Excursion to Nottingham's buildings and caves

TONY WALTHAM[1]

[1]*Nottingham Trent University, Burton Street, Nottingham, UK, NG1 4BU (Emai: tony@geophotos.co.uk)*

Abstract: The excursion includes a visit to the artificial sandstone caves that underlie the Broad Marsh shopping centre, to see the nature and extent of the caves and some methods used in construction over them. This visit is preceded by a walk through the town centre to briefly appreciate some of the finer buildings and the stone materials used in their construction.

Resumé: L'excursion fait une visit aux grottes artificielles dans le grés sous la galerie Broad Marsh, pour voir le morphologie des grottes et quelques méthodes exploités pour construction au-dessus d'eux. Cette visit est précédé par une promenade à travers le centre de ville pour apprécier quelques bâtiments et les matériels utilise pour leurs construction.

Key words: building stone, sandstone, cave, geohazard

BUILDING STONES OF NOTTINGHAM

A great variety of stones have been used in Nottingham's buildings, with only some from local sources. The excursion starts on the north side of the city centre, in front of the old collegiate buildings on Shakespeare Street. The route and numbered sites of interest are shown in Figure 1. This map and the notes are abstracted, with permission given and thanks returned, from the more extensive guide by Horton and Lott (2005).

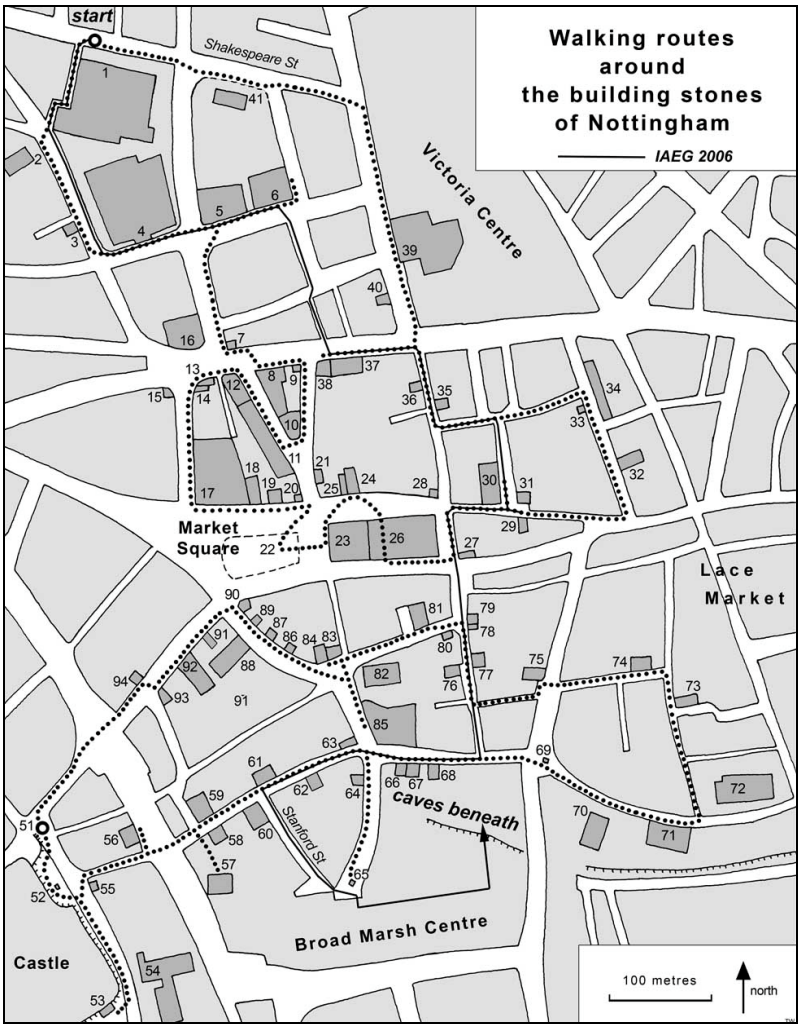

Figure 1. The city centre of Nottingham with the route of the excursion past the numbered buildings, to the site of the caves beneath the Broad Marsh Centre.

(1) Arkwright Building of Nottingham Trent University is a superb example of the decorative use and versatility of the Middle Jurassic Ancaster Stone from the Lincolnshire Limestone Formation. Built in 1877-80 for the University College (before it moved to its Lenton site), the main door frontage is decorated with colonettes, statues and a frieze, all of which are relatively unweathered, and illustrate the excellent freestone qualities of Ancaster Stone. It is roof with green Westmorland Slate. The boundary wall is mostly of Carboniferous sandstone, with repairs of coarse artificial render; it also contains pillars and copings of Jurassic limestone. In Bilbie Walk, the eastern wall of the Arkwright Building suffered major bomb damage in 1941. Some of the original Ancaster Stone was replaced by fine-grained sandstone laid on edge, so that it now shows exfoliation along the vertical bedding.

(2) St Andrews Church dates from the 1860s, and is a delightful Victorian extravaganza of honey-brown and red-tinted Bulwell (Golden) Stone from the Permian Cadeby Formation (Lower Magnesian Limestone). This coarse dolomitic limestone was the most common building stone in Nottingham from Victorian times onwards. There are decorative courses of grey, silty limestone from the Jurassic Blue Lias (now Barnstone Member of the Scunthorpe Mudstone Formation).

(4) Newton Building of Trent University is clad in sawn, white, oolitic, Upper Jurassic Portland Stone from Dorset. Some blocks are richly fossiliferous with very large bivalves picked out by differential weathering of the coping stones in the boundary wall. Resistant Millstone Grit sandstone forms the lowest courses of the building frontage, preventing the damage due to rising damp that is seen in the Portland Stone blocks near the entrance.

(5) Guildhall bears witness to the freestone quality and durability of the Millstone Grit. The stone was quarried from the Ashover Grit at Sydnope, near Matlock in 1887. A fine-grained carbonaceous sandstone, probably from the Coal Measures, has been used in the entrance steps and floor.

(**6) City Finance Department** is clad with slate sawn almost parallel to poorly-defined cleavage that lies at 60-70° to the bedding. It is probably the Silurian Burlington Slate from quarries near Ulverston, Cumbria. Across Burton Street, the large new Corner House block has columns of cast concrete faced to resemble a sandstone.

(37) Express Chambers is a fine example of work by local architect. Watson Fothergill. The bulk of the building is built of the Carboniferous Ashover Grit from the Stanicliffe quarries at Darley Dale in Derbyshire. Red Mansfield Stone, from north Nottinghamshire, forms alternate blocks in the window arches and in the ground-floor window colonettes and pillars.

(30) Nottingham and Notts Bank is often claimed as the city's finest work by Watson Fothergill. Built in 1877-82, it is now occupied by All Saints and Bravissimo. The main structure is built of Darley Dale sandstone from the Millstone Grit, with the latest renovations using matching stone from Grindleford. Red Permian Mansfield dolomitic sandstone was used for the colonettes, but some have been replaced with darker red sandstone, possibly the Triassic St Bees Red sandstone from Cumbria. The pediment along Thurland Street is a gneissose granite probably from Norway, but right of the main door, a darker granite, perhaps from Rubislaw, Scotland, has been used to fill across an original doorway. The succeeding course is Balmoral Red Granite from Finland (with a misleading trade name to aid its marketing). Colonettes and replaced parts of the frontage are of different granites, and Blue Pearl larvikite forms the Pelham Street frontage. Above the door, a carved medallion of Mansfield Red sandstone is set in a block of buff sandstone, and high above there are friezes carved in white Portland Stone. The roof is green slate, probably from Cumbria.

(29) Nottingham Journal Building (now occupied by Tanners) was built in 1860, mainly of brick and Millstone Grit sandstone. The first floor windows have narrow colonettes of pale pink granite. The rebuilt ground floor fascia is clad with a basal course of gabbro, succeeded by a narrow course of rapakivi granite, and the main panels are a beautiful, pale, foliated and folded migmatite from an unknown source. The entrance floor is a coarse terrazzo that includes blocks of various stones, including brown Sienna marble, pale-pink Italian Rosso Classico marble, grey Tranovaltos marble from Greece, green serpentinites, and the brick-red Ammonitico Rosso limestone.

(78) Gala Casino has doorway columns of pink Peterhead Granite from Scotland on plinths of grey Cornish granite, with a pale, partially-resorbed xenolith exposed in the right front panel.

(76) Flannels has a base-course facing and door plinth of rapakivi granite with its spheroidal feldspars in the well-known stone from Finland.

(68) Enfield Chambers was built in 1910 of an oolitic limestone, probably from the Middle Jurassic of Lincolnshire, which has weathering to darker than its interior buff colour.

(67) Caffé Uno is in an ornately decorated, Victorian town house, built in 1876, with Carboniferous sandstone courses, capitals, column bases, and oriole window surrounds. Its front columns are of porphyritic syenite, possibly the Bessbrook Granite from Newry, Northern lreland; the columns by its door are fine-grained, crinoidal limestone, probably the Devonian Ipplepen Stone from the Torquay area.

(63) Wallis's has, between its covered windows, a single broad column clad with a complexly foliated gneiss, probably derived from ultrabasic peridotite, but from an unknown location.

(60) Clearwater, with its ground-floor car-park, has a mixture of Carboniferous sandstone and Mansfield Red dolomitic sandstone used as a decorative course over the doors and windows; one block in the Castle Gate wall shows splendid Leisegang rings (better than the rings in the sawn paving slabs of Carboniferous sandstone).

CAVES BENEATH THE BROAD MARSH CENTRE

The Triassic sandstone on which stands Nottingham is a weak rock, soft enough to be excavated with only modest effort and yet so little fractured that its rock mass strength is great enough to ensure roof stability across excavated cavities. For over a thousand years, man has excavated "caves" within the Nottingham sandstone (Waltham, 1992). Some were to live in, but most were just to create working or storage space in a crowded town. More than 500 caves

have been documented beneath Nottingham's city centre. Only a handful of them are still in use. The remainder constitute a significant local geohazard with respect to urban re-development; larger buildings and heavier loads are now imposed upon ground that may be underlain caves excavated and designed centuries ago to be covered only by smaller and lighter structures.

Progressive redevelopment in the city has caused many caves to be lost, because their entrances have been changed, while their inner rooms remain open and potentially unstable. Appropriate ground investigation is therefore needed prior to all new construction in the inner city, which is carefully controlled with respect to rock loading over the caves (Waltham & Swift, 2004). Remedial works commonly involve concrete filling, but some caves have heritage values that mean they have to be protected while suitable foundations are placed around them or straddling them.

The first cave is only visited from above - on the way down Stanford Street. The road collapsed here in 1990, when a cave roof failed in a classic crown hole. The cave below was a wine cellar of the original Stanford House, sealed off by new foundations for the office block with the same name that replaced the old house. It was therefore unknown, until its roof failure occurred when water from a leaking water main weakened the sandstone in the roof span (Waltham, 1993). The cave is now full of concrete. Building failures due to cave collapse have been very rare in Nottingham, but this was one of a number of minor roadway collapses.

When the Broad Marsh shopping centre was built in the 1960s, it straddled the low cliff where the Trent and Leen floodplains (the broad marsh) cut into the sandstone hill that supports the old town. This cliff was a prime site for caves, as they could be excavated horizontally with easy access and natural lighting - in contrast to most of Nottingham's caves that are reached downwards from basements beneath buildings. Site clearance revealed a dense cluster of caves all along the cliff (Figure 2). Initial plans for the new development were to cut back the sandstone to "remove" the caves and establish sound rock for footings. However the site's heritage values were recognised, and the caves were given Ancient Monument status - which ensured almost total protection for them. Construction of the shopping centre therefore had to straddle the caves, by use of carefully sited column bases and one large beam structure; a few caves of lesser significance were destroyed or filled to enable efficient land use of the available site.

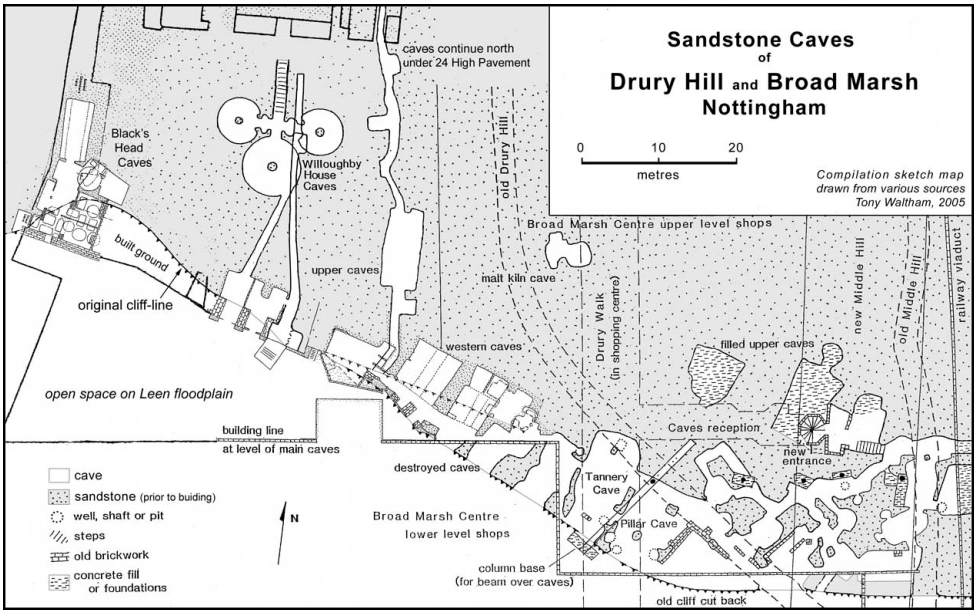

Figure 2. Outline plan of the caves in the sandstone beneath the Broad Marsh Centre.

The eastern caves under the Broad Marsh Centre have been developed as a tourist site, with access down from the upper level of shops. These include caves dated by their pottery fills to over 800 years ago, and also old beer cellars typical of many caves under public houses in Nottingham. The Pillar and Tannery Caves contain tannery vats about 500 years old, in worksites that had benefited from the almost constant temperatures underground. The foundations of the shopping centre are clearly visible, including the beam element that was required to avoid placing a column base in the finest of the tannery caves (Figure 3).

The western caves are not yet open for public access, but are currently being cleared by archaeologists, prior to a planned extension of the tourist caves after the Broad Marsh Centre is extensively rebuilt in the near future. Some of the city's more unusual and more spectacular caves include a private cellar cave excavated around 1740 for Lord Willoughby beneath the back garden of his town house. The western caves were stables, and now demonstrate the impact of weathering on the sandstone bedrock (Waltham & Cubby, 1997). Part of extensive remedial works are still visible in the Black's Head caves, where rock collapse in 1991 came close to causing failure of overlying office buildings (Waltham & MacCormick, 1993). Multiple levels of caves had been excavated from separate entrances, and perhaps a century apart. Centuries later, one cave had collapsed into the other, and the failure had propagated to the surface. The process had been initiated by leaking drains that had been damaged when the soil subsided over the upper cave that had been unroofed and back-filled with soil and rubble over a century earlier.

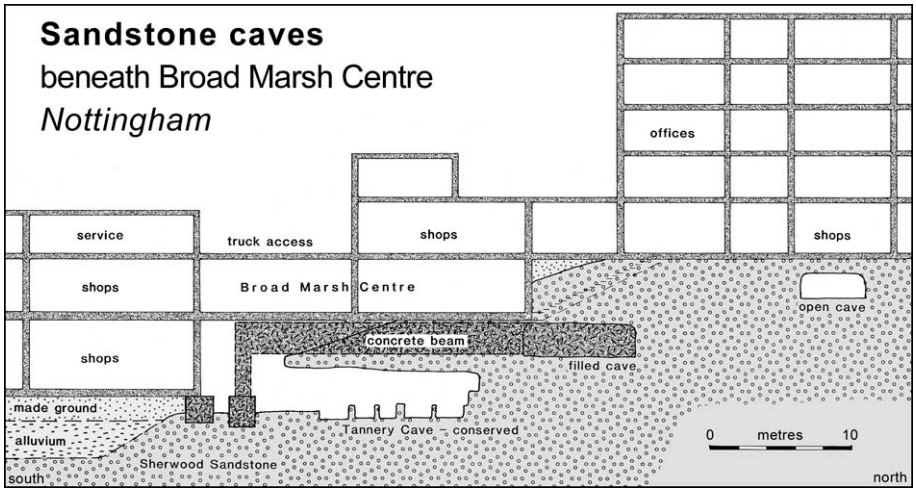

Figure 3. Profile through the Broad Marsh Centre with the concrete beam that supports it over the caves cut into the sandstone slope.

REFERENCES

HORTON, A. & LOTT, G., 2005. Building stones of Nottingham. *Mercian Geologist*, 16, 115-126.

WALTHAM, A.C., 1992. The sandstone caves of Nottingham. *Mercian Geologist*, 13, 5-36.

WALTHAM, A.C., 1993. Crown hole development in the sandstone caves of Nottingham. *Quarterly Journal of Engineering Geology*, 26, 243-251.

WALTHAM, A.C. & CUBBY, T.J., 1997. Developments in Nottingham's sandstone caves. *Mercian Geologist*, 14, 58-67

WALTHAM, A.C. & SWIFT, G.M., 2004. Bearing capacity of rock over mined cavities in Nottingham. *Engineering Geology*, 75, 15-31.

WALTHAM, T. & MacCORMICK, A., 1993. The caves, malt kilns and tannery at the Black's Head site, Nottingham. *Transactions of the Thoroton Society of Nottinghamshire*, 97, 66-73.

NOTE

The field excursion will visit caves both in and beyond the normal tourist zone. No special clothing is required, but sensible footwear is advised. Helmets will be available. Excursion delegates are requested to bring torches; only parts of the caves beyond the tourist trail are unlit, but a selection of torches within the group will improve the experience. Wheelchair access to the caves is not possible, but wheeled delegates are welcome on the city walk, which is less than 2 km long.