

## Chapter 2

# Military uses of sandstone caves of Nottingham, UK 1200-1945

T. Waltham & Russel. S. Harmon

**ABSTRACT:** The city of Nottingham stands on an outcrop of Triassic sandstone. Over 500 caves are known under the city, some over 1000 years old. The oldest caves cut into cliff faces were used as dwellings, but most provided store rooms underneath buildings, work rooms, or pub rooms and cellars (some of which are still in use). Certain caves have had military uses. Nottingham Castle was a royal fortress from 1068-1649. Claims exist that various other caves had medieval defensive roles, but there is a lack of solid evidence to support the many popular local myths. The major military use of the caves was during World War II as air-raid shelters. Some caves had other uses; one was brickwork reinforced as a bomb-proof city Civil Defence command centre and another was used for radium storage. Since 1945, the nearest thing to a military use has been the rifle range installed in one cave.

### 1. Introduction

The city of Nottingham stands on an outcrop of Triassic sandstone that forms low hills on the north side of the River Trent. The broadest of these hills was the site of the original Saxon settlement, and the higher but smaller hill just to its west was occupied as the Norman stronghold in the year 1068. Both the Saxon and the Norman towns expanded until they merged across the Market Square. They then occupied most of the sandstone outcrop immediately north of the low cliffs and bluffs that dropped to the Trent floodplain, and the town grew little more in size until the mid 1800s. The site of the old town is now roughly demarcated by the inner ring road around the modern city centre.

### 2. Geological Background

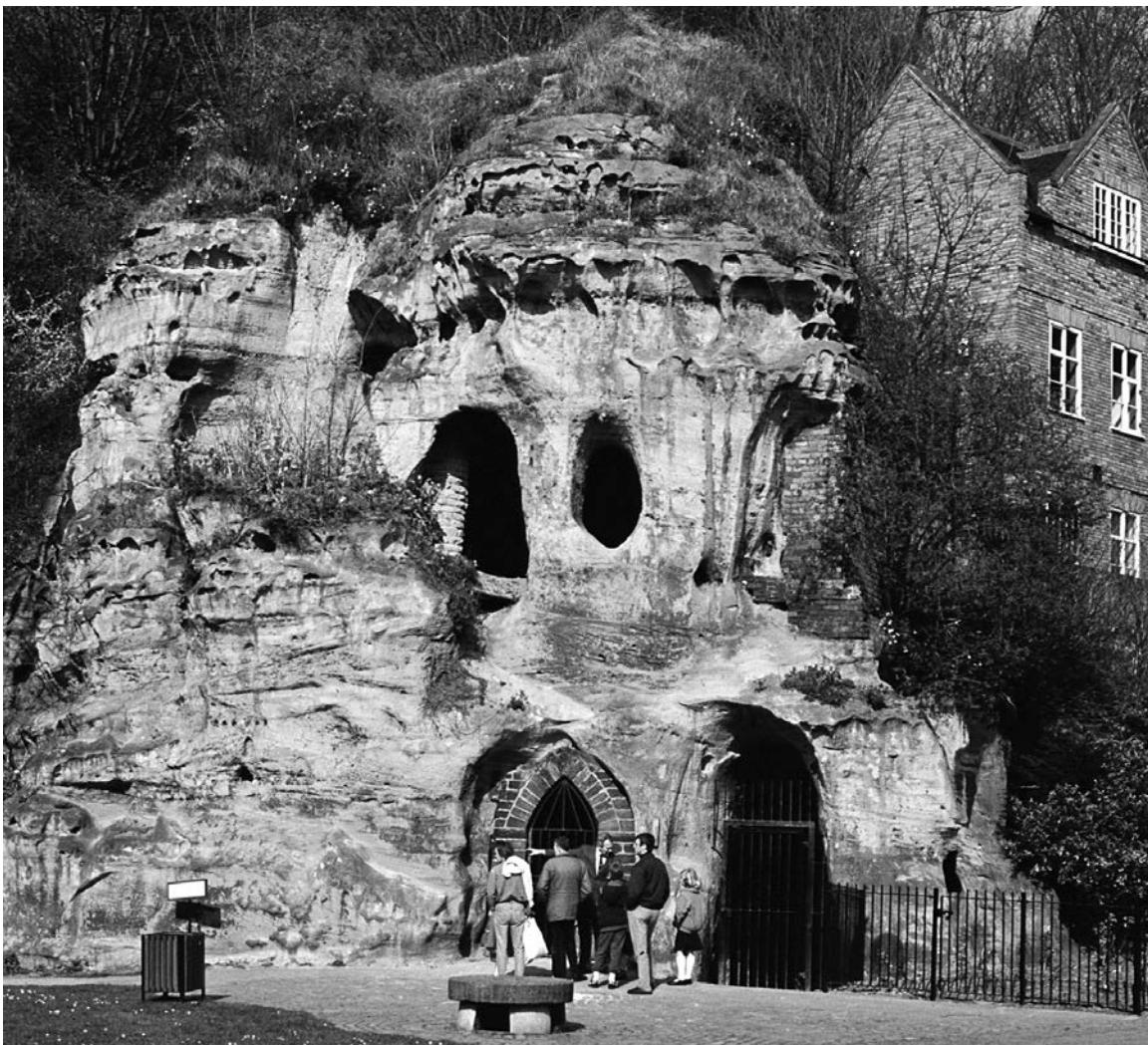
Nottingham's Triassic sandstone, locally known as the Nottingham Castle Formation within the Sherwood Sandstone Group, is distinguished by a low material but high rock mass strength. The sandstone has a high porosity, from which an initial calcite cement has been leached beneath all outcrops, so that only a weak clay cement remains. Its unconfined compressive strength (UCS) declines due to weathering near the surface; at the depths where nearly all Nottingham's caves have been created, at 2-5 m below ground level, UCS is generally 5-10 MPa. This material can be excavated with hand tools, with varying degrees of effort.

The high rock mass strength of the sandstone derives from its minimal fracturing (Figure 1). Major bedding plane weaknesses, within a few degrees of horizontal, are restricted to scattered horizons of flood deposits rich in rounded pebbles and mud flakes. When saturated by such as a leaking pipeline, the rock parts from cave roofs in bedding units only about 10 mm thick, but this weakness is not apparent or significant in dry rock. Sub-vertical joints are normally spaced at intervals of 10-30 m, and the few that have been encountered within caves are easily sealed with mortar or masonry.

This fortuitous combination of a weak material and minimal discontinuities makes Nottingham's sandstone an ideal tunnelling medium; it is easily excavated and yet stands safely over an unsupported span (Waltham & Swift, 2004). This must have been appreciated by the first inhabitants of the region, who would have found it easy to create dwelling space by excavating into the foot of the sandstone cliffs along the edge of the Trent floodplain. Though making convenient homes, it is doubtful that these early caves could have had any military role. Nottingham was documented as a "house of caves" by Asser, King Alfred's chronicler in the 9<sup>th</sup> century, but little more is known of these early cave houses. All have since been destroyed. Weathering causes cliff degradation and retreat, which has been matched by the townspeople cutting back the cliff profiles; new generations of caves were then excavated behind the position of those that had collapsed or been removed when they became unstable.

More than 500 caves are known under Nottingham, but all are thought to date from post-1200, but only a small proportion from post-1850 (Owen & Walsby, 1989; Waltham, 2008). Practically all available natural cliff faces had caves cut into them, some with multiple generations, but most of the caves were excavated underneath buildings, with stairway entrances and little or no natural light inside them. Most were effectively sub-basements under

individual buildings, though some were dug out beneath the adjacent gardens or yards. Caves beneath buildings were generally dry, because the building itself prevented rainfall infiltration. Most caves are 2-6 m wide and about 2 m high, but could be as long as required or as dictated by the boundaries of the available land.



**Figure 1** Type locality of the Nottingham Castle Sandstone, with caves cut into the old river cliff.

### 3. The Caves of Nottingham

The main use for the caves was storage, especially for liquids, where the benefits of year-round constant temperature underground could be realised. Almost every inn and public house had its beer cellar carved out of the rock, with steps down from the bar and a vertical barrel-drop down from the backyard; many of these are still in use today (Figures 2 and 3).

Caves were also used as work places. These include the medieval malt-kiln caves that are unique to Nottingham, of which thirty have been discovered to date (McCormick, 2001). Also distinctive are the three underground tanneries, with tanning pits cut into their rock floors (Waltham & McCormick, 1993); these have all been found in caves along the floodplain cliff, adjacent to the town's zone of 16th century tanneries that were mainly in the open and therefore of restricted use during freezing winters. Metal works, wagon works, monastic chapels, butchers, cisterns, wine vaults and grocers' cold stores were among other uses for the caves. There were also a few ornamental follies, just three groups of mines (for sand extraction) and a few tunnels that were dug purely as routeways (Waltham, 1994).

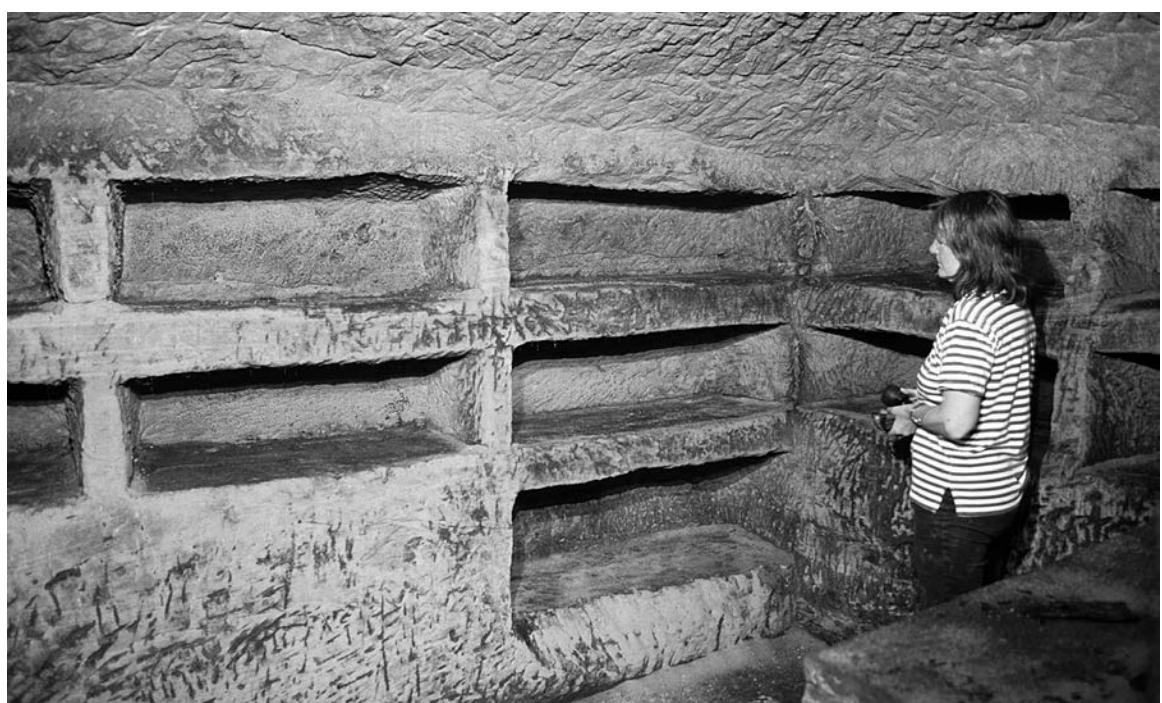
### 4. Military Roles For The Caves Before World War II

The known construction of underground chambers for military purposes extends back at least 5500 years (Eastler, 2004) and the use of natural caves probably to earliest human times. Over the years, some of Nottingham's caves have had their military uses. For long after its

core was first built in 1068, Nottingham Castle was a royal fortress and stronghold. Unfortunately, it was the site where, in 1642, King Charles I raised the royal standard in defiance of the parliamentarians thereby launching the English Civil War. This he subsequently lost, and Cromwell's republicans therefore demolished the castle in 1651. Only substantial mansions have stood on Castle Rock ever since. Beneath the castle site, the 'Rock' contains a number of caves of various ages (Figure 4). Some of these had no military role, but others were created or modified to be dungeons in which to incarcerate military and civilian prisoners. In 1346, King David of Scotland was captured and imprisoned in the castle; it has been claimed that he was held in the caves, but it would be difficult to confirm this.

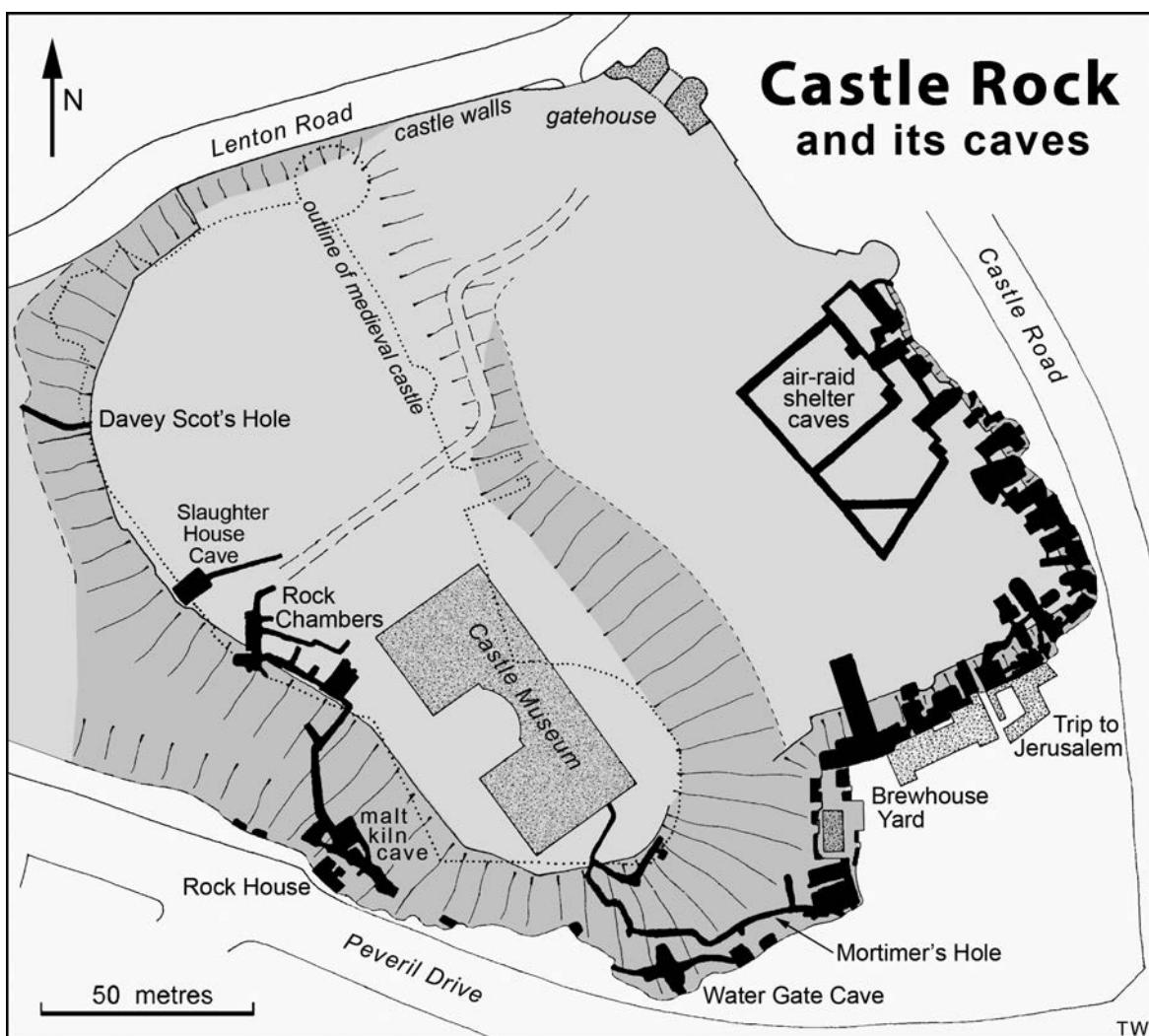


**Figure 2** An old beer cellar cave beneath a public house; it is a typical cave with its stairway entrance from the building above. The barrel thralls have been mistaken for beds in some interpretations of the cave's origin.



**Figure 3** Storage shelves cut into the rock walls of a cave under a modern building in the city centre.

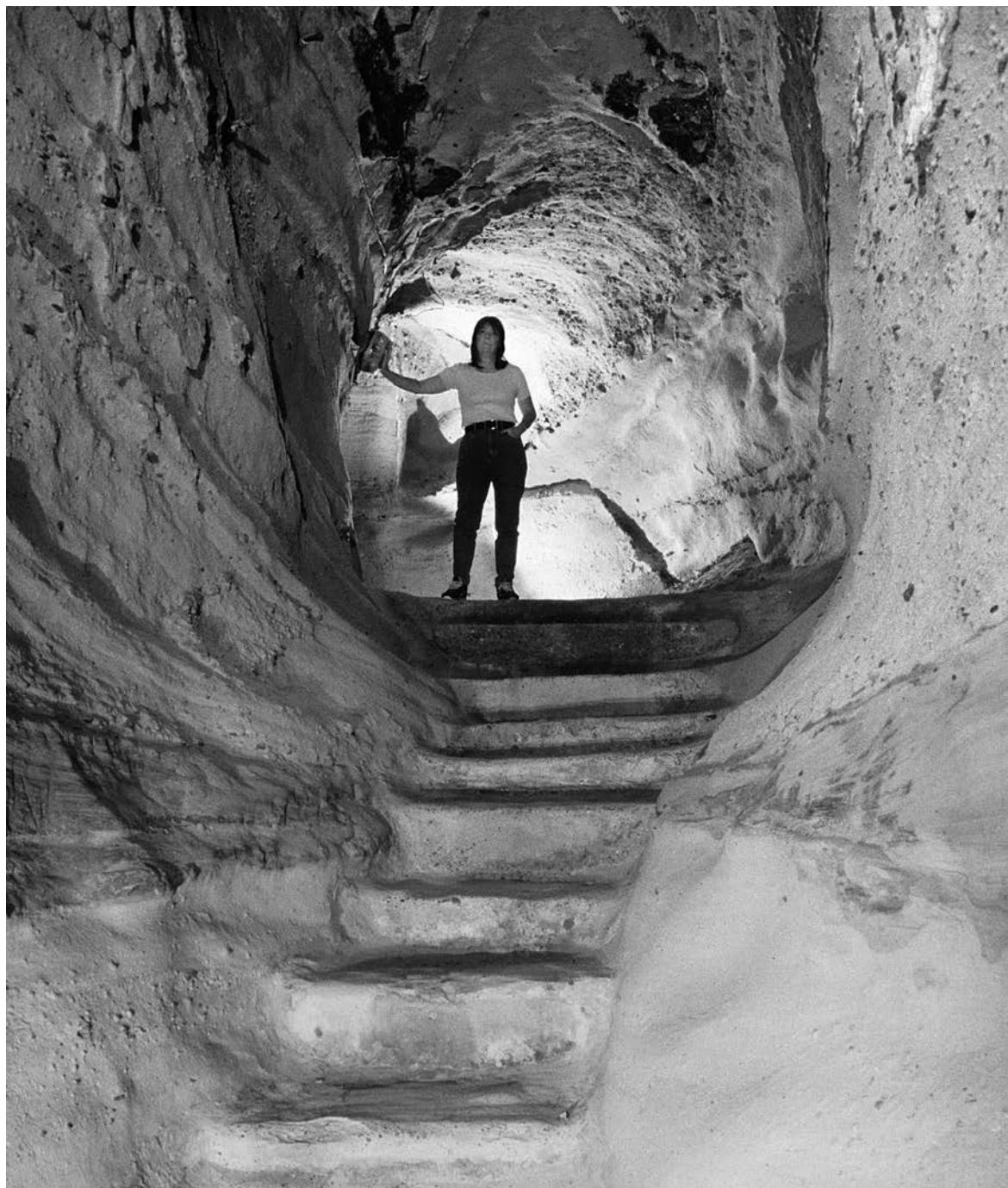
The greatest debate over a military role surrounds Mortimer's Hole. This is a steeply inclined tunnel, nearly 100 m long and almost a continuous stairway, inside Castle Rock (Figure 5). Its original top end opened inside the Castle yard, though its upper portion was later modified to emerge on the terrace of the ducal palace built for the Duke of Newcastle in the 1670s on the site of the demolished castle. Its lower end emerged adjacent to Brewhouse Yard, a site that has long held the civilian victuallers and merchants who supplied the military garrison above. The cave tunnel is named after its reputed association with Roger Mortimer, the lover of Queen Isabella and brutal murderer of Edward II, who was seized in 1330 on the orders of the vengeful young King Edward III. Whether his captors crept in via the tunnel, or whether he had previously used it to leave unnoticed after trysts with the queen, is open to debate, and the events were more probably related to a shorter cave passage on the opposite side of Castle Rock. It appears most likely that the longer cave tunnel was purely a convenient supply route from Brewhouse Yard to the castle atop the 'Rock' (as the gate and easy access was at the far end), possibly excavated on the orders of Richard I in 1194. Any flight of steps cut up the rock face would have taken little less effort to create and would soon succumb to weathering. In contrast, an underground flight of steps was far more durable, and also more easily defended should the Castle be under attack. That Mortimer's Hole was excavated as a "secret passage" to be used as an escape route seems rather fanciful, as it would only have been of use when under attack by an army too small to encircle Castle Rock.



**Figure 4** The known caves beneath Castle Rock.

At the southern edge of the Saxon town, a number of cave rooms and passages have been found under the old Shire Hall, which housed the courts, and the adjacent County Jail, both of which stood on the top of the Trent cliff. The full story of these caves is still under research, as not all have yet been found. Of those now known, it is neither clear how they relate to each other, nor is it known why each was originally excavated. Certainly over some periods of time all or most were used as cells, to hold both civilian and military prisoners. Many of these

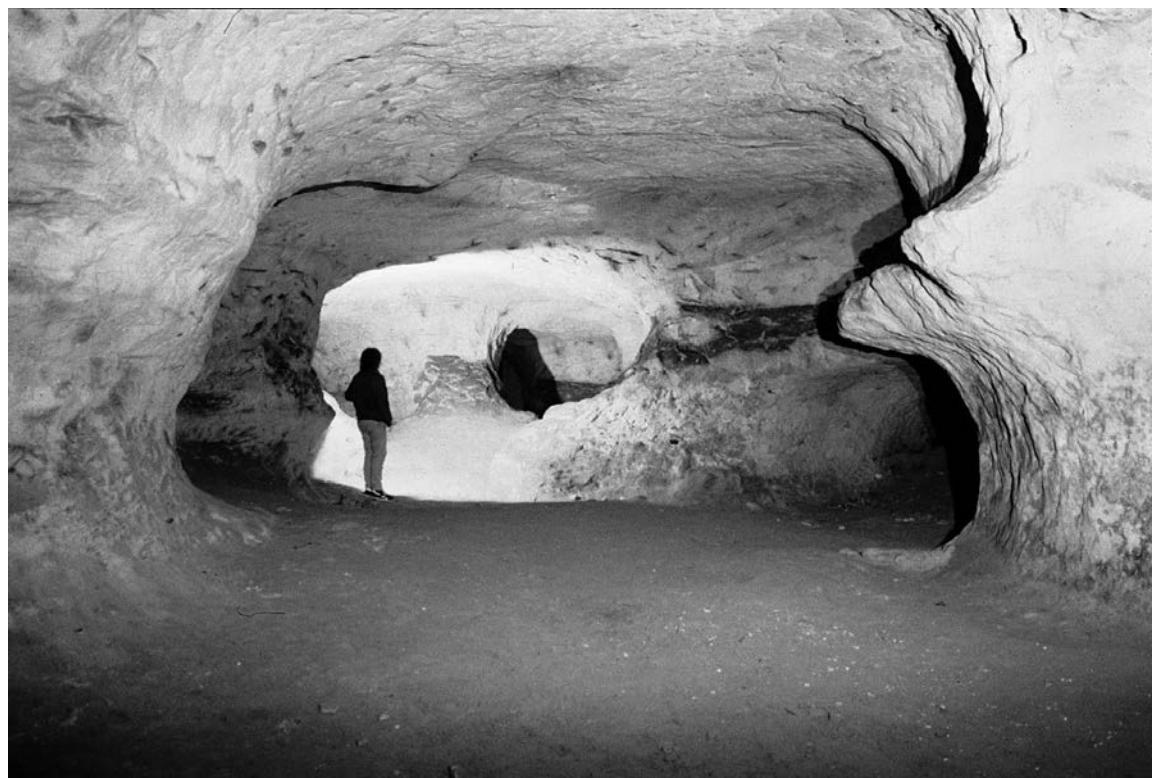
prisoners were held in the caves only until they could be transported to America or Australia, as was the normal means of disposing of convicts in the late 18th and early 19th centuries.



**Figure 5** The underground stairway known as Mortimer's Hole inside Castle Rock.

Beyond those at the Castle and Shire Hall, it is very difficult to be certain of any early military or strategic uses of the numerous caves under Nottingham's city centre. There are numerous claims that various caves had medieval defensive roles, but there is a lack of solid evidence to support the many popular local myths. A misguided report from the 1930s described defended cave houses with stone beds around their walls - that are in fact beer cellars with barrel thralls (Figure 3); holes from the surface, down which pebbles could be dropped by a lookout to warn of attack, are actually site investigation boreholes drilled to locate lost caves centuries after their first use. The old sand mine under the northern edge of town dates from about 1800, but was claimed by Victorian "historians" to be a Druid underground city; ledges in the caves "where defenders hid with weapons" are in fact traces of the two levels of the mine created before the intervening floor/roof was broken out to create a high gallery (Figure 6). Nottingham's most popular myth is of the network of caves passages that extend under the

city. There are claims of amazing escapes and underground journeys, and, not surprisingly, Robin Hood is supposed to have used one cave passage under the Saxon town site. But there are not, and never have been, any long passages, as very few caves extend beyond the confines of the single building that they underlie. Such stories may be exciting, but they lack any sound evidence or indeed any correlation with reality.



**Figure 6** The main double-level room in Rouse's sand mine, with the remnant ledges that were mistaken as Druid defensive stations by Victorian historians.

## 5. Wartime values of the caves during World War II

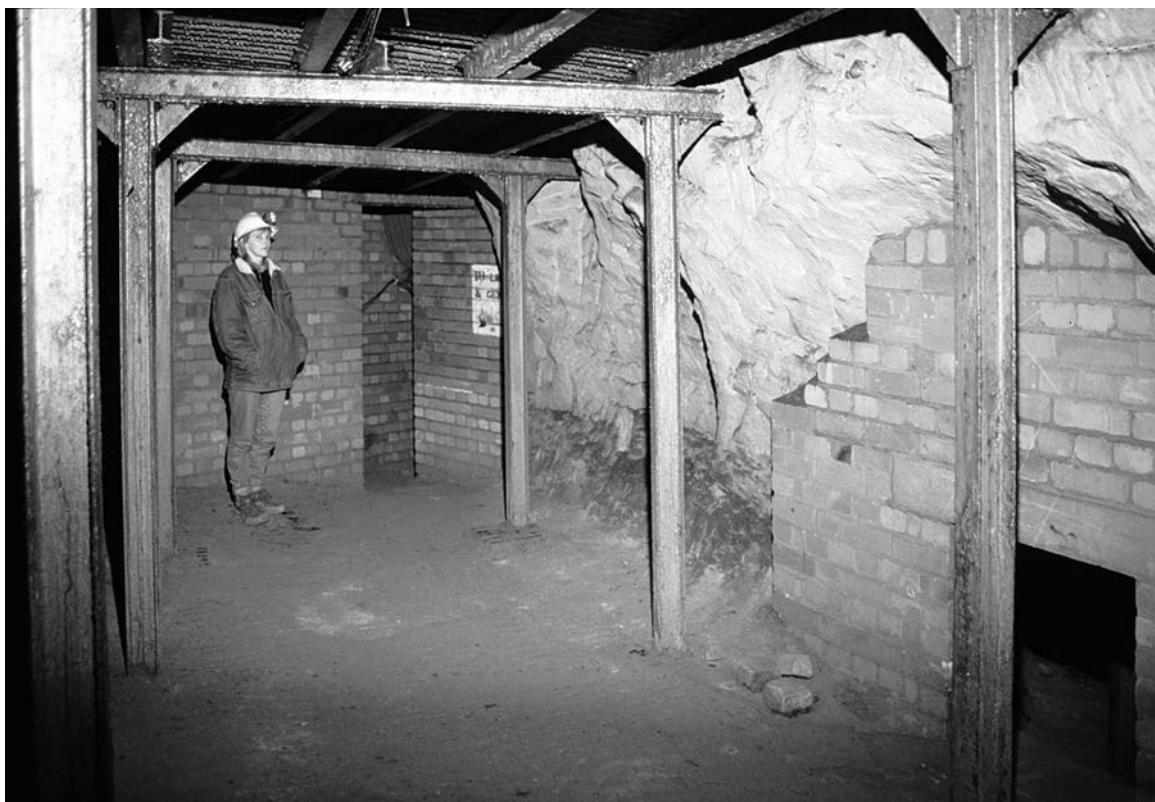
By far the most extensive military use of the caves was during the Second World War. Between 1939 and 1941, at least 86 of the caves were designated as air-raid shelters for the local population. The prospect of massive bombing of Britain's cities by the *Luftwaffe* prompted a government drive to provide adequate defensive shelters into which people could retreat at the wail of the air-raid siren set off when the bombers were sighted. It took little imagination to see the existing caves, cut deep into solid rock, as more satisfactory than the widely-used Anderson shelters with their earth banks over arches of corrugated iron. Most of the larger caves that were easily accessible at the time appeared on the register of shelters.

Development of a cave air-raid shelter required modifications to most of the existing caves. A second entrance was obligatory; in some this meant that new flights of stairs were cut through the rock - as in both the surviving sand mines; in many smaller caves this was just a shaft with a vertical ladder. At some cave shelters, short lengths of new tunnel were cut to link adjacent caves and thereby create the essential alternative access through the existing entrances; these include some of the connections within the Drury Hill caves that now constitute the unusually extensive network open to tourists beneath the Broad Marsh shopping centre. Some caves had blast walls installed near their entrances; brick buttresses a metre thick were shimmmed tightly against the cave roof, and were built in off-set pairs to act as baffles that could reflect some of the shock wave energy from a blast near an open entrance. Steel roof supports were installed in many of the shelter caves, with corrugated iron lagging between 100 mm I-beams supported on stanchions of the same size (Figure 7). In many of the deeper caves this support was a case of over-caution, because the rock roof was far stronger than the installed steelwork, but the lagging did have the benefit of preventing small-scale roof-falls that may have been triggered by bomb-blast vibrations. Most shelter caves had some form of electric lighting fitted.

At least ten of the air-raid shelter caves were purpose-built tunnels, newly excavated within the sandstone deep beneath the lines of streets in order to avoid structural loads. These new purpose-built air-raid shelter caves are distinguished by their extended linear form, with long straight tunnels mostly only 3m wide; those under Castle Rock had gothic-arch profiles (Figure 8). They lie at much greater depth than most other caves, and all of them have at least two entrances, though one of these may be only an emergency-exit shaft to a manhole in a road. To achieve the required depth and roof cover without long flights of entrance steps, they were mainly cut into sloping ground.

Another group of purpose-built air raid shelter caves was excavated just northwest of the city centre, including the large network beneath the streets around the Player's factory, that were capable of sheltering over 8000 people. However most of these tunnels were cut-and-cover excavations beneath the streets; they are brick lined, and were cut in the *in-situ* sand of the weathering zone, not deep enough to have a roof of the bedrock sandstone. A by-product of all these new cave excavations was a large surplus of sand, which was more than welcome for filling sand-bags used to defend buildings around the town.

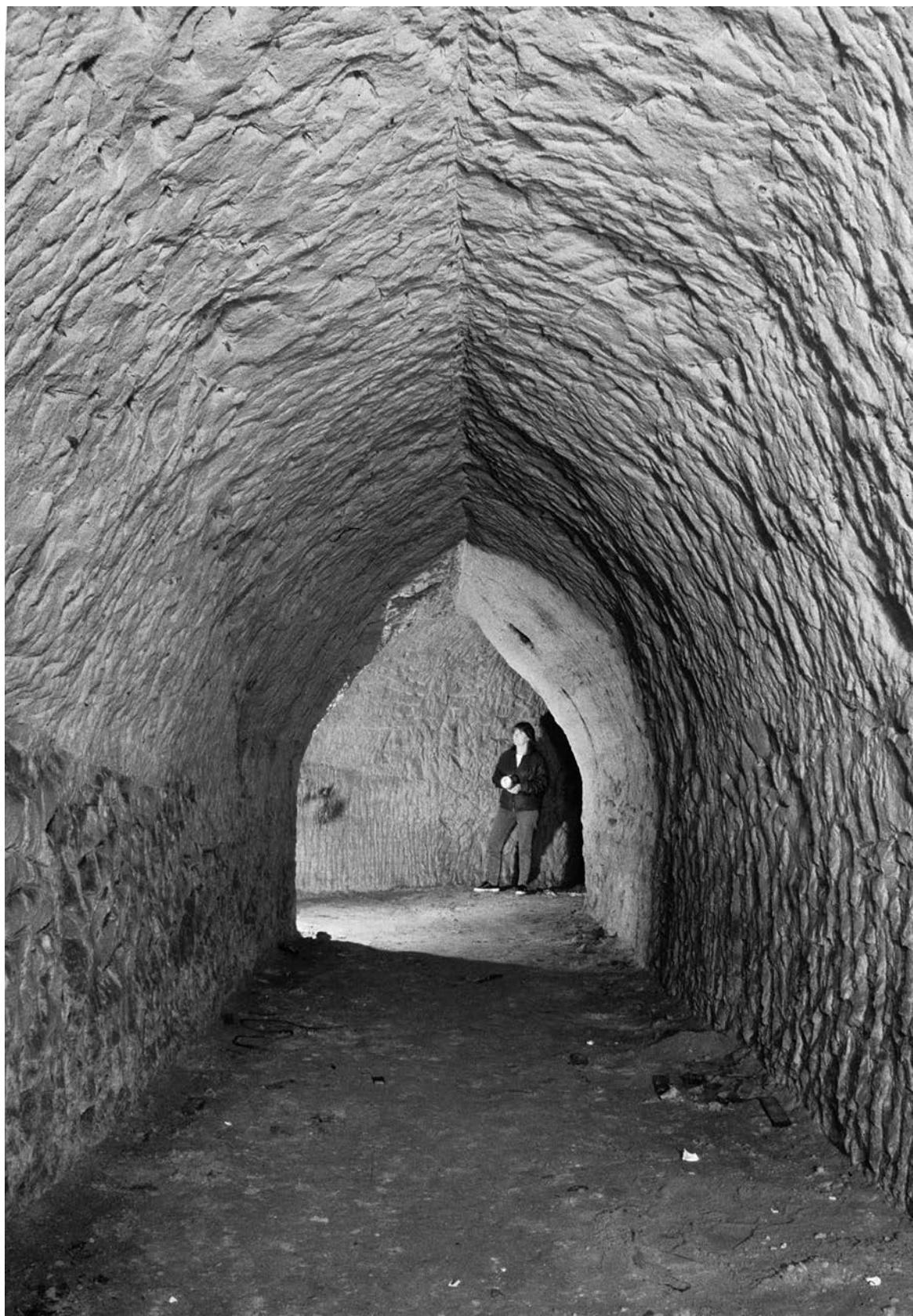
The larger air-raid shelter caves were fitted with seating, tables, water boilers and rest rooms for longer periods of occupation, but the very small number of air raids on Nottingham meant that the facilities were barely used. This contrasts with the situation in Stockport, near Manchester, where a long system of cave tunnels was excavated in the same Triassic sandstone. A small group of old cave rooms cut into a steep slope in the town centre was used as a convenient air-raid shelter, and gave the idea of increasing the capacity by extending them with new tunnels. These were broken out progressively through the long period of the war when Manchester suffered repeated bombing raids. Eventually, the Stockport complex had 3000 bunk beds installed (Figure 9), and hundreds of people stayed in the caves every night for weeks on end throughout the main blitz (Waltham, 1998).



**Figure 7** Internal steel supports that were added to a cave designated as a wartime air-raid shelter.

Back in Nottingham, one group of caves was given special treatment. The municipal buildings that include the old Guildhall, the fire station, and the central police station had been built over the old wine vaults that had been excavated for a 19th century vintner. Like most of the few other cave systems excavated after about 1850, when common lands outside the old town were made available for development by the passing of the Enclosure Acts, this cave system was larger than typical older caves under the old town. It consists of a number of large rooms, each 5-6 m wide and 10-30 m long, on two different levels (Figure 10). The cave was of ideal

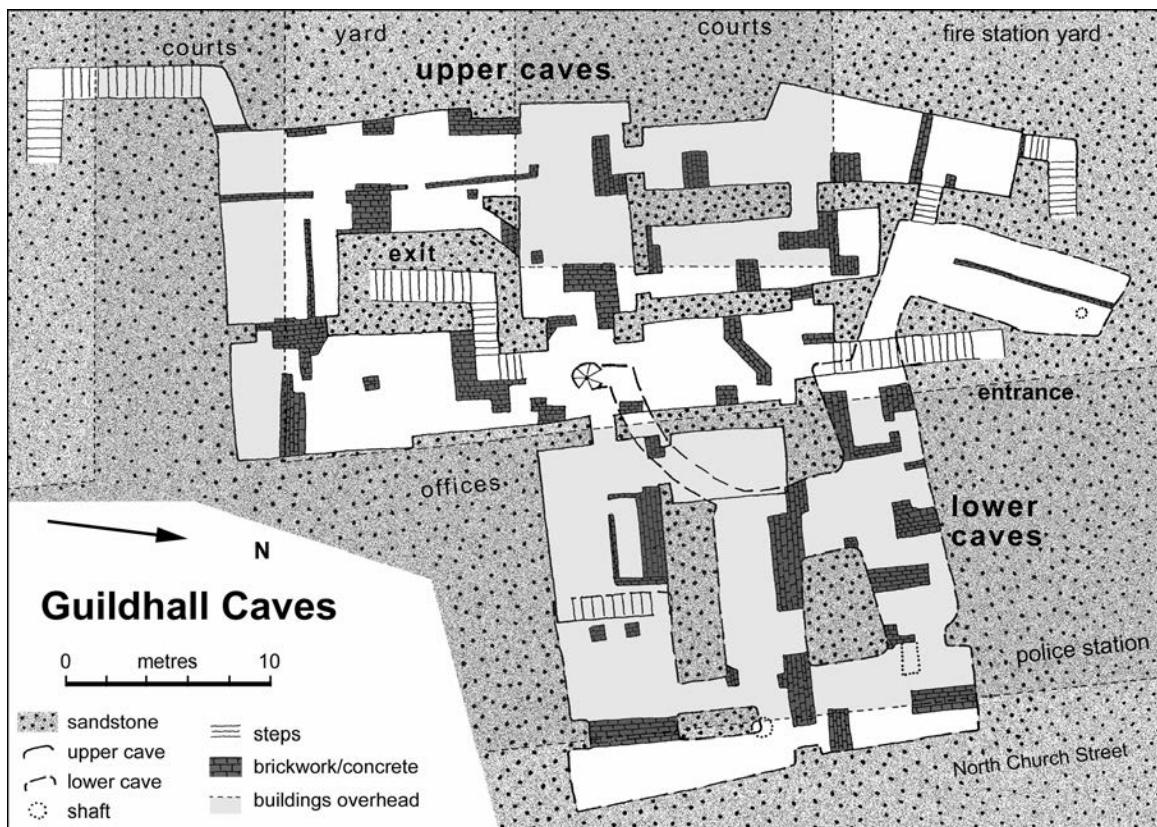
size and at an ideal site to be developed as the local Civil Defence headquarters. It was however extensively modified and strengthened by a plethora of blast walls, extra roof supports, concrete reinforcement and room dividers, and was given three extra stairway entrances. The strengthening was largely justified by the rock cover of only 3 m in some parts.



**Figure 8** A purpose-built air-raid shelter cave deep inside Castle Rock.



**Figure 9** Bunk bed frames remain in the purpose-built air-raid shelter caves under Stockport.



**Figure 10** The Guildhall caves, with all the extra masonry placed to stabilise the site as the city's bomb-proof Civil Defence headquarters to be used in an emergency situation.

One of the isolated older caves under Castle Rock was used as a wartime radium store and radon extraction plant. The cave was ideal protection for such sensitive materials and equipment, but it did require a very thorough clean-out when the radium was finally removed

in 1953. There could well have been other clandestine military operations that took place out of sight in Nottingham's caves, but records of such things are not likely to be revealed.

Since 1945, the caves could have returned to more peaceful uses, but with the exception of a number of beer cellars, they have steadily fallen into disuse. They would have little role in modern warfare. The nearest thing to a post-war military use of the caves has been a rifle range installed in one of them, but it is for recreational shooting.

## 6. References

- Eastler, T.E. 2004. Military use of underground terrain: A brief historical perspective. In: Caldwell, D.R., Ehlen, J. & Harmon, R.S. (eds) *Studies in military geography and geology*. Kluwer Academic Publishers, Dordrecht, pp 21-37.
- McCormick, A. 2001. Nottingham's underground maltings and other medieval caves: architecture and dating. *Transactions Thoroton Society Nottinghamshire*, vol. **105**, pp 73-99.
- Owen, J.F. & Walsby, J.C. 1989. A register of Nottingham's caves. *British Geological Survey Technical Report WA/89/27*. British Geological Survey, Keyworth.
- Waltham, T. 1994. The sand mines of Nottingham. *Bulletin Peak District Mines Historical Society*, vol. **12**, pp 1-11.
- Waltham, T. 2008. Sandstone caves of Nottingham. 3<sup>rd</sup> edition. East Midlands Geological Society: Nottingham, 55pp (updated from *Mercian Geologist*, 1992, vol. **13**, pp 5-36).
- Waltham, T. 1998. Underground in Stockport. *Geology Today*, vol. **14**, pp 132-133.
- Waltham, T. & McCormick, A. 1993. The caves, malt kiln and tannery at the Blacks Head site, Nottingham. *Transactions Thoroton Society Nottinghamshire*, vol. **97**, pp 64-73.
- Waltham, A.C. & Swift, G.M. 2004. Bearing capacity of rock over mined cavities in Nottingham. *Engineering Geology*, vol. **75**, pp 15-31.