Historic England

Staffordshire

and Dudley, Stoke-on-Trent, Walsall, Wolverhampton

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 Ian Simpson and Peter Floyd.

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Front cover: Chapel Lane, Longnor. Millstone Grit sandstone.
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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.

Middle Jurassic
↑ geological time period

Inferior Oolite Group, Lincolnshire Limestone Formation
↑ geological group ↑ geological formation

Lincolnshire Limestone
↑ building stone (alternative or local name)

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 Staffordshire County Council and part of the West Midlands Combined Authority mineral planning areas; and the unitary planning authority areas of Dudley, City of Stoke-on-Trent, Walsall and Wolverhampton; and the local planning authority areas of Newcastle-under-Lyme, Staffordshire Moorlands, Stafford, East Staffordshire, South Staffordshire, Cannock Chase, Lichfield and Tamworth. Part of Staffordshire lies in the Peak District National Park and is covered in the *Derbyshire and Peak District* guide.

Contents

1 Introduction

The solid geology of Staffordshire and the Dudley, Stoke-on Trent, Walsall and Wolverhampton areas mainly comprises of rocks from just three geological periods: the Carboniferous, the Permian and the Triassic. Little Permian is seen at the surface, however, and the landscape is therefore dominated by the varied lithologies of the Carboniferous and the Triassic.

To the north of a line from Market Drayton (Shropshire) in the south-west to Ashbourne (Derbyshire) in the north-east, the rocks are largely of Carboniferous age and include the well-known limestones of the Peak District and the sandstones of the grit escarpments, as well as the Coal Measures strata found around Stoke-on-Trent. To the south of this line, Triassic sandstones and mudstones predominate, although Late Carboniferous rocks occur both around and to the south of Cannock. In the Wolverhampton and Walsall areas, there are small outcrops of Silurian limestones and shales, and near Tamworth, some Late Cambrian to Early Ordovician shales, which are intruded by Late Ordovician lamprophyres.

Building stones were obtained principally from among the various sandstones of the Carboniferous and Triassic successions, with some Carboniferous limestones also being quarried on the edge of the Peak District and near to Wolverhampton and Walsall. Initially, the stones were quarried locally to their places of intended use and only roughly squared off, especially in the case of farm dwellings and workers' cottages. Some of the larger estates could afford to open their own quarries. However, with

Figure 1: Town centre buildings, Leek. Millstone Grit sandstones.

Figure 2: Royal London Mutual Insurance building, Wolverhampton. Sherwood Sandstone.

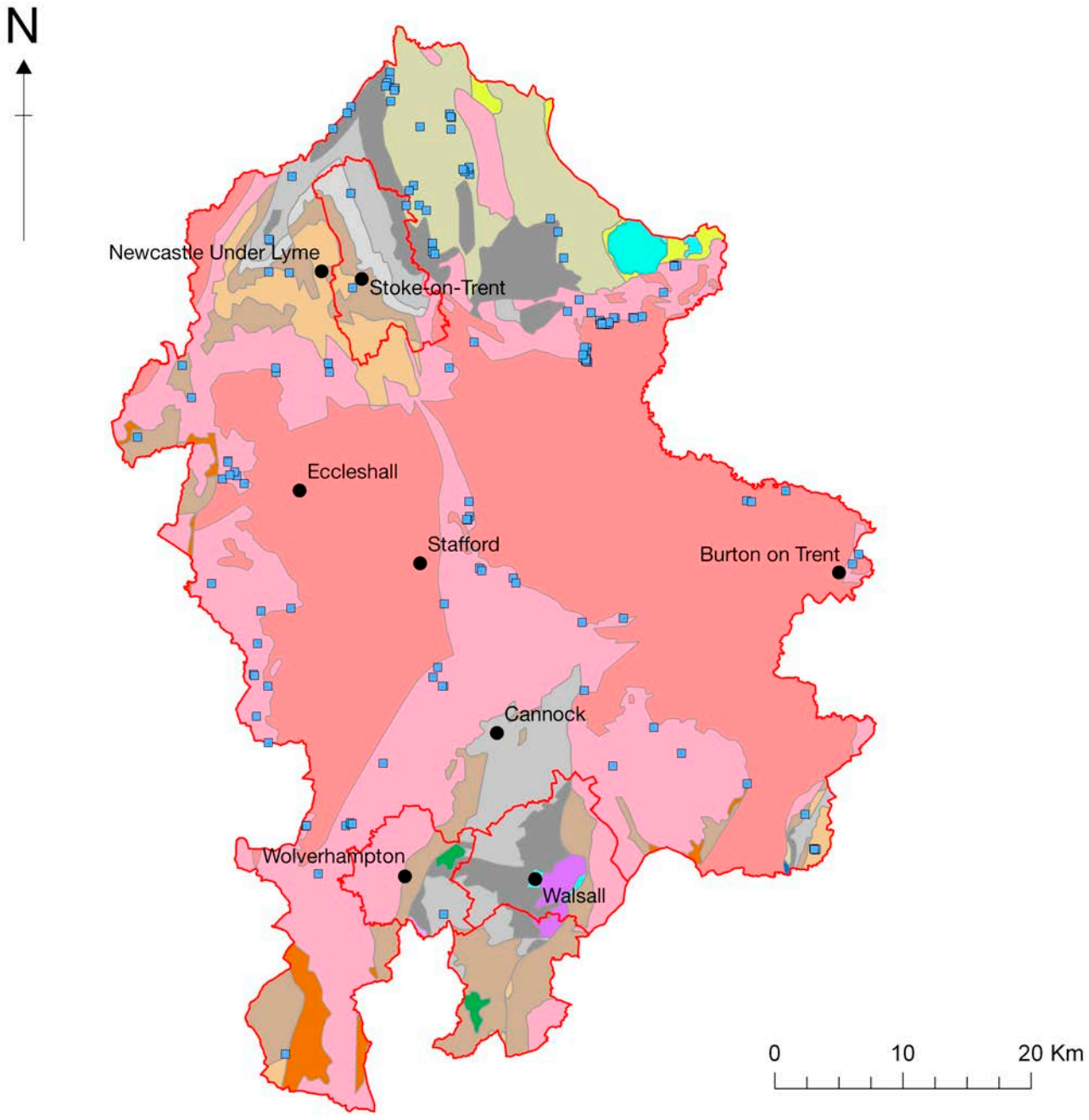
changing fashions and the need for better quality stone, attentions were focused on particular, often less proximal, sandstone beds.

The area around Hollington and Alton (north of Uttoxeter), in particular, rose to prominence. A concentration of several sandstone quarries developed here, of which three are still working today. Hollington Stone was used extensively, not only locally but also elsewhere within (and outwith) the county. In addition to providing good, durable, general purpose stone in a variety of attractive colours, the more massive, well-cemented beds were suitable for decorative and ornamental work, and generally weathered well.

Although Staffordshire has produced much of its own building materials over the centuries, other lithologies have been imported from nearby counties, in particular Shropshire, Yorkshire and Leicestershire.

Figure 3: Keele Hall, Keele University. Hollington Stone.

Bedrock Geology Map



Key

Building stone sources

Bedrock geology

Triassic Rocks (undifferentiated) — mudstone, siltstone and sandstone

Triassic Rocks (undifferentiated) — sandstone and conglomerate, interbedded

Permian Rocks (undifferentiated) — sandstone and conglomerate, interbedded

Warwickshire Group — mudstone, siltstone, sandstone, coal, ironstone and ferricrete

Warwickshire Group — siltstone and sandstone with subordinate mudstone

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

Pennine Middle Coal Measures Formation and South Wales Middle Coal Measures Formation (undifferentiated)

Pennine Lower Coal Measures Formation and South Wales Lower Coal Measures Formation (undifferentiated)

Unnamed Igneous Intrusion, Westphalian — microgabbro

Millstone Grit Group — mudstone, siltstone and sandstone

Bowland High Group and Craven Group (undifferentiated) — limestone

Bowland High Group and Craven Group (undifferentiated) — mudstone, siltstone and sandstone

Dinantian Rocks (undifferentiated) — limestone with subordinate sandstone and argillaceous rocks

Ludlow Rocks (undifferentiated) — mudstone, siltstone and sandstone

Wenlock Rocks (undifferentiated) — mudstone, siltstone and sandstone

Silurian Rocks (undifferentiated) — limestone, mudstone and calcareous mudstone

Tremadoc Rocks (undifferentiated) — mudstone, siltstone and sandstone

Stratigraphic Table

Geological timescale	Group		Formation	Building stone	Page
Triassic	Penarth Group		Westbury Formation		
	Mercia Mudstone Group		Blue Anchor Formation		
			various	Skerry sandstones, Alabaster	21
	Sherwood Sandstone Group	Needwood Basin	Hollington Formation	Upper Mottled Sandstone, Hollington Sandstone	21
			Hawksmoor Formation, Huntley Formation		
		Stafford Basin	Kibblestone Formation, Bromsgrove Sandstone Formation	Kibblestone Sandstone, Alton Stone, Penkridge Stone, Tixall Stone, Hollington Stone, Bromsgrove Sandstone	19
			Wildmoor Sandstone Formation, Kidderminster Formations		
			Hopwas Breccia Formation		
		Cheshire Basin	Helsby Sandstone Formation	Grinshill Stone, Helsby Sandstone	18
			Wilmslow Sandstone Formation		
			Chester Pebble Beds Formation, Kinnerton Sandstone Formation		
Permian	New Red Sandstone Supergroup, Warwickshire Group		Bridgnorth Sandstone Formation		
			Clent Formation		
Upper Carboniferous			Halesowen Formation	Hanchurch Sandstone Springpool Sandstone Butterton Sandstone Keele Stone	14
	Pennine Coal Measures Group		Pennine Lower Coal Measures Formation	Coal Measures sandstones Woodhead Hill Rock Kingsley Sandstone (Woodhead Sandstone)	14
	Millstone Grit Group		Rossendale Formation	Rough Rock	11
			Marsden Formation, Hebden Formation	Longnor Sandstone, Kinderscout Grit, Sheen Sandstones, Five Clouds Sandstones, Corbar Grit, Roaches Grit, Ashover Grit (Third Grit), Chatsworth Grit	11
			Morridge Formation	Lum Edge Sandstone Blackstone Edge Sandstone	11

Geological timescale	Group	Formation	Building stone	Page
Lower Carboniferous	Craven Group	Bowland Shale Formation	Brockholes Sandstone, Knivedon Sandstone, Cheddleton Sandstone, Hurdlow Sandstone, Minn Sandstone	10
		Widmerpool Formation	Onecote Sandstone	8
		Ecton Limestone Formation		
	Peak Limestone Group	Hopedale Limestone Formation, Kevin Limestone Formation	Dinantian limestones	8
		Milldale Limestone Formation		
Silurian	not defined	Aymestry Limestone Formation	Aymestry Limestone (Aymestry Rock, Sedgley Limestone)	8
		Much Wenlock Limestone Formation	Much Wenlock Limestone, Lower Quarried Limestone	7
		Coalbrookdale Limestone Formation		
		Barr Limestone Formation		
Ordovician	Midlands Minor Intrusive Suite		Dosthill Granite, lamprophyre	7

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

2 Local Building Stones

Ordovician

Midlands Minor Intrusive Suite

Dosthill Granite, Lamprophyre

The lamprophyre sills of Dosthill, near Tamworth, were intruded into Late Cambrian to Early Ordovician shales during the Late Ordovician. Known locally as Dosthill Granite, these unusual grey-black, fine-grained igneous rocks comprise slightly larger hornblende, pyroxene, olivine and biotite crystals set within a finer grained groundmass of plagioclase feldspar. This rock was primarily quarried for roadstone, although some was used to make paving setts.

Silurian

During mid-Silurian times, the area that would ultimately become Staffordshire lay about 15 degrees south of the equator. A global sea level rise had led to the submergence of the Midlands platform by a warm, tropical sea. Richly fossiliferous, calcareous mudstones dominate the succession laid down in this, although temporary falls in sea level allowed reef growth, high carbonate productivity and the accumulation of limestones, some of which have been used for building purposes.

Group not defined, Barr Limestone Formation

The oldest limestone unit cropping out in the east Walsall area is the Barr Limestone Formation. It is a grey, fine-grained rock containing calcareous nodules. It was primarily used for the production of lime rather than building stone.

Group not defined, Much Wenlock Limestone Formation

Lower Quarried Limestone, Much Wenlock Limestone

In the Walsall area, the Much Wenlock Limestone Formation comprises the Lower and the Upper Quarried Limestone members (formerly the Lower and the Upper Wenlock Limestone), which are separated by the Nodular Limestone Member (Nodular Beds).

Figure 4: Dudley Castle, Dudley. Much Wenlock Limestone and Sherwood Sandstone.

The Lower Quarried Limestone has been used to some extent for walling and building stone, such as the 19th-century Church of St Michael at Rushall.

The grey to light blue, buff-weathering, bioclastic Much Wenlock Limestone, with its abundant shelly fauna, has been quarried since Roman times in the Wolverhampton and Walsall areas, albeit principally for the manufacture of lime.

Group not defined, Aymestry Limestone Formation

Aymestry Limestone (Aymestry Rock, Sedgley Limestone)

The Aymestry Limestone Formation (also known as the Aymestry Rock or the Sedgley Limestone) comprises a blue-grey, muddy, nodular limestone. This was worked at a small quarry near Goldthorn Park. The bulk of the quarried stone was used as flux for the iron furnaces at Coalbrookdale in Shropshire, and it was extracted to the south of the Staffordshire area around Dudley.

Lower Carboniferous

Peak Limestone Group, Craven Group, Milldale Limestone Formation, Hopedale Limestone Formation, Kevin Limestone Formation, Ecton Limestone Formation, Widmerpool Formation

Dinantian Limestones, Onecote Sandstone

The Devonian was a period of uplift and erosion in the Staffordshire area, resulting in an absence of deposits of this age. Sedimentation resumed during the early Carboniferous (Dinantian) period, when massive limestones were laid down under tropical conditions in ‘stable shelf’ environments. The best exposures of this limestone are in the Peak District, where it is principally used for aggregate or lime production rather than as building stone.

Between the stable limestone shelves were deeper water, stagnant, basinal areas, in which thick deposits of dark, cherty limestones and calcareous mudstones accumulated. Some carbonate material cascaded into the basins via turbidity currents. Small ‘reef knolls’ or algal mud mounds developed on the margins of the shelf areas.

The characteristic white to grey, variably fossiliferous limestones of the Peak District National Park (especially the White Peak) occupy only a small area in the north-east of the Staffordshire Moorlands District. Much of the limestone in the Staffordshire section of the national park is assigned to the Milldale and Hopedale Limestone formations (both Peak Limestone Group). The Milldale Limestone Formation comprises limestone of both Waulsortian reef and inter-reef facies. The single or compound mud mounds are composed of fossiliferous, massive micrite with common spar-filled cavities, whereas the inter-reef facies consists of well-bedded crinoidal biosparite and subordinate dark grey, cherty, micritic limestone. The overlying limestones are those of the typically mid-grey, coarsely bioclastic and conglomeratic Hopedale Limestone Formation and the brownish-grey or dark grey, texturally and compositionally variable beds of the Ecton Limestone Formation. These limestones give way vertically and laterally to the deeper water mudstones (with limestone) and sandstone turbidites of the Widmerpool Formation (formerly the Mixon Limestone-Shales Formation). This formation includes the pale grey-brown calcareous sandstones and siltstones of the Onecote Sandstone Member, which are used locally between Butterton and Mixon.

Most of the limestone occurring in Staffordshire is quarried for aggregate and/or cement, with little being used for vernacular buildings. Irregular white blocks are, however, commonly used as drystone field walling (often representing cleared field brash). Furthermore, a number of agricultural dwellings and cottages in villages such as Wetton, Waterhouses, Alstonefield

Figure 5: Lode Mill Bridge, Alstonefield. Limestone rubble.

and Butterton made use of quarried limestone rubble. This rubble was also employed in the construction of local bridges, including Lode Mill Bridge, Alstonefield. On the eastern side of the Staffordshire Moorlands, medieval churches such as St Peter's at Alstonefield and St Margaret's at Wetton are constructed of roughly coursed limestone, but have sandstone dressings.

Quarries that worked the Dinantian limestone include Brown End, Welton Road, Dale, Lee House and Grindon Moor, as well as those at Caldon Low and close to Alstonefield.

More exotic limestones, such as the Ashford Black Marble (Monsal Dale Limestone Formation) which were worked for ornamental purposes, do not occur in Staffordshire. However, they sometimes feature in the interiors of great county houses as carved and polished fireplace supports, including in the great hall at Keele Hall, Newcastle-under-Lyme.

Carboniferous

Coarse sandstones, generally referred to as 'grits' or 'gritstones', typify the geology of much of the Staffordshire Moorlands and escarpments to the east of Biddulph and Stoke, and around Leek. These rocks have been used as querns and millstones since at least medieval times due to their hard and abrasive nature. They have also been in demand as building and roofing materials.

The Late Dinantian to Namurian periods witnessed the progressive infilling of several thermally subsiding basins, with the development of extensive pro-grading deltas. Sandy sediment was derived from two main sources: a minor South Midlands source, which supplied quartz-rich sands lacking in feldspar (for example, the Minn and Cheddleton sandstones), and a major northern (Scottish) source, which supplied the feldspar-rich Millstone Grit sands. Many of the resultant sandstone bodies, including the Roaches Grit, the Chatsworth Grit and the Rough Rock, have been used extensively for building and walling.

Craven Group, Bowland Shale Formation

Brockholes Sandstone, Knivedon Sandstone, Cheddleton Sandstone, Hurdlow Sandstone, Minn Sandstone

The oldest of these sandstones is the graded, quartzose Minn Sandstone, which was originally quarried at Gunn stone pits in the Churnet area, Cliff Farm and Hollins Farm Quarry to the north of Leek. Minn Sandstone makes poor building stones because of their tendency to break into small blocks and because they are discoloured by red ironstone nodules. Consequently, they were worked for walling stone and road aggregate, and, more recently, for local stone fireplaces and general repair. The other orange-grey, protoquartzitic sandstones include the Hurdlow Sandstone, Cheddleton Sandstone, Kniveden Sandstone and Brockholes Sandstone from the Bowland Shale Formation all of which have been used for local buildings and walling.

Millstone Grit Group, Morridge Formation, Marsden Formation, Rossendale Formation

Longnor Sandstone, Kinderscout Grit, Sheen Sandstones, Five Clouds Sandstones, Corbar Grit, Roaches Grit, Ashover Grit (Third Grit), Chatsworth Grit, Rough Rock

Sandstones such as Blackstone Edge Sandstone and Lum Edge Sandstone have been used for local buildings and walling. These southerly-derived protoquartzitic sandstones of the Morridge Formation is conformably succeeded by the thick, quartzo feldspathic northerly-derived gritstones of the Millstone Grit Group. The boundary between the two successions is complex, with interlocking of the two sequences at the transition. However, the fluvio-deltaic gritstones rapidly become dominant, forming substantial units. These gritstones are generally characterised by the presence of pink potassium feldspar crystals (sometimes up to 25 per cent) and rounded to sub-rounded grains of igneous-derived quartz (typically around 85 per cent), with some lithic fragments and quartzose pebbles.

They are invariably current bedded on various scales, and their high feldspar content gives them a more orangey-red colour than the sandstones of the underlying Morridge Formation. The nature, distribution and lateral persistence of the gritstones vary considerably across the region. Notable gritstone units include the Longnor Sandstone, Kinderscout Grit, Sheen Sandstones, Five Clouds Sandstones, Corbar Grit, Roaches Grit, Ashover Grit (Third Grit), Chatsworth Grit, and the Rossendale Formation Rough Rock.

The Church of St Luke at Leek, Cheddleton station and the Church of St Giles at Cheadle are all constructed of squared and coursed blocks of sandstone from the gritstones succession.

Figure 6: Church of St Luke, Leek. Millstone Grit Group sandstone.

Figure 7: Station building, Cheddleton. Millstone Grit Group sandstone.

These sandstones were also the preferred building material for many church towers, as seen at St Edward's Church at Cheddleton, St Edward the Confessor's Church at Leek, St Lawrence's Church at Biddulph and St John's Church at Burslem. Similarly, the Society of Friends Meeting House and other notable buildings in Leek, such as St Edward's Vicarage, Ford House and Greystones, were entirely built of these local sandstones.

The late 17th-century St Chad's School in Lichfield provides a rare example of an urban house built entirely of gritstones sandstone, and the Noell's Almshouses in Stafford exhibit well-coursed ashlar sandstone blocks.

Figure 8: Noell's Almshouses, Stafford. Namurian Sandstone.

The Chatsworth Grit sandstones are cemented to varying degrees by secondary silica, and they have been worked on the Mow Cop ridge, along with Rough Rock sandstones. Mow Cop Castle (a summerhouse built in 1754 for the Wilbraham family of Rode Hall), St Luke's Church at Mow Cop and many other buildings and walls in the villages lying along the ridge are constructed of Chatsworth Grit. The quarries at the northern end of Troughstone Hill, outside Biddulph, worked Chatsworth Grit sandstone for rough stonework in parts of Biddulph Grange, including the rockery and walling in the gardens, and the Squire's Well, Mow Cop. Chatsworth Grit was also obtained from Bagnall and to the south of Brown Edge.

Gritstones yielded by outcrops of the Roaches Grit, the Chatsworth Grit and the Rough Rock are commonly used for drystone walling but can weather badly.

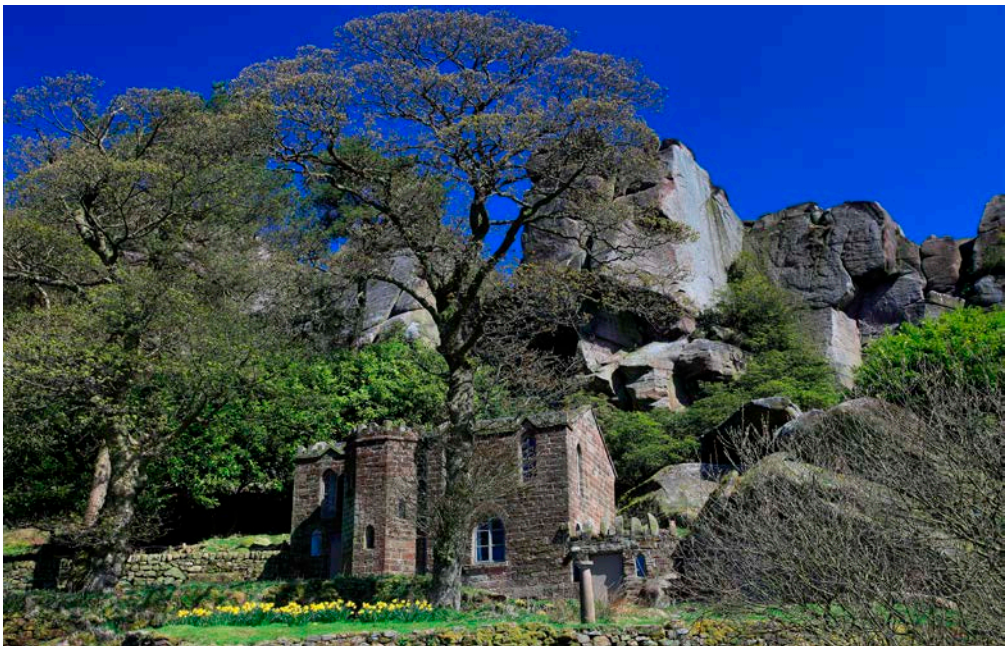


Figure 9: Rock Hall Cottage at foot of Roaches Grit outcrop, Upper Hulme. Roaches Grit.

Figure 10: Mow Cop Castle. Chatsworth Grit.

Figure 11: Squire's Well, Mow Cop. Chatsworth Grit.

Pennine Coal Measures Group, Pennine Lower Coal Measures Formation

Kingsley Sandstone (Woodhead Sandstone), Woodhead Hill Rock, Coal Measures sandstones

By the end of the Namurian, areas of shallow water developed that were periodically emergent. The subsequent extensive Westphalian epoch coal swamps, which would ultimately form the coal-bearing deposits known as the Coal Measures. Thereafter, uplift and erosion produced a large alluvial plain and extensive river deposits. Some of the resultant 'red bed' sandstone units have served as sources of building stone.

Although there are numerous sandstones associated with the Westphalian Coal Measures, particularly in North Staffordshire, not many are laterally persistent, and they tend to be weaker than the Namurian sandstones. As a result, Coal Measures sandstones have not been widely used for building purposes. The Woodhead Hill Rock and the Kingsley Sandstone (or Woodhead Hill Sandstone), both of which form prominent ridges in the Staffordshire Moorlands, were quarried in the vicinity of Kingsley, however.

New Red Sandstone Supergroup, Warwickshire Group, Halesowen Formation

Keele Stone, Butterton Sandstone, Springpool Sandstone, Hanchurch Sandstone

The majority of the stone used for building in North Staffordshire was quarried from the Halesowen Formation of the Warwickshire Group. The Halesowen Formation is largely grey-green coloured but in places is red depending on its base. For example, beds such as the Hanchurch Sandstone show a lateral colour change from grey to red. In South Staffordshire, the Halesowen Formation is largely but not entirely grey, with a number of major sand bodies in the lower and middle parts of the sequence. The finely laminated, grey sandstones of the Halesowen Formation generally do not make good building stones because the fine lamination is susceptible to

attack by the agents of weathering. Despite this, the Guildhall in Newcastle-under-Lyme is said to be built of this stone.

Figure 12: The Guildhall, Newcastle-under-Lyme. Halesowen Formation sandstones.

The Church of St Editha at Tamworth is believed to be constructed of reddish-brown Halesowen Formation sandstone (referred to as the Big Brown Sandstone of the Coal Measures in early British Geological Survey accounts), but the rock is generally too friable to make a good building stone. A more common usage has been as tombstones, examples of which are seen in local graveyards around Newcastle-under-Lyme and Dudley Castle, Dudley.

The Hanchurch Sandstone was worked at Job's Wood Quarry and Quarry Bank Quarry near Silverdale, while small quarries on the Sneyd estate, Keele, provided local sources of red, laminated Springpool Sandstone and Butterton Sandstone. The Church of St John the Baptist at Keele and Keele Hall feature, to some extent, the local Butterton Sandstone and Springpool

Sandstone, both of which were used rough walling stone. Keele Hall, built in a Jacobean Revival style, is said to be constructed of local Keele Stone, but it is largely composed of good quality red sandstone with cream sandstone dressings and dimension stone. These particular sandstones are probably more representative of the variegated sandstones of the Triassic (Bromsgrove Sandstone Formation) rather than those of the more proximal Upper Carboniferous succession.

Figure 13: The Church of St John the Baptist, Keele. Butterton and Springpool sandstones.

Permian

New Red Sandstone Supergroup, Warwickshire Group, Clent Formation, Bridgnorth Sandstone Formation

Three rift basins (the Stafford, Needwood and Cheshire basins) developed during the Upper Carboniferous or Early Permian and provided depositional sites for a range of continental sediments. In South Staffordshire, the resultant Permian sequence is split into two stratigraphic units: the Clent Formation (Warwickshire Group) and the Bridgnorth Sandstone Formation. The Clent Formation, here, comprises mainly red-purple mudstones with thin red-brown sandstones.

Bridgnorth Sandstone, meanwhile, is a brick-red, medium-grained, aeolian sandstone, with well-rounded grains and large-scale cross-bedding. It is poorly cemented and weathers rapidly, so does not make a good building stone.

Triassic

In general, the 'lower' sandier part of the Triassic sequence, formerly known as the Bunter and Keuper Sandstones, is now referred to as the Sherwood Sandstone Group. The 'upper' part of the Triassic sequence, which is dominated by mudstones with occasional thick evaporite beds, is known as the Mercia Mudstone Group. The black marine mudstones, within thin sandstones, occurring towards the top of the Triassic sequence are assigned to the Penarth Group.

Sherwood Sandstone Group

Developments of the Sherwood Sandstone Group are present within three separate depositional basins in Staffordshire (that is, those originating in the Upper Carboniferous or Early Permian), each basin being characterised by slightly different sandstone-dominated successions.

In the north-west of the county, forming part of the Cheshire Basin, the oldest exposed Triassic unit is the Kinnerton Sandstone Formation. It is a red-brown to yellow, fine to medium-grained, cross-stratified sandstone, largely of aeolian origin. In the other basins, the basal units are represented by locally derived breccias and conglomerates, with associated sandstones and subordinate mudstones, namely, the Hopwas Breccia Formation in the Stafford Basin and the Huntley Formation in the Needwood Basin.

The Hopwas Breccia Formation (of uncertain age, and quite possibly Permian in part) comprises a coarse breccia of Carboniferous Limestone and quartzite clasts, with red calcareous sandstone interbeds. The calcareous cement is readily removed by the agents of weathering, and although the sandstones were quarried near to Hopwas itself, they are too soft to serve as a good, durable building stone. The other basal Triassic formations are similarly poorly cemented and are generally considered to be poor building stones.

Overlying the basal Permo-Triassic units are developments of variably pebbly sandstones (the former Bunter Pebble Beds), including the Chester Pebble Beds Formation of the Cheshire Basin and the Kidderminster Formation of the Stafford Basin. Essentially, pebble-free sandstones occurring within the Pebble Beds are generally too poorly cemented to be used as building stone, but locally better cementation has enabled their use. Heighley Castle, located to the west of Newcastle-under-Lyme, was built in the early 11th century of red pebbly sandstone (Chester Pebble Beds Formation) quarried from the adjacent hillside at Heighley Lane Quarry. Thequarrying operations also produced a deep defensive ditch at the back of the castle too. The castle was razed to the ground by Parliamentarian forces during the English Civil War, but much of the stone was recycled by local communities, most notably from the nearby village of Betley.

The Church of St Margaret at Betley is built of pebbly sandstones similar to those used in the construction of Heighley Castle, although the churchyard gateway is of barite-cemented Hollington Sandstone, with Millstone Grit

sandstones featuring in the nearby walls. Equivalent pebbly sandstones, such as those of the Needwood Basin's Hawksmoor Formation, were generally considered to be too pebbly and/or friable to make a good building material. However, they provided much sand and gravel, for example at Hulme Quarry at Park Hall, and at quarries in Weston Coyney, Rugeley and Brocton. In addition, there was a small quarry located to the east of Stafford at Kingston Hill (Kidderminster Formation) that supplied the local area with red sandstone containing few pebbles, and a quarry at Blythe Marsh (working Hawksmoor Formation sandstones) that supplied plinth and dressing stone for St Giles' Church at Newcastle-under-Lyme.

Figure 14: The Church of St Margaret, Betley. Sherwood Sandstone.

The stratigraphically higher Wilmslow Sandstone Formation and Wildmoor Sandstone Formation (of the Cheshire and Stafford Basins, respectively) both consist of brick-red, fine-grained, planar and cross-bedded, fluvial sandstones, which are largely devoid of pebbles. Their poor cementation usually renders them too soft for building, but the Wildmoor Sandstone has been quarried for building stone near Stourton and Bishop's Offley.

Unconformably overlying these Lower Triassic sandstones are the following (basin-specific) sandstone-dominated units: in the Cheshire Basin, sitting above the Wilmslow Sandstone Formation, lies the Helsby Sandstone Formation; in the Stafford Basin, sitting above the Wildmoor Sandstone and Kidderminster formations, respectively, lie the Bromsgrove Sandstone and Kibblestone formations; while in the Needwood Basin, sitting above the Hawksmoor Formation, lies the Hollington Formation. Collectively, these formations probably constitute Staffordshire's most important sources of building stone, and they were once quarried extensively across the county.

Sherwood Sandstone Group, Helsby Sandstone Formation

Grinshill Stone, Helsby Sandstone

The Helsby Sandstone Formation has two distinct facies, one fluvial and the other aeolian. The fluvial facies comprise reddish-brown to white, medium to coarse-grained sandstones, with sporadic conglomerates. The aeolian sandstones, meanwhile, are well sorted, fine to medium grained,

and pebble free. They are commonly cross-stratified and contain white, bladed crystals of barite. The Helsby Sandstone is currently quarried for dimension stone (Grinshill Stone) to the west of the Staffordshire area at Grinshill in Shropshire.

Sherwood Sandstone Group, Kibblestone Formation, Bromsgrove Sandstone Formation

Kibblestone Sandstone, Alton Stone, Penkridge Stone, Tixall Stone, Hollington Stone, Bromsgrove Sandstone

Bromsgrove Formation Sandstone is typically a darker red-brown colour than the Helsby Formation sandstones, but locally it is pale yellow or brown. It is mainly of fluvial origin, although some beds are aeolian. The sandstones are fine to medium grained, with abundant mica flakes, and they are generally calcite cemented. It is this cementation that makes the upper finer grained parts of the formation highly suitable for use as a building stone.

On the eastern margin of the Stafford Basin, occupying the same stratigraphic position as the Bromsgrove Sandstone, are the pale yellow-grey sandstones of the Kibblestone Formation. They are medium grained, well sorted, non-pebbly and essentially mica free, and were deposited in an aeolian environment. These sandstones were probably quarried close to Wood House (Woodhouse Farm), east of Oulton.

In the Stafford area, the Bromsgrove Sandstone Formation is light grey in colour, has both calcite and silica cements, and contains visible mica plates. Stone produced from major quarries, such as Park Quarry in Tixall Park, has been used locally for ornamental structures, and also further afield in St George's Church, Birmingham, and Sandwell Hall, near West Bromwich. Another historic structure built from Tixall Stone is Stafford Castle, although Victorian brick cladding masks the original stonework. A small quarry in the south-east corner of Sandon Park supplied stone for the memorial column to William Pitt the Younger, while Sandon Hall was rebuilt from the same stone in 1852.

Figure 15: Stafford Castle. Tixall Stone.

Bromsgrove Sandstone was also quarried (and later mined, as the good quality building stone bed was followed into the hillside) at Beech and at The Cliffs, Great Haywood. The stone produced from the Beech mines was used to build Trentham Hall in the 17th century. As it is no longer quarried, the red sandstones of the Permo-Carboniferous Warwickshire Group, Salop Formation and the Cumbrian Lower Triassic Sherwood Sandstone Group St Bees Sandstone Formation are commonly used for repairs or restoration work.

Another locality where the Bromsgrove Sandstone Formation was quarried is Stanton, near the Dove Valley. Much of the stone produced here was used to build the Elizabethan Wootton Lodge, a 17th-century house situated near Ellastone which was originally built for the High Sheriff, Sir Richard Fleetwood. Among the local Gothic Revival houses, Alton Towers and Alton Castle, also near Ellastone, are two of the best examples. They are built of Alton Stone as the original medieval castle at Alton.

Figure 16: Alton Towers. Bromsgrove Sandstone.

Variegated (red, cream and mottled) Bromsgrove Sandstone Formation sandstones were, and still are, worked at three quarries close to the village of Hollington: Red Quarry, Tearne Quarry and Fielding's Quarry. There are also a few small workings at Wootton Wood. Examples of typical Hollington Stone (not to be confused with Hollington Sandstone from the Hollington Formation) use include the portico at Biddulph Grange, near Stoke-on-Trent; the bank buildings on the High Street and part of the Guildhall in Newcastle-under-Lyme; much of Keele Hall; and Caverswall Castle, near Blythe Bridge. Hollington Stone was also used for many Victorian town halls, such as those in Stoke, Longton, Walsall and Wolverhampton. The red variety of Hollington Stone forms the bulk of the facing stone of the new Coventry Cathedral.

Penkridge Stone, a variety of Bromsgrove Sandstone, is a fine-grained freestone produced in the area of the same name. It was mainly worked at two quarries, north of Wolgarston and Quarry Heath, and used in the construction of local churches.

Figure 17: Town hall, Walsall. Hollington Stone.

Sherwood Sandstone Group, Hollington Formation

Upper Mottled Sandstone, Hollington Sandstone

The fine to medium-grained, current-bedded or finely laminated sandstones of the Hollington Formation were deposited by meandering rivers. Like their Helsby Sandstone counterparts, they are typically red-brown, but are off-white or mottled in places. The reasonably well-developed calcite and barite cements of the Hollington Formation sandstones make them highly suitable for use as a building stone, and some of the more uniform beds have provided dimension stone suitable for carving.

Mercia Mudstone Group, various formations

Skerry Sandstones, Alabaster

The Middle to Upper Triassic Mercia Mudstone Group represents the deposits of a broad alluvial plain (subject to intermittent flooding by the sea) on which ephemeral saline lakes were established. The sediments themselves essentially comprise a thick sequence of red-brown siltstones and mudstones, with locally significant developments of halite and gypsum. None of these lithologies are suitable for building purposes, and with only minor and impersistent developments of Skerry sandstones within the county, the Mercia Mudstone Group has not served as an important source of building stone in Staffordshire.

The gypsum beds at Tutbury were, however, mined for alabaster, which was used for interior decorative purposes, such as monuments and chest tombs. The second order of the Norman west doorway arch of Tutbury Church is also made from local alabaster. Several workings existed close to the Dove Valley, and gypsum is currently extracted at the Fauld Mine between Tutbury and Hanbury. Alabaster is reported to also have been quarried near Tettenhall in the 15th century.

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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