not hard enough to be used in building but some can be seen in buildings in the Richmond area.

The softer, coarser sandstones, often locally termed 'gritstones', were easier to work using primitive tools, and preferred by the earlier builders.

To the south of Craven Fault System, from Bolton Abbey eastwards, around Skipton, Gargrave, Coniston Cold, Airton and Hellifield, the Visean rocks seen at outcrop are inter-bedded limestones and mudstones and locally contain **FOSSILIFEROUS** reef limestones. Upper Visean sandstones are not found in this area and the only sandstones to be used for building were quarried from the overlying Millstone Grit Group capping the highest hills of this area.

The Millstone Grit Group (Namurian) rocks generally crop out to the east and south of the area, limestones are not common in this succession which is characterized by massive coarse, **CROSS-BEDDED** sandstones. In these areas the choice of building stones becomes much wider and there were many quarries around Skipton, Harrogate and in Nidderdale working the different sandstone beds within the sequence.

The succession then dips to the east beneath the unconformably overlying Late Permian (Zechstein Group) strata. At outcrop the Cadeby Formation **DOLOMITIC** limestone (dolostone) unit forms an abrupt, almost north-south boundary with the Millstone Grit rocks. The Cadeby Formation (formerly the Lower Magnesian Limestone) dolomitic limestone is a good **FREESTONE** and was used, together with Millstone Grit sandstone in many small market towns on the eastern fringes of the Yorkshire Dales.

The building stones of the Cadeby Formation dolomitic limestone unit are described in more detail in the in the Building Stone atlas's for North-East, South, and West Yorkshire.

To the south, across the Craven Fault System, in a small area around Burton in Lonsdale and Low Bentham, and to the east in a small area around Grewelthorpe, the late Carboniferous (Westphalian) Pennine Coal Measures Group succession crops out at the surface.

There are a few small quarries in these strata which are probably the source of building sandstone in the immediate area, but overall it does not form an important building stone resource in north-west Yorkshire.

The scouring of the valleys by ice in the Pleistocene left the more resistant rocks exposed along the valley sides in the upper Dales areas. This ice also transported large boulders and fragments of bedrock, together with silt and clay which were deposited in the valleys and low lying land to the east and the south as the ice melted.

A classic example is seen near Norber where blocks from the Austwick Formation (Silurian) of Crummackdale, have been deposited on the Carboniferous limestone outcrop. Similar blocks have been torn from the Grassington Grit of Flasby Fell and deposited as' block trails' along the direction of ice movement. Occasionally erratic blocks of more exotic stone, not readily identifiable in the immediate area, are found in the **RUBBLESTONE** used for building. On the eastern fringes of the area thick glacial till becomes more evident and in some places has obscured the underlying rock, here brick buildings become more common. Periglacial conditions had powerful erosive forces, meltwater, freeze thaw and strong cold winds could cut through and reshape the rocks in large areas, for example at Brimham Rocks near Pateley Bridge, (image below) where the crossbedded sandstones of the Brimham Grits are exposed in curiously shaped pinnacles. The subsequent development of major river systems has transported cobbles from upstream areas and buildings of rounded cobblestone can often be found in the lower lying areas adjacent to the larger rivers. e.g. Gargrave on the River Aire, Ingleton on the River Greta, and Mickley on the River Ure.

Geological mapping & building stone names in north-west Yorkshire

The earliest geological mapping and first formal naming of the rock units of the area was carried out in the C19, however, it is clear that stone had been quarried and used for various purposes for several hundred years prior to this time. Local names were often given to these stones, for example 'rag stone' was the general name used for stone suitable for building but difficult to work. In the Sedbergh area ragstone seems to have been used for sandstones and mudstones from the Coniston and Kendal group successions and the term 'blue rag' reserved for the finer grained 'blue slates' quarried from these rock units. In other areas terms like the Brimham, Follifoot and Plumpton grits were all named from their principal areas of outcrop.

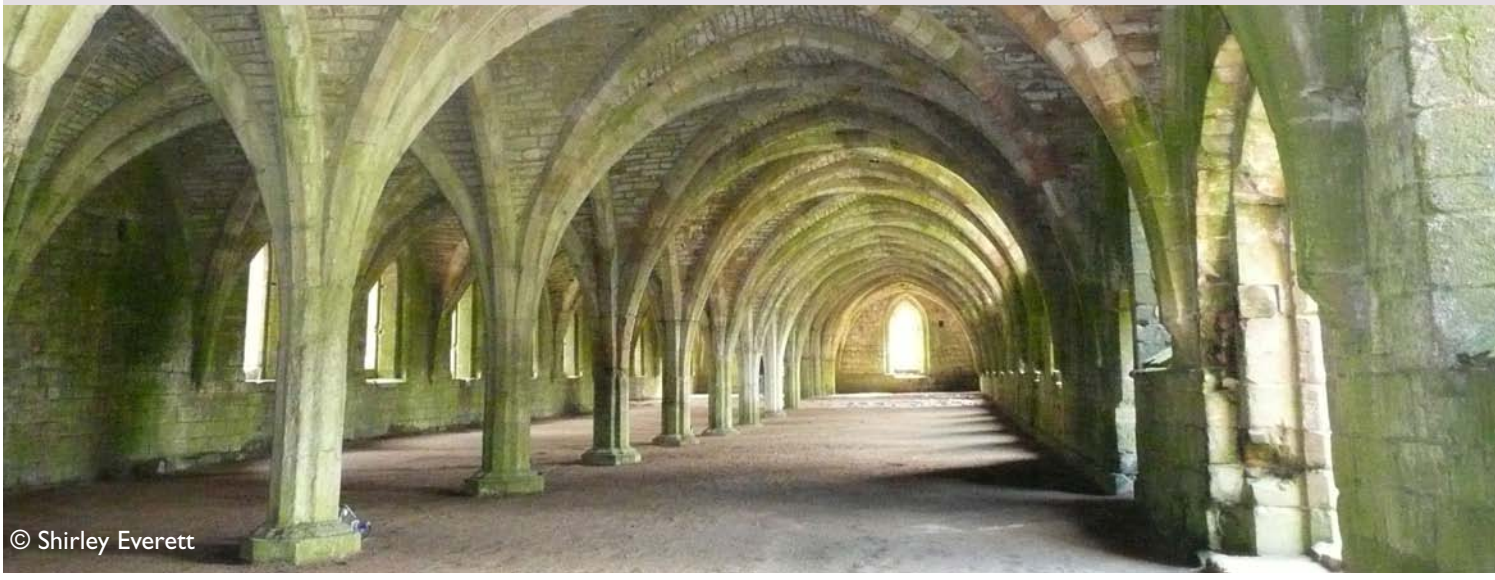
Some C19 geological maps have been updated by modern surveys at various times and the names of the geological units have often been changed. The early names could vary from area to area making correlations difficult. Some sheets have not yet been resurveyed or are published only as a provisional editions and this can still lead to difficulties in relating old geological accounts to the new mapping and geological research in the area.

In this account the terms used are the most recent names available but wherever necessary the previous names by which the rock unit has been known will also be given.

Building with stone in north-west Yorkshire

Exposed stone on the hillsides is a feature of the Yorkshire Dales and the use of stone for building dates back to Prehistoric times. In many areas of the Dales, Bronze and Iron Age settlements are still visible as remnants of platforms, enclosures and round houses, built from the stone cleared from the immediate hillsides. Examples can be found in Wharfedale, Nidderdale and Swaledale. The Romans were in Britain for around 400 years and used stone in a more organized manner building arterial roads, forts and in some cases, villas. Where they stayed for longer periods they built more permanent buildings of local stone, for example the C2 villa at Gargrave and the C4 Roman Fort of Bracchium at Bainbridge. These buildings have long since been robbed of their stone, which was often re-used in local cottages and buildings close by.

In the C11 the Normans built defensive castles from the local stone e.g. at Skipton, Middleham, Castle Bolton and Richmond. In Medieval times many monasteries were established and extended over the next 400 years. Substantial remnants of the largest monastic sites can still be seen, as at Fountains Abbey (image below), Bolton Priory and Jervaulx, but several other lesser known, smaller abbeys were also built for example at Coverham. These impressive buildings were looted for their stone after the dissolution of the monasteries in the C16, which was then recycled in other buildings around the dales, for example, near Bolton Abbey. At this time chapels and churches were also being built out of local stone throughout the Yorkshire Dales. Many surviving churches and chapels contain remnants of their medieval stonework within the fabric of the buildings and sometimes the original stone was reused in later building phases.



The ordinary people rarely used stone for their houses until the C17 when houses and other buildings throughout the country were gradually being rebuilt in stone. The source of the stone was often nearby and for some buildings it was simply a case of gathering stone from the local fields, rivers or rock outcrops. Not only were the walls built of local stone but in some locations they used local stone slates (fissile sandstones) for the roofs, these were readily available in several areas of the Dales (see pages 6-7).

Although the sandstone outcrops were extensively quarried in some areas, in others the fields were strewn with stone boulders deposited by the glaciers. Around Whaw in Arkengarthdale for example, the amount of such rubblestone available far exceeded the local demand for building and walling stone as can be seen in the image below. Consequently, large heaps of these locally cleared fieldstones are found at the edges of the fields or along the roadside. They still provide a ready source of building rubblestone.

In areas where the stone was too thinly bedded or to fissile to produce large blocks, more massively bedded sandstone was brought in from further afield for use as **LINTELS** and **QUOIN** stones. Large stone blocks were imported for use in many of the county's bridges, especially where previous structures of local rubblestone had been carried away in floods. For example, Barden Bridge, on the River Wharfe was rebuilt in 1676 after being washed away in the disastrous flood of 1673, bridges at Kettlewell and Burnsall were also destroyed in the same flood.

In the late C18 and early C19, the cotton industry, expanded rapidly, old corn mills were being converted and over 40 new mills were built across the Dales and in the towns along their fringes. Their main requirements were water, labour, good transport routes to market and a source of stone to build the mills. Land advertised for sale in 1792 at Blubberhouses as suitable for a cotton mill, advertised "much stone on the land".

Although the stone used for building varies with the geology, the ease of working also has a part to play. There are a huge number of limestone quarries both large and small across the Dales area, but not many of these were used for building stone. Where there was a choice of sandstone or limestone for building, sandstone was usually preferred. Working the limestone into square blocks was difficult and time consuming, which also made it more expensive. Where limestone was used prior to the C18 for the homes of ordinary people, it was more often used as a rubblestone. Many of the Dales quarries were producing lime for the mortar used in building both sandstone and limestone walls. Where houses and cottages were built of limestone rubble they were often, 'slobbered' or 'rough cast' with mortar or render. This render consisted of lime mixed with sand to cover the rough rubble walls and helped to make them waterproof. For larger buildings, limekilns were often built close to where the mortar was to be mixed and used. Limekilns can also be found on sandstone strata where the limestone was brought to the kiln and fired for use in the immediate area. Lime from the kilns was also used as a soil improver and much later as a flux in the steel industry. Ironically sandstone was needed to build the lime kilns as the heat generated would break down the stone if limestone was used.

The building of the railways in the C19 further stimulated the building stone industry as the industry began constructing the huge viaducts needed to span the deep river valleys that cross the area. When the lines opened, new markets for stone, from further afield, were suddenly accessible. Large quarries developed in areas where suitable stone could be found, such as Hawes, which provided good quality roofing slates, and Nidderdale where huge 'landing' stone slabs were taken from the Scotgate Ash quarries to be used at the mainline stations of Paddington, Scarborough, Darlington, Newcastle, Holyhead etc.

Roofing Slates & Flagstones

Slates and flags both from the Ordovician and Silurian were used locally for roofs and paving stones. The large quarries at Ingleton and Horton both worked the Ordovician slates which were once used extensively in the local area. The bottom right image of Slated Mansion, Ingleton has a roof of Ordovician slates from the Ingleton Group.

Inliers of Silurian rocks around Settle and in the Ribble Valley were also exploited for slates, in this case blue slates or flags. Supporters promoting the case for constructing a canal near Settle in 1774 reasoned it could become an outlet for products of the "many inexhaustible quarries of blue-flags, grit flags, excellent blue **SLATE**, and grit slate in the neighbourhood of Settle which would undoubtedly pass along this branch" (Mitchell W. R. 1985). This canal was never actually built.

Carboniferous sandstone 'slates' were also used extensively for roofing from the C16 onwards. They could be obtained both from the fissile sandstones of the Yoredale Group in the north of the area, and from beds in the Millstone Grit Group to the east, for example in the Bradley Flags at Bradley and Lothersdale and in the Upper Brimham Grits and Libishaw Sandstone near Pateley Bridge. In areas with better quality slates, above Hawes, for example, large quarries were established and the slates were transported far and wide across the Dales. Quarries in these 'slate' beds were often short lived as the overlying strata became progressively more difficult to remove. The better slate beds were in many cases followed underground so that sometimes the original surface quarry gives little impression of the full extent of the actual workings. Examples of underground workings are found at Stags Fell quarries, Seavy, Old and Raygill quarries at Burtersett, and East Shaw and Scar Head quarries at Gayle.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The top right image shows the Manor House at Redmire, Wensleydale, with very thin iron stained sandstone slates from the Yoredale Group on the roof and thicker sandstone flags for lintels. The middle right image shows traditional grey Yoredale sandstone slate roofs in Healaugh village, Swaledale. In the bottom right image, Hardy Grange Farmhouse, Beamsley, is roofed with thicker sandstone slates from the Mill Stone Grit Group.

Sandstone slates were traditionally worked by prising out blocks along horizontal bedding planes and natural joints. Once free the blocks were transferred by crane or sledge to the quarry floor for weathering prior to final dressing into individual slate (Carlisle 1990). Accounts from the rebuilding of a house in Conistone in 1685 recorded sandstone slates from 'ye hard raike in Waldenhead' were ordered in October for delivery in May the following year, to give time to weather, split and shape the slates. (Raistrick 1976). The image below is of Hard Rake (raike) Quarries where sandstone slates were quarried close to Buckden Pike in Waldendale.

There are still many houses in Yorkshire roofed in the traditional sandstone slates. In 1891 J. G. Goodchild records " A thinner kind of flagstone used to be largely quarried in years back, and employed under the name of "slate" for roofing purposes, but the cost of timbering required to support it has gradually caused its employment for that purpose to be abandoned". The coming of the railways quickly saw the demise of the industry.

The railway connections which had been good for the industry in the early years also provided better links to the west allowing metamorphic slates from the Lake District and Wales to be used more widely at a reasonable cost. In the C19 new houses near the railways were roofed, and older houses re-roofed, with Welsh or Cumbrian slates. These newly imported slates were lighter and easier to handle and did not require such strong supporting timbers.

On the eastern and northern edges of the north-west Yorkshire area, stone slates were less easy to obtain and were gradually replaced by clay pantiles, but there is a transitional area in between where the older houses are roofed mainly with pantiles, but using two or three rows of sandstone slates to the eaves. In Gilling West, for example, most of the older houses have this type of roof.

ORDOVICIAN

Lower Palaeozoic

Ingleton Group

The oldest rocks in the area belong to the Ingleton Group. They comprise a succession of steeply dipping grey-green, turbiditic sandstones and **SILTSTONES** which are exposed in an inlier around Ingleton and formerly in the flooded bottom of Horton Quarry. The old quarries in the group mainly exploited the rocks with slatey cleavage for use as a roofing material which was used extensively in the Ingleton and Bentham areas until the mid to late C19. Several quarries were also worked for roofing slates on the banks of the River Greta and thousands of tonnes of slate were extracted. In general the Ordovician rocks were not quarried as a major building stone, but they were used in the mixed rubble of the older buildings at Ingleton and in field walls. The blocks in the buildings are often rounded suggesting that these may have been recovered from the river gravels; other more angular pieces were probably sourced from the slate quarry waste. The top right image shows 1, Bank Hall in Ingleton, with the wall exposed at the rear of mixed rubble including Ordovician slates.


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SILURIAN

WINDERMERE SUPERGROUP
Coniston & Kendal groups

There are two areas where Silurian strata occur at outcrop; one is in the extreme north-west around Sedbergh, on the western side of the Dent fault, the other is in the south of the area in small inliers at Crummack Dale north of Austwick, in Ribblesdale around Helwith Bridge, in Silverdale and in a small area near Malham Tarn. The walling rubblestones of the area are mainly sourced from the Coniston and the Kendal group successions.

Sedbergh Area

The main quarries in the Sedbergh area were in the Coniston Group (Coniston Grits and Flags), which around Sedbergh is largely undivided, and in the Bannisdale Formation (Bannisdale Slates) of the overlying Kendal Group. In the Coniston Group the lithologies worked for building stone include the parallel bedded, turbiditic sandstones and siltstones (which split easily into flags) towards the base of the succession. These beds pass gradually upwards into the striped sandstones and parallel bedded siltstones and mudstones of the Bannisdale Formation. The Bannisdale Slates are thinly bedded sandy mudstones that did not make good 'roofing' slates but often provided large rough slabs for paving or building stone. Dark blue flags were said to occur in some localities in both the 'Coniston Flags' and Bannisdale Slates. In the Bannisdale Formation the higher beds include blue or grey thin-bedded lithic sandstones. Three of the quarries marked on the 1852 OS sheet in the 'Coniston Grits' were shown as 'Blue Rag' or 'Blue Ragstone Quarry'.

A ragstone indicated a stone very difficult to trim, always leaving ragged edge to the block. The lithological character of the two formations is so similar that taken out of context it is impossible to differentiate between their building stones. It is likely that locally the rubblestone buildings include stone from both formations, especially those that have used rounded cobbles from the river. In the C19 the Victorians chose the darker slates to contrast with the paler imported Carboniferous sandstone squared blocks or rubblestone. By the C19 they perfected improved methods for cutting the slate, so that a straight edge could be achieved using a metal wire with sand and water as an abrasive.

The right image of Main Street, Sedbergh, shows the proportion of blue slate in the older buildings, defined by how dark the building looks; the rubblestone buildings generally contained dark slates, pale slates and sandstones.

The image below is of Sedbergh Reading Room, now the library. The Victorians chose the darker slates and contrasted these with Carboniferous sandstone probably brought in from Uldale, further up the Rawthay Valley.

Ribblesdale Area

The Silurian succession in the inliers of the Coniston Group in the Ribble Valley, consists of turbiditic sandstones, siltstones and slates and is divided into the Crummack, Arcow, Horton and Austwick formations. The Horton Formation was the most widely exploited, mainly for flagstone rather than for walling stone.

The Austwick Formation (Austwick Flags and Grits) is composed of interbedded turbiditic sandstones and siltstones. Old quarries are found in this formation below Studrigg Scars and at Arcow Wood, but there is little information as to their output, they probably produced both sandstone flags and rubblestone. A quarry at Stainforth was recorded as Quarry (Flags) on the 1851 OS sheet.

In Ribblesdale, many quarries exploited the "Blue flags' in the Horton Formation, producing a flagstone that was easy to split along the cleavage, but difficult to shape. Beds were commonly 2-4 cm thick, too thick for roofing slates but very good for flagstones and bridges. Quarries exploited those areas with good slatey cleavage, quarrying both flagstones and roofing slates, but only a few buildings close to the quarries at Helwith Bridge and Horton in Ribblesdale have used this stone for their wallstone. It was not until the early C19 that methods were developed to cut these stones more regularly. Sawing and polishing facilities were established at Helwith Bridge, Sunny Bank, Arcow Wood and Studfold Quarries (Carlisle 2003). The flags were in great demand for paving stones, gateposts, cattle stall divisions, cisterns and roofing. Sunny Bank Quarry was still working in 1925 when it was granted a new lease, but appears to have closed soon after. The older houses of Austwick, Stainforth, Feizor contain mixed slates and grits from the Coniston Group in their rubblestone walls. Large flagstones are used to pave the path to Horton Church and were also polished and used inside the church. They can also be seen used in bridges in other parts of the Dales. The clapper bridge at Malham (right image) is built from large pieces of Horton flagstone. In Ribblesdale today, a few large working quarries dominate the landscape, but the stone produced is used is as a high friction roadstone and not for building.

CARBONIFEROUS

During the Carboniferous the sedimentation patterns developed across the area were controlled by underlying structural developments including a major granite intrusion into the Lower Palaeozoic rocks. Consequently, the succession developing to the north of the Craven Fault System (running from Ingleton to Pateley Bridge) is different in character to the succession of the subsiding basin to the south of the fault system. These differential subsidence patterns were maintained from the Dinantian into the early part of the Namurian, lasting until the deposition of the Warley Wise Grit (and its correlatives) across the whole area.

LOWER CARBONIFEROUS
(DINANTIAN) of the CRAVEN BASIN
Bowland High & Craven Groups

The Craven Basin lies south of the Craven Fault System and is characterized by thick beds of mudstones with limestones. These include the Chatburn Limestone Formation (or Haw Bank Limestone), the Thornton Limestone Member, the Worston Shale Group, comprising limestones with mudstones (including the Broughton Limestone and Rain Gill Limestone Member) and the Pendleside Limestone Formation. Towns and villages such as, Hetton, Airton, Kirkby Malham, Broughton, Rylstone, Coniston Cold and Skipton are all sited on these limestones. In these localities the older buildings are a mix of sandstone and limestone rubblestone. The limestone is locally sourced and the sandstone is likely to be derived from local erratic boulders or boulders gathered from further afield.


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The difficulty of working the local limestones meant that more massive sandstone, quarried from the Millstone Grit Group of the adjacent areas was often brought in, notably for door and window surrounds, even where the majority of the building was of limestone rubble as in the Yeomans Cottage at Kirkby Malham (top right image) contains a mix of Craven Group limestone and sandstone rubblestone (some of which was probably locally collected as fieldstone from the glacial sediments), with Millstone Grit sandstone dressings to windows and doors. Where a suitable alternative was available nearby this might be used instead of the local outcrops. In Skipton for example, the bedrock is Chatburn Limestone but the castle and most of the older buildings of the town are built of sandstones from the Millstone Grit, quarried from the adjacent hillsides. The local limestone is used for field and boundary walls and is occasionally seen as rubblestone in older buildings.

By the C19, when Airton Mill was extended and re-faced, there were better techniques available to shape the limestone and the mill is now faced with squared limestone. Sandstone has been brought in from outside the local area, for quoin stones and window dressings, probably from the Millstone Grit on Calton or Threshfield Moor. Middle right image of Airton Mill, now River Walk, is faced with squared blocks of Thornton Limestone, with Millstone Grit sandstone quoins.

There was a large quarry at Thornton in Craven which in later years produced crushed limestone for roadstone. The limestone beds, although steeply dipping, are well bedded, and this limestone was commonly used in the houses around Thornton in Craven and Broughton with sandstone from the Millstone Grit often used for the quoins and window dressings. Red Berry House, Broughton, for example, was constructed using Broughton Limestone from the Worston Shales in the rubblestone walls and Millstone Grit sandstone for the quoins and window dressings and for the sandstone slate roof (bottom right image).


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LOWER CARBONIFEROUS
(DINANTIAN) of the ASKRIGG BLOCK
Great Scar Limestone Group

In the south of the Askrigg Block, massive, Lower Carboniferous limestones form large cliff outcrops or scars. Together these limestone beds are known as the Great Scar Limestone Group, now divided into the Kilnsey Formation, a sequence of essentially dark limestones with mudstone beds, and the overlying Malham Formation with its paler limestone lithologies. These limestones proved difficult to work, especially with primitive tools, so the massive beds were more often used as a rubblestone.

Kilnsey Formation

In the villages that stand on this formation the local limestones have rarely been used as the sole building stone and often, more easily worked sandstone was brought in from adjacent areas to provide lintels for windows and doors and quoin stones, to help strengthen the corners of the buildings, for example at Kilnsey Old Hall, which has been recently restored with new cut sandstone used in the chimneys (image below).

Malham Formation

The Malham Formation is divided into a lower Cove Limestone Member and an upper Gordale Limestone Member in the Malham area. In the Hawes area these units were originally known as the Garsdale and Danny Bridge Limestone formations. Overlying the Danny Bridge Limestone a locally discontinuous sandstone known as the Thorny Force Sandstone crops out. This is generally a thinly bedded flaggy sandstone bed capping the Great Scar Limestone Group and was quarried at Hardraw, Burtersett and Hawes for sandstone slates.

The nature of the limestones often dictated how they were used as a building stone. Usually it was only the coarser grained limestones which were squared to give a more regular shaped building stone, the finer-grained limestones were more difficult to work with and more often used as rubblestone. Houses in areas where the limestones is fine-grained and homogenous are predominantly built of rubblestone . Difficulties in maintaining a watertight fabric in these rough rubblestone walls meant that they were often 'slobbered' with lime mortar.

In the Ribblesdale and Ingleton areas the limestones of the Malham Formation lie directly on Lower Palaeozoic rocks. The junction is so abrupt in Ribblesdale that some of the quarries worked both types of stone and a rubblestone mixture of the two types of rock is common of building fabrics in these areas. The top right image of Oxenber Cottage, Hollin Hill, Austwick, shows the use of mixed Carboniferous limestone and Palaeozoic rubblestone.

At the junction between these two units a **CONGLOMERATE** with pebbles of reworked Ordovician rocks is sometimes found. This coarse stone is seen in some of the quoin stones at Seed Hill, Ingleton whereas the building itself is a mainly a mix of limestone with sandstone and Ordovician slate rubblestone.

Above these conglomerates, the limestones at the base of the Malham Formation are more granular, making them easier to work and shape. Techniques of cutting the limestone improved in the C19 and the coarser grained limestones were subsequently more often dressed into square blocks. The C19 nave of the Church of St Mary at Ingleton is of snecked and dressed limestone and contrasts with the C15 tower which is mainly limestone rubblestone with sandstone blocks for the crenulation. Sandstone possibly from the Eldroth Grit is used for the windows, quoins and **BUTTRESSES** (middle right image). The limestone used in the nave contains small pebbles of Ingletonian slates and, provides a distinctive building stone (bottom right image). Some of this limestone is also fossiliferous, its coarser nature again made it easier to work and dress as seen, for example, in the fabric of Bridge End Guest House at Ingleton.

The Yoredale Group

Alston Formation

The Carboniferous succession becomes younger northwards and changes in lithological character, these changes are also reflected in the building stones used. The Yoredale Group (Yoredale Series) overlies the massive limestones of the Great Scar Limestone Group, it is characterized by repeated alternations of sandstones, mudstones and limestones and sometimes includes thin coals. Its outcrop extends over a wide area of Wensleydale and Swaledale. The sandstones from this group, many of which are unnamed, provide the main vernacular building stones sources of this area. These sandstones are an important building stone throughout the northern Dales and though often thinly bedded, were strong enough to be quarried for flags or roofing slates.


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J. G. Goodchild wrote a section on building stones in the Geological Survey Memoir for the area around Mallerstang in 1891. "The principal building stones of the district are obtained from quarries in the Carboniferous sandstones. Locally, nearly every one of these sandstones develops into building material of more or less value; but the principal horizons are in the group of sandstones intervening between the Underset and the Three-Yards Limestones, and between the latter and the Five- Yards Limestone…". In Swaledale, the chief sandstones quarried are those below the Hardraw Scar, Middle, and Five-Yards Limestones and that between the Three and Five-Yards Limestones". The right image shows sandstone from the Alston Formation, St Agatha Church, Gilling West.

The individual sandstone beds are lithologically very similar in character and out of context are particularly difficult to tell apart in buildings. They are all generally fine to medium-grained, occasionally coarse-grained, forming relatively thin, often parallel beds. They are commonly iron-rich giving them a distinctive orange colour, often tinged with grey. Where they are very fine-grained they may be very hard and show an almost conchoidal fracture, similar to limestone. Even the fine-grained rock could produce good building stone and were broken relatively easily into squared blocks. However, if the stone is strongly laminated then the edges of the stone can weather and flaking can sometimes occur. The medium-grained sandstones are often quite decorative with the swirls of orange iron staining within each block. Examples of this staining can be seen in the stonework at Gayle Methodist Church, Lion House, Hawes, St. Margaret's Church Hall, Hawes and in the White Rose Hotel in Askrigg.

The sandstone underlying the Hawes Limestone is known as the Thorny Force Sandstone and that below the Hardrow Scar Limestone is the Wintertarn Sandstone Member. However, not all the many remaining sandstone beds are formally named and for the purposes of this account these unnamed sandstones are given the same name as the corresponding overlying limestone. Thus the main sandstone building stones in the Yoredale Group include the Thorny Force Sandstone, the Wintertarn Sandstone, the Middle Sandstone, the Five-Yard Sandstone, the Three-Yard Sandstone, and the Underset Sandstone. In many areas the outcrops of these sandstones appear discontinuous making precise correlations difficult and are simply referred to the Alston Formation without further subdivision.

Although sandstone was usually the building stone of choice there were many quarries in the harder limestones. Although many of these quarries were for lime for mortar or to mix with sand for render, a mix of limestone and sandstone rubblestone is often apparent in the fabric of more basic buildings

Where the limestone was highly fossiliferous e.g crinoidal, some of the beds were hard enough to take a good polish and were quarried for decorative purposes, different beds providing different decorative 'marbles'. Thick beds of these granular, crinoidal limestones were also quarried to provide the large strong blocks needed in the construction of huge pillars for the viaducts of the new railways which crossed many areas of the Dales in the C19. In some areas, however, the limestone beds change in character and a particular limestone quarried for polished stone in one locality may be entirely unsuitable for polishing in another.

The main characteristics of each limestone and sandstone bed within the Alston Formation are described below in ascending sequence:

Hawes & Gayle limestones

Dark grey, poorly sorted, bioclastic wackestones and packstones, with abundant crinoids fragments. They are difficult to differentiate when used in a building and probably contribute to the rubblestone of local buildings but do not form a major building stone source.

Wintertarn Sandstone Member

This compact, yellow, fine-grained sandstone below the Hardrow Scar Limestone at Mill Gill Force, north-west of Askrigg, has been quarried here for building stone and was also quarried between Gunnerside Beck and Spring End and used as a building stone in Swaledale.

Hardrow Scar Limestone, (Hardraw Limestone or Black Marble)

This is the youngest limestone quarried from the Alston Formation that is suitable for decorative purposes. The stone is dark coloured with a bluish tinge and has a conchoidal fracture; the weathered surfaces are a greyish colour. Sedgewick (1835) recorded that "Some of these beds take a beautiful polish; and when they can be raised in large slabs free from white spots, and without seams or cross joints, are of considerable value. Unfortunately many of the quarries are almost spoilt by the cracks and fissures which traverse all the component strata: and many of the more solid masses are injured by the imbedded organic remains (such as Encrinites, Caryophylliae, Productae, Spirifers etc)."

Although the bed crops out in several of the Dales, nearly all the quarries exporting the black marble were in Dentdale. Contained in the floor of the Church of St Andrews, Dent (top right image), are at least four different marbles from Dentdale, together with red marble, possibly from near Kendal and a brown marble possibly from Bentam Fell. This limestone could also provide strong masonry for building and the coming of the railways meant that such good, strong workable stone was in great demand for the viaducts that were built across the dales. One of Dent Head Viaduct pillars sits within a marble quarry, the owners were paid compensation when the viaduct was being built, it is partly built of Hardrow Scar Limestone and partly of Simonstone Limestone from the adjacent hill (middle right image). Arten Gill Viaduct was also built of this stone. The Coldstones Cut, an artist-designed viewpoint completed in 2010, on the edge of Coldstones Quarry, Greenhow was built using large blocks of limestone from Coldstones Quarry (Hardrow Scar Limestone). It was constructed using a double wall construction with natural joint planes to give flat faces (bottom right image).


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Simonstone Limestone (Strong Post Limestone)

Resembling the Hardrow Scar Limestone in colour, but thicker, stronger and coarser grained it was not generally considered fit for polishing, but provided a strong material for the construction of door posts, small pillars, quoins and coping stones. (Sedgewick 1835). Dent Head Viaduct was built partly from Simonstone Limestone, quarried in Short Gill adjacent to the viaduct. Although Sedgewick had described the beds as generally unfit for polishing Strahan described the Simonside Limestone as "a black and homogenous rock, has been quarried in Oliver Gill for "black marble". (Dakyns et al 1890)

Middle Sandstone

This sandstone was quarried and used as a building stone and provided sandstone slates in Swaledale around Thwaite, Gayle, Hawes and Burtersett. In Dent Dale this bed has been worked for flags at Wydern and Kirkbank. In Cow Gill, five miles above Dent, "there is a quarry of hard, white **SILICEOUS** grit capable of being split into very thin flags, coated with silvery **MICA**, and forming the most beautiful roofing slate I have seen in the Carboniferous chain" (Sedgewick 1835). Below the very thin flags were beds of thicker flags that were quarried for flooring or paving stones.

Middle Limestone

This unit includes the Mosdale or Wold Limestone, the Five-Yard Limestone and the Three-Yard Limestone. These named limestone beds separate the following sandstones but were not themselves generally used as a building stone and only a few quarries are to be found in them.

Five-Yard Sandstone

This sandstone was quarried and used as a building stone in Swaledale and Wensleydale. Sedgewick (1835) recorded that there were fine building stone quarries in Rawthay Gill, between Ravenstonedale and Sedbergh. The sandstone is micaceous and fissile, and generally more open grained. Good, thick flagstones were extensively quarried in Great Gill, Wensleydale, at Low Row Pasture in Swaledale, at High Pike quarries at the head of Deepdale, at Scotcher Gill just north of Dent and at Cottersdike and Bridge End quarry in Garsdale where levels were driven for two or three hundred metres into the hill.

Around Whaston and Gayles these beds were worked for building stone and sandstone slate and at Castle Bolton the sandstone on the hillside behind the castle was quarried for the walls of the castle. The bottom image shows wall detail from St Margarets, Preston Under Scar, showing laminated sandstone, from the Five Yard Sandstones above the village.

Five Yard Limestone

This limestone is often a very thin bed of only 0.7m in parts of upper Wensleydale but is more than 8m thick in a quarry near Kelds Head Mine in Wensleydale. It splits into two leaves in Swaledale, Dentdale, Garsdale and Nidderdale, the top leaf being coarsely crinoidal in places.

In Nidderdale these beds were quarried for 'Nidderdale Marble' at Blayshaw and Lofthouse producing two types of marble - a crinoidal limestone with two ranges of crinoid sizes, 2-5mm and 8-11mm in diameter, and a fine-grained bioclastic limestone with broken coral, bryozoa, shell and crinoid debris, predominantly less than 2mm. Both of these types of Nidderdale Marble were used as decorative stone in Fountains Abbey (Blacker and Mitchell, 1998) and Nidderdale Marble was also used for the steps of St Georges Chapel at Windsor.

Three-Yard Sandstone

This sandstone includes fissile beds which have been quarried for roofing slate and flagstone in Garsdale Hall Pastures, High Pike in Dent and around the upper crags on Ingleborough. Near Hawes it is known as the Lower Hawes Flagstone and was quarried at High Quarry, Stags Fell, Simonside. The beds are generally of a dark bluish grey colour and are liable to decomposition. Around Ingleborough they are brownish grey in colour and of a finer texture.

Thicker beds of sandstone are found in the lower section which sometimes, although rarely, becomes very coarse like Millstone Grit. In Wensleydale flags were extensively quarried on the north side of the river, a little east of the road from Hawes to Muker. The surfaces of the flags worked here show some unusual tracks of invertebrate animals. There were large quarries in this sandstone in Gunnerside Gill in Swaledale.

Underset Sandstone

This sandstone was quarried for building stone in Swaledale; for flags at High Pike, west of Whernside; for flags and slates at Stags Fell, Simonside, where it was known as the Upper Hawes Flagstone. This bed was also worked in Waldendale at Hudsons Quarry above West Burton, behind Oswalds High Wood and above Witton Steeps.

Underset Limestone (Four Fathom Limestone)

This limestone has a very variable thickness and fossil content but on the north side of Garsdale, where the fossils were white and crystalline and embedded in a dull grey matrix, they form a fairly compact bed. The strongest beds were extensively quarried to supply the Kendal Marble Works.

There was a marble quarry on Crag Fell at the head of Ease Gill and quarries were also opened in these strata in Dentdale, but were abandoned when better material was discovered in the Main Limestone. Coarsely fossiliferous limestone beds from this unit were also quarried for building stone at Melsonby and marketed as Swaledale Fossil Limestone.


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Main Sandstone

This sandstone was quarried for sandstone slates at Swinithwaite and used in the local area.

UPPER CARBONIFEROUS (SILESIAN)

NAMURIAN

Millstone Grit Group

Depositional patterns in the Millstone Grit Group times, again shows contrasting basin and block developments in the early Pendelian, south and north of the Craven Fault System. The building stone lithologies found in these two areas below the Warley Wise Grit are described separately.

Pendelian (early) of the Craven Basin

In the Craven Basin the succession is essentially a thick sequence of mudstones and siltstones comprising the Bowland Shale Formation, overlain by the Pendleton Formation (Pendle Grit Member) which is succeeded by the generally coarser, strongly cross-bedded, Warley Wise Grit. The Pendle Grit and the Warley Wise Grit provide the principal building stones of this succession. Note that quarries to the north of Skipton are currently shown as undifferentiated sandstone of Pendleian age, however, the Pendle Grit and Warley Wise Grit have recently been recognised in these areas. (Jochem Bijkerk, personal communication). The left image of the Old Grammar School, Skipton, shows laminated Pendle Grit with Warley Wise sandstone quoins.

Bowland Shale Formation

Pendleside & Harlow Hill Sandstone

This is essentially a thick sequence of mainly fissile mudstones, with occasional massive fine-grained siliceous sandstones. It may include concretionary limestone 'bullions' and thin beds of dark crinoidal limestone. This sequence does not contribute greatly to the building stone resources in the Craven Basin, but there is quarry in the Pendleside Sandstone at Long Preston. During early Pendlian times the Craven Basin extended eastwards into the area around and to the south of Harrogate where there were numerous quarries in the Harlow Hill Sandstone at Harlow Hill and at Beckwith to the south west of Harrogate.

These quarries supplied building sandstone in the local area around Beckwithshaw and Harlow Hill, and also probably for developments in west Harrogate generally. The sandstone at Harlow Hill Quarry was described as greenish grey in colour when unweathered, weathering to a light brown, it is fine-grained, comprising angular **QUARTZ** grains with some silica **CEMENT**, **FELDSPAR** is rare.

Pendleton Formation
Pendle Grit Member

The Pendle Grit is characterised by siltstones, silty mudstones and feldspathic sandstones. It is the sandstones that were important sources of building stone in the local area. They are generally well laminated and micaceous and may include bands or nodules of ironstone. Beds are of variable thickness and include fine, medium and coarse-grained sandstones, with pebbles present in the medium and coarse-grained rock. North of Skipton the Pendle Grit sandstones crop out at the bottom of Embsay Moor.

Despite their proximity, however, they were not used by the builders of Skipton Castle, who preferred the coarser, more easily worked Warley Wise Grit on the moor top. The building stone sourced from the Pendle Grit in late C18 to early C19 buildings is characterized by generally thin, medium to course-grained, laminated blocks of sandstone. The Pendle Grit was quarried both north and south of Skipton and the stone from Witshaw Bank was used in the construction of Embsay Reservoir.

The quarries at Jenny Gill and Snaygill to the south of Skipton provided building stone for Skipton town, together with sandstone from many other quarries in the Pendle and Warley Wise grits. The quarries in the Pendle Grit were largely developed in the C19 when mechanized, cutting equipment became more common. There were sandstone quarries in this grit at Settle, Rathmell, Threshfield, Elslack, Carleton, Eshton, Flasby, Lothersdale, Hazlewood with Storiths, Bolton Abbey, Pannal and near Skipton. The image below of Trappes Hall, Carleton, was constructed in 1686, it is built of Pendle Grit sandstone rubblestone.

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PENDELIAN (EARLY) of the ASKRIGG BLOCK

In the northern dales and around Richmond there is a continuation of the cyclic sequences of the Yoredale Group up into the Pendleian with the sequence now becoming more siliceous and including several beds of chert. In this area the base of the Main Limestone is taken as the base of the Pendleian and the sequence includes, the Main Chert, Little Limestone, Richmond Chert, Ten Fathom Grit, Crow Limestone, Crow Cherts together with various unnamed interbedded sandstones, mudstones and siltstones. The main buildings stone sources were in the Ten Fathom Grit, the Main Limestone, the Little Limestone and the cherty limestones of the Richmond Chert. In Richmond Castle itself all of these buildings stones are evident in wall fabrics together with the Underset Sandstone which can be found cropping out close-by to the north.

Main Limestone (or Twelve Fathom Limestone)

This grey to dark grey, medium-grained biosparite limestone is locally characterized by an abundance of crinoid stems in the middle beds, which can sometimes make up the whole mass of the rock. The limestone is generally grey and cryptocrystalline and forms hard beds that can be polished. The best variety of this fossil marble was quarried at Snays-wold Fell, between Dent and Garsdale and at High Rake Moss at Cowgill. Sedgewick (1835) described this marble as follows:- "The dull grey base in which the fossils are commonly embedded, is there enlivened by many dark cloudy blotches, arising out of the irregular distribution of the colouring bituminous matter." An example of this marble can be seen in the marbles of the floor of the Church of St Andrew in Dent (seem image top right p. 15). The stone was also used for walling stone in Gayles.

Stainmore Formation

Little Limestone & the Richmond Chert

The Little Limestone in Swaledale is typically a medium-grey, crinoidal biosparite which further north at a quarry in Aldborough St John becomes a grey, argillacous, laminated limestone. The Richmond Chert is recognized separately in Swaledale as consisting of siliceous cherts, cherty limestones and limestones, overlying the Little Limestone, but in the north of the area these cherty upper beds were known simply as the Top Little Limestone. In some areas the cherty limestone contains red beds with abundant crinoid debris.

These beds were quarried and used for building stone at Richmond, Aldbrough St John, Forcett, Stanwick St John and East Layton in the north of the area. The lighter grey cherty limestones with abundant crinoid debris is often seen as a building stone in Richmond, but the actual chert bands of the Richmond Chert were quarried and used for road metal and for facing grindstones, but were rarely used as a building stone. At Richmond the stone used to build the castle reflects the availability of materials around the castle site and the alternating sandstones, red cherty limestones and white crinoidal limestones and even the mudstones of the Stainmore Group bedrock are all seen in the older parts of the castle walls. The exterior walls of the keep, built in C12, are of Underset Sandstone (image below). The Church of St Paul, Albrough St John, is built from the red, crinoidal, cherty limestones of the Richmond Chert (bottom image).


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Ten Fathom Grit

A hard, light grey, thin-bedded sandstone that could be readily cut into squared blocks. It was quarried at Keld, Thwaite, Angram and Melbecks and, as it is the only sandstone quarried close to these villages it can be assumed that the building stone used is principally from this unit. It was also quarried at Downholme, Marrick, Newbiggin, Ravenseat, Grinton, Hurst Moor, Gunnerside Moor and on Freestone Ridge near Whaw. The Ten Fathom Grit was the most continuous bed of sandstone that could be mapped , however, it does not always comprise thick sandstone beds, but may include **MICACEOUS** and thinly laminated sandstones that were quarried for roofing slates. Where other unnamed sandstones beds were quarried close by it is difficult to differentiate them from the Ten Fathom Grit sandstone as they generally have the same grey coloration with orange iron staining. The buildings of Keld Village in Upper Swaledale were all constructed using sandstone from Ten Fathom Grit (image below).

Crow Limestone (Crag Limestone in Barnard Castle area)

This is a grey, fine to medium-grained, thin bedded and siliceous limestone, containing crinoids and brachiopods. It was quarried at Caldwell, East Witton and Richmond. It is not a major building stone but was probably used locally for buildings in parts of Richmond.

Late Pendelian & Arnsbergian (of the Craven Basin & the Askrigg Block)

These successions are still basically cyclic sequences but now contain fewer limestones and consist mainly of sandstones, mudstones, and thin coals. The most important stone sources are the sandstones and many of these provided good building stone. In the Dales areas they cap the highest hills and generally thicken to the east. The sandstone beds are, however, variable in character both laterally and vertically and some of the larger quarries, for example; Scotgate Ash Quarry in Nidderdale, quarrying the Libishaw Sandstone could offer several types of building stone for different purposes. Often different beds of good quality sandstone could be found on the same hillside for example in Upper Nidderdale, the Red Scar Grit and the Scar House Formation sandstone above it were both quarried for the construction of Scar House Dam, and both were of similar lithology. The principal sandstone beds used for building stone in this sequence are described in ascending order.'

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Pendleton Formation

Warley Wise Grit (Grassington Grit/ Howgate Edge Grit/Brennand Grit/ Almscliffe Grit)

The Pendle Grit passes laterally into the coarser Grassington Grit on Grassington Moor (Lower Howgate Edge Grit around Ingleborough and Fountains Fell), and passes upwards into the Warley Wise Grit (aka Grassington Grit (upper part) around Skipton and Settle, the Almscliffe Grit near Harrogate, and Upper Howgate Edge Grit in the northern Dales). These coarser sandstones are laterally persistent and overstep the successions of the Askrigg Block as well as those in the Craven Basin. They consists of massive, cross-bedded, coarse-grained, pebbly sandstones, locally reddened around Flasby and on the hills north of Skipton, commonly giving massive and persistent scarps along the hillside.

These coarser grained grits were favoured by the medieval builders and used to build Bolton Priory, Barden Tower, the Holy Trinity Church and the Norman Castle at Skipton. They were generally used in larger blocks and contrast markedly with the smaller blocks of Pendle Grit, more commonly worked in the C18 and C19, which are often used in the same areas. The Warley Wise Grit was commonly used for quoins, window and door surrounds and for large coping stones.

It was also widely used for constructing bridges in the Dales and was quarried for this purpose extensively on Embsay and Eastby Moors. To the south of Skipton, the more thinly bedded Bradley Flags provided a good source of sandstone roofing slates for the area. Skipton Castle (image below) is built of Warley Wise Grit from quarries on Embsay Moor, and the Priesthouse and Chapel at Barden is built of Millstone Grit, probably Warley Wise (bottom image). Warley Wise Grit from Embsay Fell was used for many of the old local bridges e.g. Barden Bridge over the River Wharfe near Bolton Abbey. The quarries at Flasby and around Sharp Haw, north east of Gargrave, were known to quarry a reddened sandstone which can be seen in the houses at Flasby and Gargrave, and was used to build the C19 nave of St Andrews Church, Gargrave.

Marchup Grit

This sandstone bed, between the Warley Wise Grit and Red Scar Grit, was worked in Airedale at Cowling, to the east of Skipton at Blubberhouses, Hazlewood with Storiths and Thornthwaite to the north of the river Wharfe at Askwith, Denton, Denton Moor, Farnley, Timble and Weston, and to the south of Harrogate at Pannal. There were many quarries at Hookstone and Stonefall, in the mid C19, these now lie along the eastern edge of Harrogate and are likely to have provided building stone for High Harrogate, then a separate village to Low Harrogate. It is likely that it was quarries in this area that were mentioned in The Stray Award in 1778 "The Stray Award is made whereby George III gives the Stray, local quarries and mineral wells to the town.

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Two hundred acres, including Bog's Field as part of the Stray, are to remain open with free public access" (Friends of the Valley 2010). In the late C19, Harrogate became a famous Victorian tourist destination and significant new building, using local sandstones took place, eventually merging the two villages to form the present town. The left image shows the Crown Hotel, Harrogate, c1847.

Silsden Formation

Red Scar Grit (Scar Grit & Pickersett Edge grits)

This medium to coarse-grained sandstone, cross-bedded, feldspathic and sometimes red stained was quarried in Colsterdale, Garsdale and Nidderdale, at Middlesmooor, Ramsgill, Wath, Pannal, Thornthwaite for use in local buildings, and also in Upper Nidderdale for the construction of Scar House, Angram and Gouthwaite reservoir dams. It was quarried on Baugh Fell for sandstone slates and building stone.

Nesfield Sandstone (Scar House Formation, Upper Nidderdale)

The Nesfield Sandstone was quarried and used for local buildings in the south of the area, at Nesfield and Middleton, north of the River Wharfe near Ilkley. Similar to the Red Scar Grit, the sandstone from the Scar House Formation was also used in the construction of Scar House, and Angram Dams. The quarries used to construct Scar House Dam are behind the dam in the image below.


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Lower Follifoot Grit (Silsden Formation) & Upper Follifoot Grit (Samlesbury Formation)

These two sandstones are separated by fissile mudstones, but often occur together and are quarried in the same area, they are often very similar in lithology and in buildings would be difficult to tell apart. Quarries were more numerous in the Lower Follifoot Grit than in the Upper Follifoot Grit in the Nidderdale area. However, both sandstones were quarried widely in Nidderdale at Middlesmoor, Lofthouse, Ramsgill, Wath, Kettlesing, Birstwith, Burnt Yates, Clint, Hampswaite, to the north of Harrogate at Ripley and Killinghall ,and to the west of Harrogate at Thornthwaite with Padside, Blubberhouses, Menwith, Timble, south of Harrogate at Pannal and to the east of Harrogate at Starbeck. These sandstones were also quarried in Wensleydale, at Masham, Ellingstring and East Witton. At Middlesmoor it was recorded as '6 inches of flaggy grit' and '6 inches of grit' and may have also been used locally as a source for sandstone slates. The image below is of All Saints Church, Kirby Overblow, constructed of Follifoot Grit.

The only working quarry today is Grey Yaud Quarry at Hammer Farm on Witton Fell, East Witton. This quarry is working the Lower Follifoot Grit, supplying fine to medium and medium to coarse-grained, buff coloured sandstone for use in repairs and renovation of local buildings. Stone from old quarries in this sandstone are believed to have supplied the stone for Jervaulx Abbey, although there are also quarries close-by in the Red Scar Grit and the Libishaw Sandstone. This sandstone was also used in the construction of Fewston Dam.

Hebden Formation

Libishaw Sandstone

This fine to medium-grained, micaeous, feldspathic, thin bedded sandstone of variable colour (buff, brown, pale yellow, and grey) was quarried widely in the C19 on the north side of Pateley Bridge. The well-known Scotgate Ash quarries were famous for their flagstones and landing stones but, in 1820 the sandstone was described as "owing to the beds being thin, it is not well adapted for general building purposes'. As the quarries expanded better stone beds must have been found as in 1886 the following types of stone were advertised as available from the now much larger enterprise at Scotgate Ash. (Blacker J.G. 1995).

"Green Crag: laminated, dark greenish – brown stone with minute specks, used principally for window heads, sills and coping; White Crag: a light brown colour, looking almost white when tooled, with similar specks, used for landings, steps, paving; Bottom bed: similar to White Crag but more micaeous, used for similar purposes and also for monuments; Block Stone: a fine, homogenous brown stone, largely used for high class masonry and monumental purposes; Rag: a laminated stone with dark thin lines of mica, suitable for bases; Grit Stone: a coarse stone, used mostly for dock walls and cheap masonry."

The variable nature of the Libishaw Sandstone clearly lent itself to many applications and after the railway came to Pateley Bridge in 1862 the quarries expanded sending stone all over the country. The Libishaw Sandstone from Scotgate Ash was used in many prestigious buildings such as the National Gallery and South Kensington Museum in London and H.M. Government Works at Enfield, Woolwich, Aldershot, Plymouth, Portsmouth and York and for principal buildings in Harrogate. The thin sandstone blocks used in the walling of St Cuthbert's Primary School at Pateley Bridge (image below), which lies on the road leading up to the Scot Gate Ash quarries, were probably sourced from the flagstone beds in the quarry.

The beds were also quarried for sandstone slates south west of Pateley Bridge at Moorhouses, and Middle Tongue, in the upper part of Nidderdale at Lofthouse, on the moor above at Healey, Swinton and Masham as well as around Blubberhouses and Thruscross. Further down the River Nidd they were also quarried at Glasshouses and around Ellingstring and Fearby.

Addlethorpe Grit

This is a brown or red stained, coarse-grained, thickly bedded sandstone, with cross bedded units up to 6m thick, although locally around Follifoot, it becomes thinly bedded and micaceous. It was quarried at Hampsthwaite, Killinghall, Ripley, Markington, Kirkby Overblow, Spofforth, Bishop Thornton, Grantley, Clint and New Park and Grange, Harrogate. Extensive quarrying at Knox and Warren Bank provided stone for the north side of Harrogate.

Lower Brimham Grit (Lower Plompton Grit, Eldroth Grit / Upper Brimham Grit, Upper Plompton Grit)

These sandstones are difficult to distinguish in buildings especially where the lower and upper beds were quarried in close proximity to each other and so have been described together in this account. The sandstones are named after the localities where they were originally identified. They are often a pinkish colour but may show a variety of others colours including pale yellow, buff and grey in buildings.

They tend to be medium to very coarse-grained, are locally pebbly, relatively soft and subject to erosion along the current bedding planes when exposed to the weather. This type of weathering is strikingly seen at the tourist locality of Brimham Rocks where the effects of Devenisian ice and wind has worn the rocks into curious shapes (see image on p. 3). Medieval builders appear to have favoured these sandstones perhaps because of their workability. The substantial remains of Fountains Abbey, built near the River Skell in the C10, still stand alongside the outcrop of 'Lower Plompton Grit' that provided the source of the sandstone used in its construction.

Older buildings in Pateley Bridge such as 'Ye Olde Sweete Shoppe' (image below), Pateley Bridge, 1661, were all built using the coarse-grained Brimham Grits sandstones. The Pateley Club, originally built in 1664 as the George & Dragon Inn, becoming a brewery in 1777, has recently had the rendering removed to reveal very large blocks of yellow/brown, coarse-grained stone used for the base of the building, these were sourced from the local Lower Brimham Grit. The render has protected these softer sandstones from the weathering suffered by other buildings in the Main Street which have also used this stone, for example in the lower walling blocks of the Crown Hotel. The Crown Hotel was rebuilt in 1767, using smaller blocks, probably from quarries in the Libishaw Sandstone. This latter stone has barely weathered and shows a contrast with the larger, weathered blocks of Lower Brimham Grit used at the base of the building. There were several small quarries in this sandstone above Pateley Bridge, but these were not as numerous or as large as those in the Libishaw Sandstone. The Lower Brimham Grit was also quarried and used for building stone at Blubberhouses, Thornthwaite and West End between Skipton and Harrogate, and at Masham and Grewelthorpe to the north east of Ripon.

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Upper Brimham Grit

The Upper Brimham Grit was quarried at Grewelthorpe, Ilton and Mickley with numerous quarries in the area around Kirkby Malzeard, at least one of which was recorded as quarrying sandstone slates. For the most part, however, it is a massive, cross-bedded, sandstone that could be cut into large blocks. The skill with which it could be carved is demonstrated at St Andrews Church by the decorative C15 Norman archway and the strip of carved stones which encircles the C16 tower, some of which are now, unfortunately, weathering away. These remarkable examples have survived despite the church being gutted by fire and extensively damaged in 1908 (image above).

Eldroth Grit

The Eldroth Grit, is also an equivalent of Lower Kinderscout Grit and occurs in a relatively limited area to the west and was quarried and used locally for building at Eldroth, High Bentham, Low Bentham and Newby.

Lower & Upper Plompton grits

The Plompton Grits are named after the type locality, Plompton Rocks to the South east of Harrogate where again, the weathered outcrops form curious shapes. Their building sandstones are characterized by variegated blocks of red or yellow, buff or almost white stone, often quite friable with quartz pebbles. There are numerous quarries in the Lower Plompton Grit at Shaw Mills, Sawley, Ripley, Killinghall, Nidd, Bishop Thornton, Follifoot, Sicklinghall, Spofforth and at Knox Hill and Hall Lane at Harrogate all of which probably supplied some stone for building in and around north Harrogate. Most of Ripley village is built of sandstones from the Plompton grits, including the castle (image below)and the medieval church.


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At Spofforth, the castle stands on the Upper Plompton Grit (image below) from which it has been built, the lower half of the castle has a doorway and staircase carved in the rock outcrop itself. Current bedding is clearly seen, red staining is common, and is also seen throughout the village, many buildings of which are built from stone robbed from the castle. However, as the bed rock is exposed at various locations in the village some houses were probably built of sandstone taken direct from the outcrop. The Upper Plompton Grit was also quarried at Sicklinghall, Knaresborough, Goldsborough, Kirk Deighton and Birkham Wood and Harrogate, again supplying stone to the town.

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MARSDENIAN

Midgley Grit (no formation attribution)

Generally a coarse-grained sandstone found only in the south of the area at Cowling and Hart Head Moor where it has been quarried to provide local building stone.

YEADONIAN

Rossendale Formation

Rough Rock (Laverton Sandstone)

This medium to thickly bedded, grey, medium to coarse-grained, cross-bedded sandstone has been quarried extensively around Grantley, Laverton and Galphay. There are also quarries at Grewelthorpe, Ilton, Kirkby Malzeard, Winksley, Knaresborough, Scotton, Farnham and Cowling.

UPPER CARBONIFEROUS

WESTPHALIAN

Pennine Lower Coal Measure Formation

Winksley Sandstone

To the south of the Craven Fault System in a very small area around Burton in Lonsdale and Low Bentham, and to the east in a small area around Grewelthorpe and Kirkby Malzeard, the Pennine Lower Coal Measure Formation including the Winksley Sandstone occurs at outcrop. There are a few small sandstone quarries which are likely to be the source of some of the building stone used in the immediate area, but overall it does not form an important building stone in north-west Yorkshire.

At eastern edge of the north-west Yorkshire area the Carboniferous rocks disappear beneath the Permian succession. The boundary between the two geological systems forms an abrupt almost north south line. Percolating groundwaters from this overlying ferruginous Permian succession are thought to have been the cause of the red staining commonly seen in much of the underlying Carboniferous succession.

The pattern of building stone use at this eastern margin reflects the availability of both locally worked Carboniferous sandstones and the dolomitic limestones from the Cadeby Formation. Both were often used together in villages such as Masham and West Tanfield on the fringes of the Yorkshire Dales, for example, West Tanfield Church with a sandstone tower and Permian Magnesian Limestone nave (right image), and the HSBC Bank in Masham, built in 1856 of Permian Cadeby Formation limestone with sandstone dressings (image below).

QUATERNARY

In north-west Yorkshire a large part of the lower lying land and some of the valleys are mantled by unconsolidated Quaternary fluvio-glacial deposits, these are sometimes of considerable thickness and can totally mask the underlying bedrock. Lithologically they consist of a variable mixture of sand, gravel and boulder clay. In these areas building stone is more difficult to obtain and generally towards the eastern side of the area being described, brick buildings become more common. These deposits are principally quarried for sand and gravel as aggregate for concrete production.

The north-west Yorkshire area is dissected by numerous rivers, and the villages built along these river courses, especially where they have cut through the glacial boulder clay cover, have provided a source of rounded cobbles for buildings. Cobbled market places and streets are common in these riverside villages and towns, for example at Dent, Askrigg and Richmond. River cobbles can also be seen as walling stone, for example at North Street, Gargrave, using cobbles from the River Aire and the Church of St John, Mickley, uses fluvial or glaciofluvial material from the River Ure, with a Welsh purple Penrhyn slate roof (image below).

New from Old – recycling building stone

This area of north-west Yorkshire has a long history of building traditions where the more affluent builders could afford the manpower to quarry, cut and shape the stone, whereas the common people had often to use the closest reasonable building material to hand. The Cistercian monks and Norman Lords built elaborate monasteries and castles which as the centuries passed fell into ruin. Sometimes these old buildings were simply poorly built, or became redundant and ignored, and over time, began to fail. Later builders often made use of this ready-dressed building material and "quarried" or recycled these sources for their building stone. Examples of re-used stone from earlier buildings can be seen all over the area. At Forcett, for example, fragments of Anglo Saxon crosses and the remains of a medieval gravestone have been used in the walls of St Cuthbert's Church.

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Glossary

Buttress: A projection from a wall and bonded to the wall to create additional strength and support.

Cemented: The materials which bind the grains and/or fossil components together to form a rock.

Conglomerate: A sedimentary rock made up of rounded pebbles (>2mm), cobbles and boulders of rock in a finer-grained matrix.

Cross-bedding: A feature principally of sandstones formed by the movement of sand grains in currents to produce layering oblique to the margins of the beds.

Dolomitic, dolomitised, dolostone limestone: Descriptive terms for a limestone that has had some of its calcium carbonate replaced by magnesium carbonate.

Feldspar: A commonly occurring aluminium silicate mineral of potassium, sodium and calcium.

Fossiliferous: Bearing or containing fossils.

Freestone: Term used by masons to describe a rock that can be cut and shaped in any direction without splitting or failing.

Granite: Coarsely crystalline igneous rock, composed primarily of quartz, feldspars and micas, with crystal sizes greater than 3 mm.

Limestone: A sedimentary rock consisting mainly of calcium carbonate ($CaCo_3$) grains such as ooids, shell and coral fragments and lime mud. Often highly fossiliferous.

Lintel: A horizontal beam over an opening to support the wall over it.

Lithology: The description of a rock based on its mineralogical composition and grain-size e.g. sandstone, limestone, mudstone etc.

Mica: Group of silicate minerals composed of varying amounts of aluminum, potassium, magnesium, iron and water. All micas form flat, plate-like crystals. Crystals cleave into smooth flakes. Biotite is dark, black or brown mica; muscovite is light-coloured or clear mica.

Micaceous: A rock which contains a high proportion of the platey micaceous minerals muscovite and/ or biotite.

Mudstone: A fine-grained sedimentary rock composed of a mixture of clay and silt-sized particles.

Outcrop: Area where a rock unit is exposed at the ground surface.

Quartz: The crystalline form of silica (silicon dioxide, Sio_2).

Quoin: The external angle of a building. The dressed alternate header and stretcher stones at the corners of buildings.

Rubble: Rough, undressed or roughly dressed building stones typically laid uncoursed (random rubble) or brought to courses at intervals. In squared rubble, the stones are dressed roughly square, and typically laid in courses (coursed squared rubble).

Sandstone: A sedimentary rock composed of sand-sized grains (i.e. generally visible to the eye, but less than 2 mm in size).

Siliceous: A rock which has a significant silica content (non-granular) usually in the form of an intergranular cement e.g. siliceous limestone, siliceous sandstone.

Siltstone: A sedimentary rock composed of silt-sized grains (i.e. only just visible to the eye).

Slate: A compact fine-grained metamorphic rock with a closely spaced cleavage formed by the alteration of a mudstone or siltstone by heat and pressure.

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