Strategic Stone Study
A Building Stone Atlas of Wiltshire

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Introduction

The character of a region is largely determined by a combination of landscape and the local stones used to build its towns and villages. Even where there is a lack of stone (for example in the Chalk downs), the alternative building materials traditionally used are distinctive. It is the harder limestones and sandstones that have commonly been used for building. The properties of the stone: colour, texture, bed thickness, durability, lateral extent and currently available technology for extraction and preparation, all determine the choice of stone as opposed to alternative (often cheaper) building materials. Transport has always been a major factor in stone use because of its sheer weight and bulk. It was the development of more efficient transport with the advent of some 29 river navigation improvements during the 16th and 17th century, then the railways in the 19th century and subsequently roads, that opened the way for more widespread transport of stone far from its source of origin. This has sadly meant that the local character of towns and villages is being lost where non-local building materials are brought in and the old sources neglected. The use of local building stone has significantly declined in the last hundred years, due mainly to the expense and the easy availability of cheaper alternative building materials.
**Jurassic**

Jurassic limestones have provided the best stone for building in Wiltshire and beyond.

**Lower Jurassic**

**Lias Group**

The rocks of the Lias Group crop out only in the valleys of west Wiltshire, but were not used for building purposes in this small area. However, outcrops of the group are more extensive south-west of the county boundary, in Gloucestershire and Somerset, and building stones from this area have been imported and used to some extent in Wiltshire

**Blue Lias Formation**

This formation consists of interbedded limestones and fissile mudstones, and occurs in the lowest part of the Lias Group. The hard, fine-grained muddy limestone beds are only up to 0.3m thick. Blue-grey when fresh, they weather rather patchily to shades of pale yellow brown. It was used extensively near its outcrop in buildings but the paving stones travelled more widely. In the 12C and 13C it was used for polished shafts as an inferior substitute for Purbeck Marble.

**Ham Hill Stone**

This is a local coarsely shelly limestone facies of the Upper Lias west of Yeovil in Somerset, capping the isolated plateau of Ham Hill and nearby hills to the south. The upper 4-15 metres are durable, high-quality freestone, composed of well-sorted shell fragments with a distinctive golden-brown colour and strong cross-bedding, often accentuated by weathering. It has been used since Roman times and can be found in buildings over a wide area, often as dressings in association with other materials.

**Middle Jurassic**

**Inferior Oolite Group**

**Doulting Stone**

Although these shelly, ooidal limestones do crop out along the river valleys of western Wiltshire, the most important building stone from this group, used in the county is Doulting Stone, still quarried east of Shepton Mallet in Somerset. It has been widely used, particularly in the 19th and 20th century, beyond the boundaries of Somerset.

The freestone beds are 8-9m thick and readily distinguished by their cross-bedding and coarsely granular texture, formed from the broken-up remains of fossil crinoids (sea lilies) cemented by spar calcite. It tends to weather grey, but is yellowish-white to creamy–brown when fresh. It was much used for ashlar and dressings.

**Great Oolite Group**

The Great Oolite Group in Wiltshire includes several limestone units that have yielded durable building stones - Chalfield Oolite, Corsham Limestone, Forest Marble and the Cornbrash formations. The Chalfield Oolite (formerly the Great Oolite Formation) and the Forest Marble formations are the most important units of the group for building stones in Wiltshire. The Cornbrash Formation is now included at the top of this group, while at the base is the Fuller’s Earth, a mainly clay-rich formation.

A typical village building in the Wiltshire Cotswolds built entirely of limestone from the Great Oolite Group.
**Chalfield Oolite Formation**

**Bath Stone**

This formation includes the nationally renowned ‘Bath Stone’. It is up to 30m thick but is only present north of Norton St Philip (Somerset). The Bath stones form part of the Cotswold Stone belt which crosses north-western Wiltshire, from Farleigh Hungerford to Malmesbury. Freestones, ragstones and tile-stones have been widely used in the Cotswold region for both buildings and dry-stone walls. The older parts of the towns and villages of northwest Wiltshire all have buildings made of these Jurassic limestones. The limestones were extensively used even in the clay vales to the east, e.g at Laycock, as transport distances were not great.

The Bath Stone ooidal and shelly limestones are virtually free of large fossils, so can be cut freely in any direction, without splitting, hence its name, ‘freestone’. They comprise three distinct geological Units: the lowest is the Combe Down Oolite; the Bath Oolite lies above, usually separated by ragstone; the highest freestone is the Ancliff Oolite, nowadays placed in the overlying Forest Marble Formation. These massive limestone beds have been utilised for building since Roman times, some two thousand years ago, when it was used extensively in Roman Bath. In the Anglo-Saxon period, usage over a surprisingly large area has been recorded (e.g. the 7C St Laurence chapel in Bradford on-Avon), continuing through the Middle Ages (Winchester Cathedral, Malmesbury Abbey, Lacock Abbey, Monkton Farleigh Priory, Great Chalfield Manor, and Longleat House).

However, the ‘Golden Age’ of Bath Stone was in the building of Bath as a fashionable resort in the 18th century. The stone was originally cut from surface quarries but, as the best quality beds are usually only a few metres thick, it soon became necessary to follow them into the hillsides. Vast underground mine workings developed. Along the route of the Kennet and Avon canal, steep tramways linked the quarries high on the Avon valley sides with the canal at Avoncliff, Murhill and Conkwell. Murhill Quarry opened in 1803 to supply stone for constructing the Kennet and Avon canal. It was not an ideal choice, as the limestone could not withstand the constant dampness from the leakage of water from the canal as witnessed by the crumbling face of the Avoncliff Aqueduct (below), now repaired. The quality of the limestones does vary greatly, differences in durability being related to the porosity, fossil content, thickness of beds and stratigraphic level in the formation. The more durable varieties are known as groundstones (e.g. forming the lower 3.6 m of the freestone at Box quarries).
The strength of Bath Stone comes from the crystalline, spar calcite cement between the grains, rather than from the ooids. The cement prevents water being absorbed into the rock by the softer, porous ooids. This cement is in part derived from carbonate leached from shell fragments mixed in with the ooids, which re-crystallised after burial. Thus, it is no coincidence that the best weatherstone in the area, Box Ground (Combe Down Oolite), contains the highest proportion of shell debris. The same level was extensively worked in the hills around Bath and is still quarried there on Combe Down. It was probably these lower beds of the formation that gave Bath Stone its reputation.

Two articles in The Builder of 1895 (Anon and quoted in Perkins et al. 1983) describes in some detail 47 working Bath Stone quarries in the Bath/Bradford-on-Avon/Corsham area. Of these, the higher and softer level of the freestone (Bath Oolite) is still worked underground at Westwood (Westwood Ground), Limpley Stoke (Stoke Ground), Hartham Park at Corsham (left), Monk’s Park and Elm Park to the south. The Bath Oolite here is up to 13 metres thick and there is enough shell debris and crystalline cement between the ooids to produce good building stone.

The Westwood mines were opened originally as a source of stone to build the railway, and it was the building of the Great Western Railway’s Box Tunnel which revealed more valuable high quality stone running in the direction of Corsham. This discovery leads to the development of the vast underground workings in this area below the Forest Marble Formation, which continue to the present day.

By 1900 there was a network of tunnels and tramways for the removal of stone totalling around 60 miles in length. Any irregularities or cracks ruin the stone for top quality building, thereby reducing its value. The stone is soft and easy to work when first quarried. It is traditionally kept underground until May because the freshly quarried stone can be damaged by frost (owing to its high water content). It is then seasoned on the surface through the summer, where it dries out naturally.

The huge demand for stone in the 19th century often resulted in unseasoned stone being used, with disastrous consequences. The stones must also be kept the right way up when building, with the bedding planes horizontal, otherwise fine layers will tend to flake off from the surface because weathering picks out any weaknesses in the bedding.
Forest Marble Formation

This formation comprises a varied sequence of limestones, sands and clays. The name derives from the ancient Forest of Wychwood in Oxfordshire where a harder limestone that could be polished was formerly quarried.

The freestone from the Bradford-on-Avon area, the Ancliff Oolite, occurs locally here in the lower part of the Forest Marble. It is distinctive, being characterised by strongly developed cross-bedding, with layers of well sorted shell fragments, which are picked out by weathering. It was widely used from the 18th to the 20th century in Bradford and Trowbridge but is no longer worked. Hall’s Almshouses in Bradford-on-Avon (above) are constructed of Ancliff Oolite.

Ragstone

In the Forest Marble Formation generally, the bedding is more irregular and there are clays separating the limestones. The limestones, known as ‘ragstone’ are typically yellow-brown with a blue ‘heart’. They are made up of broken shell debris and are less thickly bedded than the ooidal limestones: cross-bedding is typical and the matrix is crystalline calcite, making them a good weatherstone but they are too intractable to be used for dressings.

They have been extensively used for cottages, farm buildings and as a walling stone. Thinly bedded, fissile, shelly limestones, provided the stone roof slates, typical of the older Cotswold buildings (below), as well as cobbles and larger paving slabs. Small pits in fields around Bradford-on-Avon, Atworth, Gastard and Malmesbury were excavated for this purpose.
**Cornbrash Formation**

This is the uppermost formation of the Great Oolite Group. It weathers to a rich brown colour and is a shelly ragstone used mainly for walling along the outcrop.

**Ancholme Group**

**Kellaways Formation**

**Kellaways Rock**

This is the lowest unit found in the Avon and Thames valleys, which separate the Wiltshire Cotswold region from the Chalk downlands. It does contain a local building stone horizon at the top, known as the Kellaways Rock (which crops out northeast of Chippenham, around the village of Kellaways). Here the hard calcareous sandstone up to 4 metres in thickness has been used to build Maud Heath’s Causeway, a 15th-century footbridge over the floodplain (below).

**Upper Jurassic**

**Corallian Group**

This group includes many different rock types used locally for building: sandstones, sandy and shelly limestones, often with peloids or ooids, and coral fragments. They are generally not very regularly bedded, but do provide durable building stones.

**Calne Stone**

The white Calne Stone is a cross-bedded peloidal limestone with small shell fragments. It was quarried around Lyneham and Calne.

Freestones are exceptional in this group however and the Corallian limestone areas typically show a variety of hardstone blocks and rubblestone in the buildings. The wide variety of textures and tones of cream, grey and brown impart a particular charm to the villages and towns along its outcrop with Highworth and Wootton Bassett. Dressings are often of local brick or freestone, as can be seen at Highworth (above). The Coral Rag Formation is a fine-grained coralline rubbly limestone, formed around the reefs as detrital build-ups, which can make good quality, durable, building stone.
Portland Group

Chilmark Stone/Tisbury Stone
In Wiltshire, beds of the Portland Group outcrop beneath the Cretaceous rocks in the Vale of Wardour and at Swindon. The succession contains both sandstones and limestones. In the Vale of Wardour, the upper part of the group, known as the Portland Stone Formation has been quarried extensively for building during and since Medieval times. It is generally known as Chilmark Stone though the main outcrop is around Tisbury, where it is known as Tisbury Stone. The beds vary from highly calcareous, greenish-grey sandstone to pale cream sandy limestone, all with a variable speckling of glauconite grains (a dark green iron silicate mineral). The beds are up to 20 metres thick and still worked for building stone at Chicksgrove Quarry nearby and in a small valley south east of Chilmark.

Here a stratigraphically higher ooidal freestone has been exploited in the past, it is over 5 metres thick, with less sand and no glauconite. These stones together give a distinctive character to the local villages.

In Victorian times the architect Giles Gilbert Scott specified these stones for cathedral and church restorations across south east England. The stones were also used extensively in Salisbury Cathedral (Tatton-Brown 1998). These freestones are quite different in character to the white ooidal Portland Stone of the same geological age quarried on the Isle of Portland. The hill at Old Swindon contains several old quarries, from which much of the hard calcareous sandstone (Swindon Stone) used to build the Old Town, was worked (with dressings of Bath Stone).
Jurassic - Cretaceous

Purbeck Group

In Wiltshire, the Purbeck beds contain white, fine-grained limestones, also used for building locally. Some beds were sufficiently fissile for roofing. Limestones of this age have been utilised only in the Vale of Wardour and at Swindon. Elsewhere, they are absent, subsequently removed by erosion in early Cretaceous times.

Cretaceous

Lower Greensand Group

The Lower Greensand has only locally been used as a building stone, where natural cementation by iron oxide has rendered it sufficiently durable. The area around Sandy Lane (south-west of Calne) had quarries which provided the dark orange-brown sandstone for the cottages in the village (top right).

Selborne Group

Upper Greensand Formation

The Upper Greensand is recognisable by the abundance of small dark green grains of glauconite (ferroan silicate) in the sandstone that give it a distinctive greenish grey colour. There is commonly a scattering of shells and fossil burrows throughout its fabric.

Hurdcott Stone

This stone is still quarried near Barford St Martin, 6 miles east of Tisbury, where it is used particularly for restoration work. The Upper Greensand is generally only hard enough for building purposes in the south of the county, where it is cemented by calcite and silica. It has been widely used for building in Mere and around Shaftesbury. Norman churches in south Wiltshire contain Upper Greensand. The upper part of the formation contains nodular chert beds which have been used locally for building e.g. at Stourhead. Farther north, buildings of Upper Greensand are not common, with the exception of the Potterne Rock, a fine-grained calcareous sandstone used locally at Potterne and in the Vale of Pewsey. The stone was found to make a good damp course, transmitting less moisture from the ground than brick; so it was commonly used for house foundations and is often seen in the plinths of brick and timber buildings.
This group has the most extensive outcrop in the county, so of necessity it was, in former times, pressed into service, though it is not generally considered a satisfactory building stone. It is normally too soft and even the hard nodular ‘rock’ bands (such as the Melbourn Rock and the Chalk Rock) have variable weathering properties, though these have both been used in the past in buildings. This stone is known as “clunch”. It was usually necessary to have quoins of a harder stone or of brick, while around windows and doors wooden beams, limestone or brick dressings provided extra support. Chalk can be porous and weather badly and it was essential to have “good shoes and a hat” to keep a wall dry, reducing absorption of water and thus preventing flaking on freezing in the winter. A foundation of less porous material (brick or stone) is therefore required, with a protective cover of brick, tile or thatch (left). Chalk is found occasionally in walls, as rubbly infill panels in old cottages, and on the internal walls of some churches e.g. at Aldbourne.

In Chalk regions, chalk has traditionally been ground up and mixed with water into a slurry with clay, chopped straw, horsehair or other binders like manure to make “cob”. This is a durable, if not water-resistant, building material. Cob walls were built up layer upon layer, each layer being left to dry before the next was added. The resultant broad walls can be identified by their rounded outlines; corners were avoided. Sometimes, a chalk, mud and water slurry was poured between shuttering to make pugged walls. Wattle and daub involves daubing such a chalky mixture onto a framework of wood. Plaster is applied on top to make it waterproof. Cob and pug, like wattle and daub, needed covering to protect them from the rain. Hence the quaint tiling or thatching which forms an attractive feature of some village walls in the Chalk country. Stone or brick foundations were again necessary to avoid damp rising from below.
Flints

Flints are particularly common as siliceous nodules or bands in the Upper Chalk and are virtually indestructible. They are resistant to weathering and can thus be used in walls as a protective outer layer. Flints can be used in their original nodular form, to give a wall a rough appearance, or can be split or “knapped” to give a smoother, glassy surface on the outward-facing side. In skilful hands, the flints can be knapped into rectangular blocks with a flat face, which can be laid in courses like bricks to produce a neat wall. However the shiny impervious surfaces of fully knapped flints don’t bond as well with mortar as those flints with their porous white outer layer still intact. Stone or brick courses were often incorporated in a flint wall to give it extra strength. Limestone was used for carved window dressings, doorways, quoins and buttresses. Decorative effects have been achieved by alternating flint with bricks or stone. This can be seen throughout eastern and southern Wiltshire, where a chequered pattern of flint and stone, characteristic of the Chalk country, has been produced; dressings are brick or limestone. This use of flint with limestone characterises the majority of church buildings in the chalk downlands.

Tertiary

In the east and south east borders of the county, preserved above the Chalk, are sands and clays of the Lambeth, Thames and Bracklesham groups, laid down in the succeeding Tertiary period. Most of these beds are unconsolidated, with the exception of ferruginous sandstones in the Bracklesham Groups and the well known Sarsen siliceous sandstones.
Eocene
Bracklesham Group

Locally the coarse, pebbly sands in the Bracklesham Group of south-east Wiltshire have been cemented by iron oxides to produce a red pebbly sandstone. This ferruginous sandstone can be seen in the older buildings around Downton.

Sarsens
Sarsen stones, found today scattered over the Marlborough Downs, have been used for building locally since Prehistoric times, when they were used for the standing stone circles of Avebury and Stonehenge. They were probably once more widespread in their distribution, but over the years they have been cut up and incorporated into buildings and walls. Romano-British foundations often contain them; and they have been used as tramway setts and curbstones.

Their pervasive silica cementation means that they have an unfortunate habit of “sweating” in damp weather, by condensing atmospheric water vapour onto their surface when there are rapid temperature changes. Medieval builders split them by lighting a fire to heat them, then rapidly cooling them by pouring on cold water.

Imported Stones Used in Wiltshire

Purbeck Marble
This hard, fossiliferous limestone is of Lower Cretaceous age, the most famous of the Purbeck stones and comes from Dorset’s, Isle of Purbeck. It is a hard, dark limestone composed largely of the shells of small fresh water snails, which can take a polish. It was used extensively for columns, paving and monuments all over the country. In Salisbury Cathedral it is used extensively for columns, the dark bluish-grey contrasting with the pale Chilmark Stone used elsewhere in the building.
**Glossary**

**Ashlar**: Cut stone, worked to even faces and right angled edges. Used on the front of a building and laid in horizontal courses with vertical joints.

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

**Calcite**: A mineral made of calcium, carbon and oxygen — $\text{CaCO}_3$; the principal carbonate component of limestone, Chalk and marble.

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

**Cobbles**: Rounded rock clasts (of any lithology) between 64 mm and 256 mm in size.

**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.

**Detrital**: Descriptive of a particle, generally of a resistant mineral, derived from an existing rock by weathering and/or erosion.

**Dressings**: To say a building is constructed of brick with stone dressings means that worked stone frames the corners and openings of the structure.

**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.

**Ferruginous**: Containing iron minerals usually in the form of an iron oxide which gives the rock a ‘rusty’ stain.

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

**Glaucgonite**: A clay mineral found as an authigenic mineral in sedimentary 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.

**Limestone**: A sedimentary rock consisting mainly of calcium carbonate ($\text{CaCO}_3$) grains such as ooids, shell and coral fragments and lime mud. Often highly fossiliferous.

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

**Nodular**: An irregular, spherical to ellipsoidal, flattened to cylindrical body, commonly composed of calcite, siderite, pyrite, gypsum and chert, common in soils and evaporate deposits.

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

**Oolite**: A limestone composed principally (>50%) of ooids and known as an oolite.

**Peloid**: A sand-size grain of carbonate mud.

**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.

**Ragstone**: Coarsely shelly limestone.

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

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

**Silica**: The resistant mineral quartz (silicon dioxide) $\text{SiO}_2$ an essential framework constituent of many sandstones and igneous rocks, but it also occurs as a natural cement in both sandstones and limestones.

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

**Stratigraphic**: 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.
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Further Reading


