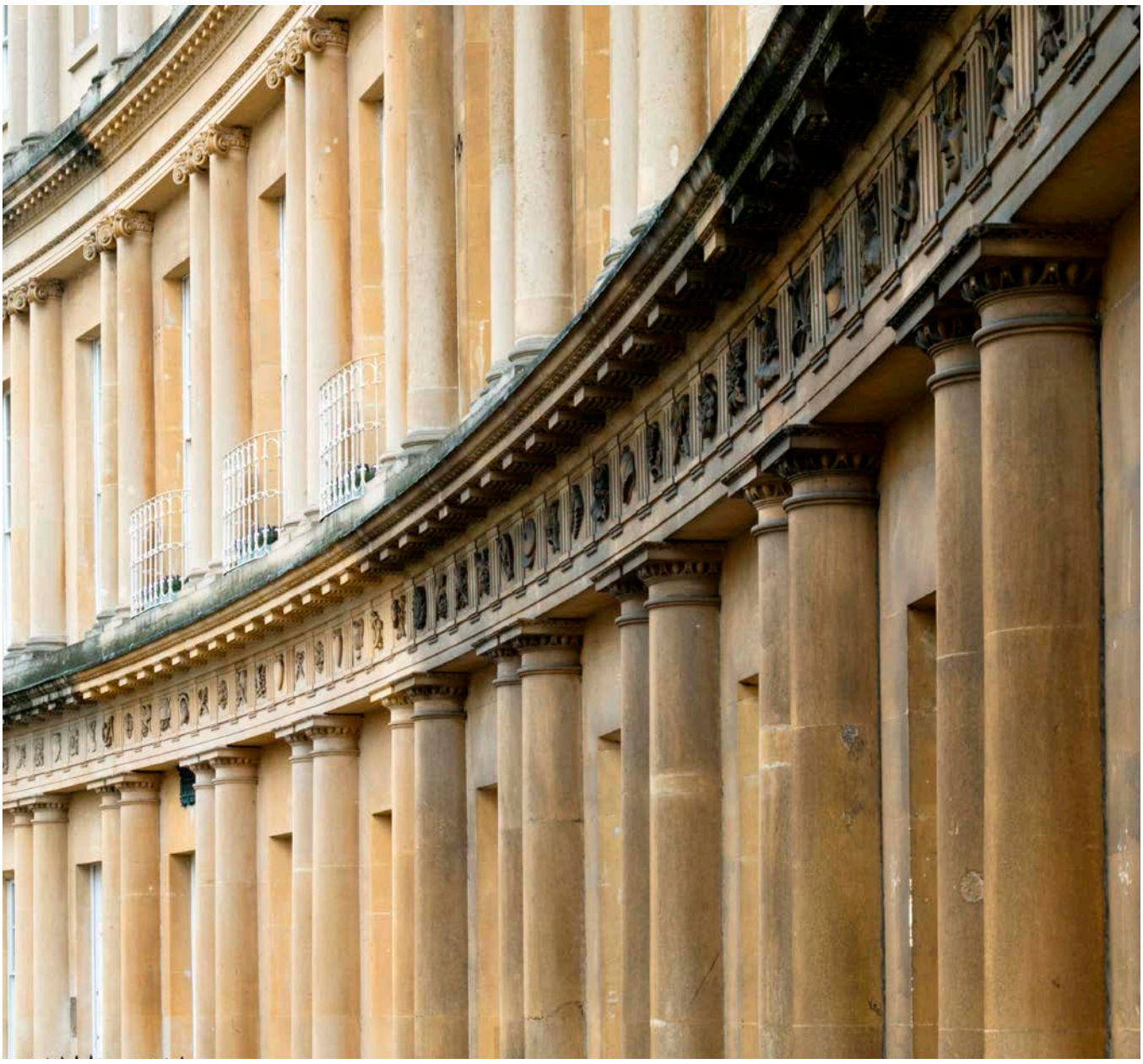
Historic England

Bristol, Bath and Surrounding Areas

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 is based on original research and text by Andy King (Geckoella Ltd).

First published by English Heritage August 2011 and republished by Historic England in 2017. This edition published by Historic England May 2023.

Please refer to this guide as:

Historic England 2023 *Bristol, Bath and Surrounding Area. Building Stones of England*. Swindon. Historic England.

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

Front cover: The Circus, Bath. Combe Down Stone. © John Michaels / Alamy Stock Photo.

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 West of England Combined Authority area, and the mineral planning and unitary authority areas of North Somerset Council, Bristol City Council, Bath and North East Somerset Council, and South Gloucestershire Council.

Contents

1 Introduction

The solid geology of the Bristol, Bath, North East Somerset and South Gloucestershire area is complex. The sequence is dominated by sedimentary rocks that range from Early Ordovician to Late Jurassic in age. A few minor volcanic rocks also occur, interbedded with Palaeozoic sediments in the Weston-super-Mare and Tortworth areas. In very general terms, the geology can be regarded as decreasing in age from west to east, but numerous unconformities and faults create a complicated outcrop pattern of inliers and outliers and a varied topography.

The geological heritage of the area is very diverse: it includes a number of classic localities, such as the Avon Gorge, which have been highly instrumental in the development of British Lower Carboniferous stratigraphy, and the former Bristol and Somerset Coalfield, which played a key role in the economic and social development of the region.

Given this varied geology, it is not surprising that the area has a high diversity of building stones. Some of them, such as the Bath Stones, are justly famous and have been used for many prestigious buildings within the area. They have also been exported nationally and internationally. The Romans were among the first to use Bath Stone in their construction of the hot baths at Aquae Sulis (Bath), and many of the classic Georgian terraces and crescents in the city owe their beauty to the extensive use of these stones.

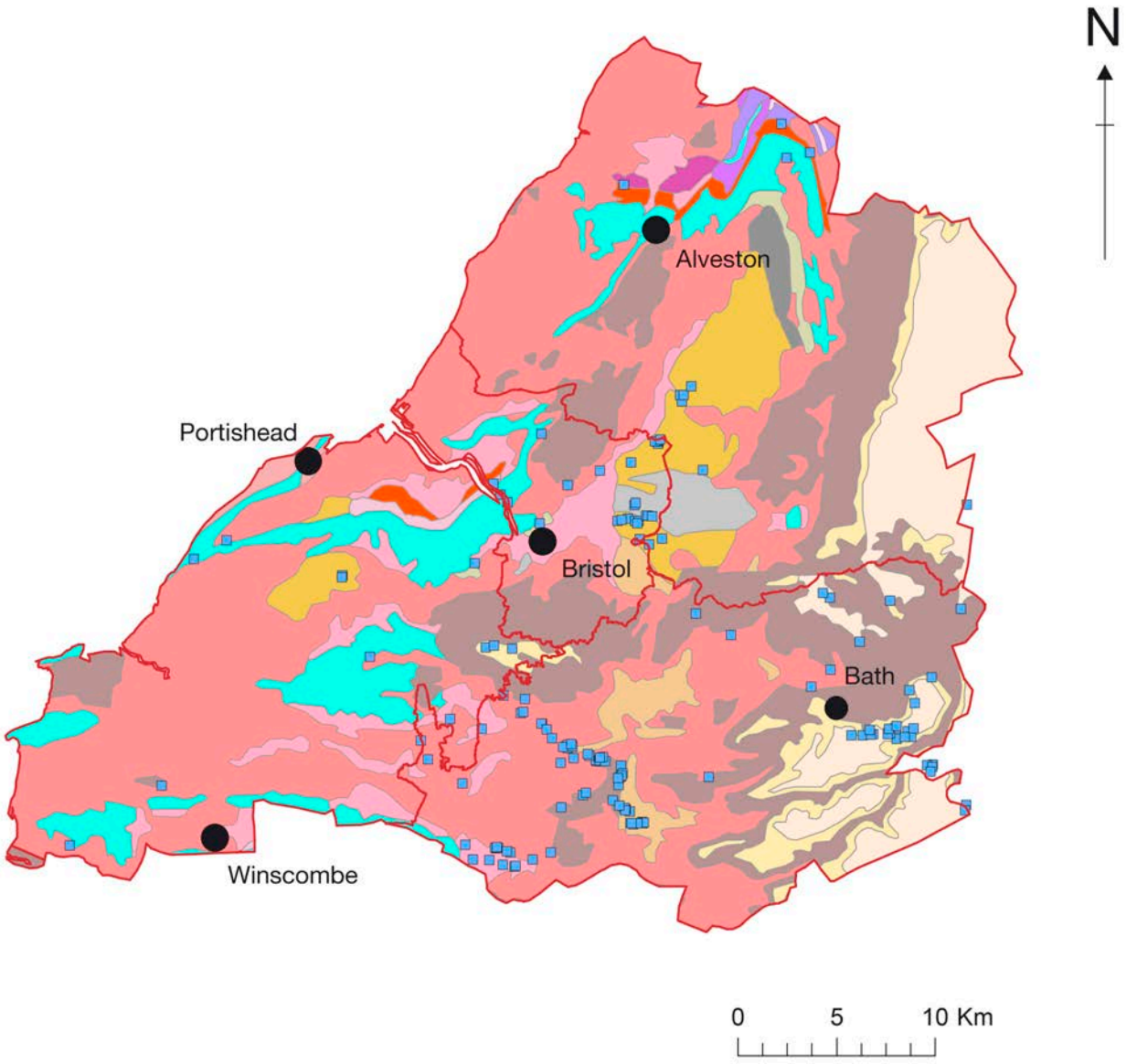
The principal stones used for building purposes include Devonian red sandstones, grey Lower Carboniferous limestones, grey-green quartzitic Millstone Grit and Pennant sandstones, reddish-grey dolomitic conglomerate, grey (yellow weathering) Blue Lias limestones and creamy-yellow Inferior Oolite and Great Oolite limestones. Other local stones have also been employed for construction, mainly as rough building stones or rubblestones.

The heyday of quarrying building stones in the area has long passed, and many of the former workings have since disappeared or been sterilised by redevelopment. Some of the larger remaining quarries still extract stone, but often this is for aggregate or road construction purposes. The former scale of the building stone industry is reflected in the large number of local stone names for varieties of stone, and it is not uncommon for buildings to be constructed of more than one stone type, especially in the Bristol and North Somerset areas.

Figure 1: Cottage, Newton St Loe. Blue Lias.

Figure 2: Temple Meads Station, Bristol. Pennant Sandstone and Bath Stone.

Bedrock Geology Map



Key

Building stone sources

Bedrock geology

Great Oolite Group — sandstone, limestone and argillaceous rocks

Inferior Oolite Group — limestone, sandstone, siltstone and mudstone

Lias Group — mudstone, siltstone, limestone and sandstone

Triassic Rocks — mudstone, siltstone and sandstone

Triassic Rocks — (marginal facies) sandstone and conglomerate, interbedded

South Wales Upper Coal Measures Formation — mudstone, siltstone, sandstone, cioal, ironstone and ferricrete

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

Unnamed Extrusive Rocks, Silurian — mafic lava and mafic tuff

Pennine Lower Coal Measures Formation and South Wales Lower Coal Measures Formation — mudstone, siltstone, sandstone, coal, ironstone and ferricrete

Pennine Middle Coal Measures Formation and South Wales Middle Coal Measures Formation — mudstone, siltstone, sandstone, coal, ironstone and ferricrete

Marros Group — mudstone, siltstone and sandstone

Dinantian Rocks — limestone with subordinate sandstone and argillaceous rocks

Upper Devonian Rocks — mudstone, siltstone and sandstone

Upper Devonian Rocks — sandstone and conglomerate, interbedded

Lower Devonian Rocks — sandstone and conglomerate, interbedded

Pridoli Rocks — mudstone, siltstone and sandstone

Wenlock Rocks — mudstone, siltstone and sandstone

Llandovery Rocks — mudstone, siltstone and sandstone

Silurian Rocks — limestone, mudstone and calcareous mudstone

Stratigraphic Table

Geological timescale	Group	Formation	Building stone	Page
Middle Jurassic	Great Oolite Group	Cornbrash Formation	Cornbrash Limestone	35
		Forest Marble Formation	Forest Marble Limestone	34
		Chalfield Oolite Formation	Bath Stone (Bath Oolite) Twinhoe Beds Stone Combe Down Stone (Combe Down Oolite, Odd Down Stone, Bathampton Stone, Horsecombe Stone)	32 31 29
		Athelstan Oolite Formation	Athelstan Oolite, Lower Rags	29
		Fuller's Earth Formation, Tresham Rock Formation		
	Inferior Oolite Group	various	Inferior Oolite limestone, Dundry Stone (Dundry Freestone)	26
Lower Jurassic	Lias Group	Bridport Sands Formation, Whitby Mudstone Formation		
		Beacon Limestone Formation	Marlstone, Cephalopod Limestone	26
		Dyrham Formation		
		Charmouth Mudstone Formation		
		Blue Lias Formation	Harptree Beds stone Brockley Down Limestone Blue Lias (Banwell Stone, Keynsham Stone, Saltford Stone and Stowey Stone)	26 25 24
Triassic	Penarth Group	Lilstock Formation	White Lias, Cotham Marble (Landscape Marble)	22
		Westbury Formation		
	Mercia Mudstone Group	Blue Anchor Formation		
		Branscombe Mudstone Formation, Arden Sandstone Formation	Skerry Sandstones (Chew Magna Stone, Stanton Drew Stone, Woodford Hill Stone, Castle Hill Sandstone)	21
			Butcombe Sandstone	20
		Sidmouth Mudstone Formation	Redcliffe Sandstone	19
		marginal facies	Dolomitic Conglomerate (Penpole Stone, East Harptree Stone, Almondsbury Stone, Draycott Marble)	17

Geological timescale	Group	Formation	Building stone	Page
Upper Carboniferous	Warwickshire Group	Grovesend Formation, Pennant Sandstone Formation	Pennant Sandstone (Conham Stone, Hanham Stone, Nailsea Stone, Stapleton Stone, Temple Cloud Stone)	15
	South Wales Coal Measures Group	South Wales Middle Coal Measures Formation		
	Marros Group	Quartzitic Sandstone Formation	Quartzitic Sandstone (Millstone Grit, Long Ashton Stone, Brandon Grit, Brandon Hill Stone)	14
Lower Carboniferous	Pembroke Limestone and Avon groups	Cromhall Sandstone Formation	Cromhall Sandstone	13
		various	Black Rock Limestone (Dolomite, Abbots Leigh Stone, Clevedon Stone), Gully Oolite, Caninia Oolite, Birnbeck Limestone, Goblin Combe Limestone, Burrington Oolite, Clifton Down Limestone, Hotwells Limestone	10
Devonian	Upper and Lower Old Red Sandstone groups	Quartz Conglomerate Formation, Tintern Sandstone Formation	Tintern Sandstone Quartz Conglomerate	9 9
		Portishead Formation	Portishead Sandstone	8
		Black Nore Sandstone Formation	Black Nore Sandstone	7
Silurian	Pridoli Series	Raglan Mudstone Formation, Thornbury Formation	Thornbury Sandstone	7
	Wenlock Series	Brinkmarsh Beds		
	Llandovery Series	Tortworth Beds		

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

2 Local Building Stones

Silurian

Pridoli Series, Raglan Mudstone Formation, Thornbury Formation

Thornbury Sandstone

The Thornbury Formation occurs in just two outcrop areas in South Gloucestershire, around Thornbury near Kington and at Whitfield. The formation contains brownish, purple-red or green, fine to medium-grained, impersistent flaggy sandstones, interbedded with thick, blocky, faintly laminated, red-brown, silty mudstones. The sandstones are typically highly micaceous, and at outcrop they become more numerous and thicker in the upper parts of the sequence. The sandstones commonly contain mudstone clasts and may infill mudcracks in underlying mudstones. These clasts weather easily, leaving a distinct pitted surface. The Thornbury Beds are relatively soft and only used very locally as a general rubblestone and walling stone.

Devonian

Upper and Lower Old Red Sandstone groups, Black Nore Sandstone Formation

Black Nore Sandstone

The largest outcrop of the Black Nore Sandstone occurs in the Portbury–Failand area of North Somerset, extending to the southern bank of the River Avon. The beds are also exposed in coastal sections near Portishead, between Redcliffe Bay and Kilkenny Bay, and at Black Nore promontory. A small outcrop is also present on the northern banks of the River Avon, extending to near the Sneyd Park and Stoke Bishop areas of Bristol.

The formation consists of dark, purplish-red, current-bedded sandstones and mudstones, with much green mottling. When fresh, the rock is slightly calcareous, and bands of conglomeratic dolomitic concretions (calcrete or cornstones) are sporadically developed. Thin wisps and strings of dark cherty pebbles are locally present. At outcrop, the proportion of sandstone to mudstone increases upwards in the succession. Locally, the sandstones contain abundant fossil fish debris.

As the Black Nore Sandstone is relatively soft, it is only used very locally in the Portishead area as a general rubblestone and walling stone. The lower calcareous units tend to be harder and more resistant.

Upper and Lower Old Red Sandstone groups, Portishead Formation

Portishead Sandstone

These strata crop out at Portishead and extend to near Clevedon. However, they also occur in the Failand–Abbots Leigh area, stretching to the southern bank of the River Avon (North Somerset). In Bristol, small outcrops are present near Shirehampton and Westbury-on-Trym as well as on the northern bank of the River Avon as far as Sneyd Park.

The Portishead Formation is of variable lithology, but red, reddish-purple, yellow and pale grey, fine-grained, quartzitic sandstones dominate. Fossil fish are present at some levels. Pebbly conglomerates also occur at intervals, the pebbles comprising mostly augen quartz and dark brown quartzite. Jasper, chert, mica schist and silicified igneous rock are also present. At outcrop, red and green mudstones and marls occur, interbedded with coarser units. The conglomeratic lenticular horizons are traceable over considerable distances in the Failand area. The Portishead Formation splits laterally into the Tintern Sandstone and quartz conglomerate in the Buckover area and Forest of Dean (Gloucestershire). The Portishead Formation was formerly quarried as a building stone in several locations, especially in the Abbots Leigh area near Bristol. It was used as a general purpose building and walling stone in and around Portishead, in particular, where a number of 19th-century properties, such as the terrace along Woodhill Road, are constructed of roughly dressed sandstone blocks.

Figure 3: Terrace houses, Woodhill Road, Portishead, Bristol. Portishead Sandstone.

Upper and Lower Old Red Sandstone groups, Tintern Sandstone Formation, Quartz Conglomerate Formation

Tintern Sandstone and Quartz Conglomerate

This formation occurs as a narrow continuous linear exposure trending north-east from near Alverston, via Buckover, to Tortworth and Charfield (South Gloucestershire). It is of variable lithology, but mainly comprises purplish-brown, grey or green, flaggy sandstones, with subordinate red and green silty mudstones, marl partings and occasional nodular cornstones (concretionary limestones). The lower parts locally rest on hard purplish-brown or greenish pebbly sandstones and conglomerates (quartz conglomerate), which contain well-rounded pebbles of quartz, jasper and green mudstone. At outcrop, cross-bedding is typically seen within the pebbly units and sandstones.

The sandstones and conglomerates are fairly hard and resistant. They have been used locally as a general rubblestone and walling stone, at the pedestrian precinct in Thornbury, for example. However, generally, the formation has proved to be lithologically too variable for building stone, but it has been quarried for roadstone.

Figure 4: St Mary Street, Thornbury. Sandstones and conglomerates.

Lower Carboniferous

Pembroke Limestone and Avon groups, various formations

Black Rock Limestone (Dolomite, Abbots Leigh Stone, Clevedon Stone), Gully Oolite, Caninia Oolite, Birnbeck Limestone, Goblin Combe Limestone, Burrington Oolite, Clifton Down Limestone, Hotwells Limestone

The Pembroke Limestone Group has a very extensive outcrop area in North Somerset, including the Clevedon to Portishead ridge, Ashton Court and the south bank of the River Avon, as well as the large Lulsgate inlier, the northern and southern edges of the Mendip ridge, Bleadon Hill and prominent headlands and inliers north of Weston-super-Mare. It also famously occurs along Avon Gorge, and the outcrop continues through various suburbs of Bristol, including Durdham Down, Eastfield, Southmead, Brentry and Henbury, and along Kings Weston Hill and Severn Way towards Shirehampton. Small exposures also occur in the Hotwells and south Clifton areas, and near Compton Martin and East Harptree (Bath and North East Somerset), as well as in the Olveston, Alveston, Almondsbury, Tytherington, Cromhall (where the outcrop widens) and Chipping Sodbury areas (South Gloucestershire). The Pembroke Limestone Group comprises a varied group of different limestone facies and formations. The various limestones have been given different stratigraphical names along the outcrop and they vary from pale grey to dark grey or blackish, fine-grained, homogeneous limestones through massive ooidal to bedded crinoidal limestones. Some horizons are dolomitized, or cherty. Many of the limestones are highly fossiliferous and contain brachiopod shells and corals, which can also be used to help identify the various lithologies.

Black Rock Limestone (also called Dolomite, Abbots Leigh Stone, or Clevedon Stone) are predominantly dark grey to black, well-bedded, fine-grained limestones with abundant crinoidal debris (packstones and wackestones) and coarser-grained crinoidal limestones. Distinct chert horizons occur. Some limestones also commonly dolomitized and hard and stand out as strong features. Shaly partings are common. Fossils are abundant, especially corals, brachiopods.

The Gully Oolite and Caninia Oolite limestones are massively bedded with subordinate beds of fine-grained skeletal packstones, and locally dolomitized or traversed by strong joints. They are pale pinkish grey or pinkish. The oolites are sparsely fossiliferous. In the north Bristol to Tytherington area, the base is characterised by a 5m thick, pale grey, well-sorted, crinoidal limestone (the ‘Sub-Oolite Bed’) which contains abundant brachiopods.

Birnbeck Limestone is predominantly thick-bedded in the lower part. It is a fine- to coarse-grained, bioclastic and oolitic limestone (skeletal packstones and grainstones), with thin beds and partings of shaly dolomite mudstone and siltstone. It is pale to dark grey. The limestone is poorly fossiliferous in

lower parts with occasional corals; and in the upper parts there are more fossil corals and chonetid brachiopods.

Goblin Combe Limestone is a thick-bedded to massive, medium- to coarse-grained oolite and ooidal limestone with lenses of crinoidal limestone. Individual beds vary from oolites with scattered crinoid debris, to pure crinoidal limestones. The limestone is pale grey to grey.

Burrington Oolite is a light grey, massive oolitic and crinoidal limestone. The upper parts of the bed have occasional pale grey calcite-mudstone bands, or oolitic limestone pebbles or calcite-mudstone pellets.

The grey Clifton Down Limestone is a well-bedded calcareous and dolomitic mudstone with poorly sorted bioclastic limestone, algal limestone (Seminula Pisolite) and cross-bedded ooids (Seminula Oolite) topped by thick calcareous algal mudstones (Concretionary Beds). Sparsely fossiliferous, except some bands locally crowded with corals and brachiopods; algal limestones distinctive.

Hotwells Limestone is a massive, grey crinoidal and oolitic bioclastic limestone, sometimes also flaggy, black splintery limestones with chert nodules and seams. There are abundant fossil corals and thick-shelled brachiopods throughout the rock bed.

Figure 5: Blagdon Primary School, Blagdon. Lower Carboniferous Limestone.

Figure 6: Former United Reformed Church, Woodhill Road, Portishead, Bristol. Clevedon Stone.

Figure 7: Terrace houses, Chandos Road, Redland, Bristol. Lower Carboniferous Limestone.

Cromhall Sandstone

The Cromhall Sandstone Formation occurs as small scattered exposures extending from near Long Ashton through Ashton Court estate to the River Avon (North Somerset), and in the Hotwells and south Clifton areas of Bristol. In South Gloucestershire, a narrow strip of exposure extends from Olveston through Tytherington to Cromhall (where the outcrop widens) and then southwards to Yate. However, the outcrop in these areas is much obscured by younger Triassic and drift deposits. Small isolated exposures also occur near Almondsbury and Rudgeway and west of Doynton.

The formation includes up to three sandstone units, formerly termed the lower, middle and upper Cromhall Sandstones. The lower unit comprises brown and red, fine to coarse-grained, quartzitic sandstones, with subordinate mudstones and sparse thin limestones. At outcrop, its base is locally conglomeratic. The middle unit is similar but contains units of dolomitized limestone. The upper unit comprises grey and red, coarse-grained, quartzitic sandstones and sandy crinoidal and ooidal limestones, with mudstones, siltstones and grey seatearths arranged in stacked cyclic sequences.

The Cromhall Sandstone is used locally as a general building stone along its outcrop, although it is relatively soft in comparison with the overlying Millstone Grit and Pennant Sandstones. It is susceptible to pyrite decay.

Figure 8: St Andrew's Church, Cromhall. Cromhall Sandstone.

Figure 9: 64 Rounceval Street, Chipping Sodbury. Thin, dark bands of Cromhall Sandstone alternate with thicker courses of pale grey Lower Carboniferous Limestone.

Upper Carboniferous

Marros Group, Quartzitic Sandstone Formation

Quartzitic Sandstone (Millstone Grit, Long Ashton Stone, Brandon Grit, Brandon Hill Stone)

In Bristol, the Quartzitic Sandstone Formation (often referred to informally as the Millstone Grit) occurs in small scattered outcrops near Long Ashton, south of the River Avon, and on high ground (Brandon Hill) in the Clifton–Tyndall's Park area. In South Gloucestershire, the strata occupy a semicircular narrow outcrop, stretching from Tytherington, via Cromhall Common and Hall End, towards Yate.

The lithology comprises hard, pale grey, quartzitic sandstones (pebbly in places), with grey mudstones, seatearths and thin carbonaceous or coaly beds. At outcrop, sandstones predominate in the middle of the sequence, with cherty beds developed at the base. The pebbly sandstones contain clasts of white quartz, quartzite, chert, siderite (ironstone) and mudstone. The sandstones are rarely fossiliferous but may contain very occasional goniatites.

The Quartzitic Sandstone Formation is very hard and resistant, and locally produced durable building stones. Within the Bristol area, the sandstones were formerly quarried at Long Ashton (Long Ashton Stone) and Brandon Hill (Brandon Hill Stone, Brandon Grit).

Warwickshire Group, Grovesend Formation, Pennant Sandstone Formation

Pennant Sandstone (Conham Stone, Hanham Stone, Nailsea Stone, Stapleton Stone, Temple Cloud Stone)

The Pennant Sandstone Formation is represented predominantly by grey, green-grey or blue-grey, lithic, feldspathic, or micaceous arenitic sandstones. Some conglomeratic or pebble beds with grey or red fissile mudstones and thin workable coal seams also occur, mainly in the lower Downend Member. Sandstones within the Mangotsfield Member often weather to a distinctive red or purple colour and exhibit cross-bedding. In outcrop, they often occur with thinner mudstone or siltstone interbeds, and occasional seatearths and coals. The various lithologies are often arranged in fining-upwards, channel-fill sequences, although the strata may range from massive, relatively structureless units to beds exhibiting low-angle cross-bedding and cross-lamination.

Pennant sandstones occur extensively in the area. In North Somerset, they have a linear outcrop stretching from Clevedon eastwards north of Gordano Valley and along the M5 corridor, via Norton's Wood and Clapton Wick, and widening out at Clapton-in-Gordano. A large outcrop/subcrop area also extends from West End through much of Nailsea. In Bristol, the strata underlie the Fishponds, St George, Crew's Hole, Stapleton–Broomhill, Brislington–Hicks Gate and St Anne's Park areas. In Bath and North East

Figure 10: Warehouses, Host Street, Bristol. Brandon Grit and Pennant Sandstone.

Somerset, there are exposures north-west of Keynsham near Hicks Gate, around Clutton to High Littleton, near Stanton Wick and Chelwood, and between Pensford and Compton Common, with important quarry areas at Temple Cloud and east of Corsham. In South Gloucestershire, the outcrop is mainly around Kingswood and Oldland, Hanham and Longwell Green, and Winterbourne to Mangotsfield, extending through Frampton Cotterell to Nibley and Yate and stretching to Pucklechurch, Henfield and Westerleigh.

The Pennant Sandstone Formation has been quarried all along its outcrop, and this has given rise to a number of local 'trade' names being applied to the sandstone, such as Conham Stone, Hanham Stone, Nailsea Stone, Stapleton Stone and Temple Cloud Stone. When encountered *ex situ*, distinguishing between the various lithologies and assigning individual stones to particular members of the group are often extremely difficult, and sometimes impossible. In these cases, it is useful to be able to refer to these building stones under the general name 'Pennant Sandstone'.

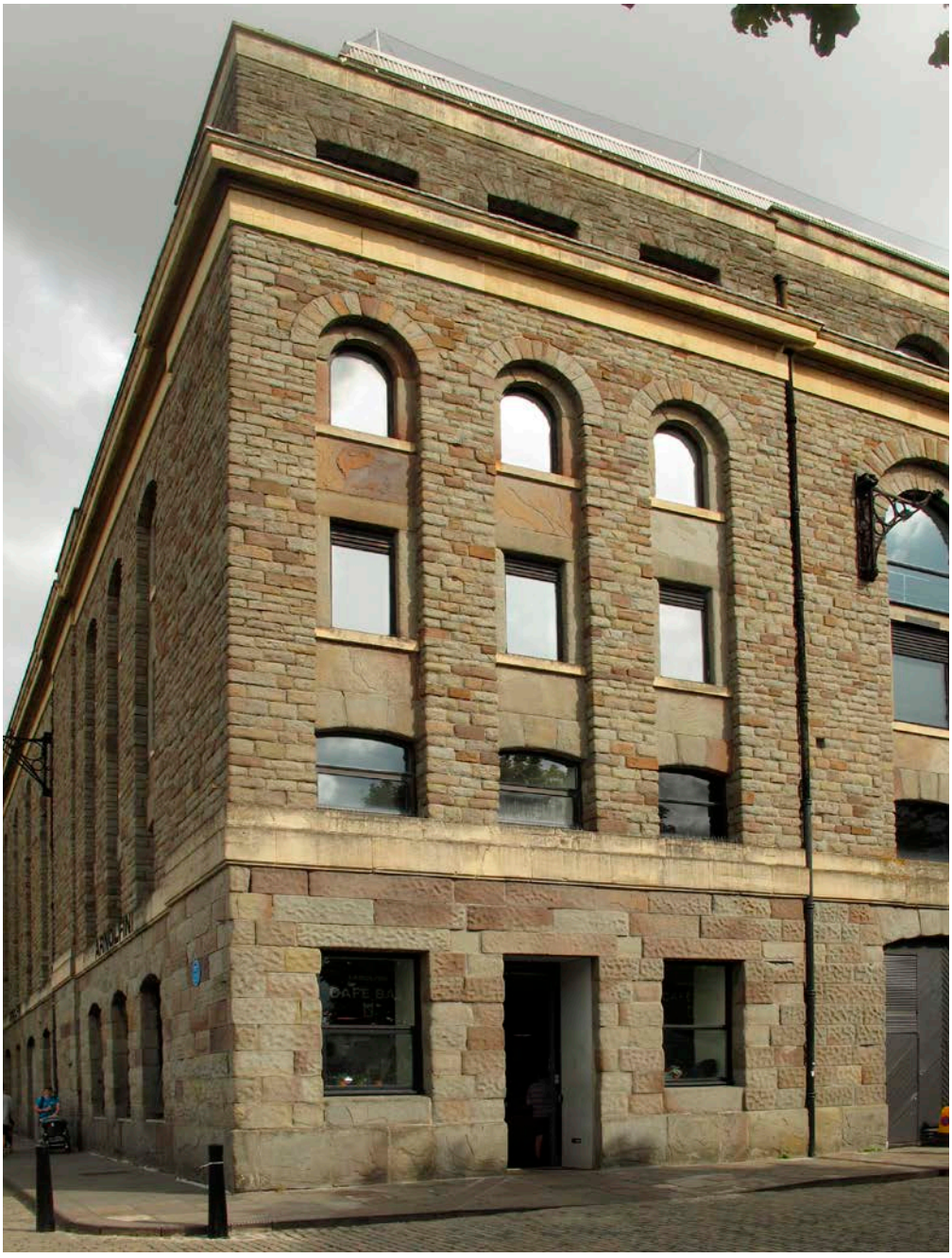


Figure 11: 16 Narrow Quay, Bristol. Pennant Sandstone.

The combination of their widespread occurrence, thickness and hardness (the quartzitic sandstones, in particular, are resistant) has meant that Pennant sandstones are widely used as building stones throughout the outcrop. The many large quarries that were once worked have now been abandoned. Large sandstone quarries were concentrated in the Avon Valley between Hanham and Newham, and in the Frome Valley above Stapleton. Pennant Sandstone was used on a very large scale for dressed building stone, kerbs and paving. The suburbs of east Bristol built during the 19th and early 20th centuries show abundant examples of grey or reddish Pennant Sandstone houses with lintels and sills of Bath Stone.

Figure 12: Lodge, St John's Road, Clifton, Bristol. Pennant Sandstone, some Lower Carboniferous Limestone, and Bath Stone quoins, ornament and window surrounds.

Triassic

Mercia Mudstone Group, marginal facies

Dolomitic conglomerate (Penpole Stone, East Harptree Stone, Almondsbury Stone, Draycott Marble)

The dolomitic conglomerate occupies large areas, and it is used extensively as a building stone throughout the outcrop. In North Somerset, it essentially flanks (to the north and south) and infills coombes within the large Carboniferous limestone inliers and ridges, centred on Lulsgate Bottom–Felton and Wraxall–Failand–Leigh Woods. It also occurs on the northern banks of the River Avon. There, the main larger outcrop (approximately 4sq km) covers the Sea Mills, Sneyd Park, Westbury-on-Trym, Henbury and Brentry areas of Bristol; the smaller outcrop (approximately 1.5sq km) is centred around the Clifton and Hotwells areas of the city. Dolomitic conglomerate also occurs along the southern edge of Bath and North East Somerset, from Ubley to Compton Martin and East Harptree. In South Gloucestershire, it occurs at Almondsbury, north of Thornbury, between Wick and Doynton.

Figure 13: Terrace houses and walls, Whatley Road, Clifton, Bristol. Dolomitic Conglomerate.

The stone is a clast-supported breccia or conglomerate, composed of grey angular to sub-angular fragments of reworked Carboniferous limestone clasts set within a matrix of reddish to red-brown sandy marl or fine-grained limestone. The overall effect gives an attractive and distinct pinkish or pinkish-grey hue to the rock. The limestone clasts are usually 20 to 40mm in diameter, but larger boulder-sized clasts also occur. Secondary changes are characteristic of this stone. In particular, these include hematisation, which produces an intense, red-coloured, 'earthy', iron-rich, friable rock known as red ochre, and dolomitization, which typically turns the rock yellowish. A hard silicified facies is known to occur locally near West Harptree and East Harptree (East Harptree Stone).

Figure 14: Walling, College Road, Clifton, Bristol. Deep red Dolomitic Conglomerate used with Carboniferous Limestone and Oolitic Limestone.

The dolomitic conglomerate is used extensively as a building stone along its outcrop, typically as rough rubblestone for walls. Its lithology does not enable it to be cut as ashlar. However, it works readily into long pieces and is employed as lintels, chimney pieces, gateposts and paving stones.

Temple Meads station in Bristol is constructed of dolomitic conglomerate from the Draycott area in Somerset, where it is known locally as Draycott Marble.

The occurrence of Penpole Stone is confined to the Kingsweston area of Shirehampton, Bristol. It is an attractive, non-conglomeratic, fine-grained variety of dolomitic conglomerate, which is yellowish in colour and tinged pink. It is a hard resistant stone, and its fine grain size means it can be cut into fine ashlar blocks.

Figure 15: Kings Weston House, Bristol. Penpole Stone.

Mercia Mudstone Group, Sidmouth Mudstone Formation

Redcliffe Sandstone

The distinctive intensely red-coloured Redcliffe Sandstone crops out in the Bristol area between Bedminster and Frenchay, and in eastern and southern parts of the city, notably at Stapleton, Easton and Redcliffe. It also forms cliffs along the River Avon at Redcliffe Parade and is well exposed on the south side of the New Cut between Bathurst Basin and Ashton Gate. In South Gloucestershire, a narrow outcrop belt extends from north Bristol (Frenchay) via Winterbourne as far north as Tockington. The lithology comprises dark red (occasionally buff or fawn), calcareous and highly ferruginous, fine to medium-grained, unfossiliferous sandstones. The brilliant red sandy soil developed on the crop of Redcliffe Sandstone is recorded in the names of districts, such as Redcliffe and Redfield. It is used locally as a rough building stone along its outcrop but has limitations due to irregularly developed cementation. Decalcified Redcliffe Sandstone is soft and friable when dry, and it also breaks down quickly when water saturated. Consequently, when employed as a building stone, it tends to be used in conjunction with more resistant dolomitic conglomerate or other sandstones. A typical example of

its use can be seen in houses adjoining Eliston Lane and Fairview Drive in Redland, Bristol, where the houses are constructed of intensely red Redcliffe Sandstone and paler red dolomitic conglomerate blocks, roughly faced and irregularly laid in a crazy paving style.

Figure 16: Houses, Fairview Drive, Redland, Bristol. Redcliffe Sandstone and Dolomitic Conglomerate.

Mercia Mudstone Group, Branscombe Mudstone Formation, Arden Sandstone Formation

Butcombe Sandstone

Butcombe Sandstone has a scattered outcrop, occurring around Churchill, through Wrington to the northern end of Blagdon Lake (North Somerset) and in the Chew Valley area, north and west of Chew Valley Lake (Bath and North East Somerset).

It is heterolithic, consisting of fine to medium-grained, varicoloured green, brown, buff or mauve sandstones, interbedded with grey, green and purple mudstones and siltstones. Beds of conglomerate occur locally. The proportion of fine to coarse clastics varies laterally within the formation. The thicker sandstone units typically exhibit a lenticular geometry and are often associated with celestine or gypsum-bearing layers. The sandstones are unfossiliferous, but exhibit a range of sedimentary structures, including bioturbation, small-scale ripple drift cross-bedding, occasionally trough and planar cross-bedding, and sometimes mudcracks.

Butcombe Sandstone has small-scale use within the outcrop area, and it is mainly employed as a rough building stone, walling stone and rubblestone in villages such as Chew Magna. The thicker, better cemented sandstone beds are locally hard enough to be used as reasonable building stone, but the softer sandstone layers are susceptible to water erosion leading to gypsum dissolving and cavities being created.

Figure 17: Cottages, The Street, Chew Stoke. Skerry Sandstone and Butcombe Sandstone.

Skerry Sandstones (Chew Magna Stone, Stanton Drew Stone, Woodford Hill Stone and Castle Hill Sandstone)

Above the dolomitic conglomerate, within the mudstone-dominated sequence that characterises the rest of the Mercia Mudstone Group, there occurs a series of thin sandstone units, known as Skerry Sandstones or simply 'Skerries'. In the Bristol and Bath area their occurrence seems confined to a series of scattered outcrops in the Chew Valley area, particularly north and west of Chew Valley Lake (Bath and North East Somerset), where they form slight topographic highs within an otherwise flat landscape.

These Skerries comprise thin, red or reddish grey-green, fine-grained sandstones, with some interbedded red mudstones and siltstones. They are often associated with celestine or gypsum-bearing layers and may exhibit small-scale cross-bedding or cross-lamination but are unfossiliferous. Like the Butcombe Sandstone, the thicker, better cemented (calcium or magnesium carbonate) Skerry Sandstone beds are sufficiently hard locally to be used as building stone, although the softer layers are susceptible to water erosion, gypsum solution and cavities.

Skerry Sandstones have been quarried (often on a relatively small scale) all along the outcrop, and this has given rise to a number of local names, such as Chew Magna Stone, Stanton Drew Stone, Woodford Hill Stone and Castle Hill Sandstone. The sandstones are mainly employed on a local basis, as rough building stone, walling stone and rubblestone.

Figure 18: Cottages, West Harptree. Skerry Sandstone and Dolomitic Conglomerate (including East Harptree Stone).

Figure 19: Cottages, Chew Magna. Skerry Sandstone and Butcombe Sandstone.

Penarth Group, Lilstock Formation

White Lias, Cotham Marble (Landscape Marble)

The hard, white, flaggy, fine-grained (almost porcellanous) limestones of the Lilstock Formation were once widely employed as a local building stone, especially in areas around the Bristol and Somerset Coalfield. The uppermost White Lias beds, in particular, provide a tough, creamy-coloured stone

almost immune to frost action. The beds have a wide but narrow outcrop pattern, immediately underlying the very extensive Blue Lias limestones. Examples can be seen in several areas of Bristol, and in the villages that lie along the White Lias and Blue Lias outcrop. The Chapel of the Three Kings of Cologne, Bristol, is a fine example of the use of White Lias with Bath Stone. The famous Cotham Marble (or Landscape Marble) is a thin, pale, algal limestone with a curious vermiform upper surface, which originates from the lower part of the Lilstock Formation (Cotham Member). It is too soft to be used as an external stone, but it takes a good polish and is employed in the construction of ornamental internal walls and decorations.

Figure 20: Carvings, Chapel of the Three Kings of Cologne, Colston Road, Bristol. Coursed White Lias with Bath Stone dressings and sculpture.

Lower Jurassic

Lias Group, Blue Lias Formation

Blue Lias (Banwell Stone, Keynsham Stone, Saltford Stone and Stowey Stone)

Blue Lias limestones are one of the most important and widely used stones for building houses and walls in the Bristol and Bath area. The outcrop area is extensive: the beds occur in and around Banwell (North Somerset); as a semi-continuous belt north of Dundry Hill, around Hengrove and Horfield (Bristol); as complex outcrops around Blagdon, Chew Valley Lake, Paulton, Timsbury, Farmborough and Marksbury, widening out into extensive areas around Burnett, Corston, Saltford and Keynsham (Bath and North East Somerset); and in east-central and western areas of South Gloucestershire, around Upton Cheyney, Chipping Sodbury, Wickwar, Patchway and Rudgeway.

The stone is typically represented by blue-grey or pale yellow, fine-grained, muddy (calcilutite) limestones. Some limestones are finely crystalline, hard and splintery, with bedding tops and bases either level or wavy. Others are more flaggy and composed of finely comminuted remains of fossil oysters and other bivalves in a limy-mud matrix. Individual grains cannot usually be resolved with a hand lens. Building blocks are commonly made of the complete thickness of a limestone bed, no more than 300mm thick and in many cases much thinner. The presence of finely divided iron pyrites in some limestones facilitates the decay and crumbling of the stone. When fresh, the rock is dark to light grey, but characteristically weathers to a fawn or buff colour. Blocks with weathered pale yellow outer parts (including along joints) and grey interiors (blue-hearted) are common. Some beds also exhibit a tendency to weather along lamination planes.

Blue Lias limestones have been quarried extensively (often on a relatively small scale) all along the outcrop, and this has led to various local names, Banwell Stone, Keynsham Stone, Saltford Stone and Stowey Stone, for

Figure 21: Old Manor House, Bristol Road, Keynsham. Keynsham Stone.

example, being applied to essentially the same strata. The limestones have been widely employed in the Avon Valley between Bristol and Bath, and in the central part of the former Bristol and Somerset Coalfield between Stoke Gifford and Radstock. The building stones are usually laid in courses (coursed rubble or rough ashlar), which may be of different thicknesses, each course corresponding to blocks taken from a single bed of limestone. The Blue Lias is also used for quoins and dressings, floor slabs and tombstones.

Figure 22: Houses, Bath Road, Saltford. Saltford Stone.

Brockley Down Limestone

These grey, coarse-grained, detrital, bioclastic limestones occur near Dundry Hill, mainly west of a line from Barrow Gurney to Winford, and in an area around Bristol airport, extending through Lulsgate Bottom, Potters Hill and Felton, then west of Kingdown and north of Redhill. To the north (around Barrow Gurney), the beds interdigitate with normal basal Blue Lias facies.

The Brockley Down Limestone contains conspicuous bands of shell (bivalve) debris, which lie parallel to bedding. Larger pieces of shell are infrequent. The limestones are typically porous and cavernous at outcrop, containing many solution cavities caused by the action of groundwater. The basal limestones are usually conglomeratic, with angular or slightly rounded clasts of Carboniferous limestone (up to 300mm in diameter). Generally, the strata are very massive, with hardly any bedding planes visible, although current bedding may become well developed locally (as at Winford).

Brockley Down Limestone was quarried chiefly from Downside and Felton on Broadfield Down, and it was widely employed for building locally. Stone from Felton was used in the construction of Old Bristol Bridge.

Harptree Beds stone

The Harptree Beds are massive, brownish, very hard and resilient cherts, with occasional moulds of shells. They are confined to two small irregular areas (the larger being approximately 1.5km wide) on the southern edge of Felton Hill, near Bristol airport. They are derived from the local replacement (silicification) of Brockley Down Limestone, with which they form a strongly sinuous boundary. The Harptree Beds are only used very locally as a rough building stone in the Felton Hill–Bristol airport areas.

Lias Group, Beacon Limestone Formation

Marlstone, Cephalopod Limestone

These limestones typically occur as small scattered outcrops and outliers around Dundry Hill (much obscured by landslips or cambering), near Timsbury and Farmborough (Bath and North East Somerset), and on the southern border of South Gloucestershire near Bitton and Upton Cheyney. They also crop out in a narrow belt extending from Lower Hamswell via Dodington, Old Sodbury and Little Sodbury to Hawkesbury Knott (South Gloucestershire).

The lithology comprises grey to rusty-brown, ferruginous, shelly, calcarenite to silty limestones, locally oolitic and iron shot, occasionally with mudstone clasts and pebbles. They may pass into a more massive, grey-brown, ferruginous sandy limestone with clay partings. The limestones are highly fossiliferous and often crowded with belemnites, brachiopods and bivalves. The Beacon Limestone Formation is used very locally along its outcrop length for a variety of purposes, including rubblestone, walling and some rough-dressed ashlar.

Middle Jurassic

Inferior Oolite Group, various formations

Inferior Oolite limestone, Dundry Stone (Dundry Freestone)

Inferior Oolite limestones have a wide outcrop in the West of England area, occurring notably at Dundry (North Somerset and Bath and North East Somerset). They also occur as small isolated outcrops near Charlcombe and Battlefields, then south in a broad, wide discontinuous belt from around Wilmington and Englishcombe and centred on Tunley and Shoscombe (Bristol), and as a narrow belt, extending all along the eastern side of South Gloucestershire from Lower Hamswell, east of Old Sodbury and Dodington, via Little Sodbury to near Inglestone Common and Hawkesbury Upton.

The Inferior Oolite varies markedly and irregularly in thickness and lithology across the area. Generally, it comprises buff, grey-centred, shelly or rubbly to nodular sandy limestones, interbedded with buff, more massive, sandy, ferruginous, ooidal limestones. The limestones are characterised by

dispersed white crinoid ossicles up to 2mm across. These coarser grains and the colour and smaller size of the building blocks distinguish Inferior Oolite limestone from other ooidal limestones. Inferior Oolite limestones are often highly fossiliferous, containing brachiopods, ammonites and other mollusc shells. They are widely quarried and used along their outcrop, especially for rubblestone walling and some ashlar. One of the best-known building stone varieties is Dundry Stone.

This Inferior Oolite limestone forms a large outlier and capping at Dundry Hill, south of Bristol, where the rocks are much affected by superficial cambering and landslips. Dundry Stone is a massive, pale yellow, bioclastic limestone, which at outcrop overlies thinly bedded, often iron-shot limestones and thin conglomerate, with limonite and serpulid-coated, blue-grey limestone clasts.

Dundry Stone was famed as a building stone. It was partly quarried and partly mined from galleries around Dundry village, but it has long been worked out. The ornate tower of the Church of St Michael the Archangel in Dundry, built in 1484, was constructed of Dundry Stone and served as a beacon for sailors, as it was visible from the Severn estuary off Clevedon.

Figure 23: Church of St Michael the Archangel, Dundry. Dundry Stone.

Dundry Stone was also used in the construction of the Church of St Thomas the Martyr and Church of St Mary Redcliffe at Bristol, built in the 13th to 15th century and founded on Triassic Redcliffe Sandstone.

In medieval times, Dundry Stone was exported in some quantity, in the form of carved monuments, to many abbeys and religious centres sited along the east coast of Ireland.

Figure 24: Church of St Thomas the Martyr, Bristol. Dundry Stone.

Great Oolite Group, Athelstan Oolite Formation

Athelstan Oolite, Lower Rags

The continuation of the belt of Great Oolite Group strata continues into north-east South Gloucestershire, where it is represented around Badminton and Hawkesbury Upton (extending into Gloucestershire) by massively bedded, pale ooid grainstones and oolitic limestones, often containing millet seed-type ooliths. These well-sorted limestones belong to the Athelstan Oolite Formation, but they are used very locally as wallstone because their weathering qualities are relatively poor when compared to the other Great Oolite limestones.

Great Oolite Group, Chalfield Oolite Formation

The Chalfield Oolite Formation represents the main component of the Great Oolite Group within Bath and North East Somerset, and it crops out as a belt of irregular exposure, much affected by topography and landslip areas. The crop is several kilometres wide, extending semi-continuously along the eastern and north-eastern side of the unitary authority area from near Peasedown St John via Bath, and from near North Stoke eastwards to St Catherines.

The formation includes some of the most important building stones in England: the Bath Stones and Combe Down Stone ooidal freestones are world famous, and they have been used for many prestigious buildings nationally and internationally. These freestones have been employed extensively in Bath and its surroundings. They were first used by the Romans for the construction of the hot baths of Aquae Sulis, and have been employed throughout medieval times to the present day. The attractive appearance of the World Heritage City of Bath owes much to the consistent use of local stone, especially during the 18th and 19th centuries when many of the magnificent Georgian-style terraces and crescents were built. The stone is soft enough to be intricately carved, but it is susceptible to blackish staining when subjected to water run-off or high air pollution levels in urban areas.

The Chalfield Oolite Formation comprises mainly ooidal grainstone, predominantly pale grey and pale yellow to creamy-white in colour. The fine to coarsely grained oolites exhibit variable bioclastic content, and occur in medium to thick beds. The two main ooidal freestone beds used for building purposes occur within the Combe Down and Bath Oolite members.

Combe Down Stone (Combe Down Oolite, Odd Down Stone, Bathampton Stone, Horsecombe Stone)

The Combe Down Member occurs in the Bath area, and it was formerly mined on Combe Down, Odd Down, Bathampton Down and further east on Box Hill. It comprises cream-coloured, fine to coarse-grained, current-bedded, ooidal limestones (mainly oosparites and biosparrudites). The upper parts contain ooidal freestones, passing into shell-detrital, marly, ooidal limestones. At outcrop, the top surface of the member is frequently planar, bored and

encrusted with fossil oysters. It is distinguished from Bath Oolite by its scattered fine-grained shell debris and its tendency to contain fine calcite-cemented stringers (water marks).

Combe Down Stone is generally regarded as the most weather-resistant variety of the Bath oolites and freestones. Like the local Bath Stones, it has been used in many prestigious buildings, including Bath Abbey, which originally was a Norman church built on earlier (9th to 11th-century) foundations. Most of the present building dates from the 16th century and is constructed in late Perpendicular style, with distinct flying buttresses and pinnacles.

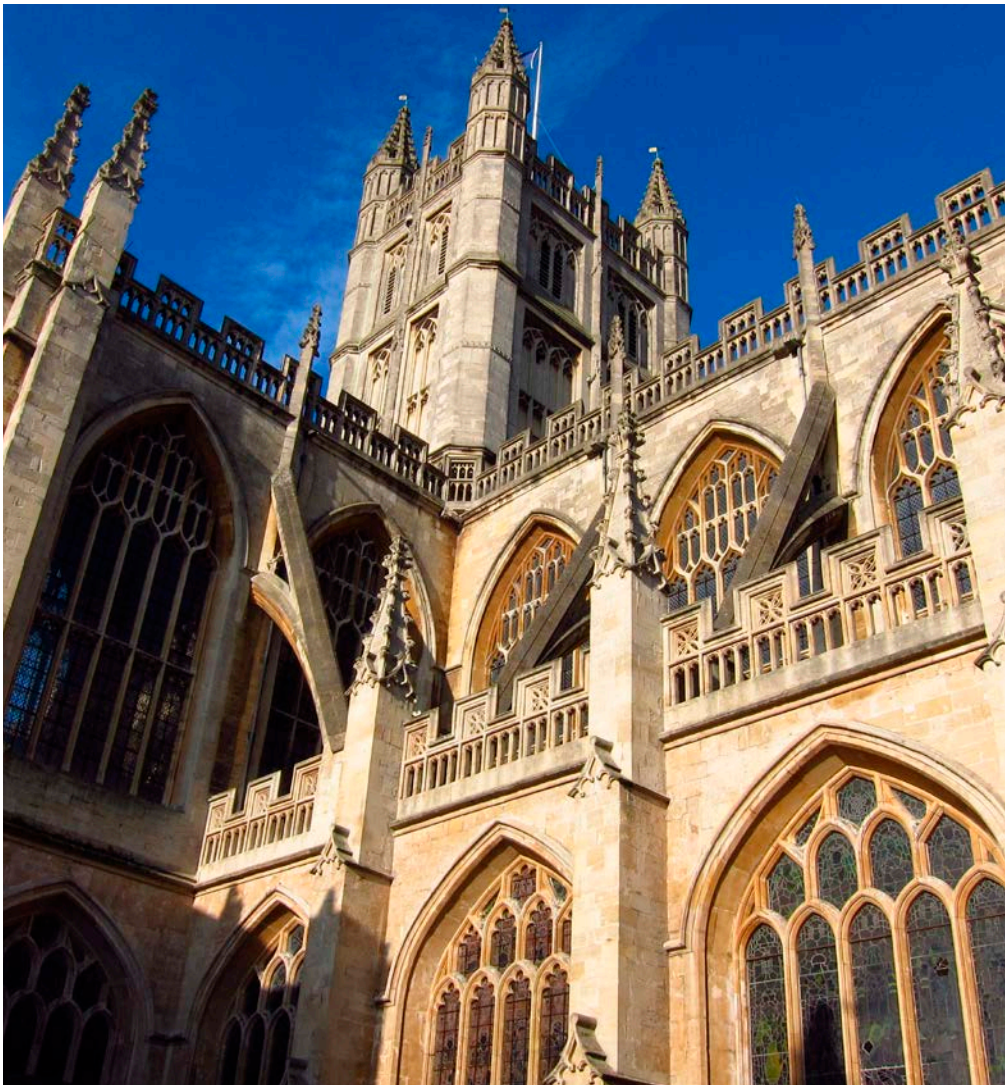


Figure 25: Bath Abbey. Combe Down Stone.

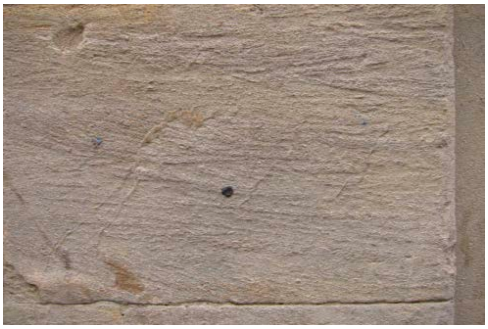


Figure 26: Combe Down Stone details showing fine-grained shell debris and calcite-cemented stringers.

Twinhoe Beds Stone

The Twinhoe Member crops out around Bath, but it is mainly developed south of Corsham. It comprises yellowish-buff to cream-coloured, compact, fine-grained, bioclastic (shell-detrital) limestones, which are distinctly pisoidal in places. Subordinate rubbly marly limestones are also present in outcrop. Some beds are characteristically ferruginous, becoming strongly iron shot near base.

Examples of its use include All Saints House, Saints Lane and parts of the Market Chambers, St Nicholas Street in Bristol; and walls along Charlotte Street and Queen Square, Bath.

Figure 27: All Saints House, All Saints Lane, Bristol. Twinhoe Beds.

Figure 28: Twinhoe Beds stone details.

Bath Stone (Bath Oolite)

The Bath Stone was formerly extensively mined within the Westwood to Hayes, Monk's Park (Wiltshire) and Limpley Stoke to Monkton Farleigh (Wiltshire) areas.

It consists of uniform, cream-coloured, medium to coarse-grained, cross-bedded, ooidal limestones, mainly oosparites, but sometimes oomicrites or biosparrudites. At outcrop, it passes upwards into lenticular beds of coarser grained, coralliferous limestone (called the Coral Rag), and the upper surface is erosively planed and bored. Bath Oolite tends to be a very pure oolite, lacking the amounts of scattered fine-grained shell debris and calcite-cemented stringers present within the Combe Down Oolite.

Many of the most prestigious buildings in Bath are constructed from the Bath Stone oolites, including the panoramic Georgian-style, ionic-columned Royal Crescent. The stone was also used for prestigious buildings in Bristol, such as the Old Vic Theatre in King Street.

Bath Oolite is softer than the underlying Combe Down Oolite freestone. When newly dug, it is readily cut by saw and is ideal for mouldings, but it hardens on exposure to air. The intricacy of carving that can be achieved is demonstrated by the statues on the face of the Chapel of the Three Kings of Cologne, which is constructed of Pennant Sandstone and White Lias limestone.

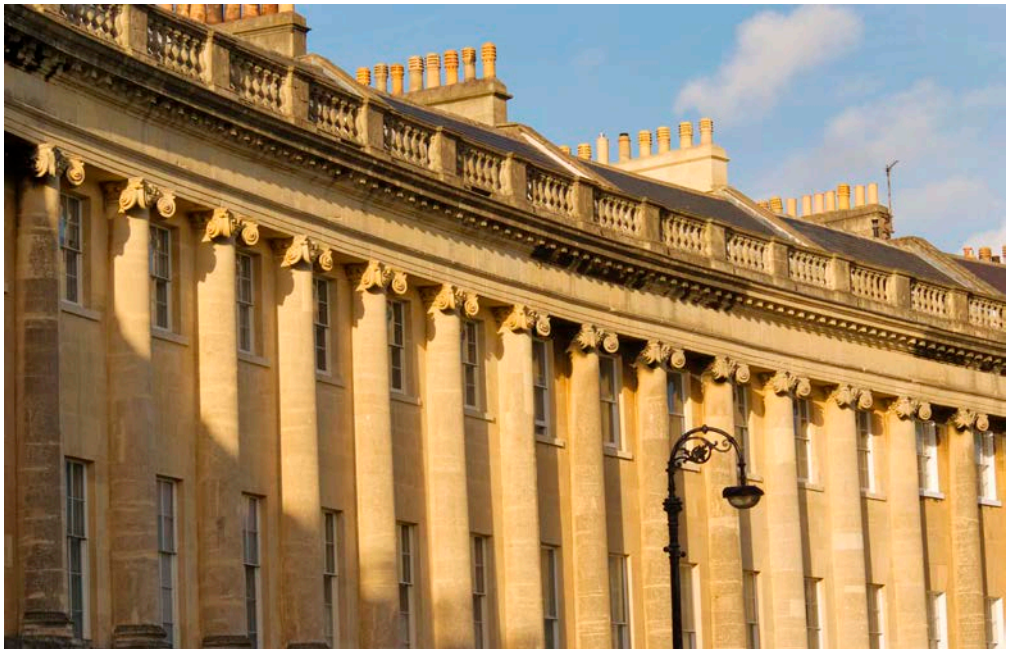


Figure 29: The Royal Crescent, Bath. Bath Stone.

Figure 30: St John's Gateway and Church, Broad Street, Bristol. Bath Stone and Brandon Grit.

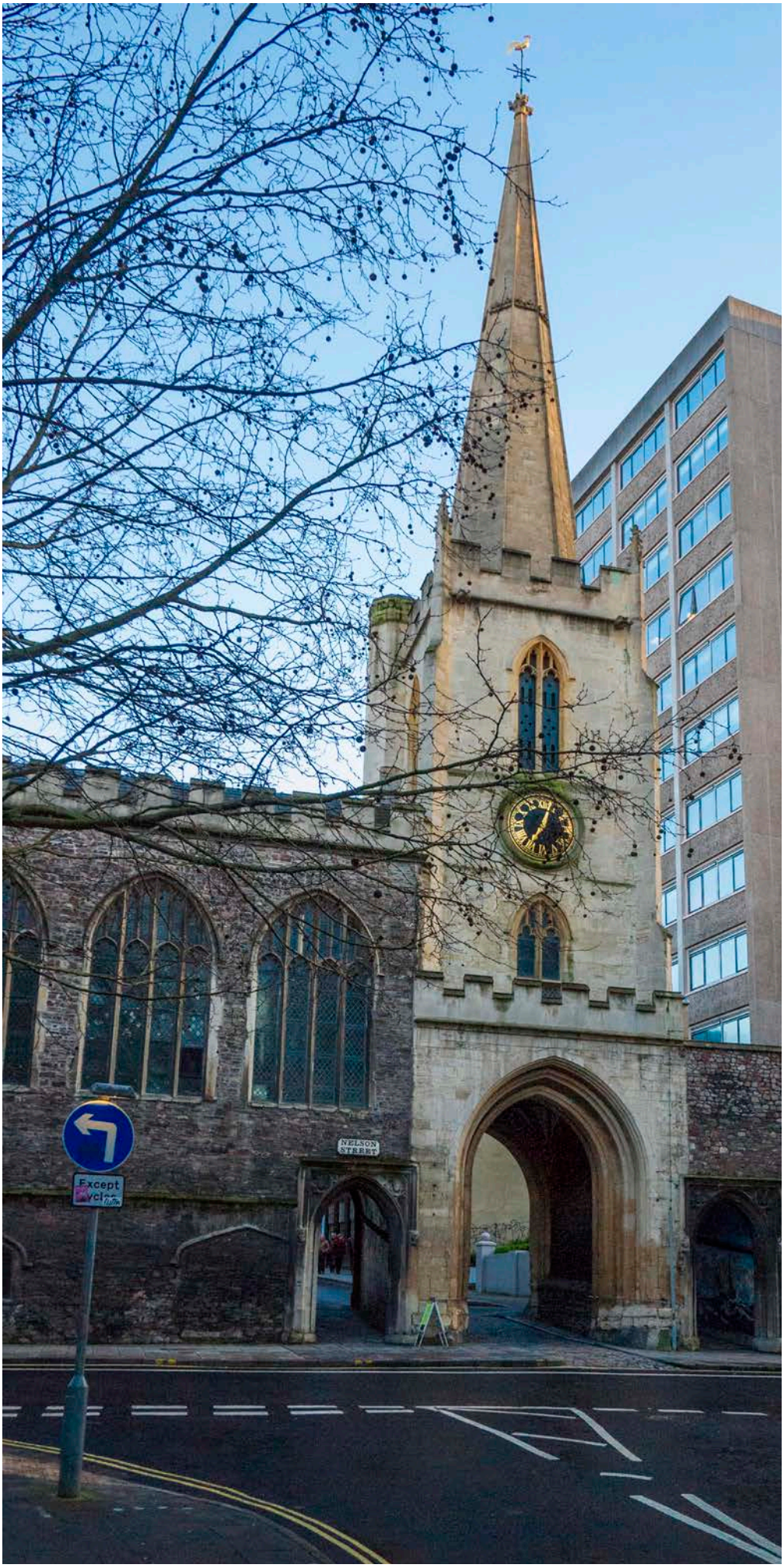


Figure 31: Bristol Old Vic Theatre, King Street, Bristol. Bath Stone.

Figure 32: Bath Stone details.

Great Oolite Group, Forest Marble Formation

Forest Marble Limestone

The Forest Marble Formation is of variable lithology, but it typically comprises greenish-grey, laterally impersistent limestones, interbedded with thin, orange-coloured, calcareous sandstones and greyish mudstones. The limestones vary from cross-bedded, sparsely ooidal varieties to massively bedded, shelly, blue-hearted sparites. Characteristically, the limestones are often packed with fossil bivalve shells, especially small oysters, which lie parallel with the bedding and are clearly winnowed. The formation crops out in the south-east of Bath and North East Somerset (mainly in the Hinton Charterhouse area) and South Gloucestershire (around Acton Turville, extending north towards Badminton). In these areas, the Forest Marble limestones have been widely used for houses and walls along the outcrop, typified by cottages along Green Lane, Hinton Charterhouse, where they are employed for rubble walling and roughly dressed ashlar. Some thinly bedded limestones are also used as stone roofing slates, and larger flagstones are utilised for bridging ditches.

Figure 33: Cottage, Green Lane, Hinton Charterhouse. Forest Marble Limestone.

Great Oolite Group, Cornbrash Formation

Cornbrash Limestone

Small isolated outcrops of creamy-yellow, irregularly bedded, shelly limestones belonging to the Cornbrash Formation occur along the eastern edge of Bath and North East Somerset near Hinton Charterhouse. Their rough flaggy nature means the beds are not capable of being dressed, but they are used very locally for farm buildings and walling along the outcrop.

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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5 Acknowledgements

The guides series was developed by Geckoella Ltd (Andy King), the British Geological Survey (Don Cameron, Graham Lott, and Stephen Parry), and Historic England (Clara Willett).

Historic England and the British Geological Survey developed the Building Stone Database for England with advice from many local geologists and historic building experts and all these individuals are thanked for their contributions.

The Department for Levelling Up, Housing and Communities supported the development of the Building Stones of England database project.

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Product code: HEBSE03
Publication date: August 2011
Reissue date: December 2017
Reissue date: May 2023
Design: Historic England