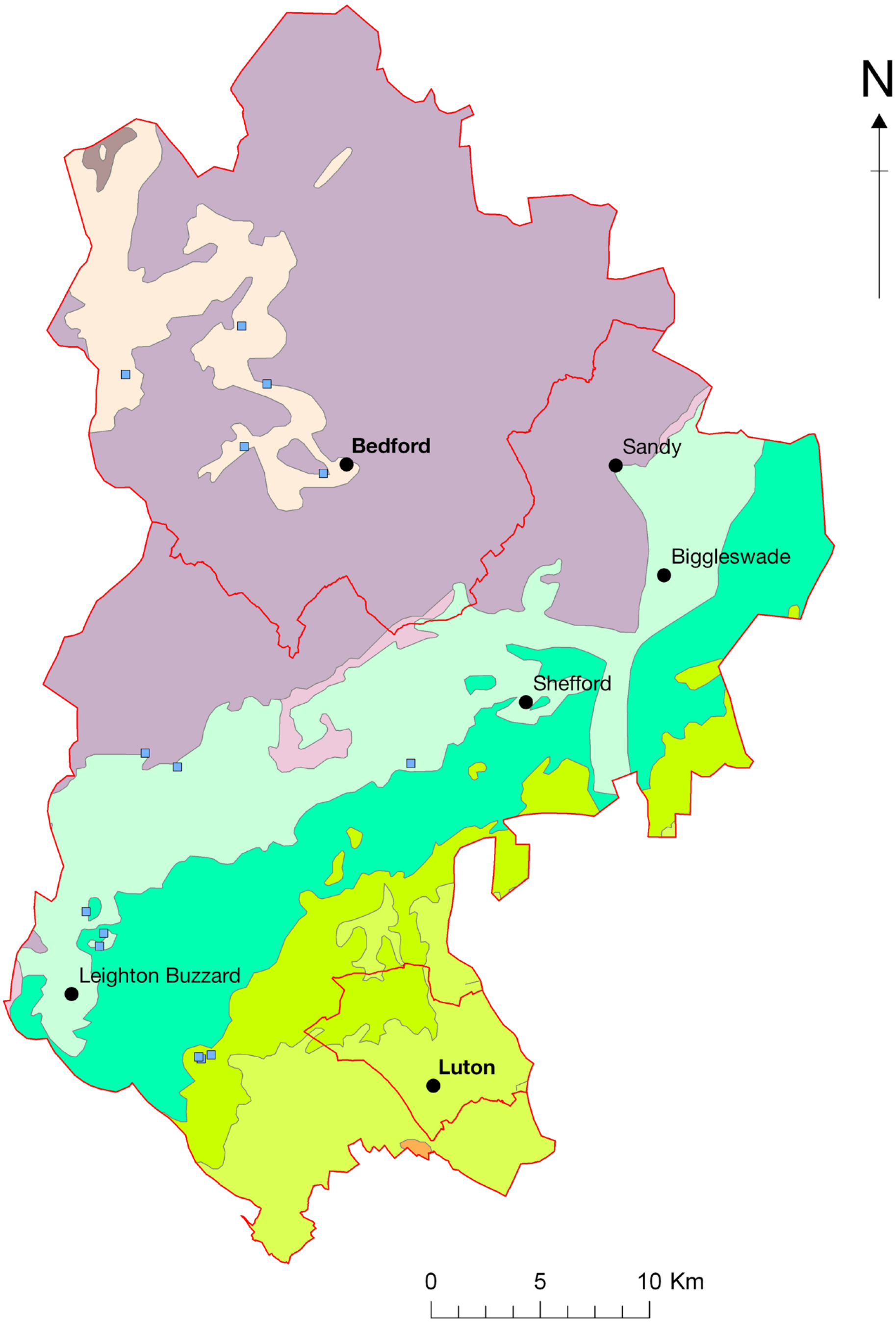
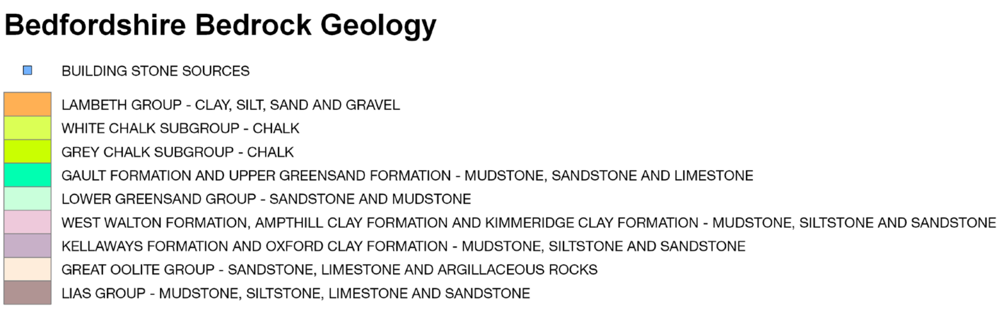
STRATEGIC STONE STUDY

A Building Stone Atlas of BEDFORDSHIRE

ENGLISH HERITAGE

Bedfordshire Bedrock Geology





Click on this link to visit Bedfordshire's geology and their contribution to known building stones, stone structures and building stone quarries (Opens in new window http://maps.bgs.ac.uk/buildingstone?County=Bedfordshire)

Introduction

The following narrative describes the building stones of Bedfordshire, underpinned by data that has been gathered for the county from a variety of sources. Chief amongst these are geological, architectural and historical surveys conducted by national and local experts. Significantly, this data has been checked and amplified through site visits wherever possible. The characteristics of each building stone are described, along with illustrated examples of how and where they have been used. Whilst essentially retrospective, the account concludes with a summary of the current stone resource in the county.

The county of Bedfordshire is underlain by relatively soft **SEDIMENTARY** rocks that were deposited during the Jurassic and Cretaceous periods. They consist of a series of **LIMESTONES** and **SANDSTONES** separated by thick sequences of **CLAYS,** and whilst the clays have historically been used for brick making, it is the limestones and sandstones that are locally important as building stones. Bedfordshire is certainly not as well endowed with building stones as nearby Oxfordshire and Northamptonshire (Davey, 1976), but churches and vernacular buildings reflect the nature of these rather scarce resources and provide architectural distinctiveness across the county.

A glance at the geological map on page 1 shows that the oldest rocks occur in the northwest where the River Great Ouse has cut through the overlying strata to reveal a thin series of Middle Jurassic limestones and **MUDSTONES**. Of these, only the Great **OOLITE** forms a good building stone and it has been used extensively in the local villages. A large number of pits and small quarries were developed to extract this stone and the river was then used to transport it.

One of Bedfordshire's most distinctive landforms is the 'Greensand Ridge' which straddles the central part of the county in a narrow tract from Leighton Buzzard to Sandy. This steep, north-facing escarpment rises above the Vale of Bedford and is formed by relatively resistant sandstones of Lower Cretaceous age.

These rocks are known as the Lower Greensand and they are particularly important as a source of unconsolidated **SILICA** sand for the glass-making and construction industries. However, some of the sandstones are more tightly **CEMENTED**, enabling them to be used as a walling stone, primarily in churches throughout mid-Bedfordshire.

Another clay vale separates the Greensand Ridge from the Upper Cretaceous Chalk hills that characterise the southern part of the county around Dunstable and Luton. Again, the fact that the **CHALK** forms a steep escarpment and is part of the Chiltern Hills indicates that it is relatively resistant, but there are only two or three horizons within it that are sufficiently indurated to be used as building stone. By far the most important of these is the Totternhoe Stone, which is only a few metres thick, but has been quarried and mined extensively since Roman times (Curran, 2005). It has been widely used as **FREESTONE** in churches and grand houses throughout the county and it is still extracted on a small scale for restoration work. **COBBLES** and **FLINT** are used commonly as uncoursed **RANDOM RUBBLE** set in mortar for walling or for decorative purposes.

In the north-eastern corner of the county, far removed from the outcrops of limestone, it is clear that only the local Lower Greensand and the plentiful supply of cobbles and flints in the overlying superficial deposits were available for building ancient churches. Cobbles are variable in size and rounded, having been eroded and transported by glaciers and rivers during the last half million years. Flints originate from the Chalk and they are highly resistant, but rather small and irregular in shape.

MIDDLE JURASSIC
Great Oolite Group

In Bedfordshire the Great Oolite succession is only about 20 metres thick. It underlies the entire county but is generally obscured by younger rocks, except in the deeply incised valleys of the River Great Ouse northwest of Bedford. The succession is dominated by **MICRITIC** shell-fragmental limestones with occasional **OOIDS** and **PELLETS**. The ooids are made from tiny spheres or egg-shaped bodies of calcium carbonate up to two millimetres in size. They were formed as chemical precipitates around a tiny nucleus, their concentric layered structure produced by constant agitation from currents in a warm, shallow sea about 165 million years ago.

The shifting currents also produced inclined, cross-cutting surfaces (**CROSS-BEDDING**) within the limestone. Further variety is created by the presence of marine fossils, typically fragments of brachiopods, bivalves and echinoids, which are commonly scattered throughout the rock or occasionally concentrated into distinctive shell bands. The Great Oolite limestones are pale grey on fresh surfaces, but weather to characteristic shades of yellow, although these are commonly obscured by a dark grey superficial staining caused by atmospheric pollution. The top right image shows a Great Oolite rock face near Pavenham with a pale grey, unweathered 'heart' and the more typical pale yellow tint.

They form hard and durable building stones and the thicker-bedded intervals have a uniform grain size that makes them suitable as freestones. The presence of cross-bedding often characterises the appearance of the stone, particularly when it is used as sawn blocks. Typical uses include **COURSED RUBBLE** and plain **ASHLAR** walling, **QUOINS**, **MOULDINGS** and carvings. Several villages in northwest Bedfordshire are dominated by buildings made from the Great Oolite limestones, the best examples being Harrold, Felmersham, Pavenham, Sharnbrook and Turvey.

The bottom image shows the stone lock-up on the green at Harrold, built in the 1820s. Many of the buildings in this village use local limestone from the Great Oolite Group succession which was extensively quarried in the valley of the River Great Ouse.

In addition, several important buildings in Bedford have used this stone, including parts of the C11 church of St Mary's where parish records confirm that it was quarried in Pavenham. The image below shows the use of random rubble walling arranged in a crude herringbone pattern in St Mary's Church, Bedford. Some of the blocks are re-used mouldings derived from an earlier building, whilst the remainder are varied shelly and ooidal limestones from the Great Oolite Group succession.

It is important to note that much of the ooidal limestone that is used to such good effect in north Bedfordshire may not have been quarried locally, but transported in from nearby counties. For example, the Ancaster Stone used in Bedford town hall and the Weldon Stone of Willington church originate from the Inferior Oolite Group of Lincolnshire and Northamptonshire respectively. Whilst these stones are distinguished by local names they are typical Middle Jurassic limestones and are broadly similar in character to those that occur in Bedfordshire (Barron, et al 2006).

Much of the stone seen in Turvey is thought to be from a large quarry formerly located about one kilometre north of the village. Hereabouts the Great Oolite Group succession is highly variable and includes ooidal horizons, coarse shelly beds and fine-grained, cross-bedded, shell fragmental limestones. Examples of each can be seen in the local buildings, usually in the form of rubble walling, although the better-quality stone is rough dressed and laid in courses or used for quoins.

LOWER CRETACEOUS
Lower Greensand Group

The Lower Greensand sequence in Bedfordshire is now referred to as the Woburn Sands Formation by geologists (e.g. Shephard-Thorn, et al 1994; Moorlock, et al 2003), but the original term prevails in older literature and is still widely used. The sequence is up to 120 metres thick and is absent throughout the northern half of the county. Most of the sandstones within the formation consist of loose, unconsolidated grains of **QUARTZ** that are not suitable as building stone. However, several horizons towards the top of the sequence have cements that bind the quartz grains tightly together, producing irregular beds of resistant rock. A good example is seen at the Scout Hut Quarry in Potton (top right image) where several hard bands are developed, but here they are too thin and impersistent to form a good building stone.

The cement is usually formed by iron oxide compounds, although sometimes quartz occurs. These rocks are characteristically cross-bedded, having formed in a shallow estuarine environment where tidal activity moved the unconsolidated sediment across the seabed. The original bedding is also much disturbed by the burrows of various animals, typically worms and crustaceans, that sought refuge in the sandy sediments. Ironstone nodules, pebbly horizons and clasts of mudstone also occur within this highly variable rock.

Despite its name, the Lower Greensand is not typically green, but brown. Occasional tinges of green are produced by an iron-rich mineral called glauconite, but normally the rock has weathered to produce an attractive range of rich, ochreous brown colours as the iron compounds within it oxidise The extent to which the Lower Greensand forms a useful building stone depends principally on the composition and extent of the cements. A spectrum exists from rather friable 'carstones' that are suitable only for rough rubble walling, to highly durable stones which can be dressed for coursed work or used for quoins. The image middle right shows the thick beds of Lower Greensand in Lodge Quarry at Sandy Warren. This stone was used for building local churches, for example, St Swithun's Church at Sandy, which can be seen in the bottom right image, the church at Everton, and bridges (e.g. Sutton) from medieval times until the C18.


© Martin Whiteley


© Martin Whiteley


© Martin Whiteley

The top left image shows an unusual example of Lower Greensand being used in the construction of a boundary wall at Village Farm in Sutton where small, elongated blocks have been laid in a distinct sweeping diagonal pattern. In contrast, the image top right shows a wall near Tilsworth church, made of highly irregular blocks and slabs set generously in mortar and supported by a buttress, capped with large, heavy, undressed boulders

Many churches along the Greensand Ridge are built almost exclusively of this stone (Notcutt & Eccles, 1987). Typically they are adorned with pale yellow ooidal limestone quoins, **STRING COURSES** and **TRACERY**, as seen at Ampthill and Houghton Conquest, which provide a strong visual contrast and delicacy to the architecture. Maulden church (bottom image) is typical of many on the Greensand Ridge that use this attractive stone in both coursed and uncoursed random rubble walling, in tandem with paler ooidal limestone dressings. Here the quality of the Lower Greensand is excellent and it has even been used for the protective **HOOD MOULDINGS** on the buttresses. The softer sandstone blocks, particularly in exposed western and northern elevations, usually show signs of selective weathering caused by the elements and the activities of masonry bees.

One particularly spectacular example of Lower Greensand that does live up to its name is seen in the church walls at Husborne Crawley (top right image). Nowhere else in the county is the stone so obviously green, or so hard and notice how it differs from the characteristically rusty-brown blocks of Lower Greensand that have an iron-rich cement. A detailed study of this particular stone is being undertaken, but it is probably not 'Upper Greensand' as reported in the current county guide. The church is located on a pronounced ridge of Lower Greensand, suggesting that the bedrock here is resistant, so it is tempting to speculate that the late medieval church builders simply excavated part of the hillside to win the stone. Historical evidence for 'boulders or blocks of green-coloured sandstone' being found in a sand pit just beyond the churchyard further supports the notion that this is a local stone.

A number of vernacular buildings around Leighton Buzzard use the Lower Greensand to good effect. This area has been extensively worked for both building stone and loose sand, often from the same quarry. Wellington House and Heath Park House are substantial dwellings that were built in the 1860s, combining sandstone coursework with limestone dressings. Close by, Pages Almshouses stand in the disused quarry that was opened specifically to provide stone for them and a neighbouring church, although the church is now demolished.

Wilkes Almshouses, (bottom right image) in the centre of Leighton Buzzard are made of good quality, even-textured **FERRUGINOUS** sandstone that has been dressed and laid in courses. Neatly coursed random rubble walls of Lower Greensand, with a straight coped gable and pale orange string courses, provide attractive ornamentation, quite apart from the brick mullions with the leaded lights and the yellow brick door surrounds.

© Martin Whiteley

© Martin Whiteley

UPPER CRETACEOUS

Chalk Group

Totternhoe Stone

Described by some as 'England's best-known chalk', the Totternhoe Stone forms a thin horizon some 20-30 metres above the base of the Upper Cretaceous chalk succession. Unlike most chalks, which are composed of microscopically small skeletal remains of calcareous algae (called coccoliths), the Totternhoe Stone is a coarser-grained, gritty chalk made of fine shell debris and **PHOSPHATIC** pebbles. It is also hard, having formed at a time when **SEDIMENTATION** ceased and the seabed was able to consolidate and become encrusted with burrowing organisms. In general terms, chalk deposition commenced widely across Britain about 95 million years ago and some of the hard bands within it, such as the Totternhoe Stone, Melbourn Rock and Chalk Rock, can be recognised beyond the county. Where they have been used as a building stone they are often called 'clunch', a generic term that enjoys widespread usage.

Despite being generally less than three metres thick, the Totternhoe Stone beds sometimes produce a subtle topographical feature on the long concave slope at the base of the chalk escarpment. It thickens locally in the Totternhoe area to about five metres, but even here the surface outcrop is so small that much of the stone was mined in a series of **ADITS** sunk deep into the escarpment. Totternhoe Stone is greyish white to greyish brown in colour and it hardens on exposure to the air. Soon after the stone is quarried, when it is still saturated with water, it can be easily sawn, moulded or carved. Only after drying out for about a year does it become sufficiently hard to be incorporated into a building.
It is susceptible to water ingress, frost action and salt crystallization, and is best protected by more resistant hood mouldings or limewash shelter coatings when used externally (Little, 2001). For these reasons Totternhoe Stone has a limited life in external locations, as evidenced by the large amount of restoration work required on buildings more than a two or three centuries old. Its freestone qualities are best displayed in fine carvings and intricate mouldings, many of which date from the C12, but are still well preserved in interior settings where they have been subjected to only small changes in humidity and temperature.

Totternhoe Stone is commonly used in churches in south Bedfordshire, including Dunstable, Kensworth and Toddington, although it is much more widespread in neighbouring south Buckinghamshire and Hertfordshire (West, 1951; Roberts, 1974). An example of its use is seen in the C13 church at Eaton Bray. Here, the internal north arcade consists of an elaborate series of fluted pillars with ornate carved capitals that support richly moulded arches (image below), whilst the external ashlar is constantly being repaired or replaced (bottom image). Despite the fact that Eaton Bray church is little more than a kilometre from the quarry at Totternhoe that produces small quantities of restoration stone, conservation work cost almost £100,000 in 2003.

© Martin Whiteley

© Martin Whiteley

Woburn Abbey is perhaps the best known secular building employing Totternhoe Stone. The Abbey and outbuildings were largely rebuilt and extended in 1747, the walls are faced with ashlar in the Classical style of architecture. Progressive disfigurement by blistering, splitting and **SPALLING** has necessitated cutting back the decayed face of individual blocks and finishing them with a shelter coat of limewash (Little, 2001).

Other fine buildings that incorporate this stone include Priory House in Dunstable, the Swan Hotel (bottom image) and Wing House (top right image) in Bedford, and Southill Park. These examples of Georgian architecture are testimony to the enduring popularity of this unusual building stone, although the degree to which it has been subjected to conservation and replacement confirms its poor durability when used externally.


© Martin Whiteley

© Martin Whiteley

PLEISTOCENE

Cobbles

Superficial unconsolidated deposits occur widely across Bedfordshire, obscuring the bedrock beneath and often forming low hills on the otherwise flat clay vales. These deposits contain a wide variety of reworked rock types that were transported into the area, initially by an ice sheet that extended over most of Britain about 450,000 years ago. During subsequent warm and cold climatic phases, the rocks were reworked and overlain by river gravels, forming deposits several tens of metres thick.

Cobbles are typically fist-sized, smooth and rounded because they have been worn down by ice and water. Most of them are made from highly resistant rocks such as flint or quartzite and they are commonly stained reddish-brown or black by iron and manganese oxides (Hopson, et al 1996). They are easily collected and are usually set in mortar for rubble walls or used for decorative panels or infill. The church at Higham Gobion makes use of such 'erratic' cobbles and boulders that originated in the Midlands, as well as locally derived flints (Notcutt & Eccles., 1987). The image top right shows an uncoursed random rubble wall set in mortar overlying large, rusty-brown, tool-faced blocks of coursed Lower Greensand at Toddington church. The rubble comprises a variety of quartzite cobbles, lumps of chalk, ironstone and the occasional red tile. Cobbles have also been used, almost exclusively, as a building material at Little Barford church (middle right image).


© Martin Whiteley


© Martin Whiteley

Flints

Flints form as nodules or irregular-shaped masses, often in distinct layers, within the upper part of the Chalk Group succession. They are formed of pure silica (silicon dioxide), better known as quartz, and are exceedingly hard and resistant. Such concentrations of silica were probably derived from the skeletal remnants of **SILICEOUS** sponges and other micro-fossils that colonised on the chalky seabed. Flints have a thick outer layer which is porous and pale in colour, whereas the inside is smooth and glassy and typically darker in shades of brown, grey and black. These features are evident in the bottom right image where broken flints are laid in a strong mortar at Houghton Regis church.


© Martin Whiteley

Their small size and hardness preclude them being worked like traditional building stones and normally they are simply embedded in mortar to form thick uncoursed random rubble walls. Alternatively, flint can be split or 'knapped' to reveal its glassy interior or, in skilful hands, worked into rectangular blocks for laying in courses.

Several churches in south Bedfordshire combine flints and Totternhoe Stone in a chequer-board pattern, both for ornamental effect and to retard weathering (West, 1951). Good examples are seen at St. Mary's, Luton and Houghton Regis (below image). At the latter, the effects of differential weathering are obvious and much of the Totternhoe Stone has been replaced with a more resistant limestone or sandstone from outside the county.


© Martin Whiteley

Stone Resources in Bedfordshire

At present there is only one working stone quarry – Totternhoe – in the county, which provides small quantities of stone for restoration. Because the Totternhoe Stone is thin and dips beneath the Chiltern escarpment it has traditionally been extracted by adit mining. When the Totternhoe quarries enjoyed their last peak period of prosperity, in the mid-C18, some of the adits were 200 metres long (Curran, 2005).

In contrast to the Totternhoe Stone, the Lower Greensand sandstone resource is volumetrically significant and relatively accessible. However, it can be difficult to predict where the cemented (and hence durable) horizons that constitute the best building stone occur within the succession. Historically, large quarries have been opened in the Greensand escarpment and it is possible to envisage working 'sweet spots' of good quality stone in the future.

The Great Oolite Group succession perhaps offers the greatest potential for a modest revival of the stone industry in Bedfordshire. The existing limestone villages and other structures (below image shows the Great Oolite bridge at Felmersham) are constantly in need of stone for conservation, quite apart from that required for the small number of new stone buildings erected in these conservation areas. At present this demand is met by Weston Underwood quarry in neighbouring Buckinghamshire, but development options are currently being considered for a disused quarry in Pavenham (Central Bedfordshire County Council, 2006). Several other sites along the Ouse valley offer similar resources and the scale of any potential working need not be intrusive.

For these reasons there is some hope that our built heritage, that so faithfully represents the geology of the county, can at least be maintained with local stone in the future.

Glossary

Adit: A horizontal passage into a mine.

Ashlar: Stone masonry comprising blocks with carefully worked beds and joints, finely jointed (generally under 6 mm) 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.

Brachiopod: An invertebrate sea animal with a hinged shell.

Bivalve: A mollusc with two moveable valves (shells).

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

Chalk: A very fine-grained white limestone composed principally of microscopic skeletal remnants known as coccoliths.

Clay: Sediment of very fine-grained particles less than 2 microns in size (in reality pure clays are rare, most fine-grained sediments are muds (mudstones) which are a mixture of clay and coarser silt-grade particles).

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.

Echinoid: Globular marine invertebrates composed of calcareous plates coated with surface spines, commonly known as sea urchins.

Flint (or Chert): Hard, resistant beds or nodules composed of cryptocrystalline silica. The use of the term flint is restricted to nodules and beds that occurr only in Chalk (Upper Cretaceous) rocks.

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.

Hood mouldings: A projecting moulding on the face of a wall above an arch, usually following the form of the arch.

Limestone: A sedimentary rock consisting mainly of calcium carbonate ($CaCO_3$) grains such as ooids, shell and coral fragments and lime mud. Often highly fossiliferous.

Micritic: Limestone consisting of microcrystalline calcite mud or a very finely crystalline carbonate cement.

Mouldings: Anything with a contour or section, either projecting or inset, to give emphasis, usually to horizontal and vertical lines, casts shadows and defines areas.

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.

Oolite: A limestone composed principally (>50%) of ooids.

Pellets: Minute rounded clay or micritic carbonate lumps, generally of faecal origin.

Phosphatic: Containing phosphate minerals, either dispersed as cements or in the form of nodules.

Quartz: The crystalline form of silica (silicon dioxide, SiO_2).

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

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).

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

Sedimentation: Process whereby loose and weathered material is transported (by water, wind, ice, volcanic eruption, etc.) and then deposited as layers of sediment.

Silica: The resistant mineral quartz (silicon dioxide SiO_2) is 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).

Spalling: Deterioration in the form of detaching flakes, scales or lens-shaped fragments from a generally sound surface.

String courses: A horizontal band or line of mouldings on a building.

Tracery: An architectural term used primarily to describe the stonework elements that support the glass in a Gothic window. The term probably derives from the 'tracing floors' on which the complex patterns of late Gothic windows were laid out.

Acknowledgements

This study, written by Martin Whiteley, is part of the Bedfordshire Geology Group's contribution to the Strategic Stone Study, sponsored by English Heritage.

Edited by Graham Lott, British Geological Survey

Designed by Tarnia McAlester, English Heritage

We are grateful for advice from the following:

Don Cameron, British Geological Survey

Graham Lott, British Geological Survey

Further Reading

Barron, A.J.M., et al. (2006) Geology of the Wellingborough district – a brief explanation of the geological map Sheet 186 Wellingborough (England and Wales). B&B Press Ltd, Rotherham.

Brenchley, P.J. & Rawson, P.F. (eds) (2006) The Geology of England and Wales (2nd Edition). The Geological Society of London.

Curl, J.S (2003) Encyclopaedia of Architectural Terms. Donhead.

Curran, J. (2005) The Story of Totternhoe Quarries. Church End Publishing, Dunstable.

Davey, N. (1976) Building stones of England and Wales. Bedford Square Press, London.

Hopson, J.M., et al. (1996) Geology of the country around Hitchin – Memoir of the British Geological Survey, Sheet 221 (England and Wales). HMSO, London

Moorlock, B.S.P. et al. (2003) Geology of the Biggleswade district – a brief explanation of the geological map Sheet 204 Biggleswade (England and Wales). B&B Press Ltd, Rotherham.

Notcutt, G. & Eccles, C. (1987) The geology of Bedfordshire churches. Bedfordshire Magazine, 20, 341-347.

Pevsner, N. (1968) The Buildings of England: Bedfordshire and the County of Huntingdon and Peterborough. Reprinted by Yale University Press (2002).

Roberts, E. (1974) Totternhoe Stone and Flint in Hertfordshire churches. Medieval Archaeology, 18, 66-89.

Shephard-Thorn, E.R. et al. (1994) Geology of the country around Leighton Buzzard. Memoir of the British Geological Survey, Sheet 220 (England and Wales). HMSO, London.

Toghill, P (2010) The Geology of Britain - An Introduction. Airlife.

West, B.B. (1951) The use of stone in Bedfordshire architecture. Bedfordshire Magazine, 2, 305-312.

Unpublished Sources

The Building Stones of Bedfordshire. Available online at www.bedfordshiregeologygroup.org.uk

Look at the building stones of Bedford – a town trail. Booklet produced by the Bedford Retirement Education Centre (1991).

The use and conservation of Totternhoe Stone. Dissertation for the RICS Postgraduate Diploma in Building Conservation by S.J. Little (2001).

A walk-round guide to the parish Church of Saint Mary the Virgin, Eaton Bray. Pamphlet available in the church.

Bedfordshire and Luton Minerals Development Plan Documents. Issues and Options Paper, Part II (2006). Available online at www.centralbedfordshire.gov.uk

BEDFORDSHIRE GEOLOGY GROUP
bringing landscape to life

Communities and Local Government

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

ENGLISH HERITAGE