Strategic Stone Study
A Building Stone Atlas of Avon

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The former county of Avon encompasses the four Unitary Authority areas of North Somerset (NSom), Bristol, Bath and North East Somerset (BaNES) and South Gloucestershire (SGlos). For convenience, the abbreviations given in brackets are used throughout this report.

The solid geology of Avon is complex. The sequence is dominated by sedimentary rocks which 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 younging from west to east, but numerous unconformities and faults create a complicated outcrop pattern of inliers, outliers and a varied topography. The geological heritage of Avon 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 Somerset and Bristol Coalfield which played a key role in the economic and social development of the region.

Given this varied geology, it is not surprising that Avon has a high diversity of building stones, some of which, such as the ‘Bath Stones’, are justly famous and have been used for many prestigious buildings within Avon, and exported nationally and internationally. The Romans were amongst the first to use Bath Stone in their construction of the hot baths at ‘Aquae Sulis’, and many of the classic Georgian terraces and crescents in that city owe their beauty to the extensive use of these stones. The various named varieties of Bath Stone are detailed and illustrated in Table 2 of this report.

The principal stones used for building purposes in Avon 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 of course also been employed for vernacular construction, but these tend to either have a relatively limited geographical; consequently they tend to have been mainly used as rough building stones or rubblestones in local circumstances.

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

Useful accounts of the geology and use of building stones in Avon are mainly provided within the relevant memoirs of the British Geological Survey.
Avon Bedrock Geology Map

Derived from BGS digital geological mapping at 1:625,000 scale, British Geological Survey ©NERC. All rights reserved.
Silurian

**Thornbury Formation**

**Thornbury Sandstone**

The Thornbury Formation occurs in just two outcrop areas in SGlos around Thornbury near Kington and 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 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 general rubblestones and walling stones.

Devonian

**Lower Old Red Sandstone**

**Black Nore Sandstone Formation**

**Black Nore Sandstone**

The largest outcrop of the Black Nore Sandstone occurs in the Portbury-Failand area of NSom extending to the southern bank of the River Avon, but 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 (calcrite 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. The sandstones locally contain abundant fossil fish debris.

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

**Upper Old Red Sandstone**

**Portishead Formation**

As their name implies, these strata crop out at Portishead, and extend to near Clevedon; but they also occur in the Failand-Abbot’s Leigh areas, stretching to the southern bank of the River Avon (NSom). In Bristol, small outcrops are present near Shirehampton, Westbury-on-Trym and 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. Pebby conglomerates also occur at intervals, the pebbles comprising mostly augen quartz and dark brown quartzite, but 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 Failand area. The Portishead Formation splits laterally into the Tintern Sandstone and Quartz Conglomerate in the Buckover area and Forest of Dean (SGlos). The Portishead Formation was formerly quarried as a building stone in several locations, especially in the Abbot’s Leigh area near Bristol. It was used as a general purpose building and walling stone, especially in and around Portishead where a number of 19th-century properties, such as the terrace along Woodhill Road (above) are constructed of roughly dressed sandstone blocks.
Tintern Sandstone Formation
Tintern Sandstone, Quartz Conglomerate

This formation occurs as a narrow, continuous linear exposure trending northeast, from near Alverston, via Buckover to Tortworth and Charfield (SGlos). 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, and have been used locally as a general rubblestone and walling stone, as for example in the pedestrian precinct in Thornbury (below). However, generally the formation has proved to be lithologically too variable for building stone but has been quarried for roadstone.

Lower Carboniferous
Pembroke Limestone Group
‘Lower Carboniferous limestones’

The Pembroke Limestone Group has a very extensive outcrop area in NSom including the ‘Clevedon to Portishead Ridge’, Ashton Court and the south bank of River Avon, the large ‘Lulsgate Inlier’, 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, Henbury and along King’s Weston Hill and Severn Way towards Shirehampton.

Small exposures also occur in Hotwells and south Clifton areas, and near Compton Martin and East Harptree (BaNES) and the Olveston, Alveston, Almondsbury, Tytherington, Cromhall (where the outcrop widens) and Chipping Sodbury areas (SGlos).
The Pembroke Limestone Group comprises a varied group of different limestone facies and formations which are informally referred to here as ‘Lower Carboniferous limestone’. The various limestones have been given different stratigraphical names along the outcrop and 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). A summary of the different formations and subgroups present in Avon (with local names) is given in Table 1.

These limestones represent some of the most extensively quarried stones in Avon, and they are widely used as building stones throughout the area. Some beds are tabular and blocky, but are not easy to dress as ashlar, so blocks are usually roughly shaped and laid in various uncoursed walling styles.

Lower Carboniferous limestones make durable building stones, their low porosity making them suitable for external buildings, and they have low susceptibility to frost damage. However, although the limestones have formerly been widely used for building purposes (for example in 19th-century properties in Clevedon, Clifton, Redland, Westbury-on-Trym and Sneyd Park), and were previously burnt for lime, they are now worked exclusively for crushed rock, concrete aggregate or roadstone.
The United Reformed Church, Woodhill Road, Portishead is constructed of locally sourced Clevedon Stone, a ferruginous variety of Lower Carboniferous limestone which typically weathers to a yellowish-brown colour.

<table>
<thead>
<tr>
<th>FORMAL FORMATION/ SUBGROUP NAME</th>
<th>INFORMAL/LOCAL NAME</th>
<th>COLOUR AND FOSSILS</th>
<th>LITHOLOGICAL DESCRIPTIONS OF LIMESTONES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxwich Head Limestone Formation</td>
<td>Hotwells Limestone</td>
<td>AA AA AA AA</td>
<td>Massive, grey crinoidal and oolitic bioclastic limestones, sometimes also flaggy, black splintery limestones with chert nodules and seams. Abundant fossil fauna of corals and thick-shelled brachiopods.</td>
</tr>
<tr>
<td>Clifton Down Limestone Formation</td>
<td>Clifton Down Limestone</td>
<td>AA AA AA AA</td>
<td>Grey, well-bedded calcareous and dolomitic mudstones with poorly-sorted bioclastic limestone, algal limestones (Seminar Pisolite) and cross-bedded ooids (Seminar Oolite) topped by thick calcareous algal mudstones (Concretionary Beds). Sparsely fossiliferous, except some bands locally crowded with corals and brachiopods, algal limestones distinctive.</td>
</tr>
<tr>
<td>Burrington Oolite Subgroup</td>
<td>Burrington Oolite</td>
<td>AA AA AA AA</td>
<td>Light grey, massive oolitic and crinoidal limestones, the upper parts with occasional pale grey calcite-mudstone bands, or oolitic limestone pebbles or calcite-mudstone pellets.</td>
</tr>
<tr>
<td>Goblin Combe Limestone Formation</td>
<td>Goblin Combe Oolite</td>
<td>AA AA AA AA</td>
<td>Pale grey to grey, 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.</td>
</tr>
<tr>
<td>High Tor Limestone Formation</td>
<td>Birnbeck Limestone</td>
<td>AA AA AA AA</td>
<td>Pale to dark grey, predominately thick-bedded in the lower part, fine- to coarse-grained, bioclastic and oolitic limestones (skeletal packstones and grainstones), with thin beds and partings of shaly dolomite mudstone and siltstone. Poorly fossiliferous in lower parts, occasional corals; upper parts with more fossil corals and chonetid brachiopods.</td>
</tr>
<tr>
<td>Gully Oolite Formation</td>
<td>Gully Oolite, Caninia Oolite</td>
<td>AA AA AA AA</td>
<td>Massively bedded, pale pinkish grey or pinkish, oolitic grainstone with subordinate beds of fine-grained skeletal packstones. Locally dolomitized or traversed by strong joints. Sparsely fossiliferous, but in north Bristol to Tytherton area, the base is characterised by a 5 m thick, pale grey, well-sorted, crinoidal limestone (the ‘Sub-Oolite Bed’) which contains abundant brachiopods.</td>
</tr>
<tr>
<td>Black Rock Limestone Subgroup</td>
<td>Black Rock Limestone or Dolomite, Abbots Leigh Stone, Clevedon Stone</td>
<td>AA AA AA AA</td>
<td>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, standing out as strong features. Shaly partings common. Fossils abundant, especially corals, brachiopods.</td>
</tr>
</tbody>
</table>

Table 1. Main types of Lower Carboniferous limestones (Pembroke Limestone Group) in the Avon area which may be used for building purposes. (Key: AA = abundant fossils throughout beds; A = fossils locally common in some beds; s = sparsely fossiliferous).
Cromhall Sandstone Formation

Cromhall Sandstone

The Cromhall Sandstone Formation occurs as small, scattered exposures extending from near Long Ashton through Ashton Court Estate to River Avon (NSom), and in the Hotwells and south Clifton areas (Bristol). In SGlou a narrow strip of exposure extends from Olveston through Tytherington to Cromhall (where outcrop widens) and then southwards to Yate, although the outcrop in these areas is much obscured by younger Triassic and drift deposits. Small isolated exposures also occur near Almondsbury, 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, sandy crinoidal and ooidal limestones with mudstones, siltstones and grey seatearths arranged in stacked, cyclic sequences.

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

An unusual example of polychrome banding is seen in several buildings in the High Street at Chipping Sodbury, such as the Rounceval House Hotel, which exhibits thin bands of brownish Cromhall Sandstone, alternating with thicker bands of pale grey Lower Carboniferous Limestone.

The late 13C church of St Andrew at Cromhall is composed of roughly squared blocks of Cromhall Sandstone, the quoins and window tracery are largely of Bath Stone.
Upper Carboniferous

Marros Group
Quartzitic Sandstone Formation

‘Millstone Grit’, Brandon Hill Stone, Brandon Grit, Long Ashton Stone

In Bristol the Quartzitic Sandstone Formation (often referred to informally as the ‘Millstone Grit’) occurs in scattered, small outcrops near Long Ashton, south of the River Avon, and on high ground (Brandon Hill) in the Clifton - Tyndall’s Park area. In SGlos the strata occupy a semi-circular, 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 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
Pennant Sandstone and Grovesend Formations

‘Pennant Sandstone’

The general name ‘Pennant Sandstone’ is given to a succession of grey, green-grey and blue-grey sandstone beds totalling more than 2 km in thickness, which are commonly feldspathic, micaceous or lithic in composition. 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 Avon: in NSom they have a linear outcrop stretching from Clevedon eastwards north of Gordano Valley and along the M5 corridor, via Norton Wood, 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 City - Drew’s Hole, Stapleton – Broomhill, Brislington - Hicks Gate and St Anne Park areas; in BaNES there are exposures northwest of Keynsham near Hicks Gate, around Clutton to High Littleton, near Stanton Wick and Chelwood, between Pensford and Compton Common, with important quarry areas at Temple Cloud and east of Corsham; in SGlos the outcrop is mainly around Kingswood and Oldland, Hangham Green and Longham Green, and Winterbourne to Mangotsfield areas, extending through Frampton Cotterell to Nibley and Yate and stretching to Pucklechurch, Henfield and Westerleigh.

The combination of their widespread occurrence, thickness and hardness (the quartzitic sandstones in particular being resistant), has meant that Pennant sandstones are widely used as building stones throughout the outcrop.

When encountered ex situ, distinguishing between the various lithologies and assigning individual stones to particular members of the group is 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 of ‘Pennant Sandstone’.

Avon Strategic Stone Study 8
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.

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. Formerly Pennant Sandstone was used on a very large scale for dressed building stone, kerbs and paving, but all of 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. The suburbs of east Bristol built during the 19th and early 20th century show abundant examples of grey or reddish Pennant Sandstone houses with lintels and sills of Bath Stone.

The Grovesend Formation is principally exposed in the coalfield areas and is represented mainly by a sequence of argillaceous, grey mudstones and siltstones, with subordinate greyish sandstones, seatearth clays and thin worked coal seams. The sandstones are typically of lithic, feldspathic, micaceous ‘Pennant-type’, but the Publow Member also contains massively-bedded quartzitic sandstones and locally developed red mudstones. Sandstones within the Farrington Barren Red and Radstock Members are typically poorly bedded and relatively thin. An extremely localised development of fissile and sandy beds (called ‘delves’) occurs in the Barren Red member at Westerleigh, near Iron Acton and Yate. Slates from this level were probably sourced from an old quarry on Ram Hill and used in the construction and roofing of Westerleigh church.
Triassic
Mercia Mudstone Group
Sidmouth Mudstone Formation
Redcliffe Sandstone Member

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 (west of St Mary Redcliffe), and is well exposed on the south side of the New Cut between Bathurst Basin and Ashton Gate. In SGlos, 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 locally used as a rough building stone along its outcrop, but has limitations owing to irregularly developed cementation. Decalcified Redcliffe Sandstone is soft and friable when dry, and it also quickly breaks down 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’ type style.

‘Marginal Facies’
Dolomitic Conglomerate, Almondsbury Stone, East Harptree Stone

The Dolomitic Conglomerate occupies large areas in Avon, and is extensively used as a building stone throughout the outcrop. In NSom it essentially flanks (to north and south) and infills coombes within the large Carboniferous limestone inliers and ridges centred on Lulsgate-Felton, and Wraxhall-Failand-Leigh Woods; it also occurs on the northern banks of the River Avon, the main larger outcrop (approximately 4 sq km) covering the Sea Mills, Sneyd Park, Westbury-on-Trym, Henbury, Brentry areas of Bristol; the smaller outcrop (approximately 1.5 sq km) centred around Clifton and Hotwell areas of the city. Dolomitic Conglomerate also occurs along the southern edge of BaNES from Ubley to Compton Martin and East Harptree; and in SGlos it occurs at Almondsbury, north of Thornbury, between Wick and Doynton.
The stone is a clast-supported breccia or conglomerate composed of grey angular to subangular fragments of re-worked 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 2-4cm diameter, but larger boulder-sized clasts also occur. Secondary changes are characteristic of this stone, in particular hematitization (which produces an intense red coloured ‘earthy’ iron-rich friable rock termed ‘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 (the East Harptree Stone).

The Dolomitic Conglomerate is widely and extensively used 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 used 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 was known locally as Draycott Marble.
Penpole Stone

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, its fine grain size enabling it to be cut into fine ashlar blocks.

Arden Sandstone Formation

Butcombe Sandstone

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

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 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 sufficiently hard to be used as reasonable building stone, but the softer sandstone layers are susceptible to water erosion, gypsum solution and development of cavities.
‘Skerry Sandstones’

**Chew Magna Stone, Stanton Drew Stone, Woodford Hill Sandstone, 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, termed ‘skerries’ or ‘skerry sandstones’. Within Avon, their occurrence seems confined to a series of scattered outcrops in the Chew Valley area, particularly north and west of Chew Valley Lake (BaNES) 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 carbonate (calcium or magnesium carbonate) cemented skerry sandstone beds are locally sufficiently hard to be used as building stone; although the softer layers are susceptible to water erosion, solution of gypsum and development of 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 being applied to them, such as Chew Magna Stone, Stanton Drew Stone, Woodford Hill Stone and Castle Hill Sandstone. Use of the sandstones is mainly on a local basis, as rough building stone, walling stone and rubblestone.

**Penarth Group**

**Lilstock Formation**

**White Lias, Cotham 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 of its use 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 in Colston is a fine example of the use of White Lias with Bath Stone (see below section on 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 takes a good polish and is used in the construction of ornamental internal walls and decorations.
Jurassic
Lias Group
Blue Lias Formation
Rugby Limestone and Wilmcote Limestone members
Blue Lias, Banwell Stone, Keynsham Stone, Saltford Stone, Stowey Stone

Blue Lias limestones are one of the most important and widely used stones for building houses and walls in many areas of Avon. The outcrop area is extensive, the beds occurring in and around Banwell (NSom); 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 (BaNES); and in east-central and western areas of SGlos, around Upton Cheyney, Chipping Sodbury, Wickwar, Patchway and Rudgeway.

The stone is typically represented by blue-grey or pale yellow, fine-grained, muddy (calciilutite) 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 usually made of the complete thickness of a limestone bed, no more than 30 cm thick and in many cases much thinner. The presence of finely divided iron pyrites in some limestones facilitates their 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 extensively quarried (often on a relatively small scale) all along the outcrop, and this has given rise to a number of local names (such as Banwell Stone, Keynsham Stone, Saltford Stone and Stowey Stone) 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.
Marginal Facies

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 (Lulsgate) Airport, extending through Lulsgate Bottom, Potters Hill, Felton, then west of Kingdown and north of Redhill. To the north (around Barrow Guerney), 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 30 cm in diameter). The strata are usually very massive, with hardly any bedding planes being 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 was widely used for building locally. Stone from Felton was used in the construction of Old Bristol Bridge.

Harptree Beds

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 1.5 km wide) on the southern edge of Felton Hill, near Lulsgate 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 - Lulsgate Airport areas.

Beacon Limestone Formation

Marlstone, Cephalopod Limestone

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

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

Inferior Oolite limestones have a wide outcrop in Avon, occurring notably at Dundry (NSom and BaNES); 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 SGlos from Lower Hamswell, east of Old Sodbury and Doddington, via Little Sodbury-Grickstone, 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-centered, 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, and these coarser grains, the colour and the 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.

**Dundry Stone, Dundry Freestone**

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 landslipping. Dundry Stone is a massive, pale yellow, bioclastic limestone, which at outcrop overlies thinly-bedded, often ironshot limestones and thin conglomerate with limonite and serpulid-coated blue-grey limestone clasts.

Dundry Stone was famed as a building stone, and was formerly partly quarried and partly mined from galleries around Dundry village; however, it has long been worked out. The ornate tower of Dundry church, built in 1484, was constructed of Dundry Stone and served as a beacon for sailors, being visible from the Severn Estuary off Clevedon. Dundry Stone was also used in the construction of the church of St Thomas, Thomas Lane, Bristol and of St Mary Redcliffe in 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 church carved monuments, to many abbeys and religious centres sited along the east coast of Ireland (Waterman, 1970).
Great Oolite Group
Chalfield Oolite Formation

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

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 have been used for many prestigious buildings nationally and internationally. These freestones have been extensively used in Bath and environs; they were first used by the Romans for the construction of the hot baths of ‘Aquae Sulis’, and have been used 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 century when many of the magnificent, classic Georgian-style terraces and crescents were built. The stone is soft enough to be intricately carved, but is susceptible to blackish staining where subject 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. Where fully developed, as in the Bath area, three distinct facies (the Combe Down Member, Twinhoe Member and Bath Oolite Member) can be recognised, and these are summarised in Table 2. The two main ooidal freestone beds used for building purposes occur with the Combe Down and Bath Oolite members.

Chalfield Oolite Formation
Combe Down Member

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

The Combe Down Member occurs in the Bath area, and 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, ooid 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 tendency to contain fine calcite-cemented stringers (‘watermarks’).

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, but most of the present building dates from the 16th century and is constructed in late Perpendicular style with distinct flying buttresses and crocketed pinnacles.
Table 2. Main types of Bath Stone (Chalfield Oolite Formation).

<table>
<thead>
<tr>
<th>STONE NAME</th>
<th>STONE DESCRIPTION</th>
<th>APPEARANCE IN BUILDINGS</th>
<th>DETAIL (ooids typically 0.5–1.5mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bath Stone, Bath Oolite (Bath Oolite Member)</td>
<td>Cream coloured, medium- to coarse-grained, cross-bedded, ooid-limestones (mainly oospartes, sometimes oomicrites or biosparrudites). Bath Oolite tends to be a very pure oolite, lacking the amounts of scattered fine-grained shell debris and calcite stringers present within the Combe Down Oolite</td>
<td><img src="image" alt="Bath Stone" /></td>
<td><img src="image" alt="Bath Stone" /></td>
</tr>
<tr>
<td>Twinhoe Beds (Twinhoe Member)</td>
<td>Yellow buff to cream coloured, compact, fine- to coarse-grained, bioclastic (shell-detrital) limestones, distinctly pisoidal in places, especially in lower parts of the sequence. Subordinate rubbly marly limestones also present. Some beds ferruginous, becoming strongly ironshot near base</td>
<td><img src="image" alt="Twinhoe Beds" /></td>
<td><img src="image" alt="Twinhoe Beds" /></td>
</tr>
<tr>
<td>Combe Down Stone, Combe Down Oolite, Odd Down Stone, Bathampton Stone (Combe Down Member)</td>
<td>Cream coloured, fine- to coarse-grained, current bedded, ooid limestones (mainly oospartes and biosparrudites); upper parts oolitic freestones, passing down into shell detrital, marly oolitic limestones. Distinguished from Bath Oolite by its scattered fine-grained shell debris and tendency to contain fine calcite stringers (termed ‘watermarks’)</td>
<td><img src="image" alt="Combe Down Stone" /></td>
<td><img src="image" alt="Combe Down Stone" /></td>
</tr>
</tbody>
</table>
Twinhoe Member

Twinhoe Beds

The Twinhoe Member crops out around Bath, but 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 ironshot near base.

Examples of its use are provided by All Saints House (top right), All Saint’s Lane, Bristol (constructed in 1903); parts of the Market Chambers and St Nicholas Street, Bristol, and walls along Charlotte Street and Queen Square Place, Bath.

Bath Oolite Member

Bath Oolite, Bath Stone

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

It consists of uniform, cream coloured, medium- to coarse-grained, cross-bedded, ooid-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 (built between 1767–74, middle right). The stone was also used for prestigious buildings in Bristol, such as the ‘Old Vic’ Theatre in King Street (built 1764–66, bottom right).
Bath Oolite is softer than the underlying Combe Down Oolite freestone, and when newly dug is readily cut by saw and is ideal for mouldings, but 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, in Colston Road, Bristol (top right) which is constructed of Pennant Sandstone and White Lias Limestone (Stonebridge 1999).

**Athelstan Oolite Formation**

**Athelstan Oolite, Lower Rags**

The continuation of the belt of Great Oolite Group strata continues into north-east SGlos where it is represented around Great Badmington 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 are used very locally as wall stone as their weathering qualities are relatively poor when compared to the other Great Oolite limestones.

**Forest Marble Formation**

**Forest Marble Limestone**

The Forest Marble Formation is of variable lithology, but 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 southeast of BaNES (mainly in the Hinton Charterhouse area) and SGlos (around Acton Turville, extending north towards Great Badmington). 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, (bottom right). Some thinly bedded limestones are also used as stone roofing slates, and larger flagstones are utilised for bridging ditches.

**Cornbrash Formation**

**Cornbrash Limestone**

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

Ashlar: Stone masonry comprising blocks with carefully worked beds and joints, finely jointed (generally under 6mm) and set in horizontal courses. Stones within each course are of the same height, though successive courses may be of different heights. ‘Ashlar’ is often wrongly used as a synonym for facing stone.

Bioclastic limestone: A limestone composed of fragments of calcareous organisms.

Calcareous: A rock which contains significant (10–50%) calcium carbonate principally in the form of a cement or matrix.

Calcrete: Carbonate nodules formed in the soil profile just below ground surface by evaporation e.g. Psammosteus Limestone.

Cementation: The diagenetic process by which the constituent framework grains of a rock are bound together by minerals precipitated from associated pore fluids (e.g. silica, calcite).

Clast: A particle of rock or single crystal which has been derived by weathering and erosion. The basic building block of a clastic sediment.

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

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

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

Facies: A term describing the principal characteristics of a sedimentary rock that help describe its mode of genesis e.g. dune sandstone facies, marine mudstone facies.

Flaggy: A finely laminated, sedimentary rock that splits into thin sheets when exposed to weathering.

Formation: A named lithostratigraphic rock unit, with recognizable boundaries, readily identified by mapping, that forms part of a Group e.g. Bromsgrove Sandstone Formation.

Fossiliferous: Bearing or containing fossils.

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

Heterolithic bedding: A fine interbedding of sand and mud formed in an area of variable current flow.

Igneous rock: Rocks formed when molten magma cools and solidifies. It includes extrusive rocks erupted from volcanoes (e.g. basalt) and intrusive rocks that cool beneath the Earth’s surface (e.g. granite, gabbro, granodiorite, dolerite).

Inlier: A term used to describe an outcrop of older rocks surrounded by geologically younger rocks.

Interbedded: Occurs when beds (layers or rock) of a particular lithology lie between or alternate with beds of a different lithology. For example, sedimentary rocks may be interbedded if there were sea level variations in their sedimentary depositional environment.

Ironstone: Sedimentary rock which is composed of more than 50% iron-bearing minerals.

Limestone: A sedimentary rock consisting mainly of calcium carbonate (CaCO₃) grains such as ooids, shell and coral fragments and lime mud. Often highly fossiliferous.

Lithology: The description of a rock based on its mineralogical composition and grain-size e.g. sandstone, limestone, mudstone etc.
**Mica**: Group of silicate minerals composed of varying amounts of aluminum, potassium, magnesium, iron and water. All micas form flat, plate-like crystals. Crystals cleave into smooth flakes. Biotite is dark, black or brown mica; muscovite is light-coloured or clear mica.

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

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

**Ooid**: A spheroidal grain of calcium carbonate formed by precipitation (by algae) of calcium carbonate in concentric layers.

**Outlier**: A term used to describe an area of younger rocks surrounded by older rocks.

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

**Pisoid (pisoidal)**: A carbonate coated grain over 2mm in diameter, with an origin similar to an ooid.

**Polychrome**: The decoration of exteriors, and interiors of buildings with several colours. Structural polychrome decoration means that the colour is not applied but is in the bricks, tiles or stones used in the construction.

**Porosity**: The ratio of the fraction of voids to the volume of rock in which they occur.

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

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

**Seatearth**: The layer of sedimentary rock underlying a coal seam.

**Sedimentary rock**: A rock that is commonly formed by the binding together (lithification) of sediment particles (e.g. sandstone, siltstone, mudstone, limestone).

**Stratigraphy**: Branch of geoscience dealing with stratified rocks (generally of sedimentary origin) in terms of time and space, and their organisation into distinctive, generally mappable units.
Acknowledgements

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The atlas incorporates data from a number of sources, including the references and BGS memoirs and reports listed below, along with independent field work. Considerable use has been made of the BGS on-line lexicon of named rock units (www.bgs.ac.uk/lexicon).

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Further Reading


BGS Memoirs and Reports


