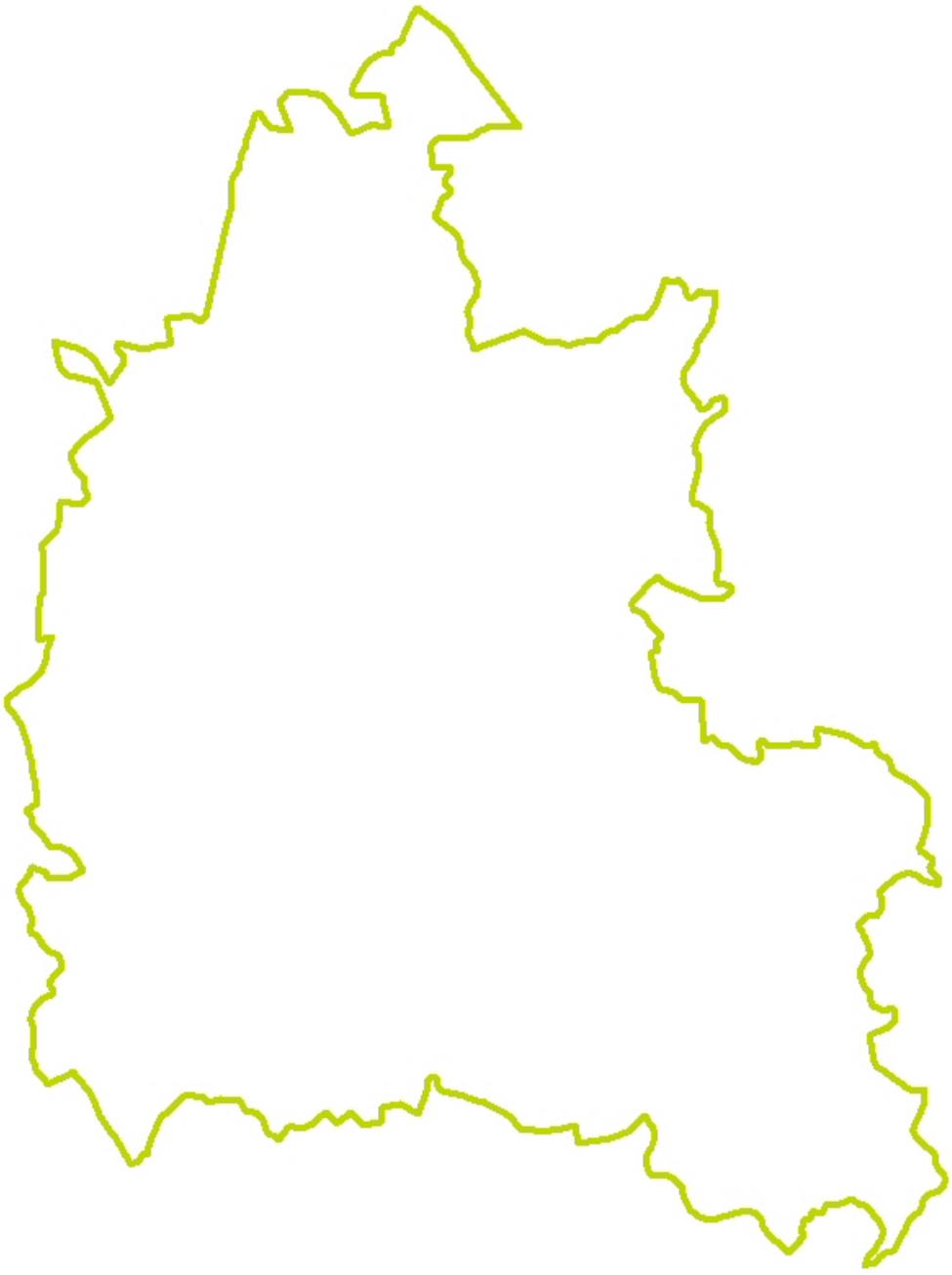
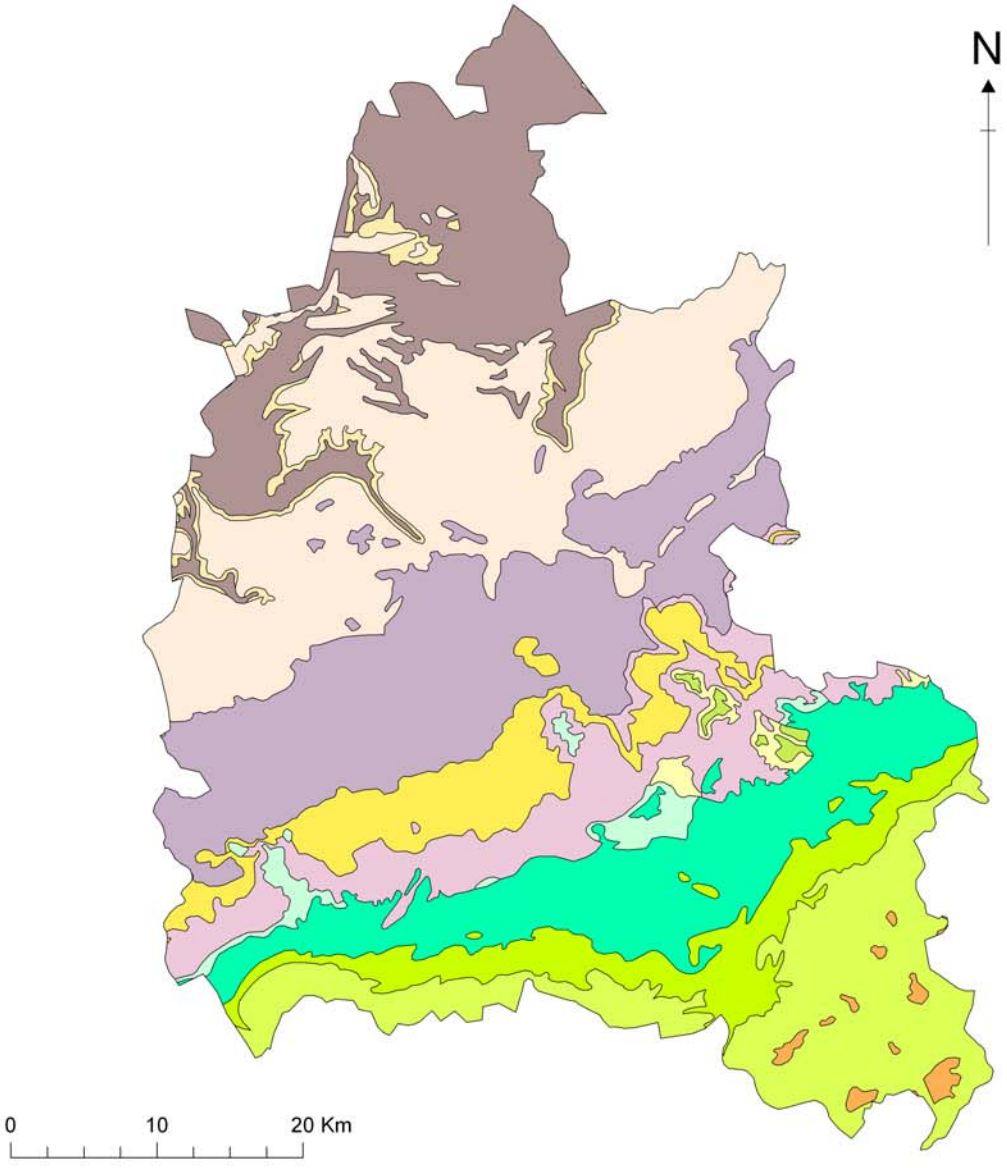
STRATEGIC STONE STUDY



Building Stone Atlas of OXFORDSHIRE

ENGLISH HERITAGE

OXFORDSHIRE BEDROCK GEOLOGY



Oxfordshire Bedrock Geology

Bedrock Geology

- LIAS GROUP - MUDSTONE, SILTSTONE, LIMESTONE AND SANDSTONE
- INFERIOR OOLITE GROUP - LIMESTONE, SANDSTONE, SILTSTONE AND MUDSTONE
- GREAT OOLITE GROUP - SANDSTONE, LIMESTONE AND ARGILLACEOUS ROCKS
- KELLAWAYS FORMATION AND OXFORD CLAY FORMATION - MUDSTONE, SILTSTONE AND SANDSTONE
- WEST WALTON FORMATION, AMPTHILL CLAY FORMATION AND KIMMERIDGE CLAY FORMATION - MUDSTONE, SILTSTONE AND SANDSTONE
- CORALLIAN GROUP - LIMESTONE, SANDSTONE, SILTSTONE AND MUDSTONE
- PORTLAND GROUP - LIMESTONE AND CALCAREOUS SANDSTONE
- WEALDEN GROUP - SANDSTONE AND SILTSTONE, INTERBEDDED
- LOWER GREENSAND GROUP - SANDSTONE AND MUDSTONE
- GAULT FORMATION AND UPPER GREENSAND FORMATION - MUDSTONE, SANDSTONE AND LIMESTONE
- WHITE CHALK SUBGROUP - CHALK
- GREY CHALK SUBGROUP - CHALK
- LAMBETH GROUP - CLAY, SILT, SAND AND GRAVEL

STRATEGIC STONE STUDY

OVERVIEW

The oldest rocks in Oxfordshire outcrop in the north of the County and are of Lower Jurassic age, around 200 million years old. Younger Jurassic and Cretaceous formations progressively outcrop towards the south. The harder limestone and chalk lithologies form escarpments, whilst clay underlies the intervening vales. The character of Oxfordshire's stone buildings is very much determined by the nature of the local stone, which leads to a fascinating variation of styles across the County. With the exception of the Jurassic oolitic freestone quarried around Taynton, few building stones were of sufficient quality to be used much beyond their immediate source area. Now only a handful of building stone quarries are still active in the County, supplying Marlstone and the Chipping Norton Limestone. Unfortunately the other building stones described in the following pages are no longer available from working local quarries.

The following summary of the principal local building stones is based largely on Arkell's work and Powell's recent "Geology of Oxfordshire". The oldest stones are described first, progressing towards the stratigraphically youngest to the south.

MARLSTONE (LOWER JURASSIC)

Marlstone, also known as Hornton Stone or Banbury Ironstone, is an iron-rich limestone up to 10 metres thick, quarried from the Middle Lias (Lower Jurassic) of North Oxfordshire. It weathers to a distinctive golden orange/brown colour but can appear bluish green when unweathered. It contains abundant shelly fossils, typically clusters of brachiopods. Both freestone and a rougher, more rubbly stone were quarried, so that Marlstone could be used for both walls and dressings, in both small and large buildings.

However it is susceptible to weathering and spalling, so that it has sometimes been later replaced with more durable oolitic limestone.

Marlstone cottages in Wroxton

However it is susceptible to weathering and spalling, so that it has sometimes been later replaced with more durable oolitic limestone. The distinctive warm-coloured Marlstone characterises the cottages in many villages such as Great Tew, Deddington, Adderbury, Bloxham, Wroxton, Hook Norton and Hornton, as well as churches such as St. Mary's in Adderbury and stately houses such as Broughton Castle and Chastleton House. In Oxford its deep colour led to use in ornamental work on buildings such as the University Museum (1859) and Christ Church Meadow Buildings (1862).

CHIPPING NORTON LIMESTONE (MIDDLE JURASSIC)

This is a buff to white, medium- to coarse-grained oolitic limestone (some 2 to 5 metres thick), from the Great Oolite of the Middle Jurassic. It lies stratigraphically below the Taynton Limestone but is similar in appearance, though is quite variable and sometimes has a flaggy character. Some bands are full of broken shells. Quarried from around Chipping Norton and Charlbury, it was used as a durable freestone in the buildings of these towns and other local villages. The more flaggy lithologies provided roofing tiles for Taynton church, and the Castle Barn quarry still produces roof tiles from this formation. The Rollright Stones, a 4000-year-old stone circle, are thought to be built from a hard siliceous variety of the Chipping Norton Limestone.

TAYNTON STONE

This is a buff to white, coarse-grained oolitic limestone (5 to 7 metres thick) from the Great Oolite of the Middle Jurassic, typically cross-bedded and with abundant broken-up shell fragments. It weathers to a light- or golden-brown colour, sometimes with a striped appearance due to differential erosion of beds of varied grain-size or cementation. Well cemented, strong and durable, it was quarried for many hundreds of years from some five quarries around Burford, the best quality coming from locations covered by some 5 metres of overlying Hampen Marly Beds. Seams were thus often followed some distance underground from the quarry face. From the Taynton Quarry itself, blocks up two metres in height could be obtained, but similar stone was quarried nearby at Swinbrook and Milton in Oxfordshire, and at Barrington, Windrush and Sherborne across the border in Gloucestershire. Stone from the Milton quarries has proved less durable over the years.

Both freestone and rubble blocks were extracted and were used not only locally, to build the honey-coloured stone houses and churches in towns such as Burford but also for many Oxford buildings (eg the 13th C Merton College Mob Quadrangle, the Divinity Schools, the 18thC Oriel College library, and the 19th C New College West Block). Buildings across Oxfordshire used the freestone in quoins and dressings together with local walling stone. It was shipped further down the Thames for use at Windsor Castle and St Pauls Cathedral, but the stone used at St Pauls has since decayed and been replaced with Portland Stone.

STONESFIELD SLATE

Stonesfield: slate roof with oolitic limestone walls

The Stonesfield Slate is a flaggy grey micaceous and calcareous sandstone, found as concretionary masses within the Taynton Stone Formation, in a thin sheet of very limited extent around the village of Stonesfield. It can be split into thin tiles, which were widely used till the mid-18th century for the roofs of Cotswold cottages and Oxford colleges (eg Merton College, Wadham College, St.Anne's College library). Thin seams of the stone (up to 2m thick) were mined from underground seams accessed from narrow hillside adits and shafts. By exposing the moist, freshly-dug slabs to the natural action of winter frosts, they became easy to split. The slates are greyish cream in colour and not as thin or smooth as the true slates of metamorphic origin from the quarries of Wales and the Lake District.

The local slate industry lasted from the late 16th C to the early 20th C and the occurrence has now been totally worked out. The smaller slates were used in the upper parts of a roof, grading into larger and heavier slabs towards the base.

WHITE LIMESTONE

This is a creamy or whitish, fine-grained, thinly-bedded limestone, from near the top of the Great Oolite of the Middle Jurassic. The bioturbated limestone contains a scattering of ooliths and pellets, and fragments of bivalve and brachiopod shells. It is used as a flaggy, rubbly walling stone in domestic buildings and churches along the south flank of the Cotswolds, in a belt from Minster Lovell to Ardley.

BLADON STONE

Quarries at Bladon near Hanborough have produced a creamy or whitish, cross-bedded, calcite -cemented shelly oolite some 4 metres thick, from the Kemble Beds of the Upper Bathonian, near the top of the Great Oolite. It was used in building the 14thC Merton College Library in Oxford, and extensively in 19th and 20th Century Oxford buildings for both coarsed rubble walling and dressings, at Somerville (1933), Rhodes House (1929) the New Bodleian (1939) and Radcliffe Science libraries, also for the University Geology and Botany Departments.

FOREST MARBLE

The term Forest Marble was first applied by William Smith to a grey, coarse-grained, cross-bedded oolitic limestone, crowded with blue-black fragments of oyster shells, from the Upper Bathonian at the top of the Great Oolite Series. The stone could be polished for decorative use and was used for internal ornamentation as well as external use. The portico columns of Canterbury Quad in St. John's College, Oxford were cut in 1636 from Forest Marble.

The stone was quarried from the Wychwood Forest area, from around Filkins and from the East End quarry at North Leigh. The best stone came from the Longround and Horsebottom quarries to the northeast of Filkins, where all of the older cottages were built of Forest Marble. A more flaggy facies was used for roofing tiles, steps, stone paving and as upright slabs for fencing.

Forest Marble flags used as fencing, Kelmscott village

In the 1920s and 1930s Sir Stafford Cripps provided locally-quarried Forest Marble for building council homes and a new Village Centre in Filkins and for the Morris Memorial Cottages in Kelmscott.

STRATEGIC STONE STUDY

CORAL RAG (UPPER JURASSIC)

The Coral Rag is a rubbly grey shelly limestone, (up to 10 metres thick), from near the top of the Upper Jurassic Corallian Group. It contains large lumps of corals, both branching and massive. The branching corals may weather out to give tubular cavities. It is relatively hard and resistant to weathering but the poorly-bedded rubbly character means that it is difficult to shape into regular building blocks and could not be used for dressings. Quarried from the hills around Oxford, it was widely used in the oldest Oxford buildings such as the Late Saxon tower of St Michael-at-the-Northgate, St Georges Tower at Oxford Castle and for the early 13thC city walls. A similar rubbly coral-rich stone from the Faringdon area was used for the walls of the 13thC Great Barn at Coxwell, and for many of the older Faringdon buildings.

Coral Rag used as rubbly walling stone in the Late Saxon tower of St Michael-at-the-Northgate, Oxford.

WHEATLEY LIMESTONE

Rubbly walling stone of the18th C Sun Inn, Wheatley

This is a pale grey, well-cemented, bioclastic limestone, up to 15m thick. It is equivalent in age and transitional to the Coral Rag, and represents a shelf slope facies of broken shells, coral debris and sparse ooliths. More versatile than the Coral Rag as a building stone, it was quarried from the Wheatley and Oxford areas from the end of the 13th Century. The rubbly-weathering stone was used for the walls of New College First Quad (ca. 1380) in Oxford, and in villages to the south and east of Oxford. Much was sent to Windsor castle, but after the 14thC use of the Headington stones became more prevalent.

HEADINGTON HARDSTONE

This is a massive, competent variety of the Wheatley Limestone from the Headington quarries, east of Oxford. It is whitish-yellow in colour, with sparse bioclastic material and ooliths, and weathers with a typically pock-marked surface due to the variable erosion of softer burrows. It could be cut easily, but hardened on exposure to a durable building stone, which has survived in place for up to five or six centuries. Large blocks were widely used in the plinths of Oxford buildings such as the Radcliffe Camera (1737) and the Examination Schools on the High Street. It was used for the New College bell tower (1396-7) with quoins and dressings of Taynton stone, and later (1841) for the gate pillars of Oxford County Hall. Replacement of weathered blocks in the Radcliffe Camera has used Portland (Fancy Roach) Stone.

HEADINGTON FREESTONE

Great Haseley: Cottage wall of Upper Portland stone, with inset of large ammonite.

This is another variety of the Wheatley Limestone from the Headington quarries, providing a creamy-white or buff-coloured freestone or ashlar in many Oxford buildings. Although widely used from the 15th Century onwards, the poorer quality material quarried from the early 18th century onwards weathered badly within a couple of centuries. The stone develops a hard, blackish crust, which blisters and exfoliates, so that many buildings have since required re-facing with more durable freestones such as Clipsham Stone. In Oxford it still survives in the lower storey of the Radcliffe Camera, built 1737, in the upper walls of Oriel College Hall, and in Trinity College Chapel (1691-3).

UPPER PORTLAND

This is a creamy-white, sandy to gritty bioclastic limestone from the Upper Portland beds, locally rich in shell fragments. It was once quarried as a freestone from a thin band (up to 2 metre thick), in the area of east Oxfordshire around Great and Little Milton, and Great and Little Haseley. The largest quarry was on the SE bank of Haseley Brook at Upper Standhill. Roughly cut, irregularly sized blocks were used in local cottages and for the walls of Great Milton church. Large Portlandian ammonites may be seen incorporated in some cottage walls.

CHALK BLOCK (UPPER CRETACEOUS)

Ashdown House, built of chalk blocks with limestone dressings

A relatively durable creamy-white chalk was obtained from a restricted area of southwest Oxfordshire. It was easy to cut, and could be shaped into uniform rectangular blocks, up to 50 cm across, for use in regularly coursed walls. Quoins and dressings were normally of a harder limestone or brick, and extra support was provided around windows and doors by wooden beams, brickwork or stone. Because chalk is porous (its porosity can be around 30%), it was essential to have "good shoes and a hat" to prevent the chalk absorbing water and "spalling". This meant a foundation plinth of brick or sarsen, with cottages having an overhanging roof (typically thatch) to keep the chalk dry. Chalk block buildings are seen in the South Oxfordshire villages around Ashbury, Compton Beauchamp, Uffington and Woolstone. The substantial 17th Century hunting lodge of Ashdown House was built of fine white chalk block with quoins and dressings of stronger limestone. The chalk is thought to have been quarried from a hard band such as the Melbourn Rock (3m thick) at the top of the Lower Chalk. In recent years a quarry at Compton Beauchamp was temporarily re-opened to provide stone for repairs at Ashdown House. A similar stone is seen in a few buildings around Watlington and Shirburn, at the foot of the Chilterns in the southeast of the County.

CHALK CLUNCH

A less durable creamy-grey coloured chalk is seen in buildings along the base of the chalk escarpment from Blewbury through Wallingford, Benson, Warborough and Watlington.

This is a friable, flakey chalk, which is not easily shaped into regular blocks. It has low strength and weathers poorly, tending to absorb water and spall as a result of winter freezing.

Such chalk was used for the regularly-coursed walls of the 400-year-old Smalls House in Mackney, but it has deteriorated over the years. More often it is seen in roughly-coursed boundary walls or rubbly infill panels, again resting on a base of less porous material (brick, sarsen or flint) and with a protective coping of brick or tile.

One source of such chalk was the Chalk Pit at Blewbury, which provided a poor quality chalk building stone from the Melbourn Rock. Other similar material may come from the underlying Upper Greensand. Totternhoe Stone has often been used as a replacement.

Smalls House, Mackney, showing recent replacement of weathered chalk clunch

FLINT

Flint is a very hard black glassy silica material, occurring as lumpy nodules, rarely more than a few tens of centimetres in size, within the Upper and Middle Chalk. The newly-excavated nodules have an outer coating of porous whiter "cortex" which may become yellow-stained from prolonged exposure to clays or soils. Flint splits along curving 'conchoidal' fractures rather than the regular bedding surfaces or joints of many sedimentary rocks. It is however 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 of rubbly appearance, or can be split or "knapped" to give a glassy surface, which is then arranged to face outwards. In skilful hands the flints can be knapped into rectangular blocks which can be laid in courses like bricks. However the shiny impervious surfaces of fully knapped flints don't bond as well with mortar as those flints which still retain their porous cortex. Stone or brick courses were often incorporated in a flint wall to give it extra strength.

STRATEGIC STONE STUDY

Local field flints, embedded in mortar, were used to build the rough walls of Saxon and Norman churches (eg St.Leonards in Wallingford), although their small size precluded use as corner stones or as window or door surrounds, for which another material, usually brick or limestone was generally used.

Flint field nodules, showing white cortex

Wallingford) or employed together with squared limestone blocks to give decorative chequer-work patterns. Limestone continued to be used for carved window dressings and doorways, for corner stones and buttresses.

This use of flint with limestone characterises the majority of church buildings in the chalk Downs. Weathered flints are common in the soils throughout the chalk districts. Supplies of freshly quarried flint can be obtained from the Hindhay quarries at Fifield near Maidenhead.

Chalk clunch boundary wall, with protective tile capping and flint base. Blewbury

By the 13th and 14th Century the flints were being laid in horizontal courses and were often knapped to give a shiny outer-facing surface.

In later church building, the flints were more carefully selected and were often fully knapped to give squared blocks which could be laid in regular courses,(eg St. Mary's church in

Flint and limestone chequerwork, Ewelme church

STRATEGIC STONE STUDY

SARSEN STONE (PALEOCENE)

Sarsen boulders scattered over valley floor near Ashdown House

Sarsen stones occur as large blocks up to several metres in length, which are found as isolated boulders resting on the chalk in valleys of the Marlborough Downs in southern Oxfordshire. These are the scattered remnants of a durable sandstone, equivalent to the friable Palaeocene sands found in the London Basin. Huge sarsen stones were used in their natural unshaped state 5,000 years ago, by the Neolithic builders of the Waylands Smithy long barrow and the Avebury stone circle. The stone is a hard, strongly-cemented quartz sandstone, which in these structures has resisted weathering for thousands of years. However, being so hard, it is not easy to shape. Thus sarsens were initially used in buildings in their original unhewn condition. Small unshaped stones are seen in rough-coursed walls around Ashbury and Uffington, with dressings made of brick, or as the foundation plinths of chalk or clunch buildings. They are also widespread as marker stones along roadside verges.

Rough sarsen stonework, with quoins and additions of chalk block, Ashbury

In later years, heating methods were used to break up the stone into blocks, suitable for walls and corner stones, although not for intricate carved ornamentation around windows.

Working the stone into regular blocks became easier in the mid 19th century with the introduction of machinery.

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FURTHER READING

Arkell, W.J., 1947, Oxford Stone, Faber and Faber, 185 pp, republished 1970 by SR Publishers Ltd

Arkell, W.J., 1947, The Geology of Oxford. Clarendon Press, 267pp

Oakeshott W.F. 1975, Oxford stone restored : the work of the Oxford Historic Buildings Fund, 1957-1974, Oxford University Press, 122 pp.
Powell, P, 2005, The Geology of Oxfordshire, Dovecote Press, 108 pp

Oxfordshire Geology Trust 2007; trail guide series "Secrets in the Landscape"

Wood-Jones, R.P., 1963, Traditional domestic architecture of the Banbury region. Manchester University Press, 309 pp.

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