

Churches of SE Nottinghamshire

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Wednesday 6th July, 2005

Churches provide an opportunity to study the lithology of rocks, many of which are no longer exposed locally. Although the parishes of Willoughby-on-the-Wolds and Upper Broughton are adjacent, the dominant building stones in the churches are different, being Barnstone Member and Sandrock respectively.

The church buildings of today are the product of up to 1000 years of construction, extension, remodelling and repair. Most of the churches were built during the period from the Norman Conquest to Henry VIII's Reformation. From then, limited repairs were made until the Victorian era, when many of the churches were 'restored', sometimes destroying their character.

Most churches are built using local material, hence the close correlation between building stones, source and rock outcrop. The parish system probably dates from the Saxon era. Some churches were built of stone before the Norman Conquest, but the centralisation of power and taxes by the Normans started a building boom.

Architectural style evolved progressively from the Celtic and Roman churches through to the 17th century. New ideas and techniques developed locally, then to be propagated by the stonemasons who travelled from site to site. New styles developed at different times in diverse places and regional variations were imposed upon them. The Victorians arbitrarily defined styles of architecture, but accepted that they could not be dated precisely.

Saxon	pre-1066
Norman	1066 - 1200
Transitional	1150 - 1200
Gothic - Early English	1170 - 1300
- Decorated	1272 - 1350
- Perpendicular	1350 - 1530
Tudor	1485 - 1689

Approximate chronology of architectural styles

St Mary and All Saints, Willoughby-on-the-Wolds

The **exterior** of the church is built almost entirely of pale grey stone derived from the Barnstone Member (Blue Lias), the basal division of the Charmouth Mudstone of the Lias Group. It is a fine-grained limestone in which three lithologies can be recognised:

- the dominant pale grey subporcellaneous limestone
- a slightly darker grey structureless micritic limestone
- a similar rock with thin cemented bands showing lamination, very low-amplitude ripple-like structures and very shallow erosional surfaces.

Fossils are rare and bioturbation has not been noted.

The outcrop of the Barnstone Member extends from Lyme Regis in Dorset to Whitby in Yorkshire. Locally it crops out in the stream bed at Widmerpool. Since Roman times it has been extensively worked at Barrow upon Soar and more recently near East Leake. It can be seen in the flooded excavations of the defunct cement factory at Barnstone in the Vale of Belvoir.

The rock is a rubblestone and is used *as dug* with a minimum of dressing. It is laid in courses, the heights of which are in part dependent on the thickness of the original bed. The clay-rich beds weather badly, showing vertical, crumbly, surface exfoliation, bedding plane flaking and differential decalcification. Cemented laminae stand out above the more clayey matrix. The sub-porcellaneous lithology is largely unweathered and still shows a subconoidal fracture.

The **Chancel** is built with massive blocks of the sub-porcellaneous limestone. This lithology is used extensively in north Leicestershire. Note that at some time the height was increased. In 1829 the church was repaired and four new windows were installed. These are all of Perpendicular style and probably include the two south-facing windows of the Chancel, the west-facing window of the South Aisle and the east-facing window of the North Aisle. The main east window, also of Perpendicular style (1350-1530) was inserted during the 1891 restoration.

Changes in the masonry show that it was smaller than its predecessor, the surrounding gap being infilled with smaller blocks of the Barnstone Member. The window frames are Lincolnshire Limestone oolite, which is also used in the parapet, facing and coping. The buttresses are built with medium-grained Triassic sandstone and some of Sandrock. All are freestones.

To the right is the junction of the Chancel with the **North Aisle**. This angle reveals the oldest masonry in the church. It comprises thin blocks of Barnstone Member, limestone rubble and larger blocks of Sandrock. This masonry encloses an Early English Y-shaped tracery window; the original sandstone mullions have been replaced by oolite. The remaining North Aisle is built of Barnstone Member and Sandrock, and there is an identical west window.

The **North Chapel**, the Willoughby Chantry, was built in the 13th century using a fine-grained Triassic sandstone. The exception is the niche at the base of the central light of the three-panel Perpendicular east window. This fawn, ripple-marked sandstone contains ferruginous grains and is laid on end (i.e. the bedding planes are vertical). It is Carboniferous, possibly from the Wingfield Flags in the Lower Coal Measures.

A small **Vestry** was added in 1998 using Barnstone Member transported from Somerset, and Lincolnshire Limestone oolite freestone was used for the door and window frames. The former comprises structureless micritic limestone, with a few blocks showing fine lamination identical to the local rocks. Some of the blocks have been split with a vice along joints that were filled with crystalline calcite.



The new vestry built with Blue Lias at Willoughby church.

The **Tower** has a Triassic sandstone basal course, succeeded by Barnstone Member rubblestone with repairs using Sandrock, Bulwell Stone and oolite. The two buttresses are of similar design, but one is built of Sandrock and the other, possibly a replacement, is of Triassic sandstone, which is also used for the quoins.

The **South Aisle** again has a sandstone basal course, overlain by Barnstone Member, and has south- and north-facing Early English Y-tracery windows of Triassic sandstone with oolite repair. The west-facing window is in Perpendicular style that used Triassic sandstone, but with coarse Millstone Grit sandstone repairs. The porch arch is framed with Millstone Grit.

Internally, the columns of the arches are circular. Two are composite with the lower part built of Sandrock, which is succeeded by pale grey Triassic sandstone; the rest are entirely sandstone. Pevsner (in *The Buildings of England: Nottinghamshire*, 1979: Penguin, p379) noted that 'one capital has primitive upright leaves: others are octagonal' and concluded 'the date is about 1200 or a little later'. He suggests that the North Chapel, the Chancel and the Tower are all 13th century. The internal wall of the Tower shows two former roof mouldings, which predate the building of the Clerestory and the present roof line (?C14th).

The **North Chapel** was built as a chantry where a priest could pray daily for the lords of the manor. It now contains the Willoughby monuments. The two oldest are ladies wearing wimples, which suggest a date of about 1300. Both effigies have been carved in oolitic limestone. The one in the corner (1 on the wall guide) is buff-coloured with shells and shell debris; the other (2) is a white oolite. Both are worn, possibly due to weathering. The adjacent tomb (3) is thought to be that of Sir Richard Willoughby, who died in 1325, and his wife; it is a brownish grey oolite with shells. The remaining tombs are of alabaster. One is the tomb of Richard (died 1362), and, on the basis of the costume of the effigy, he was a judge. Another tomb is that of Sir Hugh (died 1448) (5) and his second wife (died 1493): his first wife is remembered by a floor slab (7). A third tomb chest (8) may be H Willoughby, a priest of 1320-29, who died about 1344. In the adjacent aisle there is a brass memorial set in Bulwell Stone to

Colonel Michael Stone, who was killed in the Civil War Battle of Willoughby Field, July 5, 1648.

A notice in the porch records the current keyholders.

St Luke's, Upper Broughton

Although this is a much smaller church than that in Willoughby-on-the-Wolds, it displays a great variety of building stones that reflect the changing use of stone during various stages of construction and repair.

The oldest part of the church is a Norman-style window, which has been blocked off and is visible now only from the inside, in the second stage of the **Tower**. The external south wall of the **Nave** is built of Sandrock, and incorporates an older arcade to a former **South Aisle**. Only one complete arch and part of a second remain. The semicircular double-chamfered arch rests on a capital with dog-tooth ornamentation above a circular column. Pevsner (p360) considers this to be Transitional (late Norman) style 'c.1200 or a little later'. The south door is built into the arch. The remnant of the **South Arcade** and the **North Arcade** are both built of Lincolnshire Limestone oolite. The columns of the latter are octagonal, the arches are chamfered but slightly pointed, and the capitals show traces of dog-tooth ornamentation, which Pevsner considers to be 'later still, but also C13th'. A carved fragment of Lincolnshire Limestone oolite, originally a Norman tympanum (door head) is built into the porch.

Externally, the older parts of the church are Sandrock. This is the highest bed of the Dyrham Silt Formation, which underlies the Marlstone Formation. Both are Lias Group of Early Jurassic. Unweathered, the Sandrock is a pale greenish grey chamositic silty sandstone with a calcareous cement; the colour depends on the iron content, and the proportion of shells and shell debris varies. Stratigraphically, it is overlain by the Marlstone, with the boundary marked by a thin conglomerate of reworked phosphatised platy nodules. The rest of the Marlstone is a chamositic-sideritic limestone with shell debris and ooliths.



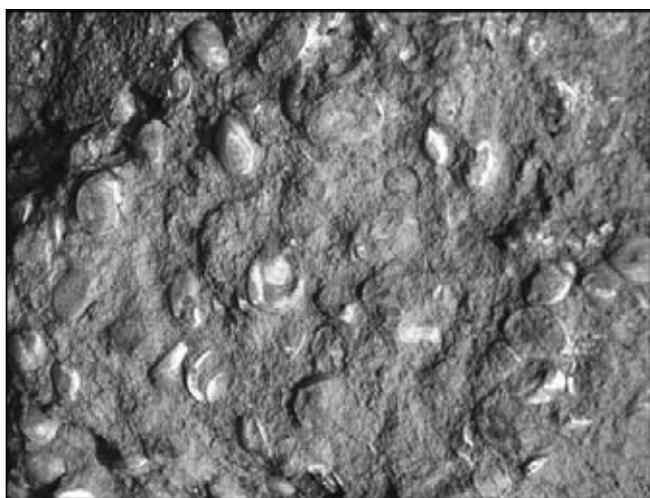
St Luke's church at Upper Broughton

Both rocks are very susceptible to oxidation by percolating ground water, so that, in the near-surface zone, iron minerals have been altered to limonite, giving the stone its characteristic ochreous colour. Leaching of the calcium carbonate of the Marlstone limestone increases the residual iron content to the level at which the rock becomes ore grade. This, and the redistribution of the limonite as veins, generally renders the rock unsuitable for use as a building stone.

However, some hard, dense, reddish brown, ironstone blocks have been used for repair work on the upper part of the western end of the South Aisle. The Sandrock was sufficiently uniform to be used as a freestone, with large blocks in ashlar style. Unfortunately the stone weathers badly and in some cases up to 100 mm of the surface block has been lost, leaving a rounded surface. Differential weathering has caused the crystalline calcite brachiopods, belemnites and some bivalves to stand out above the weathered surface. Some beds show weak grain-sized banding of shell debris, while others are intensely bioturbated, with paler burrows up to 4 mm in diameter. The brachiopods 'float' in the matrix, and clusters of them could be growth assemblages.

When brachiopods die the dentition tends to keep the valves closed. Where silt only partly fills the body cavity, and crystalline calcite fills the upper part, the shell can be used to determine the 'way up' of the rock, to indicate the depositional base of the bed in which it occurs. In tectonically complex areas, such structures are used to identify overturned beds. In churches they only tell us whether the building block has been laid as dug, on edge or upside down.

Because of the susceptibility to weathering, many blocks of the original Sandrock have been replaced, particularly by pale cream-coloured Lincolnshire Limestone oolite, for example in the second stage west wall of the **Tower**. Elsewhere, Bulwell Stone, Barnstone Member (Blue Lias) and very rarely an unidentified shelly limestone of the Charmouth Formation (Lower Lias) and ironstone have been used.



Brachiopods in Sandrock at Upper Broughton church

The new clasping buttress of the west end of the Tower, Choir Vestry, and that between the Tower and the North Aisle are built with Banbury Marble from the Wroxton area to the north-east of Banbury. Similar to the Sandrock in lithology and with superb burrows, it is less weathered at outcrop and some blocks show only slightly oxidised, green-tinted core stone. This is an excellent freestone, and like the Sandrock has been used in the past for window frames, mullions and quoins. Sadly, some blocks already show weathering fractures, mostly vertical exfoliation cracks parallel to vertical faces, probably the result of freeze-thaw.

The outside wall of the **Nave** is almost entirely built of Sandrock. The oolite windows are in the Decorated Style, but there is evidence that they replace much younger Classical Style windows. The date of the removal of the **South Aisle** is not known. This predates construction of the **Porch** in 1733, when an unusual Lincolnshire Limestone lithology was used. This rubblestone is a cream micritic limestone with 'floating' ooliths, a little shell debris and a few shells; it is characteristic of the lower part of the Lincolnshire Limestone. A crudely carved oolite lintel is built into the inside wall of the Porch. A Norman-style window on the inside wall of the first stage of the Tower is further evidence of the antiquity of the building.

The **Chancel** was rebuilt in 1844-5 using Sandrock with inset dressed blocks of the Barnstone Formation (Blue Lias). These are the more argillaceous variety, characteristic of Victorian churches in Nottingham.

The **North Aisle** was rebuilt in 1980 using dressed Bulwell Stone, a slightly orange-tinted, honey-brown dolomite, above three original courses of Sandrock. The Permian Bulwell Stone originated as a limestone, and was changed to dolomite by magnesium replacement during diagenesis. Because dolomite has a smaller crystal volume than the calcite it replaced, the new crystals developed rhombic crystal faces around voids, creating the saccharoidal texture.

The Sandrock and Marlstone Formation form the escarpment to the south of the church, and there are ancient workings in the Sandrock at Stonepit Spinney [702233]. Early last century there were extensive opencast excavations of the Marlstone Formation iron ore in the Wartnaby, Ab Kettleby and Holwell areas. The Barnstone Formation crops out from Barrow on Soar to Newark; its nearest source would have been the stone pits [630285] north of Widmerpool. Bulwell Stone quarries are at Bulwell and Linby, NW of Nottingham. The source of the Lincolnshire Limestone is uncertain; the nearest outcrop is at Wartnaby on the Wolds, NE of Melton Mowbray, but major quarries worked it at Weldon, Kelton, Clipsham and Ancaster.

The key to the church is available during licensing hours from the Golden Fleece public house.