Historic England

North Yorkshire, West

Building Stones of England

The Building Stones of England

England's rich architectural heritage owes much to the great variety of stones used in buildings and other structures. The building stones commonly reflect the local geology, imparting local distinctiveness to historic towns, villages and rural landscapes.

Historic England and the British Geological Survey (BGS), working with local geologists and historic buildings experts, have compiled the Building Stones Database for England to identify important building stones, where they came from and potential alternative sources for repairs and new construction.

Drawing on this research, plus BGS publications and fieldwork, guides like this one have been produced for each English county. The guides are aimed at mineral planners, building conservation advisers, architects and surveyors, and those assessing townscapes and countryside character. The guides will also be of interest if you want to find out more about local buildings, natural history, and landscapes.

This guide is based on original research and text by Shirley Everett.

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Front cover: Barns and walls, near Gunnerside. Local sandstone rubblestone. © Andrew Ray / Alamy Stock Photo.

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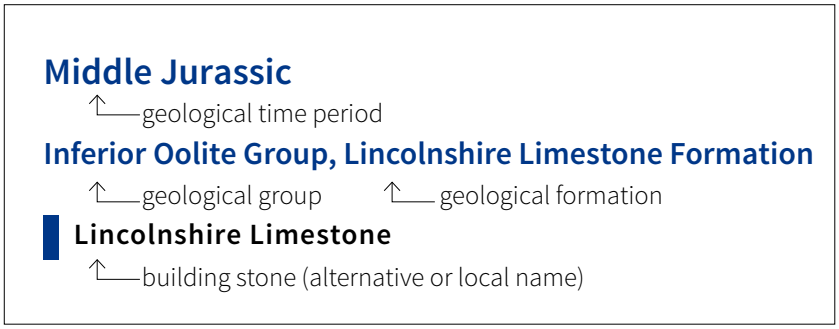
HistoricEngland.org.uk/advice/technical-advice/

How to Use this Guide

Each guide describes the local building stones in their geological timescale order, starting with the oldest layers through to the youngest. The guide ends with examples of other notable building stones from other parts of England and further afield.

Geological time periods, groups, formations and building stones

Each building stone is listed under the relevant geological timescale, group and formation. A formation may be divided into members and where relevant these are referenced in individual building stone sections.



Bedrock geology map and stratigraphic table

To help you with the geology of the area, there is a bedrock geology map and a stratigraphic table which shows the layers of rocks and the associated building stones in this geological timescale, group, formation order.

Page numbers for each building stone are included in the stratigraphic table for ease of reference. The page numbers are inverted to correspond with the geological age order.

Contents list

If you click on the page number for a building stone in the Contents list, you will go straight to the relevant section in the guide.

Building stone sources and building examples

A companion spreadsheet to this guide provides:

- More examples of buildings. Information is included on building type, date, architectural style, building stone source, and listed/ scheduled status
- A list of known (active and ceased) building stone sources such as quarries, mines, pits and delphs
- Additional information on building stones including lithology, grain size, sedimentary structures, key identification features, and notes on failure/weathering, and use.

The Building Stone GIS map allows you to search the Building Stones Database for England for:

- A building stone type in an area
- Details on individual mapped buildings or stone sources
- Potential sources of building stone sources within a given proximity of a stone building or area
- Buildings or stone sources in individual mineral planning authority area.

Further Reading, Online Resources and Contacts

The guide includes geological and building stone references for the area. A separate guide is provided on general Further Reading, Online Resources and Contacts.

Glossary

The guides include many geological terms. A separate Glossary explaining these terms is provided to be used alongside the guides.

The guides use the BGS lexicon of named rock units.

Mineral and local planning authorities

This guide covers the mineral planning authority areas of North Yorkshire County Council (western part) and the Yorkshire Dales National Park (except the Cumbrian dales); and the local planning authority areas of Selby (part), Harrogate, Craven, Richmondshire, Hambleton (part) and the national park. The Cumbrian dales are covered in the *Cumbria* guide, and the other parts of Selby and Hambleton local authority areas are covered in the *North Yorkshire, East* guide.

Contents

1 Introduction

The underlying geology of western North Yorkshire and the impact of its subsequent palaeoclimatic history have defined the character of the current landscape and the building materials that typify the area. Much of it lies in the Yorkshire Dales National Park and consists largely of upland, dissected by numerous valleys that drain to the south and east. The word 'dale' originates from the Nordic word *dalr* and old English word *dael*, both 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, Nidderdale and many other smaller dales.

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. It is 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 (Cumbria) 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, as at Kilnsey Crag, for example, or meltwater, as at Gordale Scar.

In contrast, in the northern part of the Askrigg Block, the Upper Visean rocks are typified by rhythmic, cyclic sequences of sandstones, fissile mudstones and limestones, which 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 buildings, but some can be seen in the Richmond area.

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

To the south of the Craven Fault System, from Bolton Abbey eastwards, around Skipton, Gargrave, Coniston Cold, Airton and Hellifield, the Visean rocks seen at outcrop are interbedded limestones and mudstones and locally contain fossiliferous reef limestones. Upper Visean sandstones are not found here, 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 rocks generally crop out to the east and south of the region. Limestones are not common in this succession, which is characterised 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 Nidderdale working the different sandstone beds within the sequence.

The succession then dips to the east beneath the unconformably overlying Late Permian 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 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 *Building Stones of England* guides for *North Yorkshire, East*, and *West and South 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 Upper Carboniferous 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 they do 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 south as the ice melted.

A classic example is seen near Norber, where blocks from the Austwick Formation (Silurian) of Crummackdale were deposited on the Carboniferous limestone outcrop. Similar blocks were 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 it has obscured the underlying rock. Here, brick buildings become more common. Periglacial conditions had powerful erosive forces: meltwater, freeze/thaw cycles and strong cold winds could cut through and reshape the rocks in large areas. At Brimham Rocks near Pateley

Bridge, for example, the cross-bedded sandstones of the Brimham Grits are exposed in curiously shaped pinnacles. The subsequent development of major river systems transported cobbles from upstream, and buildings of rounded cobblestone can often be found in the lower-lying areas adjacent to the larger rivers. Examples include Gargrave on the River Aire, Ingleton on the River Greta and Mickley on the River Ure.

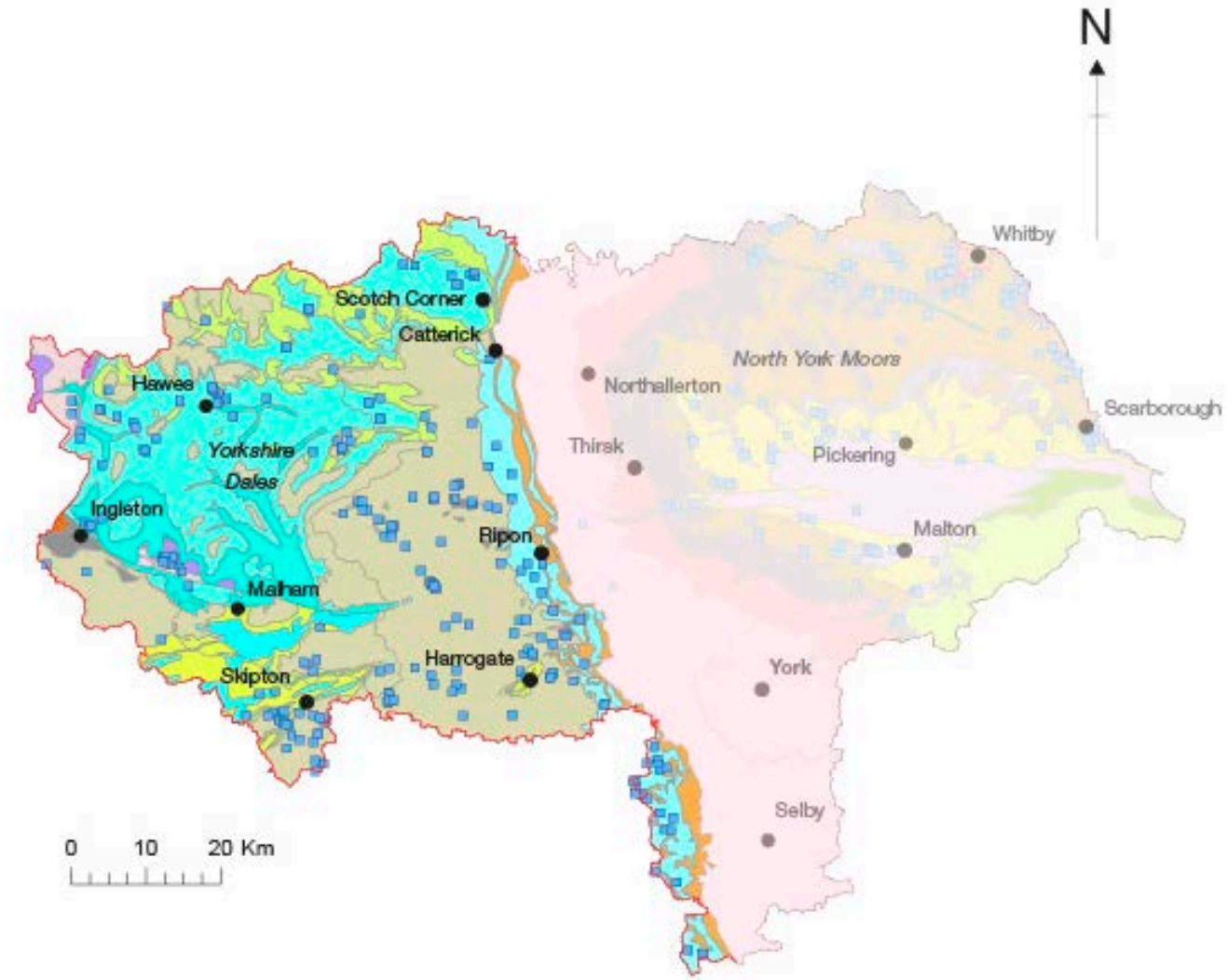
Geological mapping and building stone names

The earliest geological mapping and first formal naming of the rock units of the area were carried out in the 19th century. 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 'ragstone' was the general name used for stone suitable for building but difficult to work. In the Sedbergh area, the term 'ragstone' seems to have been used for sandstones and mudstones from the Coniston Group and Kendal Group successions, and the name 'blue rag' was reserved for the finer grained 'blue slates' quarried from these rock units. In other areas, Brimham Grit, Follifoot Grit and Plumpton Grit, for example, were all named from their principal areas of outcrop.

Some 19th-century 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 re-surveyed or are published only as provisional editions, and this can lead to difficulties in relating old geological accounts to the new mapping and geological research. In this guide, the most recent names are used.

Figure 1: Kilnsey Crag, Wharfedale. Great Scar Limestone.

Bedrock Geology Map



Key

Building stone sources

Bedrock geology

Zechstein Group (Cadeby and Brotherton Formations) — dolomitised limestone and dolomite

Permian Rocks — mudstone, siltstone and sandstone

Permian Rocks — sandstone and conglomerate, interbedded

Pennine Coal Measures Group — mudstone, siltstone, sandstone, coal, ironstone and ferricrete

Pennine Upper Coal Measures Group — mudstone, siltstone, sandstone, coal, ironstone and ferricrete

Pennine Lower Coal Measures Formation and South Wales Lower Coal Measures Formation

Millstone Grit Group — mudstone, siltstone and sandstone

Yoredale Group — limestone with subordinate sandstone and argillaceous rocks

Yoredale Group — limestone, sandstone, siltstone and mudstone

Bowland High Group and Craven Group — limestone

Bowland High Group and Craven Group — mudstone, siltstone and sandstone

Dinantian Rocks — limestone with subordinate sandstone and argillaceous rocks

Dinantian Rocks — sandstone, limestone and argillaceous rocks

Wenlock Rocks — sandstone and conglomerate, interbedded

Silurian Rocks — mudstone, siltstone and sandstone

Silurian Rocks — sandstone and conglomerate, interbedded

Ashgill Rocks — mudstone, siltstone and sandstone

Ordovician Rocks — mudstone, siltstone and sandstone

Igneous Rocks

Unnamed igneous intrusion, Palaeogene — mafic igneous rock

Unnamed igneous intrusion, Ordovician to Silurian — felsic rock

Unnamed igneous intrusion, Ordovician to Silurian — mafic igneous rock

Stratigraphic Table

Geological timescale	Group	Formation	Building stone	Page
Quaternary	various	various	Cobbles	43
Permian	Zechstein	Cadeby Formation	Lower Magnesium Limestone	42
Upper Carboniferous	Pennine Coal Measures Group	Pennine Lower Coal Measures Formation	Winksley Sandstone	42
	Millstone Grit Group	Rossendale Formation	Rough Rock (Laverton Sandstone)	41
		not defined	Midgley Grit	41
		Hebden Formation	Lower Brimham Grit, Upper Brimham Grit, Eldroth Grit, Lower Plompton Grit, Upper Plompton Grit Addlethorpe Grit Libishaw Sandstone (Green Crag, White Crag)	38 38 37
		Samlesbury Formation	Upper Follifoot Grit	36
		Silsden Formation	Lower Follifoot Grit Nesfield Sandstone Red Scar Grit (Scar Grit, Pickersett Edge Grit)	36 35 35
		Pendleton Formation	Pendle Grit, Warley Wise Grit, Grassington Grit, Bradley Flags, Howgate Edge Grit, Brennand Grit, Almscliffe Grit, Marchup Grit	32
		Stainmore Formation (Askrigg Block area)	Crow Limestone (Crag Limestone) Ten Fathom Grit Richmond Chert Little Limestone (Top Little Limestone)	32 31 30 30
		Bowland Shale Formation (Craven Basin area)	Pendleside Sandstone, Harlow Hill Sandstone	29

Geological timescale	Group	Formation	Building stone	Page
Lower Carboniferous	Yoredale Group	Alston Formation	Main Limestone (Twelve Fathom Limestone)	28
			Main Sandstone	28
			Underset Limestone (Four Fathom Limestone)	28
			Underset Sandstone (Upper Hawes Flagstone)	28
			Three Yard Sandstone (Lower Hawes Flagstone)	27
			Five Yard Limestone	27
			Five Yard Sandstone	26
			Middle Limestone, Mosdale Limestone (Wold Limestone)	26
			Middle Sandstone	26
			Simonstone Limestone (Strong Post Limestone)	26
			Hardraw Scar Limestone (Hardraw Limestone, Black Marble)	24
			Hawes Limestone, Gayle Limestone	24
	Great Scar Limestone Group	Malham Formation	Danny Bridge Limestone	20
			Garsdale Limestone	20
			Gordale Limestone	20
			Cove Limestone	20
			Malham Formation Limestone	20
		Kilnsey Formation	Kilnsey Formation Limestone	20
	Bowland High and Craven groups	various	Pendleside Limestone	18
			Rain Gill Limestone	18
			Broughton Limestone	18
			Thornton Limestone	18
			Chatburn Limestone (Haw Bank Limestone)	18
Silurian	Kendal Group	Bannisdale Formation	Bannisdale Slate	17
	Coniston Group	Neals Ing Formation	Coniston Grits and Flags (Blue Ragstone)	17
		Horton Formation	Horton Flagstone (Blue Flags)	17
	Tranearth Group	Arcow Formation	Austwick Flags and Grits	17
		Austwick Formation		
	Stockdale Group	Crummack Formation		
Ordovician	Ingleton Group	various	Ingleton Slate	16

Building stones in geological order from the oldest through to the youngest layers.

2 Local Building Stones

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 organised manner, building arterial roads, forts and, in some cases, villas. Where they stayed for longer periods, they built more permanent buildings of local stone, including the 2nd-century villa at Gargrave and the 4th-century Roman fort at Bainbridge. These buildings have long since been robbed of their stone, which was often reused in local cottages and other buildings.

In the 11th century, the Normans built defensive castles from the local stone, at Skipton, Middleham, Castle Bolton and Richmond, for example. In medieval times, many monasteries were established and then extended over the next 400 years. Substantial remnants of the largest monastic sites can still be seen, at Fountains Abbey, Bolton Priory and Jervaulx, for example, but several lesser known, smaller abbeys were also built, including at Coverham. After the Dissolution of the Monasteries in the 16th century, these impressive buildings were looted for their stone, which was then recycled

Figure 2: Fountains Abbey. Lower Plompton Grit, Five Yard Limestone, Millstone Grit.

in other buildings around the Dales, near Bolton Abbey, for example. 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 17th century, when houses and other buildings throughout the county 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 also in some locations they used local stone slates (fissile sandstones) for the roofs. These were readily available in several areas of the Dales.

Although the sandstone outcrops were quarried extensively in some parts, 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. Consequently, large heaps of locally cleared fieldstones are found at the edges of the fields or along the roadside. They still provide a ready source of building rubblestone.

Figure 3: Hillside above Whaw, Arkengarthdale. Sandstone rubblestone.

In areas where the stone was too thinly bedded or too 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 18th and early 19th centuries, the cotton industry expanded rapidly. Old corn mills were converted and more than 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. Suitable land for a cotton mill was advertised for sale in 1792 at Blubberhouses, stating '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 18th century for the homes of ordinary people, it was more often employed 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 help make them waterproof. For larger buildings, lime kilns were often built close to where the mortar was to be mixed and used. Lime kilns 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 because limestone was unsuitable and would break down under the heat generated by such kilns.

The building of the railways in the 19th century further stimulated the building stone industry, as huge viaducts were 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. These included 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 and so forth.

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 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 Ordnance Survey sheet in the Coniston Grits were shown as ‘Blue Rag’ or ‘Blue Ragstone Quarry’. The term ‘ragstone’ indicated a stone very difficult to trim, always leaving ragged edges 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 feature rounded cobbles from the river. In the 19th century, the Victorians chose the darker slates to contrast with the paler imported Carboniferous sandstone squared blocks or rubblestone. By that time, they had perfected methods for cutting the slate, so that a straight edge could be achieved using a metal wire with sand and water as an abrasive.

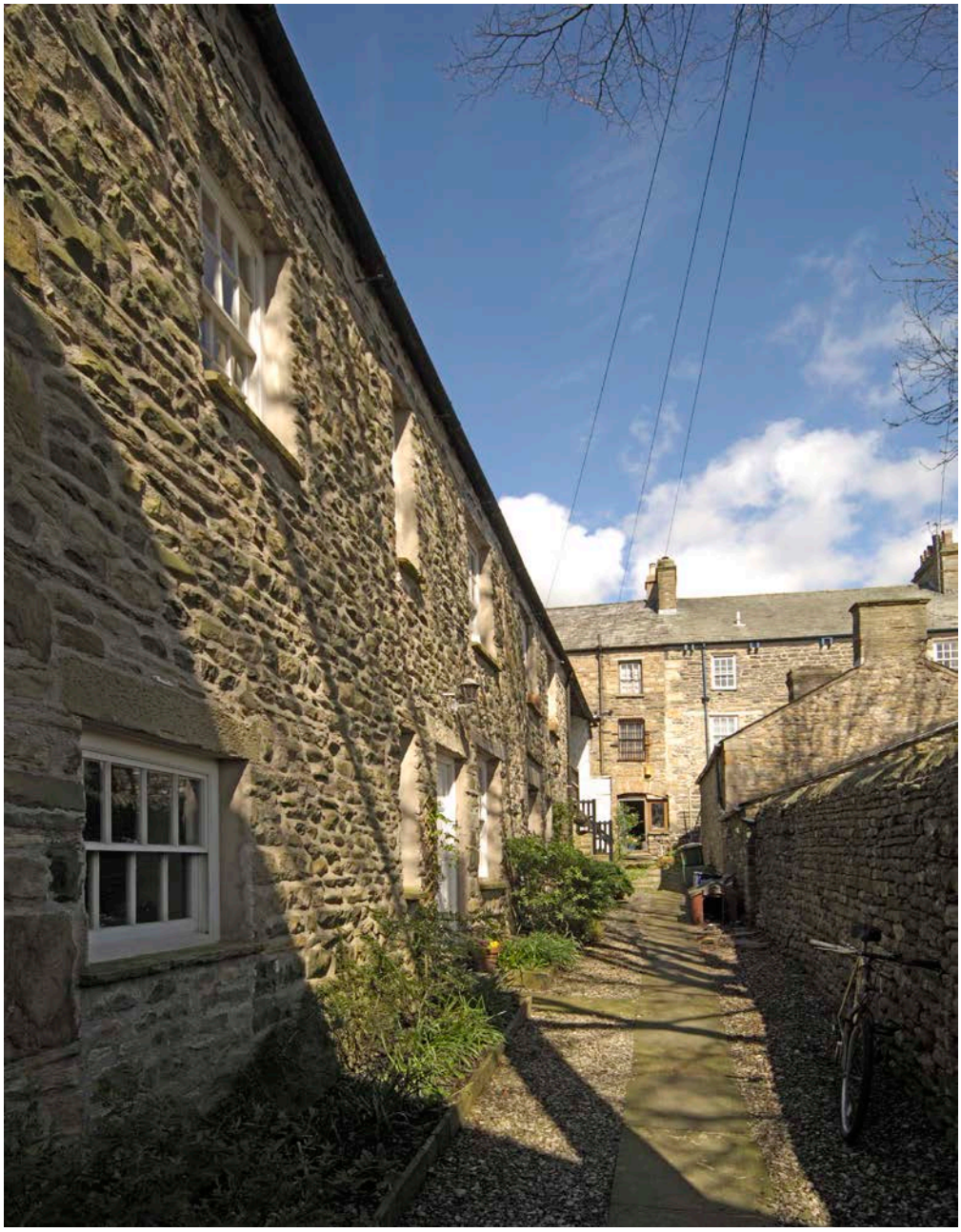


Figure 4: Railton Yard, Sedbergh. Sandstone rubblestone.

Figure 5: Reading Room, Sedbergh. Carboniferous sandstone, and slate roof.

Ribblesdale area

The Silurian succession in the inliers of the Coniston Group in the Ribble Valley consists of turbiditic sandstones, siltstones and slates. It is divided into the Crummack, Arcow, Horton and Austwick formations. The Horton Formation was the most widely exploited, mainly for flagstone rather than 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 Scar 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 Ordnance Survey 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 20 to 40mm thick: too thick for roofing slates but very good for flagstones and bridges. Quarries exploited the areas with good slaty cleavage, quarrying both flagstones and roofing slates. However, 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 19th century 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. 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 and Feizor contain mixed slates and grits from the Coniston Group in their rubblestone walls. Large flagstones pave the path to St Oswald's Church at Horton, and they were polished and used

inside the church, too. The stones can also be seen in bridges in other parts of the Dales. In Ribblesdale today, a few large working quarries dominate the landscape, but the stone produced is used as a high-friction roadstone and not for building.

Roofing slates and flagstones

Slates and flags from both 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.

Inliers of Silurian rocks around Settle and in the Ribble Valley were also exploited for slates, in this instance 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'. This canal was never actually built.

Carboniferous sandstone slates were also used extensively for roofing from the 16th century onwards. They could be obtained from both 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 Grit 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. Consequently, the original surface quarry sometimes gives little impression of the full extent of the actual workings. Examples of underground workings are found at Stags Fell Quarries, Seavy Quarry and Old Quarry near Burtersett, and East Shaw and Scar Head Quarries at Gayle.

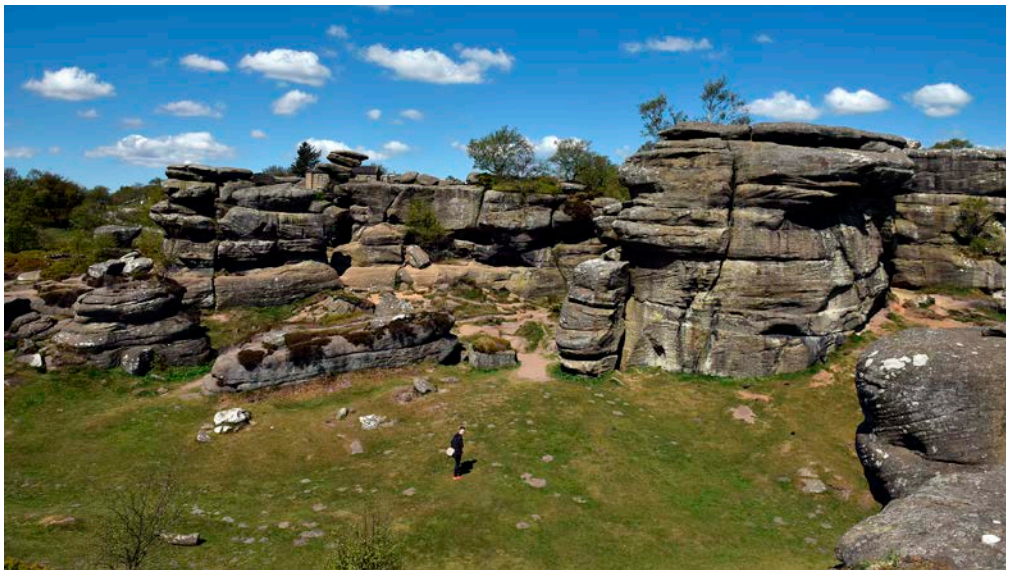


Figure 6: Brimham Rocks, Pateley Bridge. Brimham Grit.

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. Accounts from the rebuilding of a house in Conistone in 1685 record that 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.

Figure 7: Former Hard Rake Quarries, Waldendale. Sandstone slates.

There are still many houses in Yorkshire roofed in traditional sandstone slates. An account from 1891 notes: ‘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 sandstone slate industry.

The railway connections that had been transformative 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 19th century, 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 North Yorkshire (West), stone slates were less easy to obtain and they were gradually replaced by clay pantiles. However, there is a transitional area in between where the older houses are roofed mainly with pantiles, with 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.

Figure 8: Manor House, Redmire, Wensleydale. Yoredale Group sandstone roof slates and lintels.

Figure 9: Healaugh village, Swaledale. Yoredale sandstone slates.

Figure 10: Hardy Grange Farmhouse, Beamsley. Millstone Grit Group sandstone roof slates.

Ordovician

Ingleton Group, various formations

Ingelton Slate

The oldest rocks in the area belong to the Ingleton Group. They comprise a succession of steeply dipping grey-green, turbiditic sandstones and siltstones that 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 slaty cleavage for use as a roofing material. These were employed extensively in the Ingleton and Bentham areas until the mid to late 19th century. 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 they may have been recovered from the river gravels. Other more angular pieces were probably sourced from the slate quarry waste.

Figure 11: Cottage, Ingleton. Ingleton Slate roof.

Figure 12: 1 Bank Hall, Ingleton. Mixed rubble including Ordovician slates.

Silurian

Tranearth Group, Coniston Group, Kendal Group, Austwick Formation, Acrow Formation, Horton Formation, Neals Ing Formation, Bannisdale Formation

Austwick Flags and Grits, Horton Flagstone (Blue Flags), Coniston Grits and Flags (Blue Ragstone), Bannisdale Slate

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

Figure 13: Malham Beck bridge, Malham. Horton Flagstone.

Carboniferous

During the Carboniferous period, the sedimentation patterns 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. 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

Bowland High Group and Craven Groups, various formations

Chatburn Limestone (Haw Bank Limestone), Thornton Limestone, Broughton Limestone, Rain Gill Limestone, Pendleside Limestone

The Craven Basin lies south of the Craven Fault System and is characterised 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.

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. For example, the Yeomans Cottage at Kirkby Malham contains a mix of Craven Group limestone and sandstone rubblestone (some of which was probably collected locally 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 in 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 19th century, 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 was brought in from outside the local

Figure 14: Yeomans Cottage, Kirkby Malham. Craven Group limestone and sandstone rubblestone. Millstone Grit sandstone dressings.

area for quoin stones and window dressings, probably from the Millstone Grit on Calton or Threshfield Moor. 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 employed for the quoins and window dressings. Redberry House, Broughton, for example, was constructed using Broughton Limestone from the Worston Shale Group for the rubblestone walls and Millstone Grit sandstone for the quoins and window dressings and for the sandstone slate roof.

Figure 15: Airton Mill. Thornton Limestone facing and Millstone Grit sandstone quoins and window dressings.

Figure 16: Redberry House, Broughton. Broughton Limestone and Millstone Grit sandstone quoins, window dressings and roof slate.

Great Scar Limestone Group, Kilnsey Formation, Malham Formation

Kilnsey Formation Limestone, Malham Formation Limestone, Cove Limestone, Gordale Limestone, Garsdale Limestone, Danny Bridge Limestone

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 rubblestone.

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

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 Limestone Formation and the Danny Bridge Limestone Formation.

Figure 17: Kilnsey Old Hall. Kilnsey Formation Limestone and other local stones.

The nature of the limestones often dictated how they were used as a building stone. Generally, it was only the coarser grained limestones that were squared to give a more regular-shaped building stone. The finer grained limestones were more difficult to work with and were more often used as rubblestone. Houses in areas where the limestone 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 in building fabrics in these areas.

Figure 18: Oxenber Cottage, Hollin Hill, Austwick. 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 house, Ingleton, whereas the walling is 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 19th century and the coarser grained limestones were subsequently more often dressed into square blocks. The 19th-century nave of the Church of St Mary at Ingleton is of snecked and dressed limestone and contrasts with the 15th-century 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. The limestone employed in the nave contains small pebbles of Ingletonian slates and provides a distinctive building stone. Some of this limestone is also fossiliferous: its coarser nature again made it easier to work and dress, as seen in the fabric of Bridge End Guest House at Ingleton, for example.

Figure 19: Church of St Mary, Ingleton. Malham Formation limestone with pebbles of Ingletonian slate (nave); limestone rubblestone and sandstone blocks (tower); Eldroth Grit sandstone windows, quoins and buttresses.

Figure 20: Church of St Mary, Ingleton. Malham Formation Limestone.

Yoredale Group, Alston Formation

The Carboniferous succession becomes younger northwards and changes in lithological character. These changes are reflected in the building stones used. The Yoredale Group overlies the massive limestones of the Great Scar Limestone Group. It is characterised 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 stone sources of this area. These sandstones are an important building stone throughout the northern Dales. Although often thinly bedded, they were strong enough to be quarried for flags or roofing slates.

There are a dozen building stones in the Yoredale Group alone. The range of these Carboniferous sandstones in the area is described in an 1891 Geological Survey of England and Wales Memoir. 'Locally, nearly every one of these sandstones develops into building material of more or less value'. The building stones include the Three Yard Sandstone and the Underset Sandstone. In many areas, the outcrops of these sandstones appear discontinuous, making precise correlations difficult so referred to as the Alston Formation without further subdivision.

The individual sandstone beds are lithologically very similar in character, and out of context they 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 rocks could produce good building stone and they were broken relatively easily into squared blocks. However, if the stone is strongly laminated then the edges of the

Figure 21: St Agatha's Church, Gilling West. Alston Formation sandstone.

stone can weather and flaking can sometimes occur. The medium-grained sandstones are often quite decorative, with swirls of orange-coloured iron staining within each block. Examples of this staining can be seen in the stonework at the Methodist Church in Gayle, Lion House and the Church Hall, both in Hawes, and the White Rose Hotel in Askrigg.

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

Where the limestone was highly fossiliferous, for example crinoidal, some of the beds were hard enough to take a good polish. These were quarried for decorative purposes, with different beds providing various 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 that crossed many areas of the Dales in the 19th century. 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.

Hawes Limestone, Gayle Limestone

These limestones are dark grey, poorly sorted, bioclastic wackestones and packstones, with abundant crinoid 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.

Hardraw Scar Limestone (Hardraw Limestone, 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. In 1835, geologist Adam Sedgwick noted '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'.

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 Andrew at Dent are at least four different marbles from Dentdale, together with a red marble, possibly from near Kendal, and a brown marble, possibly from Bentham Fell. Hardraw Scar Limestone could also provide strong masonry for building, and the coming of the railways meant that good, strong, workable stone was in great demand for the area's viaducts. One of the pillars at Dent Head Viaduct sits within a marble quarry, so the owners were paid compensation while the viaduct was under construction. It is partly built of Hardraw Scar Limestone and partly of

Simonstone Limestone from the adjacent hill. Arten Gill Viaduct was also built of Hardraw Scar Limestone. The Coldstones Cut, an artist-designed viewpoint completed in 2010, on the edge of Coldstones Quarry, Greenhow, was built using large blocks of Hardraw Scar Limestone from the quarry. It was erected using a double-wall construction, with natural joint planes to give flat faces.

Figure 22: Church of St Andrew, Dent. Black Marble and other Dentdale marbles.

Figure 23: Dent Head viaduct. Hardrow Scar Limestone and Simonstone Limestone.

Figure 24: Coldstones Cut public art viewpoint, near Pateley Bridge. Hardraw Scar Limestone.

Simonstone Limestone (Strong Post Limestone)

Resembling the Hardraw Scar Limestone in colour, but thicker, stronger and coarser grained, Simonstone Limestone provided a strong material for the construction of door posts, small pillars, quoins and coping stones. The Dent Head Viaduct was built partly from Simonstone Limestone blocks. The viaduct crosses over the quarry that produced the stone.

Although the stone was not generally considered fit for polishing, the Geological Survey of England and Wales memoir of 1890 describes the Simonstone Limestone as 'a black and homogenous rock, [which] has been quarried in Oliver Gill for "black marble".'

Middle Sandstone

This sandstone was quarried and used as a building stone. It also provided sandstone slates in Swaledale, around Thwaite, Gayle, Hawes and Burtersett. In Dent Dale, the bed was worked for flags at Wydern and Kirkbank. In Cowgill (now in Cumbria), 8km above Dent, the bed was quarried for hard, white siliceous grit that could be split into very thin flags and used as attractive roofing slate. Below the very thin flags were beds of thicker flags that were quarried for flooring or paving stones.

Middle Limestone, Mosdale Limestone (Wold Limestone)

This Middle Limestone unit includes the Mosdale or Wold Limestone. These named limestone beds were not 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, and records show that there were fine building stone quarries in Rawthey Gill, between Ravenstonedale and Sedbergh in Cumbria. The sandstone is micaceous and fissile, and generally more open grained. Good, thick flagstones were extensively quarried at Low Row Pasture in Swaledale, High Pike at the head of Deepdale, Scotcher Gill just north of Dent and

Cottersdike and Bridge End in Garsdale, where levels were driven for 200 to 300m into the hill.

Around Whashton and Gayle, 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 Church of St Margaret at Preston-under-Scar uses laminated sandstone from the Five Yard Sandstone above the village.

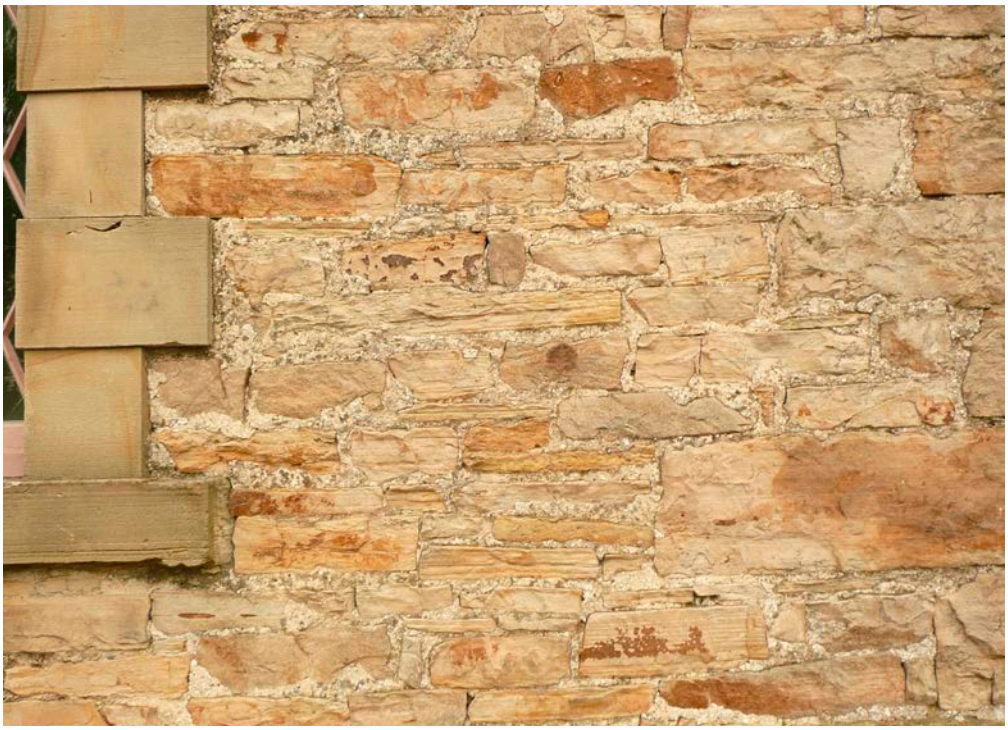


Figure 25: Church of St Margaret, Preston-under-Scar. Five Yard Sandstone.

Five Yard Limestone

This limestone is often a very thin bed of only 0.7m in parts of upper Wensleydale, but it is more than 8m thick in a quarry near Keld Heads Mine near Preston-under-Scar. It splits into two leaves in Swaledale, Dentdale, Garsdale (Cumbria) 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 in diameter. Both of these types of Nidderdale Marble were used as decorative stone in Fountains Abbey near Ripon, and Nidderdale Marble was also used for the steps of St George's Chapel at Windsor in Berkshire.

Three Yard Sandstone (Lower Hawes Flagstone)

This sandstone includes fissile beds that have been quarried for roofing slate and flagstone in Garsdale, High Pike in Dent and around the upper crags on Ingleborough. Near Hawes, it is known as the Lower Hawes Flagstone and it

was quarried at High Quarry, Stags Fell, Simonstone. 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 (Upper Hawes Flagstone)

This sandstone was quarried for building stone in Swaledale, for flags west of Whernside, and 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 Oswald 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, and it is 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. However, these quarries 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.

Main Sandstone

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

Main Limestone (Twelve Fathom Limestone)

This grey to dark grey, medium-grained, biosparite Great Limestone Member is locally characterised 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 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. Sedgwick described this marble as ‘enlivened by many dark cloudy blotches, arising out of the irregular distribution of the colouring bituminous matter.’ An example can be seen in the marble floor of the Church of St Andrew at Dent. The stone was also used for walling in Gayle.

Upper Carboniferous

Millstone Grit Group, Craven Basin and Askrigg Block

The Craven Basin area and Askrigg Block area successions are basically cyclic sequences but 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 area, 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, such as Scotgate Ash Quarry in Nidderdale, quarrying the Hebden Formation Libishaw Sandstone, could offer several types of building stone for various 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 reservoir dam, and both were of similar lithology.

Millstone Grit Group, Bowland Shale Formation (Craven Basin area)

Harlow Hill Sandstone, Pendleside Sandstone

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.

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 one quarry in the Pendleside Sandstone at Long Preston. During early Pendleian 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 Beckwith.

These quarries supplied building sandstone in the local area around Beckwithshaw and Harlow Hill, and probably also for developments in west Harrogate generally. The sandstone at Harlow Hill Quarry is 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.

Millstone Grit Group, Stainmore Formation (Askrigg Block area)

In the northern dales and around Richmond, there is a continuation of the cyclic sequences of the Yoredale Group up into the Millstone Grit Group, with the sequence becoming more siliceous and including several beds of chert. The sequence includes Little Limestone (Top Little Limestone), Richmond

Chert, Ten Fathom Grit and Crow Limestone (Crag Limestone) together with various unnamed interbedded sandstones, mudstones and siltstones. The main building stone sources were in the Ten Fathom Grit, Main Limestone, Little Limestone and cherty limestones of the Richmond Chert. In Richmond Castle itself, all of these building stones are evident in wall fabrics, together with the Underset Sandstone, which can be found cropping out close by to the north.

Figure 26: Richmond Castle, Richmond. Ten Fathom Grit, Stainmore Formation limestones and Underset Sandstone.

Little Limestone (Top Little Limestone), Richmond Chert

The Little Limestone in Swaledale is typically a medium grey, crinoidal biosparite that becomes a grey, argillaceous, laminated limestone further north at a quarry in Aldbrough St John. The Richmond Chert is recognised separately in Swaledale as consisting of siliceous cherts, cherty limestones and limestones, overlying the Little Limestone. However, in the north of the area, these cherty upper beds are 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 are often seen as a building stone in Richmond. However, the actual chert bands of the Richmond Chert were quarried and used for road metal and facing grindstones, and rarely used as a building stone. At Richmond, the stone used to build the castle reflects the availability of materials around the castle site. Alternating sandstones, red cherty limestones and white crinoidal limestones, and even 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 the 12th century, are of Underset Sandstone. The Church of St Paul at Aldbrough St John is built from the red, crinoidal, cherty limestones of the Richmond Chert.

Figure 27: Church of St Paul, Aldbrough. Richmond Chert.

Ten Fathom Grit

Ten Fathom Grit is a hard, light grey, thin-bedded sandstone that could be readily cut into squared blocks. It was quarried at Keld, Thwaite, Angram and Melbecks. As it is the only sandstone quarried close to these villages, it can be assumed that the building stone used there is principally from this unit. It was also quarried at Downholme, Marrick, Newbiggin, Ravenseat, Grinton, Hurst Moor, Gunnerside Moor and 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 and 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 because, generally, they have the same grey colouration and orange iron staining.

Figure 28: Cottages, Keld, Upper Swaledale. Ten Fathom Grit.

Crow Limestone (Crag Limestone)

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.

Millstone Grit Group, Pendleton Formation

Pendle Grit, Warley Wise Grit, Grassington Grit, Bradley Flags, Howgate Edge Grit, Brennand Grit, Almscliffe Grit, Marchup Grit

The Pendleton Formation is characterised by siltstones, silty mudstones and feldspathic sandstones. These sandstones were the important building stones in the local area with the Pendle Grit and the Warley Wise Grit providing the principal building stones of this succession. 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 Pendleton Formation sandstones crop out at the bottom of Embsay Moor.

Despite their proximity, however, the Pendle Grit was not used by the builders of Skipton Castle, who preferred the coarser more easily worked Warley Wise Grit on the moor top. In late 18th to early 19th-century buildings, the building stone sourced from the Pendleton Formation is characterised 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.

Figure 29: Skipton Castle, Skipton. Warley Wise Grit.

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 Grit and Warley Wise Grit. The quarries in the Pendle Grit were largely developed in the 19th century, when mechanised 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 and Pannal as well as near Skipton.

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 around Skipton and Settle, the Almscliffe Grit near Harrogate, and the Upper Howgate Edge Grit in the northern Dales. These coarser sandstones are laterally persistent and overstep the successions of the Askrigg Block and 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 medieval builders and used to build Bolton Priory, Barden Tower, the Holy Trinity Church and the Norman Castle, all in or near Skipton. They were generally used in larger blocks and contrast markedly with the smaller blocks of Pendle Grit, more commonly worked in the 18th and 19th centuries, that are often employed in the same areas. The Warley Wise Grit was generally used for quoins, window and door surrounds and for large coping stones. It was also widely used for constructing bridges in the Dales, and it was quarried for this purpose extensively on Embsay and Eastby Moors.

Figure 30: Old Grammar School, Skipton. Pendle Grit with Warley Wise Grit quoins.

To the south of Skipton, the more thinly bedded Bradley Flags provided a good source of sandstone roofing slates for the area. Warley Wise Grit from Embsay Fell was used for many of the old local bridges, including 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. This can be seen in the houses at Flasby and Gargrave, and it was also used to build the 19th-century nave of St Andrews' Church at Gargrave.

This sandstone bed, between the Warley Wise Grit and Red Scar Grit, was worked in Airedale at Cowling Hill. It was also worked 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. In the mid-19th century, there were many quarries at Hookstone and Stonefall. These now lie along the eastern edge of Harrogate and are likely to have provided building stone for High Harrogate, then a separate village from 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. Two hundred acres, including Bog's Field as part of the Stray, are to remain open with free public access'. In the late 19th century, 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.

Figure 31: Trappes Hall, Carleton. Pendle Grit.

Figure 32: Priesthouse and Chapel, Barden. Millstone Grit, probably Warley Wise Grit.

Figure 33: Crown Hotel, Harrogate. Marchup Grit.

Millstone Grit Group, Silsden Formation

Red Scar Grit (Scar Grit, Pickersett Edge Grit)

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

Nesfield Sandstone

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 reservoir dams.

Figure 34: Scar House Dam. Nesfield Sandstone.

Millstone Grit Group, Silsden Formation, Samlesbury Formation

Lower Follifoot Grit, Upper Follifoot Grit

These two sandstones are separated by fissile mudstones, but they often occur together and are quarried in the same area. They are generally very similar in lithology and in buildings they would be difficult to tell apart. Quarries were more numerous in the Lower Follifoot Grit (Silsden Formation) than in the Upper Follifoot Grit (Samlesbury Formation) in the Nidderdale area. However, both sandstones were quarried widely in Nidderdale at Middlesmoor, Lofthouse, Ramsgill, Wath, Kettlesing, Birstwith, Burnt Yates, Clint and Hampsthwaite; to the north of Harrogate at Ripley and Killinghall; to the west of Harrogate at Thornthwaite with Padside, Blubberhouses, Menwith Hill and Timble; to the 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 been used locally as a source for sandstone slates.

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 quarries close by in the Red Scar Grit and the Libishaw Sandstone, too. Lower Follifoot Grit was also used in the construction of Fewston reservoir dam.

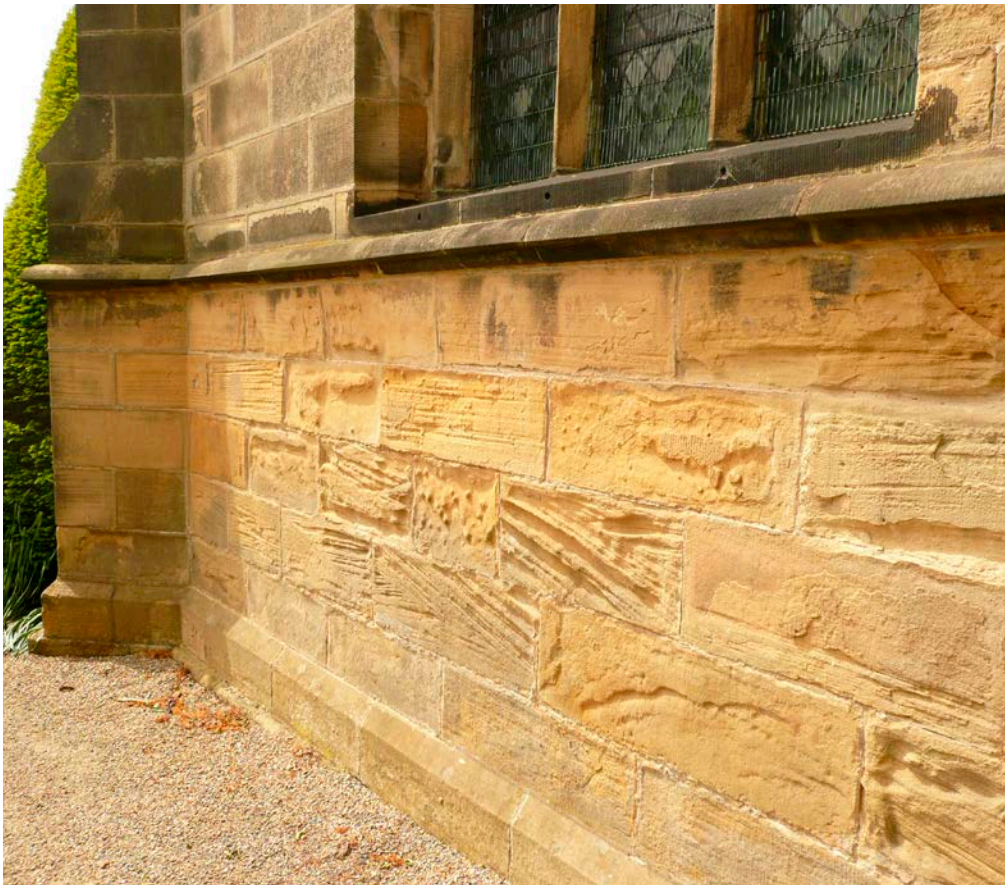


Figure 35: All Saints' Church, Kirkby Overblow. Follifoot Grit.

Millstone Grit Group, Hebden Formation

Libishaw Sandstone (Green Crag, White Crag)

This fine to medium-grained, micaceous, feldspathic, thin-bedded sandstone of variable colour (buff, brown, pale yellow and grey) was quarried widely in the 19th century on the north side of Pateley Bridge. The Scotgate Ash quarries were well known for their flagstones and landing stones, but the thin-bedded sandstone was described in 1820 as 'not well adapted for general building purposes'. As the quarries expanded, better stone beds must have been found, because in 1886 the following types of stone were advertised as available from the now much larger enterprise at Scotgate Ash: '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 micaceous, 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 numerous prestigious buildings, such as the National Gallery and South Kensington museums in London and HM Government works at Enfield, Woolwich, Aldershot, Plymouth, Portsmouth and York, as well as principal buildings in Harrogate. The thin sandstone blocks used in the walling of St Cuthbert's Primary School at Pateley Bridge, on the road leading up to the Scotgate Ash quarries, were probably sourced from the flagstone beds in the quarry.

Figure 36: St Cuthbert's Primary School, Pately Bridge. Libishaw Sandstone.

The beds were also quarried for sandstone slates south-west of Pateley Bridge, at Moorhouse and Middle Tongue; in the upper part of Nidderdale at Lofthouse; on the moors above Healey, Swinton and Masham; and also around Blubberhouses and Thruscross. Further down the River Nidd, they were 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. However, 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 in the Harrogate area. Extensive quarrying at Knox and Warren Bank provided stone for the north side of Harrogate.

Lower Brimham Grit, Upper Brimham Grit, Eldroth Grit, Lower Plompton 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. 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.

The sandstones tend to be medium to very coarse-grained, and 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 spot of Brimham Rocks, where the effects of Devensian ice and wind have worn the rocks into curious shapes. 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 10th century, still stand alongside the outcrop of Lower Plompton Grit that provided the sandstone used in its construction.

Older buildings in Pateley Bridge, such as the shop at 39 High Street built in 1661, were all constructed using the coarse-grained Brimham Grit sandstones. 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 village that also used this stone. For example, the Crown Hotel was rebuilt in 1767, using smaller blocks, probably from quarries in the Libishaw Sandstone. This stone has barely weathered and contrasts 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 they 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.

Figure 37: 39 High Street, Pately Bridge. Lower Brimham Grit.

The Upper Brimham Grit was quarried at Grewelthorpe, Ilton and Mickley. There were also numerous quarries in the area around Kirkby Malzeard, at least one of which was recorded as quarrying sandstone slates. For the most part, however, the Upper Brimham Grit is a massive, cross-bedded, sandstone that could be cut into large blocks. The skill with which it could be carved is demonstrated in the decorative 15th-century Norman archway and the strip of carved stones that encircles the 16th-century tower at St Andrew's Church at Kirkby Malzeard. Although some of the stone is now weathering away, these remarkable examples have survived despite the church being gutted by fire and extensively damaged in 1908.

Figure 38: Norman arch, St Andrew's Church, Kirby Malzeard. Upper Brimham Grit.

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

The Plompton Grits are named after the type locality: Plompton Rocks to the south-east of Harrogate, where the weathered outcrops form curious shapes. Their building sandstones are characterised 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 and Spofforth, as well as at Knox Hill and Hall Lane in Harrogate, all of which probably supplied some stone for building in and around north Harrogate. Most of Ripley village, including the castle and the medieval church, is built of sandstones from the Plompton Grits.

Figure 39: Ripley Castle. Lower Plompton Grit.

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

Figure 40: Spofforth Castle. Upper Plompton Grit.

Millstone Grit Group, formation not defined

Midgley Grit

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

Millstone Grit Group, 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.

Millstone Grit Group, Pennine Lower Coal Measures 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 Measures Formation, including the Winksley Sandstone, occurs at outcrop. There are a few small sandstone quarries that 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.

Permian

Zechstein Group, Cadeby Formation

Lower Magnesian Limestone

At the eastern edge of north-west Yorkshire, 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 be 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 dolomitic limestones from the Cadeby Formation. They were often used together in villages such as Masham and West Tanfield on the fringes of the Yorkshire Dales. For example, the former bank at 14 Park Square, Masham, was built in 1856 of Permian Cadeby Formation limestone with sandstone dressings and St Nicholas' Church at West Tanfield has a sandstone tower and limestone nave.

Figure 41: 14 Park Square, Masham. Cadeby Formation limestone with ashlar sandstone dressings.

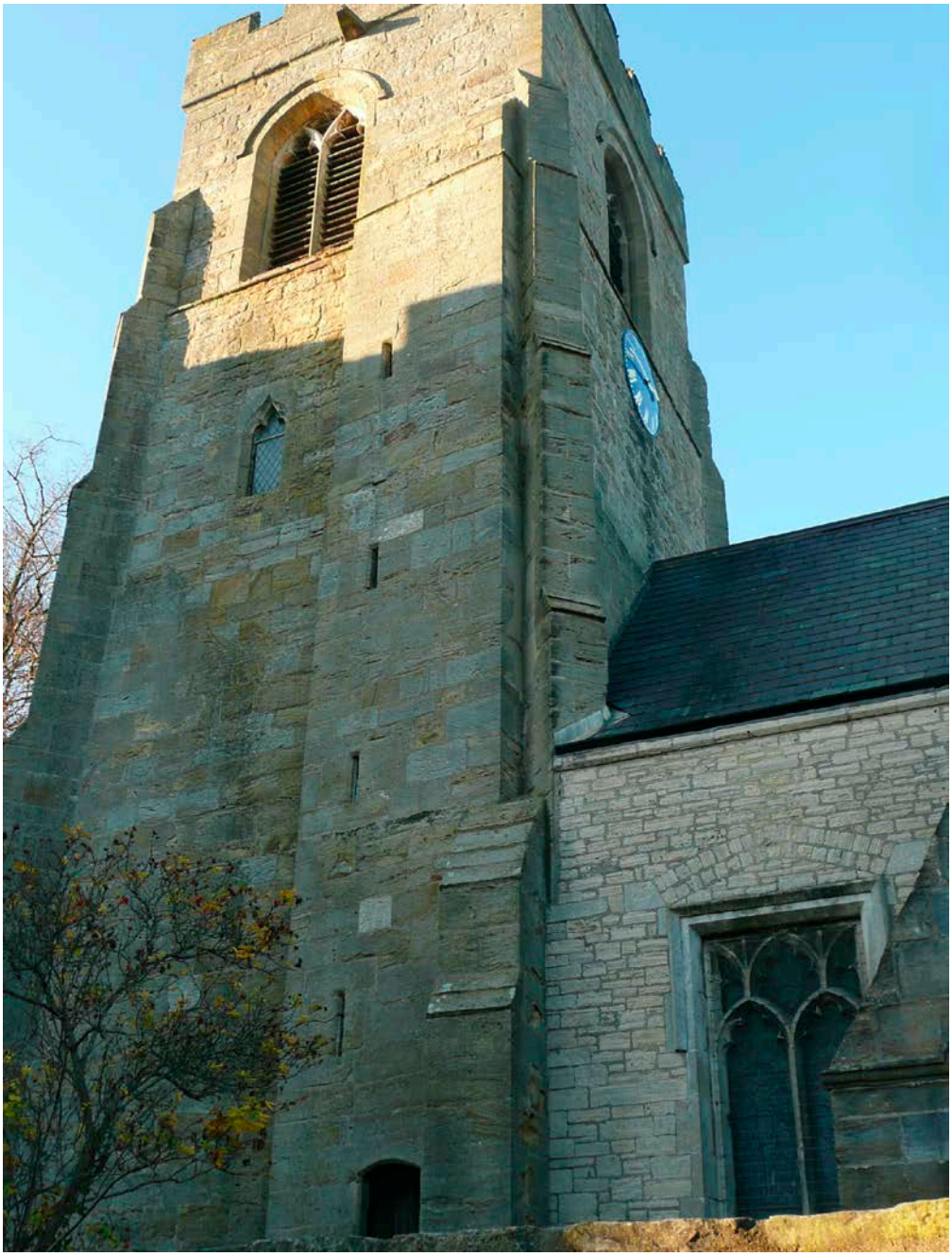


Figure 42: St Nicholas' Church, West Tanfield. Cadeby Formation limestone nave and sandstone tower.

Quaternary

Various groups, various formations

Cobbles

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 this area, building stone is more difficult to obtain and, generally, moving eastwards, brick buildings become more common. These deposits are principally quarried for sand and gravel as aggregate for concrete production.

Numerous rivers dissect the north-west Yorkshire area, and the villages built along these river courses have provided a source of rounded cobbles for buildings, especially where they have cut through the glacial boulder clay cover. Cobbled market places and streets are common and can be seen at Dent, Askrigg and Richmond, for example. River cobbles can also be seen as walling stone, including at North Street, Gargrave, which uses cobbles from the River Aire, and the Church of St John the Evangelist at Mickley, which uses fluvial or fluvio-glacial material from the River Ure, with a Welsh purple Penrhyn slate roof.

Figure 43: Church of St John the Evangelist, Mickley. Fluvial/fluvio-glacial material from the River Ure with Welsh purple Penrhyn Slate roof.

3 Further Reading

The Further Reading, Online Resources and Contacts guide provides general references on:

- Geology, building stones and mineral planning
- Historic building conservation, architecture and landscape.

There is also a separate glossary of geological terms.

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Figures

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