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RAF Bentley Priory Dingle Station and Tunnel Underground Naples WWI Tunnels in France

Subterranea Britannica



www.subbrit.org.uk

Subterranea Britannica is a society devoted to the study of man-made and man-used underground structures and the archaeology of the Cold War. The society is open to all and its membership includes all walks of life. Members are invited to contribute to this magazine even if this just means sending very welcome snippets from newspapers and magazines.

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Front cover photo: Storm overflow sewer leading to an outfall by the Albion Groyne alongside the Palace Pier in Brighton. These days, foul water would only enter the sea in extreme and prolonged storm conditions. A short distance along the overflow sewer is a vertical shaft, 100 foot down into the overflow tanks beneath the beach. Photo Nick Catford

One of the new computer suites built during the refurbishment of the former WWII bunker at Bentley Priory Back page upper: in the 1960s. Photo Nick Catford

**Back page lower:** The Sub Brit party 'on parade' at the Wartling Rotor radar station during the September 2012 Sussex weekend. John Smiles holds the original Rotor identification panel which will be replaced in its original position in the upper spine corridor. Photo Mark Russell

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Newsletters of Subterranea Britannica are published by the committee of Subterranea Britannica. Original articles, book reviews, press cuttings, extracts from books and journals, letters to the Editor etc are welcome. However the Editor reserves the right not to publish material without giving a reason.

> The committee of Subterranea Britannica and the Editor do not necessarily agree with any views expressed and cannot always check the accuracy of any material sent in.

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## **Chairman's Welcome**

## **Martin Dixon**

A warm welcome to all new members – I hope to meet you above or underground soon.

It's been a great year for visits to underground places – from the Neolithic La Hougue Bie in Jersey to the enigmatic Williamson's Tunnels in Liverpool. The NAMHO conference opened up some cracking mines and at other times members were able to take a close (enough!) look at parts of the sewers in London, St Helier (Jersey) and Brighton. We also took in our usual dose of military heritage – including the atmospheric Fighter Command Control at Uxbridge, the now dry depths of RAF Wartling, the moving artwork at Wavertree airraid shelter and the rich variety at Newhaven Fort.

I know I speak on behalf of everyone in thanking those who have arranged access, organised trips and otherwise helped with arrangements. The visits mentioned were open to all members but for those who couldn't make them we always try to include a write-up in *Subterranea* – thanks to the authors too.

One thing that many of the visits have in common is that we work with other groups, volunteers and authorities. As a UK (indeed, worldwide) organisation with broad interests, there are often likely to be other local or specialist groups involved with specific sites of interest. Two examples of such groups who we've worked with are the Channel Islands Occupation Society and Friends of Williamson's Tunnels in Liverpool.

It is really great to see their local work going on – be it excavation, restoration or interpretation. Sub Brit's members are, of course, involved in quite a number of sites themselves, from the smaller individual ROC posts to work and restoration at larger sites such as Wartling [RAF Rotor station] or Craigiebarns [ROC Group HQ]. The September opening of Paddock standby Cabinet War Room for London Open House was a great success with over five hundred visitors; many thanks to all those Sub Brit members who acted as guides.



It is refreshing when local authorities recognise the importance of underground structures and work with us. Liverpool City Council were hugely helpful in allowing us access to sites for the October weekend – including authorising us to demolish and then reinstate the blocked entrance to Wavertree air-raid shelter. We have also worked with Lambeth Council in London to erect (at their expense!) a display board describing the deep-level shelter at Clapham South. (see page 75)

On the other side of the metropolis it was disappointing to learn that the London Borough of Brent withheld funding for London Open House which threatened the regular Paddock open day. We were delighted when our friends at Stadium Network Housing stepped into the breach and helped fund the Open House programme.

So, wherever in the world you live or work, please look for opportunities to work with other groups or authorities. No one has a monopoly on celebrating our underground heritage and the (w)hole is often greater than the sum of the parts.

chairman@subbrit.org.uk



For more information, see the Flyer enclosed with this magazine. Cost is expected to be around £300 – £350, covering hotel, meals, transport and entrances.

If you have any questions, please email info@subbrit.org.uk

## SUBTERRANEA BRITANNICA DIARY Summary of Forthcoming Events 2013

#### Sub Brit specific events

26 January SB Committee meeting 1 March Copy deadline for *Subterranea 32* End April *Subterranea 32* published 20 April SB Spring Meeting and AGM 10-13 May SB Visits weekend to Gothenburg, Sweden 15 June SB Committee meeting 1 May (tbc) Paddock open day 19 October (tbc) SB Autumn meeting and visits 21 September Paddock open day For more information, email info@subbrit.co.uk or contact the Society concerned **Other underground-related events** 

13 and 20 January The return of steam to the Underground www.ltmuseum.co.uk/whats-on/lu150

17-18 January Going Underground: Travel Beneath the Metropolis 1863-2013. Underground Conference, Institute of Historical Research (University of London) events.history.ac.uk/event/show/7023

- 21 January Talk: The Underground Pioneers. Cubic Theatre, London Transport Museum
- 27 April SERIAC (South East Regional Industrial Archaeology Conference) hosted by Kent
- Archaeological Society www.kentarchaeology.org.uk 28 June to 1 July NAMHO conference and visits, Aberystwyth www.namhoconference.org.uk
- Sat 13 Sun 28 July Festival of British Archaeology (CBA) www.festival.britarch.ac.uk
  - 12-15 September Heritage Open Days www.heritageopendays.org.uk
  - 21-22 September London Open House www.londonopenhouse.org.uk

## Subterranea Britannica Notice of Annual General Meeting 2013

\*\* Important Information \*\*

The AGM will be held on Saturday 20 April 2013, at 10.00am at the Royal School of Mines, London, in association with the Spring Meeting Documents for the AGM will be available on our website at www.subbrit.org.uk at least 28 days in advance of the meeting A note will be sent to the 'announce' email list to advise when such documents are available Those members who have registered to receive documents by post will be sent them when they become available Minutes of the AGM 2012 were printed in *Subterranea 30*, August 2012. Spring Meeting 2013 Saturday 20 April, commencing at 10.20am

## Royal School of Mines, London SW7 2BP

There will be the usual mix of interesting illustrated talks, including Bryan Lawton on 17th-century tunnelling, Gabriel Moshenska on the archaeology of air-raid shelters in Spain and Britain,

## Nick Catford on Underground London,

Bob Hunt on the Portsdown complex and Naval fuel bunkers in Portsmouth,

along with Members' contributions and a chance to

## meet and mingle with fellow enthusiasts

A Paper Booking Form is enclosed with this issue of Subterranea The programme & booking form will also be on the website

## Please put the date in your 2013 diary now!

## **Committee Notes – September 2012**

## Chairman

Martin Dixon introduced Richard West, who attended as an observer, but had volunteered to join the committee. The Chairman reported on contacts that had been made with various other bodies, including the Italian 'artificial cavities' speleology group, English Heritage, the CIOS and The National Trust, which had formally opened the replica OB at Coleshill in September (the project was led by Sub Brit member Richard Alexander).

## Finance

Martin Dixon reported that the 2011 accounts had been filed at the Charity Commission, and that an accountant had been appointed to produce and inspect future accounts. Tony Radstone reported that a donation from the 'Gift Aid funds' had been made to the Craigiebarns bunker, and that requests in respect of the Wartling bunker and Cuckfield ROC post were under consideration.

## Website

Richard Seabrook reported that social media sites were still going strong – Facebook 1,094 likes, Flickr 104 members and 311 images, Twitter 681 followers. During the quarter since the last meeting (June-August) we served 104,203 unique visitors over 1.5 million pages. The Chairman said that he saw implementation of CiviCRM as a key step in our web upgrade and believed that we should do all possible to achieve it this calendar year. The new 'shop' was almost complete, and would be launched as soon as possible.

## Day Visits

Bob Templeman reported that many successful visits had taken place, including the ROC HQ at Watford, Kelvedon Hatch, Upper Heyford and the 11 Group Operations Room at Uxbridge. A number of other visits were currently being planned, and would be publicised as soon as details were finalised.

## Subterranea

Nick Catford reported that there had been some production problems with issue 30, but these had all been resolved in time to meet the scheduled publication date. Issue 31 was progressing well, for publication before Christmas. In view of the number of articles awaiting publication, the committee agreed to increase the number of pages to 76.

## The Sub Brit Collection

The chairman reported that we are trying to implement new arrangements to ensure that the Collection is made available to members as quickly as possible, including an index.

## Meetings

Arrangements for the Autumn Meeting in Liverpool had been finalised, and more than sixty bookings had been received covering both days. Early planning is already under way to identify speakers for the 2013 Spring Meeting on 20 April and the Autumn meeting on 19 October. If the format of visits in combination with the Day Meeting worked, other similar locations such as Brooklands and Bletchley Park would be considered for future meetings.

## Weekend Visits

Mark Russell said that the Sussex Weekend had been a great success, with fifty members attending – many of them first-timers. Plans are being developed for 2013 for weekends in Devon and Sweden and arrangements would be publicised as soon as they were confirmed.

## Membership

Nick Catford reported that current membership was over 1,000, with renewals still being received. However, it was likely that the total for the year would be a little down compared with last year. He noted that the Site Directory was continuing to sell very well – especially at Paddock.

The next committee meeting will be held on Saturday 26 January 2013; any members wishing to raise any matter should do so in writing to the Secretary at least two weeks before.

## **Roger Starling, Secretary**



## **NEWS – ARCHAEOLOGY**

## Prehistoric to twentieth-century cave dwellings at West Hoathly, Sussex

Members of the Sussex Archaeological Society recently visited two caves or rock shelters at Chiddingly. Adulam's Cave is associated with prehistoric worked flints and was reportedly occupied by a 'hermit' until the early twentiethcentury, by which time a chimney had been provided (now home to a colony of bats). Nearby, also visited, is Norraine Cave, of which no details are reported.

SOURCE: HANNA, Sarah, 2012, Chiddingly Wood Rocks: prehistoric occupation sites and a hermit's hideaway. *Sussex Past & Present* 127 (August 2012), page 6.

## NEWS – CONSERVATION AND HERITAGE

## Radstock Museum, Somerset

Radstock museum, commodiously housed in the former market hall in the centre of the town, is operated by members of the Radstock, Midsomer Norton and District Museum Society. The standard of presentation is impressively professional.

The displays cover a number of aspects of this district within the Somerset coalfield, with coal-mining prominent amongst them. The last mine closed as recently as 1973. A small shop sells a range of published material relating to the collieries, including Shane Gould's very informative booklet *The Somerset coalfield* published in 1999 by the Somerset Industrial Archaeology Society, and a reproduction of a 1902 Ordnance Survey plan of the town as it was in that year, with an astonishing array of collieries, passenger and freight railway lines (one of Alan Godfrey's maps). With these in hand, a series of local walks in the district would guide modern visitors to the remaining tangible evidence for the industrial heritage here. The museum makes a charge for entrance: £5 but reduced to £3.50 for concessions.

The museum's website is www.radstockmuseum.co.uk REFERENCE: Radstock, Midsomer Norton & District Museum Society, 2002, *A guide to Radstock Museum*. 20pp.

## English Heritage's at-risk register is growing faster than buildings are being saved

One of the first atomic bomb stores built in England has joined a bell foundry, a fairground roller coaster and a tumble of stones which may once have been a monks' kitchen among more than 5,800 important listed buildings and structures which appear on the latest English Heritage at-risk register.

Although thousands of buildings have been rescued since the register was first launched in 1998, the list is growing faster than buildings are being saved, a situation worsened by government cuts to English Heritage's funding. In the past year, 318 sites have been saved and removed from the register, but 360 new sites have been added.

Many make the list because their original purpose has vanished – fortunately in the case of the scruffy sheds

and towers at Barnham in Suffolk which was one of Britain's first purpose-built stores for atomic bombs. They were top secret when built in the early 1950s to house the RAF's first atomic bomb, codenamed Blue Danube, using a special grit-free surface to prevent the risk of sparks.

The explosive components were stored separately in deep thick-walled pits, and ringed with watch towers, triplewire security fences and guard posts. They were decommissioned within a decade and, no longer secret, soon targeted by vandals. They are now listed as Grade II\*, the second highest category, recognising their importance in the history of Britain and the Cold War.

The current owners have worked with English Heritage to repair the watchtowers and the kiosks which housed the nuclear components, but much remains to be done, and even the most ardent conservationist would find it hard to dream up a new use for such a site. This is the problem for the most intractable cases on the at-risk register, including old industrial sites, hospitals and other sites which have lost their original function and have no obvious economically viable new role which could pay for the restoration work.

Just thirteen percent of the 5,831 buildings and sites on the register are considered economic to repair. That dismal picture is about to worsen, as English Heritage appeals for volunteers and local societies and groups to help survey the condition of England's 385,000 Grade II listed buildings, which make up 92 percent of all listed buildings. Outside London these have never been included in the annual at-risk surveys, because the scale of the task was beyond English Heritage's resources. If the guesstimate is true, that at least five percent of such buildings are in trouble, next year's at-risk register will swell dramatically.

See Sub Brit web site:

www.subbrit.org.uk/rsg/sites/b/barnham\_nuclear\_bomb\_store/ index.html

SOURCE: The Guardian 12 October 2012

## **NEWS – MILITARY AND DEFENCE**

**Gwent county emergency centre to be demolished** A disused nuclear shelter built underneath the former headquarters of two councils will have to be filled in before the site can be sold – and that will slash the cash they can raise from its sale.

County Hall, in Cwmbran, which was shared by Monmouthshire and Torfaen councils, closed in March 2012 because the building has 'concrete cancer'. With rain penetrating the cladding and rusting steel supports, it would have cost £30 million to repair.

At a meeting of Monmouthshire Council in October, councillors were told that a void in the ground underneath the site is part of the reason that the value of the land has reduced by £675,000 since valuations were first made. Investigations at County Hall discovered a void underneath so large that when it is demolished "we would



have to import large amounts of soil to flatten off the site."

The Gwent County Emergency Centre at Cwmbran was completed in 1976 and utilised an existing void beneath County Hall. Part of this was converted into the emergency centre, but there were no blast doors or air filters, just a standby generator which served the whole building. Later, part of the bunker was retained for civil emergencies with the rest used as County archives centre. SOURCE: *South Wales Argus* 2 October 2012

## Soviet nuclear missile silos open to the public. Lithuania

A soviet nuclear missiles base in Lithuania, not far from Kaliningrad (a detached part of Russia), is now open to the public. Guided tours of the subsurface silos in the Zemaitija National Park are on offer in the facility built in 1960. The missiles were removed in 1978.

SOURCE: PRICE, Debbie, 2007, From sandy beaches to nuclear arms race. *Sheffield Star*, 10 November 2011.

#### Cold War missile sites get listed status

Two Cold War nuclear missile sites are to get listed status to mark the fiftieth anniversary of the Cuban Missile Crisis. The former RAF sites in Harrington, Northamptonshire and North Luffenham, Rutland, are the most intact examples of Thor missile bases in England. They were put on alert as the Soviet Union and the US came to the brink of nuclear war in October 1962. The USSR eventually agreed to remove its missiles from Cuba and the US pledged not to invade the island.

The Thor missile site at the former RAF North Luffenham, Rutland, has been given a rare Grade II\* listing, while the site at former RAF Harrington, Northamptonshire, has been listed as Grade II. The two sites still have concrete launch pads and blast walls, along with mounting bolts for the platforms that would raise the missiles into a vertical firing position.



The Thor missile launch pads at RAF North Luffenham Photo Nick Catford

The listing, which recognises the sites' architectural and historic importance, followed advice from English Heritage and is part of an ongoing project to ensure the best Cold War structures are preserved. Dr Simon Thurley, chief executive of English Heritage, said the remains of the Cold War were "fading from view faster than those of the world wars."

"These two missile sites are among the few physical reminders in this country of the Cuban missile crisis, a moment when the entire world held its breath," he added. "They deserve to be protected to remind present and future generations of this knife-edge moment in history." In total, sixty Thor missiles, developed by the US, were deployed at twenty sites in the east of England from 1958 under the codename 'Project Emily'. They were manned by the RAF, although their warheads remained under US control. The decision to launch them would have been made jointly by the two countries.

RAF North Luffenham is now St George's Barracks, while RAF Harrington is now mostly farmland.

SOURCE: BBC News 16 October 2012

## World War II air-raid shelter discovered at Cudworth, near Barnsley

Redevelopment of a former school site at Cudworth (four miles northeast of Barnsley, Yorkshire), has revealed forgotten WWII air-raid shelters under the playground. The site, in Pontefract Road, was in 2007 being redeveloped with 38 new houses for first-time buyers. Whether access to the shelters was to be retained or not is not stated.

SOURCE: ROBINSON, Michael, and Joe WALTERS, 2007, Homing in on an air-raid network. *Sheffield Telegraph* (*Property Today*), 7 December 2007.

#### Polish Führerbunker to be a museum

The ruined bunker complex set deep in the forests of northeast Poland was once the nerve centre of Adolf Hitler's war machine. More recently, tourists play paintball and pose for photographs in Nazi uniforms at the site which critics have dubbed a "grotesque Disneyland".

But now, 68 years after German troops dynamited much of Hitler's so-called "Wolf's Lair" before fleeing the advancing Soviet Red Army, Poland has announced plans to renovate the 600-acre complex and turn it into a key historical and educational centre containing outdoor exhibits and a museum.

The project has been initiated by Poland's Ministry of Culture and National Heritage which has granted a new lease for the "Wolf's Lair" under the strict proviso that the private company running the site fulfils an educational objective and drops its present fun park image.

Hitler had the "Wolf's Lair" built as his Eastern Front headquarters in what was then East Prussia, and used it to plan the Nazi invasion of the Soviet Union. The compound was a heavily guarded complex of two hundred buildings and concrete bunkers complete with its own power plant and staff of 2,000 military personnel.

Four months before German troops blew up many of the buildings in the compound in the face of the Red Army's advance, the "Wolf's Lair" was the scene of an abortive

attempt to assassinate Hitler. German army officer Claus von Stauffenberg detonated a briefcase bomb which failed to kill the Nazi leader while he was attending a staff meeting on 20 July 1944. Von Stauffenberg was caught and executed along with many other plotters immediately afterwards.



Poland's postwar communist regime opened the site for visitors but did little more to inform them of its history than display wartime photographs of the complex. After communism's collapse, Poland's new democratic authorities leased out the complex to a private company called Wolf's Nest, which tried to exploit its tourist potential.

The company turned some of the bunkers into a restaurant and hotel and opened an indoor shooting range in the offices used by General Alfred Jodl, the Nazi army commander sentenced to death at the Nuremberg war crimes trials.

Today, although some paths have been cleared through the undergrowth, most of the "Wolf's Lair" is in disrepair. Its concrete bunkers are in ruins and covered in carpets of thick moss. The "Wolf's Lair" owes its new lease of life to the end of an ownership dispute which has left it firmly in the hands of the Polish Forestry Service.

"It took years before the matter was settled. Before that, we could not think about investing," said Jan Zaluska, the director of Wolf's Nest, whose company has now agreed to work together with historians and meet the government's educational requirements for the site. SOURCE: The Independent 20 September 2012

## UK / USA Cold War station, western Berlin, Germany

After the end of World War II a great deal of Berlin was reduced to rubble. The wastelands of irreparably bombdamaged buildings were cleared, and the rubble disposed of as several huge heaps called locally trümmelberge (rubble mountains). One of these, in the park opposite Gesundbrunnen station north of the city centre, will be familiar to a number of Sub Brit members as the rubble was pushed up against, but did not entirely bury, the enormous FLAK tower where our good friends Berliner Unterwelten lead guided tours.

Another of these (the highest), in the western sectors, came to be known as Teufelsberg, from the nearby Teufelsee or 'Devil's Lake'. Here, rubble was built up over an unfinished university-cum-army technical institute designed by Albert Speer, Hitler's architect. Its dramatic Cold War-era hilltop buildings, tower, and four radomes were acquired from around 1960 onwards when the UK and USA built a joint signals interception station on the top.



Teufelsberg Photo Nick Catford

An archaeological investigation of the standing remains has now been published. Unlike so many of the East German Cold War sites visited by some of us in company with member Mike Barton, this facility has been almost completely stripped out as a part of the closing down operation from February 1992. Since then, more material has been removed for scrap. It appears that no contemporary documentation is yet in the public domain. other than some records of the former Stasi.

The report throws some light on, amongst other things, internal security boundaries between UK and US personnel. The father of John Schofield, one of the authors, served as officer in charge of the British unit in 1970-73.

SOURCE: SCHOFIELD, John, and Wayne COCROFT, 2012, The secret hill: Cold War archaeology of the Teufelsberg. British Archaeology 126 (September-October 2012), 38-43.

## Cold War spy tunnel found in German forest

A section of an ingenious tunnel built by US and British spies to intercept Russian phone conversations in Cold War-era Berlin has been found after 56 years in a forest 93 miles from the German capital.

The 492-yard-long tunnel, built in 1955, led from Rudow in West Berlin to Alt-Glienicke in Soviet-occupied East Berlin. By tapping into the enemy's underground cables, Allied intelligence agents recorded 440,000 phone calls, gaining a clearer picture of Red Army manoeuvres in eastern Germany at a time when nuclear war seemed an imminent threat.

The western part of the tunnel was excavated in 1997 and part of it is preserved at the Allied Museum in the former American sector of Berlin. The Soviet authorities dug up the eastern part in 1956 and until now, its fate was unknown.



"It seemed to have vanished without a trace," said Bernd von Kostka, a historian at the Allied Museum. "I looked through the East German Stasi files, and there was nothing to be found about its whereabouts. We assumed it had been melted down because it was made of valuable metal." The find is one missing piece of a puzzle that will take decades to solve completely, as access to intelligence files about the construction and discovery of the tunnel is still restricted.



A Soviet officer in the spy tunnel

Werner Sobolewski was chopping wood in his local forest in Pasewalk, near the Polish border north of Berlin, when he stumbled across the wide metal pipe. He remembered it being used for military exercises at the local barracks, where he had worked before the fall of the Berlin Wall. He recalled too that it was then rumoured to have been a part of the Allied

spy tunnel, infamous throughout eastern Germany after the Soviets exposed it in a major propaganda campaign in 1956.

The British had already constructed similar underground listening-posts in Vienna and brought the idea, manpower and know-how to the project. Codenamed "Stopwatch" by the British and "Gold" by the Americans, it was funded by the US at a cost of \$6.7 million and operated jointly by the CIA and the British SIS. Britain had previously been involved in the 'tapping' of Soviet cables in divided Vienna before Austria became neutral and we all pulled out. It was our expertise there which caused the Americans to invite us to participate in Operation Gold. Yet the KGB learned about the tunnel when it was still in the planning stages - thanks to intelligence from George Blake, the notorious British double agent who was later imprisoned, then escaped to the Soviet Union. Strangely, the KGB concealed its existence from the Soviet military because they wanted to protect their valuable mole.

The tunnel operated for eleven months and eleven days, intercepting some of the Red Army's most secret communications, including those between Moscow and the military headquarters in East Berlin. Historians do not know why the Soviet authorities chose to expose it when they did, on April 22, 1956. The reason is still buried in the Kremlin's files.

SOURCE: Bloomberg News 20 August 2012

## New uses for Cold War bunkers in Albania

Albania is littered with Communist-era concrete structures. Concrete domes are now being turned into cafes or hostels – or blown up for scrap.

SOURCE: GEOGHEGAN, Peter, 2012, From bunkers to bunkbeds: Albania reuses its cold war relics. *The Guardian*, 27 September 2012.

## NEWS – MINING AND QUARRYING

## South Crofty tin valued at £1.5bn

Celeste Copper Corporation (CCC), which hopes to start remining South Crofty, has estimated the mine could produce  $\pounds 1.5$ bn worth of tin.

An independent mining expert made the valuation by comparing the quantity of tin believed to be in the mine, about 7.95m tonnes, with current markets. CCC also said it planned to spend £7.8m in the next twelve months on making the site ready for mining. The work CCC is planning to carry out during 2013 includes spending £1.1m on drilling at the site and £2.6m on starting to pump water out of the flooded mine.



The Canadian-owned company, which has a number of US investors, will focus on pumping out shallow old workings in the Dolcoath area. The company has said it is mainly interested in mining in areas of rock between existing flooded mine workings, but some of those flooded areas need to be pumped for safety. So far the scheme has attracted investment of about £15m in the past ten years, but up to £75m will be needed to make it operational. It is hoped the work taking place in 2013 will lead to more companies wanting to invest.

South Crofty originally closed in 1998 after the price of tin hit an all-time low, a decrease which started in 1985. For the past six years the price of tin has been rising. CCC has said it wants to extract tin and other metals including zinc and copper at the mine with the hope of creating at least 220 jobs.

SOURCE: BBC News Cornwall 24 October 2012

## Infilling of underground Bath stone quarries at Combe Down, Somerset

Extensive underground building-stone quarries at Combe Down, a hilltop location about two kilometres south of Bath, yielded much of the stone for building the city. The quarries lie at a shallow depth below about 700 houses, three schools, and two churches, with an estimated volume of 366,000 cubic metres of void.

An important aquifer, the source of Bath's water supply, lies below the quarry floor. The extraction ratio is of the order of 85 percent, with about 15 percent of stone left *in situ* as roof support pillars. The quarries are now almost completely backfilled, although new bat hibernation habitats have been created (including a new tunnel link to an adjoining underground quarry) to accommodate large colonies of greater and lesser horseshoe bats.

SOURCE: ADAMSON, David, and Alan FRANCIS, 2012, Stabilisation of Combe Down stone mines, Somerset, UK. *Civil Engineering* 165(3), 129–137.

# Kelly mine for micaceous haematite, Lustleigh, Devon

Some surface features of the Kelly mine survive at Lustleigh, Devon. On the fringes of Dartmoor, it was a source of micaceous haematite, a variety of this iron oxide mineral occurring in mica-like flakes which make it very suitable for use as a stable mineral pigment used in paints. It was especially valued as a corrosion-proof material for painting iron and steel structures, and was extracted at this mine into the twentieth century. The mine closed in 1951. Similar material from other sources abroad is still used.



Ore-washing shed at Kelly Mine

The Kelly Mine Preservation Society has leased the site since 1984, and has refurbished surviving machinery and processing plant to working order. The ore washing, jigging and stamping equipment is now operable. Settling tanks, waterwheels, a tramway, wagons and a haulage winch can also be seen, and there is a small museum of relevant artefacts. Open days are held from time to time. SOURCE: KELLY MINE PRESERVATION SOCIETY, 2012, Devon: Kelly mine, Lustleigh. *Industrial Archaeology News* 161, 14–15.

## Second UK deep potash mine planned, North Yorkshire

Potash (a mineral form of potassium chloride) is a valuable source for the chemical industry in general, and the fertiliser industry in particular. Like the very similar compound sodium chloride (common salt) it is soluble in water, so never occurs outcropping at the earth's surface. It is extracted from deeply buried Triassic or earlier age deposits of dried-up landlocked salt water, associated with the economically less significant rock-salt, magnesium salts, and gypsum (calcium sulphate), and extracted by deep mining.

Britain's largest and deepest working mine, at Boulby south of Saltburn, is for potash and employs around nine hundred people. Mining extends inland under protected open country, and eastwards under the North Sea. Supplies are brought to the mine and products sent away by rail, protecting the dramatic Yorkshire coastline from intrusive road traffic. A large part of the output is exported from Teesside.



Boulby Mine Photo Nick Catford

Sirius Minerals has now proposed a second potash mine, also close to the Yorkshire coast, between Scarborough and Whitby. Production initially at the rate of 1.4m tonnes per annum, could commence in 2117 rising ultimately to 4.1m tonnes by 2024. Gypsum and magnesium salts might also be worked.

SOURCE: GRIBBEN, Roland, 2012, £ 3.6bn plan to mine potash in Yorkshire. *Daily Telegraph*, 1 May 2012, page B5.

# Talargoch mine engine house, near Dyserth, North Wales

Restoration of the Clive engine house at a shaft sunk in 1842–45 has commenced at Talargoch mine near Dyserth. The mine yielded mainly lead and zinc ores. The engine house in question dates from 1860 when the mine was deepened. However, the mine closed in 1884, and the very large engine was transferred to Westminster Colliery at Gwersyllt.

SOURCE: ANON, 2012, Talargoch mine. *Industrial* Archaeology News 161, page 17.



## Deaths at an illegal gold mine near Johannesburg, South Africa

More than twenty men illegally mining gold near Johannesburg were reportedly crushed to death when a shaft collapsed. This appears to have been the result of blasting in an officially disused mine. One badly injured foreign man was pulled clear of fallen rock, and told his rescuers he felt sure about twenty colleagues had died. SOURCE: ANON, 2012, 20 crushed to death at illegal gold mine. *The Evening Standard*, 9 March 2012

## **NEWS – MISCELLANEOUS**

# Tighter regulation of subterranean house extensions at Highgate, London

Highgate & Haringey Council is to impose stricter controls on the excavation of 'vast subterranean excavations' below residential properties. A backlog of twelve planning applications for this sort of development is reported, including one which would feature a 70-foot swimming pool and a 24-space underground car park.

Large-scale basement extensions are often unpopular with other local residents as residential neighbourhoods can be disrupted by the excavation noise and removal of lorry-loads of subsoil. And at Highgate there is concern that the creation of huge basements might disturb the local groundwater regime and thus the ponds on Hampstead Heath.

SOURCE: PRYNN, Jonathan, 2012, Highgate bans the basements: celebrities and wealthy face new regulations. *The Evening Standard*, 24 July 2012

## **Underground reservoir becomes 5-bedroom house** A couple have told how they spent three years creating one of Britain's most unusual properties – by converting a former underground reservoir.

Civil engineer Robert Hardy and his wife Ann began the mammoth project after falling in love with a 6,500 sq ft site at the centre of a hillock in Sidmouth, Devon. The decommissioned reservoir resembled a concrete drum, and had been lying unused for five years when they bought it from South West Water in 2008. The water company was selling planning permission for the space to be converted into a five-bedroom house – at a guide price of £300,000.



After three years of work, the couple have transformed the former underground reservoir into a modernist bolt-hole cut into the side of a hill. The roof of the property is covered in turf, meaning it blends seamlessly into the hillock

Work began in March 2008 when the turf was removed from the top of the dome – a task that had to be done by hand because Mr Hardy doubted it would stand the weight of diggers. Next, the welders had to descend into the gloom of the concrete drum to erect the steel girders that would become the skeleton of the house.

Once the dome was open to the sky, the glass and aluminium front walls went in, transforming the space into an ultra-modern idyll. A drainage system to disperse rainwater from the courtyard was installed, and plastering began on an industrial scale. Finally, almost three years on, artificial turf was laid on the roof, making the house almost indistinguishable from the surrounding countryside. Sadly, the visionary couple have not been able to enjoy 'The Reservoir', as it is now called, for as long as they had hoped. In June last year, Mr Hardy fell off a ladder at work and was rushed to hospital with a haematoma – a blood clot between his skull and his brain. Doctors told him to cut his workload for the next three years, so the couple have decided to downsize and live off the equity from the house until he has recovered fully.

Though the project set them back £800,000, Mr and Mrs Hardy look likely to make a tidy profit on their unique endeavour as the property is now on the market for £1.25m. SOURCE: *Mail Online* 3 September 2012

## Proposed roofed-over gravel pit at Hounslow, London

Property developers have proposed a novel scheme for derelict farmland within the London Green Belt between Cranford and Heston, Hounslow. After removal and storage of the topsoil a concrete slab is proposed for the site, below which gravel would be extracted. Stored topsoil would then be relaid over the concrete slab and landscaped and planted as new recreational parkland. The void created by gravel extraction below the slab would be let for commercial uses.

SOURCE: FORMAL INVESTMENTS, 2012 (?), A new public park for Hounslow.

**Record-breaking descent of the world's deepest cave** A team of cavers has just returned to the surface after a record-breaking exploration of the Krubera-Voronya Cave – called the 'Everest of Caves' because it is the deepest known cave on the planet. Ukrainian cave-diver Gennady Samokhin reached a depth of 2,197 metres below the surface, breaking his 2009 record by six metres. The Krubera-Voronya Cave lies underneath the Arabika Massif, an area of the Western Caucasus mountain range, in southern Russia. Although the area was explored as early as 1909 by Russian scientist Alexander Kruber, the cave was not discovered until 1960. Initial explorations went as deep as 310 metres, and it wasn't until more systematic methods were adopted in the 1980s that explorations made it to over a kilometre below the surface. Further missions in the '90s and into 2001 pushed the record depth to 1,710 metres, and teams have steadily pushed that limit over the past eleven years to Samokhin's recent record.



In addition to breaking the previous depth record, the team also discovered a strange species of transparent fish that lives in water only a couple of degrees above freezing and over two kilometres below the Earth's surface, showing just how resilient life really is!

SOURCE: Yahoo News - Canada 4 September 2012

## Wallingwells Hall Grotto, Nottinghamshire / Yorkshire border

This structure (like so many Cold War bunkers) is not actually underground, but simulates an underground space. It was built in the eighteeth century overlooking a lake, and was internally adorned with lead ore (galena) and spar (probably calcite) all 'arranged naturally in veins', the minerals derived from the lead mines of John White at Pateley Bridge. There were also some stalactites (robbed from caves in Derbyshire), some nearly six feet long, hanging from the ceiling although these have been taken down on 'health and safety' grounds!

SOURCE: WHITE, Christopher, 2012, The grotto, Wallingwells Hall. *Follies* 21(3)(82).

### An online data source for tunnelling history

For internet users, *Grace's guide for British industrial history* can be accessed at

http://www.gracesguide.co.uk/Main\_Page. It contains information and images on early companies, with sections devoted to, amongst other topics, tunnels and tunnelling. There is free access to a partial run of The *Engineer magazine*, 1862 to 1926. Details can be found at

www.gracesguide.co.uk/The\_Engineer\_(bound volumes)

SOURCE: ANON, 2012, *The Engineer* as a data source. *Bull. Railway and Canal Historical Soc*, 439, page 15,

## How Tower Bridge could have been Tower Tunnel

Tower Bridge is one of the most iconic bridges in London and a symbol of the capital recognised throughout the world. It could, however, have been replaced by a tunnel if design proposals submitted by a Victorian engineer had been chosen instead.

The extraordinary picture – which was the design of John Standfield – shows the landmark river crossing replaced by a tunnel with gothic towers on either side. It dates from when the City Corporation was inviting proposals for a river crossing in 1876. The oil painting of the cross-section shows the tunnel of remarkably low depth with hydraulic platforms at either end to lower horses and carts under the water.



Despite being almost inconceivable given Tower Bridge's now iconic status, the proposals by the member of the Institute of Civil Engineers were one of fifty serious submissions made to the City Corporation.

Standfield's proposals were possibly inspired by the creation of the first tunnel to be built beneath the Thames between 1825 and 1843. The Thames Tunnel, connecting Rotherhithe and Wapping, now forms part of the London Overground railway network.

SOURCE: Mail Online 8 August 2012

## Proposed repeal of 216 Acts of Parliament relating to railways that were never built, or were abandoned, more than 100 years ago

The Law Commission has carried out a consultation exercise on the repeal of obsolete legislation. A document 'Statute law repeals: consultative paper: abortive railway projects – proposed repeals' contains brief details of 216 Acts of Parliament relating to railways in England, Wales and Southern Ireland which were never built, or built but abandoned, more than 100 years ago .. mostly dated 1860–1895. The consultation period ended in 2009 but the document can be found at

lawcommission.justice.gov.uk/docs/ slr\_railways\_(abortive projects).pdf.

SOURCE: LAW COMMISSION, 2012, Repeal of obsolete railway acts. *Bull. Railway and Canal Historical Soc.* 439, page 14.

## Aerofilms archive on the web

Aerial photography for the UK dating from 1919 onwards is available at www.britainfromabove.org.uk . The Aerofilms archive contains 1.26 million negatives and over 2000 photograph albums.

SOURCE: AEROFILMS, 2012, Britain from above. *GLIAS* Newsletter 261, page 8.



## Russian Islamist sect kept children underground for a decade

A self-proclaimed prophet had a vision from God telling him to build an Islamic caliphate under the earth. The digging began about a decade ago, and seventy followers soon moved into an eight-level subterranean labyrinth of cramped cells with no light, heat or ventilation.

Children were born. They too lived in the underground cells for many years – until authorities raided the compound in August and freed the 27 sons and daughters of the sect. Aged between one and 17, the children rarely saw the light of day and had never left the property, been to school or seen a doctor. Their parents – sect members who call themselves *muammin*, from the Arabic for believers – were charged with child abuse.

The sect's 83-year-old founder, Faizrakhman Satarov, who declared himself a prophet in contradiction to the principles of Islam, was charged with negligence.

The children were discovered when police searched the sect's grounds as part of an investigation into the recent killing of a top Tatarstan Muslim cleric, an attack local officials have blamed on radical Islamist groups that have flourished in the oil-rich Volga river province.

Satarov ordered his followers to live in cells dug under a three-storey brick house topped by a small minaret adorned with a tin crescent moon. Only a few sect members were allowed to leave the premises to work as traders at a local market.

SOURCE: The Guardian 9 August 2012

## Never mind the cracks ... watch the manhole covers!

Children received, and perhaps they still do, advice to avoid treading on the cracks between the paving stones as they walked along the street, or 'the bears would get them'. The somewhat more real danger, however, seems to be exploding manhole covers! It is reported that at least seven pedestrians have been injured on the streets of London in recent months. The exploding manholes appear not to be related to gas pipes, but primarily to electricity cables. Electrical arcing seems to be the problem. That in itself can suddenly heat and explosively expand air in the confined spaces. Methane may or may not also come into the story.

One pensioner is now suing a power supply company after being seriously hurt by an exploding manhole. A 75-year-old man has had to spend nearly three months in a wheelchair after suffering injuries sustained in Harrow when a manhole he was standing on exploded. On the Edgware Road a woman has suffered twenty percent burns in a similar event. The Health & Safety Executive is investigating, and has revealed that it is aware of at least three more pavement explosions resulting in injury to pedestrians in the last year or two. Other recorded explosions, as for example in

Kingsland Road, Dalston, have not injured passers-by. SOURCE: DAVENPORT, Justin, 2012, Seven injured as pavements explode. *The Evening Standard*, 23 July 2012

## **NEWS – PUBLICATIONS – BOOKS**

## Burlington

**Review by Martin Prosser** 

Burlington, published by Folly Books, Monkton Farleigh BA15 2QP

Hardback with dust jacket: 224 pages, 250mm x 250mm ISBN: 9780 9564405 63 Price: £24.99

For a limited period only copies are available from the author at £24.50 including postage from 13 Highcroft Cottages, London Road, Swanley, Kent BR8 8DB. Or pay by PayPal for £25.50 which includes PayPal fee to nick@catford.orangehome.co.uk

A few weeks later than announced, Nick Catford's *Burlington* has finally been published, and it has been worth the wait. This is the final volume of a series of large-format, heavily illustrated and beautifully produced volumes from Folly Books detailing the history of the Corsham stone quarries in Wiltshire from the beginning of the Bath stone industry in the early nineteenth century to the end of the Cold War.

Previous works include Derek Hawkins' *Bath Stone Quarries* which covers the history of the quarries up until the eve of the Second World War and then details the subsequent resurgence of the industry in the postwar years. This is followed by Nick McCamley's *Second World War Secret Bunkers* which tells the story of the wartime conversion of the Corsham quarries (and other subterranean sites throughout Britain) into huge underground ammunition depots and factories. Nick Catford's *Cold War Bunkers* outlines an overview of Cold War developments at Corsham while giving a more general view of the astonishing range of underground structures built for the defence of Britain during the Cold War years.

And now we have *Burlington*. The first thing I have to say, before looking in detail at the contents, is to say that the book is quite superbly produced. The photographs are reproduced on a gloss art paper, unlike the silk finish of the previous volumes which, I think, makes the images appear even sharper and more vibrant than in the earlier books. Another small but noticeable improvement is in the dust jacket which is much thicker than the previous volumes, a beneficial enhancement with a large-format book of this size. The binding, too, seems firmer than the previous books, with neat little sewn header bands at top and bottom of the spine.

The book itself is in the style of the earlier Folly Books offerings. An introductory section of forty-eight pages, dedicated to a detailed account of the origins of the Government War Headquarters at Corsham, is followed by a second and larger section of 176 pages comprising a comprehensive photographic record of each of the twenty-two physical 'Areas' into which the Corsham bunker was divided.





The introduction describes the evolution of the British Government's policies for the relocation of the Seat of Government should the country come under attack, from their origins in the debate over the viability of the north London bunkers – 'Paddock', 'Station Z' etc – and the Horseferry Road Rotundas of the Second World War, through to the final demise of the Government War Headquarters at Corsham in 2004.

All of the major locations, as well as others peripheral to the story, including proposed alternative sites at Drakelow and Rhydymwyn, are illustrated by well-captioned photographs in the text and by clear and informative line drawings and plans. Large, double-page diagrams illustrate each important phase in the development of the Corsham headquarters.

The bunker had a number of code-names during its lifetime: Subterfuge, Stockwell, Burlington, Turnstile, Chanticleer and Peripheral, but Burlington is the name that it is remembered by.

The author's research highlights three dominant themes: first, that the Cabinet Office was in a constant state of reaction regarding the form and function of the bunker. No sooner was a design and operating procedure drawn up than a shift in political thinking caused the earlier plans to be scrapped and rewritten and redrawn. By the early 1960s when most of the construction work had been completed, the general opinion in Whitehall seems to have been that the bunker was not fit for purpose and the story of the next forty years was one of largely futile attempts to make the most of a bad job and to at least partially justify the huge amount of money that had been spent at Corsham.

The second theme explores the way in which the whole project was hamstrung by the excessive secrecy with which it was surrounded. It was quickly realised that Burlington could be used only once and that after that its secrets had been exposed it could never be safely used again. This, of course, precluded any possibility of its being tested or exercised.

So, should it have been brought into operation, some four thousand civil servants would have been shipped off without prior notice to a place they knew nothing about, to perform tasks they were unaware of, with equipment that no one knew whether would work or not. The risk, highlighted by the Cuban Missile Crisis, was that the site might be manned in the event of a sudden crisis that might just as quickly evaporate, and thus the secrecy would be lost or, alternatively, government might delay too long for fear of unnecessary exposure, and then find it was too late.

The third theme concerns the belated realisation that however complex and comprehensive the government machine ensconced at Corsham might be, it would be utterly impotent without the means of controlling and managing two essential assets, oil and food, which it could only obtain from the world beyond its own shores. It was from the moment in the late 1960s when this fact became clear that the ultimate irrelevance of the Corsham bunker was understood. Thereafter its operational responsibilities were gradually run down as the roles of Britain's overseas procurement staff gained prominence.

Increasingly, responsibility for postwar social and economic reconstruction was delegated to the Regions and to the Local Authorities and the function of the Corsham bunker, other than providing a point of administrative legitimacy, was to act as a communications hub for the overseas agencies.

### Superb photography

Part two is the photographic section and contains approximately 340 absolutely stunning and informatively captioned photographs. Sub Brit members will be aware of the astounding quality of Nick's photographs and the ones included in this book will not disappoint.

A separate chapter has been dedicated to each of the twenty-two areas of Burlington and each is prefaced by a detailed full-page plan of the Area accompanied by a key to all the room allocations within it. Because the allocations were in constant flux as the design and function of the bunker changed, the author has chosen to illustrate the allocations made when the plans were first drawn up. The logic behind this is the fact that from the moment of its first conception, the headquarters continually shrank so, in effect, the first rather than the final design was perhaps the most mature.

The number of photographs in each chapter varies according to the complexity of the Area illustrated. Thus Area 8, the hugely complex telephone exchange, has twenty-eight photographs spread over eighteen pages, whereas Area 22, which was allocated to the Foreign & Commonwealth Offices and consists of no more than a labyrinth of small, empty and anonymous offices, is illustrated by just two representative photographs.



To me, the pictures of Area 17, showing the rather spartan accommodation which the author suggests, quite convincingly, was provided for the Royal Family, are the most revelatory.

What is obvious is that the photographic survey of the whole site has been utterly comprehensive and nothing of importance has been omitted from this book, which will inevitably become the standard reference work on the subject. **Burlington** marks the final closure of the Corsham story and I thoroughly recommend this book which I really cannot fault.

## Guide to the industrial archaeology of Essex

DETAILS: CROSBY, Tony, 2012, *A guide to the industrial archaeology of Essex*. Association for Industrial Archaeology: 68pp [ISBN 978-0-9560251-1-1]

This is the latest of a series of illustrated gazetteers of historic industrial and transport sites, published in the first instance for members of the Association for Industrial Archaeology attending that Society's annual conference, based this year at Writtle near Chelmsford. Short introductory articles are accompanied by brief gazetteer entries arranged by administrative districts, and indexed by subject. Many entries are accompanied by small colour photographs, and there are also helpful sketch maps to show locations. Two railway tunnels at or near Audley End are featured, as well as extractive industries sites.

#### Anti-invasion sites 1500-1990 in East Sussex

DETAILS: BUTLER, Chris, 2011, *East Sussex under attack:* anti-invasion sites 1500–1990. Stroud: The History Press: 192pp [ISBN 978-0-7524-4170-2] £ 15.99 (sold at Newhaven Fort)

This is a republished and reprinted book first issued by Tempus Publishing in 2007. It consists of an account of all defensive sites in the county of East Sussex, geographically arranged, with historical and descriptive details and notes on each site's current state and accessibility.

It is curious that the geological context of the sites described is more or less ignored. Geology is a crucial determining factor for any military site. The nature of coastline to be defended is important, for example: East Sussex has chalk and sandstone cliffs as natural defences, along with low-lying and more vulnerably tracts on clays and gravels, as turned to his advantage by William the Conqueror. The construction of more or less permanent barracks and fortifications, including tunnelled parts, is more or less easy depending on the nature of the underlying rock.

Water supply and drainage are similarly dependent. And had it ever come to invasion and trench warfare, some tracts of East Sussex would have been far more easily invaded than others, depending on the subsoil to be advanced over.

## Somerset coalfield

DETAILS: GOULD, Shane, 1999, The Somerset coalfield. *Somerset Industrial Archaeology Society Survey* 11: 68pp [ISBN 0-9533539-0-7] £ 6.95.

Shane Gould grew up in the Somerset coalfield and was familiar with working collieries there until the last one, Lower Writhlington colliery at Radstock, closed in 1973. He is a professional archaeologist and amongst the relatively small band of archaeologists who have done much to earn for industrial archaeology the respect it deserves from mainstream archaeologists.

This booklet summarises what is known of the history and development of the small mines in and around Radstock, with measured drawings and photographs of surviving above-ground evidence for these and their associated transport infrastructure.

## The 33: The ultimate account of the Chilean Miners' rescue

FRANKLIN, Jonathan, 2011 *The 33* Bantam Press: 303pp [ISBN 9780593067710]

### **Review by Martin Dixon**

This is a gripping account of the successful rescue of 32 Chilean miners – and one Bolivian – who were trapped by rockfalls almost 700 metres underground in August 2010; the drama attracted worldwide media attention.

Jonathan Franklin is a US-born journalist who has lived for many years in Chile and who was given privileged access during the rescue operation at San José copper mine in the Atacama Desert. Although the ending is known it is still a compelling and easy read.

The account includes many details not released at the time such as the conflicts that boiled up underground from time to time. The role of specialists on the surface such as psychologists and medical experts is also described. At the end of the day, however, it is a journalistic account and is likely to leave any mining experts or enthusiasts feel short-changed. For example, the description and plan of the mine is limited to the spiralling access drift and there is no explanation of the underground structure from which the copper ore was actually won. Similarly ventilation shafts are mentioned in passing in the text but the mine plan does not include these.

After locating the men by drilling a borehole, three 'competing' rescue shafts were started. Engineering details of these are sparse and to some extent contradictory, as both Plan A and Plan B are described as being bored in two stages but the account doesn't make it clear at what





stage the shafts were expanded and only a single breakthrough for the successful shaft is described. Crossreferencing progress is complicated as the sectional plan has depths marked in feet whereas the description of the shafts' excavation is tracked in metres.

The book interweaves events above and below ground and there are inevitable inconsistencies, particularly in the early days underground when seventeen days passed before contact was established.

There are also a few niggling errors – for example, Plan B is described at 268 metres on day 35 but fifteen days later has only reached 85 metres. The book has an Oscarlength (three pages!) list of acknowledgements, including both the author's siblings for no apparent reason. This space would certainly have been better used for an index which is sadly absent.

The bravery and inventiveness of the trapped miners grab your attention. Coupled with the international response to the rescue mission this makes the book difficult to put down. However, it is perhaps something to borrow from the library for a single read-through, rather than a volume which cries out to be an addition to the enthusiast's bookshelf.

## **NEWS – TUNNELS**

**Meanwhile, Phyllis is tunnelling under Hyde Park** Crossrail's tunnel-boring machines (TBMs) are all (like ships) ladies. TBM 1 is *Phyllis* (named after Phyllis Pearsall, the originator of the London A–Z street atlas) and commenced tunnelling the 6.16 km towards Bond Street earlier this year. She is currently under Hyde Park. TBM 2 (*Ada*), having started later, is still approaching Paddington.

Progress on 'Drive X' has been threatened by the collapse of a hopper onto waiting waggons at the surface west of Paddington, making removal of tunnel spoil problematic. Fortunately, however, spoil can be stockpiled at Westbourne Park whilst the problem is resolved.



#### Elizabeth being lowered down the shaft

Meanwhile parts for TBMs 3 and 4 (*Elizabeth* and *Victoria*) were lowered down recently completed shafts at the Limmo peninsula (between Canary Wharf and Victoria Dock). These two have been assembled side by side and drive parallel tunnels, heading back towards Canary Wharf. Parts for TBM 5 (*Sophia*, a 'slurry'

TBM) are being delivered to Plumstead, with parts for *Mary* (another 'slurry' machine) to follow. The 'slurry' machines are designed to cope with under-river waterlogged ground, the slurry tunnelling medium being bentonite clay, a species of fullers' earth.

SOURCE: HARVEY, Dan, 2012, Collapse is spoil spoiler. *Modern Railways* 69(770), page 98.

### Giant tunnels protect Tokyo from flood threat

On the outskirts of Tokyo, behind a small government building, underneath a soccer field and skateboard park, sits a remarkable feat of engineering. It's an example of how Japan's capital, which lies in a region at high risk from flooding and tropical cyclones, is trying to figure out how to contain the elements to protect its 13 million inhabitants. The entrance, which is locked at all times, is so nondescript a visitor may walk past dozens of times without ever noticing it.

Built between 1993 and 2006 at a cost of nearly \$3 billion, the stunning complex is far more impressive than its name suggests. Winding down a series of stairs, you soon come upon a massive hall, resembling an underground Parthenon, or a scene out of a science-fiction film.



Inside the huge underground water tank

The initial water tank stretches more than 320 feet in length and towers higher than a five-storey building. When you add it all up, the complex features five massive shafts, or tanks, that are able to move water along a tunnel that stretches nearly four miles. In this area of Saitama prefecture, heavy rains would often flood the Naka River Basin. But now, that valuable farmland has an incredible drain system sitting below.

When the tanks and tunnel fill, engineers are able to turn on the heart of the system, which is a series of four turbines powered by jet engines similar to those used in a Boeing 737 airplane. The turbines are then able to rapidly funnel floodwaters to the nearby Edo River.

The engineers here are the first to point out that their system, while remarkable, is meant to deal with heavy rains – and that it would struggle to cope with a storm surge like the one that hit New York's Upper Bay at the end of October.

SOURCE: CNN News 1 November 2012



# Engineering works completed and in prospect at Farringdon Station, London

Farringdon Station, London, is served by both London Underground and Thameslink main line trains; when two new tunnels arrive, Crossrail trains will also call here. Even before the new tunnels are linked by escalators to a new ticket hall across the road from the original station buildings, much new work has been completed.

In 2009 the mainline through trains from the north to Moorgate were discontinued. This was to allow the Thameslink platforms to be extended southwards, over the former Moorgate line junction, to take longer trains on the Bedford – Croydon – Gatwick Airport – Brighton line. The Moorgate lines, in tunnel, are now to be converted by London Underground for use as additional carriage sidings. At nearby Smithfield Market, where there are existing sub-surface carriage sidings, four grout shafts are to be sunk to stabilise the ground at that location before the Crossrail tunnels are bored through it.

SOURCE: HARVEY, Dan, 2012, Farringdon transformed .. completion of Thameslink work at Farringdon. *Modern Railways* 69(768), 42–49.

### Crossrail overview, London

The magazine of the Institution of Civil Engineers publishes supplements from time to time featuring major engineering projects in course of completion or recently completed. One such Major Project Report has been published on London Crossrail. This provides a convenient overview of the entire project including of course the tunnelled central London parts.

The Report is replete with maps and diagrams and photographs including details of the eight tunnel-boring machines and the twin-bore tunnel drives they will be responsible for.

Drive G (900m) will be from the Limmo Peninsula to the Victoria Dock portal. Spoil is to be taken away by rail to Instone Wharf and Docklands.

Drive H (2.64km) is from Plumstead under the Thames to North Woolwich. Spoil is to be taken away by rail to Docklands.

Drive X (6.16km) is from Royal Oak (west of Paddington) to Farringdon. Spoil is to be taken away by rail to Northfleet (Kent).

Drive Y (8.4km) is from Limmo Peninsula to Farringdon. Spoil is to be taken away by rail to Instone Wharf and Docklands.

Drive Z (2.72km) is from Pudding Mill Lane to Stepney Green. Spoil is to be taken away by rail and road.

The rocks to be bored through include Upper Chalk, Thanet Sand, Lambeth Group (sands and clays), London Clay, and superficial river deposits of clay, gravel and sand.

SOURCE: MORGAN, Terry [Non-executive Chair of Crossrail] et al., 2012, Crossrail tunnelling starts: major project report 06/ 12. New Civil Engineer Supplement, June 2012: 56pp.

## Lost city-centre tunnel found in Peterborough

A forgotten city-centre tunnel in Peterborough thought to have played a pivotal role in a devastating blaze more than fifty years ago has been unearthed.

Construction workers carrying out the £800,000 revamp of the Cowgate area of the city discovered the mysterious channel beneath King's Street in October. While tales of medieval tunnels running under Peterborough have been passed down from generation to generation, this particular subterranean passageway is thought to have origins closer to the present day.

It is believed that the recent discovery was part of a service tunnel that once linked the two Robert Sayle buildings either side of the street. Both ends of the tunnel must have been filled in previously, leaving a middle section.

Robert Sayle was the trading name of the John Lewis Partnership in Peterborough until 1956, when the two main blocks of the building were destroyed by fire. It was thought the fire had started in one building and then spread to the other via the tunnel, which had been used to store roles of fabric from the haberdashery department. The tunnel, which was empty except for some rubble, will be filled in with foam concrete.

SOURCE: Peterborough Telegraph 11 October 2012

## Driverless London Underground trains for London?

Some time during 1980 London Underground ran a trial driverless train (carrying no passengers) from Chigwell to Grange Hill, reversing at Hainault en route. The train stopped and started at each station, its doors opening and closing, and reversed at Hainault completely automatically.

That sort of thing has been done for some years, of course, on the Docklands Light Railway, but not in passenger service as yet on the Underground. M.A.C. Horne discusses the issue in a recent edition of *Modern Railways*. But it has recently been announced that further driverless train testing will be taking place on the Jubilee Line from October 2012, initially without passengers during the night.

Subject to successful trialling, it has been reported, driverless trains could be in passenger service from 2015. Tests have also been envisaged on other deep tube lines, including the Central and Victoria lines. However, the latest reports suggest all these schemes have now been abandoned.

SOURCES: HORNE, M.A.C., 2012, Driverless underground trains for London? *Modern Railways* 69(768), 64–67; MURRAY, Dick, 2012, Tube trains with no drivers will be tested on Jubilee Line. *The Evening Standard*, 18 July 2012

## A good idea, but .. the proposed deep-level Thames super-sewer, London

There is presumably universal agreement that the efficient removal and disposal of London's sewage is a 'good thing' and that letting it into the Thames is not. Astonishing, the city is still reliant to a large degree on the sewers designed and built by Sir Joseph William Bazalgette



(1819–91) between 1858 and 1875. His system, with some modern modifications, continues to cope with normal flows, but is swamped in period of flash floods and prolonged heavy rainfall, resulting in (diluted) sewage being released into the river.

The deep-level 'supersewer' intended to run at considerable depth below the Thames (with one or two of the bends short-circuited) would, if as well designed as Bazalgette's work, see the problem remedied for another hundred years or more.

But driving a tunnel of the dimensions envisaged, including sinking access and working shafts and removing spoil, could potentially bring serious disruption to life at the surface. Contentiously, the planners have proposed some of London's parks and gardens as shaft locations, turning nearby residents' cherished open spaces into work sites for some years. Now questions have been asked about the threat of subsidence to built structures, notably the Grade II listed Hammersmith Bridge.

Now that tunnelling is under way for Crossrail, another huge tunnel being bored under the city streets, it is to be hoped that the expertise gained in that exercise can be applied to the minimisation of disruption along the route of the intended supersewer.

SOURCE: BLUNDEN, Mark, 2012, Supersewer could shut bridge for year. Dig 'may damage' Hammersmith crossing's structure. *The Evening Standard*, 19 September 2012

## Long delays refurbishing two Thames foot tunnels in Greenwich

Greenwich Council is considering legal action over the £11.4m refurbishment of two Thames foot tunnels which remains unfinished, two-and-a-half years after it began. The government-funded Woolwich and Greenwich tunnels project has been plagued by problems, which opposition councillors say are the result of council incompetence.

Dean and Dyball Civil Engineering was appointed in 2010 to manage the refurbishment contract but, after a host of delays, the council took control of the project late last year. Though the Greenwich lifts reopened in March, they have suffered numerous breakdowns, while much work is unfinished and mystery still surrounds an incident in August where people inside the Greenwich tunnel were taken ill.

A council spokeswoman said: "The work is now substantially over budget and while seeking to complete the works as expeditiously as possible, the council will be seeking to recover costs from previous contractors through negotiation, contract dispute resolution and possibly litigation." She added: "The Royal Borough of Greenwich shares the frustration of tunnel users and the general public over the time taken to complete this project and apologises for the ongoing delays to this work. Legal advice is being sought from a firm of specialist construction lawyers to determine any case for recovering the additional costs from the contractors."



The Greenwich foot tunnel

Timeline

February 2010 Council accepts a tender from Dean & Dyball Civil Engineering (DDCE) for the refurbishment of both foot tunnels. Work scheduled for completion in 12 months.

March 2010 Work starts but fails to run to schedule and exceeds cost estimates.

September 2011 DDCE agrees new programme of work to have lifts operational by Christmas. Council officers begin "intense scrutiny" of the project and estimate the deadline won't be met.

Late 2011 DDCE is asked to vacate site by December 16. Project managers Messrs Sweett and quantity surveyors Hyder Consulting see role terminated. Council takes control.

March 2012 The Greenwich tunnel opens with new lifts. Woolwich tunnel opens but without lifts. Work has since stopped.

September 2012 Cabinet member for regeneration Councillor Denis Hyland blames "significant unforeseen difficulties associated with the complexity of the structures and contractual arrangements."

Woolwich foot tunnel marked its 100th birthday in October.

SOURCE: Greenwich News Shopper 15 October 2012

### Canal tunnel rediscovered, Derbyshire

Clearance of undergrowth alongside the Chesterfield Canal has uncovered a 'lost' canal tunnel. This has been identified as the Hollingwood Common Canal, a two-milelong drive into a coal mine. The tunnel is mostly silted up, but the top of the arch is visible. No exploration is intended as the tunnel is likely to contain methane.

The canal ran below the Hollingwood Estate and Ringwood Hall to Westwood, with its inner end 250 feet below ground level. There was not a direct junction with the Chesterfield Canal: coal had to be trans-shipped. Further information is available on the Chesterfield Canal Trust's website.

SOURCES: ANON, 2012, Subterranean canal uncovered. *Waterways World*, March 2012, page 39; CHESTERFIELD CANAL TRUST, 2012, Derbyshire underground canal tunnel revealed. *Industrial Archaeology News* 161, page 14.



## Great Western Railway tunnels, bridges, viaducts and buildings listed

Dozens of former Great Western Railway tunnels and structures are being listed as of architectural or historic interest, or upgraded, by English Heritage. Included are Isambard Kingdom Brunel's Box tunnel (3212 yards), Foxes Wood (or St Anne's Park) tunnel (1017 yards), and Saltford tunnel (176 yards), all between Chippenham and Bristol on the company's first main line built in 1836– 41. Also (the portals at least) of the Chipping Sodbury tunnel (4433 yards) driven in 1900–1903 and the Severn tunnel (7698 yards) of 1873–86; and the ventilation shaft towers at Chipping Sodbury.

It is not entirely clear from the cited source to what extent these tunnels are listed in their entirety, or if only the portals are listed. A listed building has, by definition, to have been built. An unlined rock-cut tunnel with no built lining or portal cannot therefore be listed, although it could perfectly well be scheduled as an Ancient Monument.

A tunnel with built portals, masonry lining, and masonrylined associated shafts could properly be listed from end to end. There are many intermediate states: the Box tunnel, for example, is partly masonry-lined and partly cut through in situ limestone.

SOURCE: KENNEDY, Maev 2012, Brunel tunnels steam ahead to listed status. *The Guardian*, 30 July 2012

## Mysterious tunnels could link golf course with Henry VIII's Wimbledon home

An ancient tunnel system discovered on a golf course could be a secret passageway into the former home of King Henry VIII.

The extraordinary boyhood tale of an 82-year-old has shed light on the possible destination of tunnels discovered on Wimbledon Park golf course, as the Old Rectory, a former property of the famous Tudor king, went on sale for £26m in October.

Kenneth Tranter, from Lower Morden, was just 14 when he and two of his friends stumbled upon the entrance to a large tunnel hidden behind a bush on the golf course in 1944. Armed with a torch, Mr Tranter left his friends behind to explore the rat-infested passage, only to pop out into the conservatory of what he believed was the Old Rectory in Church Road – Wimbledon's oldest house, which dates back to the 1500s and was once owned by Henry VIII.

The medieval mansion is set behind St Mary's Church, overlooking the All England Tennis Club. Mr Tranter also spoke of his exploration of a second tunnel which he said led him to an orchard near Arthur Road.

In February Wimbledon Park golf course staff discovered a tunnel system matching Mr Tranter's description while carrying out irrigation work. Patrick Shanahan, general manager at the course, said: "We uncovered the brokendown entrance to a tunnel in a mound in the side of a slope. There was a little bit of exploration done where the guys who were working had a look in, but it was pitch black. They went in about 1,000m and discovered there were three branching tunnels going elsewhere."

Norman Plastow, chairman of the Wimbledon Society, said: "There have been lots of stories of tunnels there and this could well be the rectory because other sites weren't previously explored – it's all perfectly possible." SOURCE: *Wimbledon Guardian* 17 October 2012

**Editors Note**: Volume 5 of the Records of the Chelsea Speleological Society (1968) records a tunnel at Wimbledon Park House at Arthur Road, opposite the junction with Home Park Road. The main entrance is on the site of a recently demolished house (now the playing field for a girls' school) but the tunnel probably predates this house. It goes on to say: "There have been many references to the tunnels and cellars of the mansion. The tunnel was supposed to be wide enough to take eight men abreast and take a man on horseback. This is not verified by photographs.

"The other entrance is in Wimbledon Park, now a golf course, and was used in the 1920s in a pageant as a setting for Queen Matilda discovering a vault in Merton Abbey. It was in a copse but is now obscured and the owners of the park (the Borough of Merton) have no record of where it was."

The one photograph in existence (held by the John Evelyn Society Museum – now Wimbledon Museum) depicts a passage about 4–5ft wide and 6ft high. It is dead straight and there is a manhole in the barrel-vaulted roof. The distance from the Manor House site to the park is about 1,100 feet. The John Evelyn Society have no confirmed information about the tunnel, stating: "The use is problematical; we have heard that it was an access to the servants' quarters or well, or kitchen garden, or possibly to a lake in the park".

## Redundant tunnel below New Street Station, Birmingham

An art display has been staged in an abandoned tunnel under New Street Station, Birmingham. The tunnel connected to Europe's then largest postal sorting office, which has now been relocated, and has been disused since about 1997.

SOURCE: KENNEDY, Maev, 2007, Sounding the last post in tunnel art beneath station. *The Guardian*, 2 July 2007

## News from Williamson's tunnels, Liverpool

Since 1997 the Friends of Williamson's Tunnels have been active at Edge Hill, to the east of the city centre at Liverpool, in securing access to and the conservation and study of the enigmatic tunnels and rooms carved in the underlying sandstone by Joseph Williamson (1769–1840) in the early decades of the nineteenth century.

A 'rival' Joseph Williamson Society has also been active, and has opened a Williamson's Tunnels Heritage Centre off Smithdown Lane. Discussions between the two societies, various owners and occupiers of land, Network Rail (one of whose tunnels runs below Mason Street), Liverpool City Council, insurance companies, and health & safety authorities, have now culminated in significant advances.

The Friends have now secured a lease of a plot of land at Paddington, safeguarding access to a network of backfilled tunnels from which skip-loads of material are being excavated. They have also secured a licence to occupy 40–44 Mason Street, the site of Williamson's house, where only the front wall and the cellars and tunnels survive below ground. Here three containers, purchased secondhand, have been installed, to serve for the processing and storage of archaeological finds from the excavated material brought from Paddington. Professional advice has been taken from an archaeologist on how best to deal with the finds.



Paddington Photo Nick Catford

The third of the three identified Williamson's tunnels sites at Smithdown Lane (former Liverpool City stables) has the Heritage Centre in one corner, incorporating a short section of tunnels open to visitors. However, it seems that planning permission has been given to demolish some of the original nearby buildings and redevelop part of the site, possibly threatening further tunnels in the immediate vicinity. All three sites are a few minutes' walk apart.

Why Williamson paid men to dig all these tunnels and what purpose they might have been intended to serve remains enigmatic. As a rich man, the whole thing might just have been for fun. Or possibly a job creation scheme whereby the unemployed of the city could be remunerated for a day's hard (if essentially pointless) work. The tenacity of the Friends is impressive, as is their success so far. Quite apart from locating and clearing backfill from tunnels, they have also already acquired a creditable track record in documentary research, and are now poised to do serious archaeological recording as well.

Members of Subterranea Britannica have visited the sites during at least two Liverpool Study Weekends, and enjoyed the Friends' presentations at Day Conferences. Three officers, as well as Paul Sowan (also a Friend), represented the UK at an underground archaeology conference at Starigrad Paklenica in Croatia a few years ago, and subsequently the Friends hosted an international conference at Liverpool – clearly a very dynamic and successful group.

SOURCE: Various issues of *The Mole* published by Friends of Williamson's Tunnels

**Suggestion to replace highway flyovers with tunnels** Road tunnels should replace flyovers, says Martin Bentham writing in the *Evening Standard*. Problems at the Boston Manor and Hammersmith flyovers were bad enough, he said, but more to the point 'flyovers are eyesores that are as outdated as their crumbling infrastructures suggest'. They date from a time when 'plans to carpet the city with a network of elevated highways were drawn up. Most were eventually scrapped amid residents' protests and concerns about the cost'.

West London was less fortunate, he continues, with Westway built through north Kensington and then the M4 flyovers. They have been used as locations for filming 'secluded meeting places for criminals', crime scenes, and featured in J.G. Ballard's 'urban disaster, in his *Concrete Island*.

It is difficult to imagine that anybody could possibly enjoy living anywhere near them – visually obtrusive structures generating widespread noise pollution, and grim underbellies, dividing communities.

The answer, he says, is to scrap them and replace them by highway tunnels. That would of course be very expensive indeed (probably more expensive and certainly more dangerous than railway tunnels) on account of the need for lighting, signalling, and especially ventilation. Until all road vehicles are converted to run on hydrogen, there is no escaping the tonnes of carbon monoxide (not to mention carcinogenic polycyclic hydrocarbons) churned out by internal combustion engines.

SOURCE: BENTHAM, Martin, 2012, Flyovers are so outdated – we need tunnel vision. *The Evening Standard*, 13 July 2012

**Cannabis farm found in disused Rome metro tunnel** Italian police have seized cannabis from inside an abandoned metro station that was built in the 1930s by Mussolini. Officers raided the half-a-mile long tunnel system in Rome, constructed during the fascist leader's time, after detecting the pungent aroma of marijuana near the entrance.

Police seized 340kg of cannabis – with a street value of  $\pounds 2.4m$  – from the plantation, which was lit by powerful halogen lamps and hidden behind a legitimate mushroomgrowing business at the entrance to the tunnel. A fake wall had been built with revolving breeze blocks to conceal the marijuana plants.

The scale of the 4,000-sq metres plantation, which contained 1,000 plants, a drying room for harvested plants and a vacuum-packing machine, has led investigators to suspect one of Italy's mafia groups was behind it – possibly the Neapolitan Camorra.

"We wore masks when we entered in to stop our heads spinning; I have never seen anything like it," said Stefano Corsi of Italy's tax police, which mounted the raid.



Built in the 1930s under the Tor Pignattara neighbourhood and close to underground vaults used by the Bank of Italy, the 800-metre stretch of tunnel was part of Mussolini's redevelopment of Rome, but was never used due to the outbreak of the second world war.



Police breaking through the fake wall

Entering the tunnel, police found the floor littered with plastic discs that snapped loudly underfoot – a rudimentary warning system for those inside. Police sniffer dogs were then pulled out of the tunnel as the growing smell of hundreds of plants became too strong for them. "The high temperatures recently probably made the smell more intense," said one police official.

The owner of the mushroom-growing business was arrested, but no one was found working in the plantation, although police found masks, gloves, overalls and written instructions on how to manage the complex watering system used for the plants.

Workers at the cannabis factory operated in shifts and changed clothes before leaving the tunnels. It was claimed the operation may have been run by the Camorra, a violent mafia-style organised crime group based in Naples. SOURCE: *The Guardian* 14 August 2012

New metro system at Dubai, United Arab Emirates Dubai City, United Arab Emirates, has built a new and driverless 75-kilometre metro system. There are two lines with city-centre sections in tunnel, and two sub-surface interchange stations, and three depots.



The twin-track Dubai Metro tunnel

The Red Line, opened with 28 stations in September 2009, has a length of 52 km, of which 5.7 km are in tunnel. The Green Line, opened with 20 stations in September 2011, has a length of 23 km, of which 8.3 km are in tunnel. Tunnelling was done by three earth pressure balance tunnel-boring machines of 9.56m external diameter.

SOURCE: BOTELLE, Matthew, Patrick McSHEFFREY, Petros ZOUZOULAS, and Anthony BURCHELL, 2012, Dubai Metro: building the world's longest driverless metro. *Civil Engineering* 165(3), 114–122.

## V8 Land-Cruiser in Saudi Arabia falls down a 60m well

You'd think that they'd at least put up a flag to let people know there's a hole there!

In areas where there is fresh water located underground, residents dig wells and support the sides with concrete and stones to keep the sand from falling back into the well. Some of these wells are up to 100 metres deep – this particular one was 60m deep and 4m wide, and was located outside the city of Riyadh in the centre of Saudi.



Some people drove out in the desert for a bit of 'dune bashing' – on their return one of them drove into the well and dropped 60m to the bottom with his V8 Land-Cruiser. Rescue workers retrieved the car and the driver, who only had a mild concussion from hitting his head against the windscreen.

SOURCE: Google Groups Forum October 2012

## Underground Pubs with a difference

Many readers will be aware that the never-opened North End station on the London Underground Northern Line was better known by its nickname 'Bull and Bush', named after a nearby public house. Those members of a certain age may remember that Sloane Square station even used to have its own bar ('The Hole in the Wall') on the westbound platform. However, attentive travellers and drinkers should be able to name five other current stations on the London Underground network that are named after pubs. What are they? (answers inside back cover).



## Archaeology on the Somme: The work of the La Boisselle Study Group Jeremy Banning

#### Introduction

I am one of the founders of the La Boisselle Study Group and work primarily with Peter Barton (who has spoken at the Sub Brit AGM in the past) on First World War books, television programmes and archaeological sites.

Whilst working on an archaeological dig site at La Boisselle on the Somme battlefield in May we were visited by a small group of Sub Brit members who reported our work on the website. We were then asked to submit a piece about our work. The following article describes the project's evolution with special focus on our two extended archaeological digs in October 2011 and May 2012. It also includes historical information to illustrate the importance of the site.

The germ of the project started back in May 2010 whilst we were working on an archaeological dig at Mametz searching for surviving pieces of a British Livens Large Gallery Flame Projector employed during the Battle of the Somme. A programme based on the dig was broadcast on UK television as a Channel 4 *Time Team Special*.

We have always maintained a very open attitude to locals and battlefield tourists; rather than being kept at bay they are welcomed and actively encouraged. Providing safety is not compromised and visitor attendance does not impede the work, we see no reason to shield archaeological sites from the public's gaze. The steady stream of daily visitors at Mametz prompted us to hold a dedicated open day on the final weekend, an event attended and enjoyed by many hundreds.

Amongst the visitors were Claudie and Derrick Llewellyn who live at the nearby village of Montauban. Claudie's relatives, the Lejeune family, own one of the key remaining undisturbed parts of battleground. Bordering the village of La Boisselle at the heart of the Somme battlefield, the sector was known to the British troops as the 'Glory Hole'. Before the war it contained a farm with outbuildings that were bitterly fought over in 1914– 15 by French and German troops.

At a lecture Peter and I gave in Arras in November 2010, Claudie approached Peter to ask for help. The Glory Hole was under threat from development and she sought assistance in persuading the authorities of its historical importance.

We first visited the 2.5 hectare site a month later. The land contained many overlapping mine craters filled with trees and scrub plus clear depressions marking the route of myriad trenches. These had been backfilled after the war and surface wire and ordnance removed but, other than that, the landscape had remained untouched. It is one of only three such sites on the British sector of the Somme battlefield holding French, British and German trenches as well as a labyrinthine network of wartime tunnels.

With the agreement of the landowners we proposed a detailed long-term archaeological, historical, technological and genealogical study of the site. We hoped that this would help to promote multi-disciplinary international study of First World War sites along with attracting a new generation of battlefield archaeologists. Most importantly, a study of this kind would encourage the authorities to preserve the unique segment of battlefield. We expected archaeology would reveal a host of features including evidence of French, British and German occupation spanning the evolution of trench warfare. Of particular interest to Sub Brit members, we knew that the ground has also been extensively undermined, and working with the Royal Engineers and local French underground experts GIEOS (Groupe d'Intervention et d'Etude d'Ouvrages Souterrains), we planned to explore, survey and record the tunnel systems.

We were also keen to integrate the local population into the project. This multi-faceted approach would enable us to produce the most complete and thorough long-term examination of a Western Front battleground ever undertaken.

La Boisselle in the First World War – a brief history On 28 September 1914 the German advance was halted by French troops at the innocuous village of La Boisselle on the Albert-Bapaume Roman road. There was bitter fighting for possession of the civilian cemetery and again after a French attack on Christmas Eve for possession of the farm buildings on the southwestern edge of the village known to the Germans as the Granathof or 'Shell Farm', and to the French as the 'Ilôt'.

In their efforts to retake the Ilôt, in December 1914 French engineers began tunnelling beneath the ruins, beginning a prolonged struggle below ground that was to expand and deepen day by day until July 1916. With the war on the surface at stalemate, both sides continued to probe beneath the opponents' trenches and detonate evergreater explosive charges, whilst at the same time protecting their own lines by underground warfare.

When the British took over the Somme battlefront in August 1915, the French and Germans were working at a depth of 12m, and the size of their charges had reached 3,000kg. No Man's Land was already an almost continuous line of mine craters for 375 metres.

The British Tunnelling Companies deployed professional miners to extend and deepen the system, first to 24m and ultimately 30m. The size of charges also increased – to over 6,000kg. Today, the bodies of many of these miners still lie deep beneath the crater fields.



Above ground the infantry occupied trenches just 45m apart, and lived in constant danger of snipers, mortar bombs and grenades above ground and enemy mines beneath. As a result of the incessant mutual hostility, maintenance of the advanced trenches on both sides of No Man's Land was difficult and perilous. For French, German, and British soldiers, La Boisselle was one of the most notorious sectors on the Western Front.

The British attacked on 1 July 1916, signalling the start of the Battle of the Somme. The plan to capture La Boisselle was to use two converging attacks from either side of the village. The Glory Hole was judged to be too difficult to advance across and so was just to be attacked by bombing parties of the 18<sup>th</sup> Northumberland Fusiliers.

The Y-Sap and Lochnagar mines would serve to overcome opposition in the front line on either flank of the village and the high lips thrown up would screen the Germans in La Boisselle from being able to enfilade the British advance on either side. The elimination of the Y-Sap position would, it was hoped, help the capture of Ovillers to the north. At 7.28am Y-Sap dominating Mash Valley was destroyed with an 18,000kg charge whilst to the south the Schwaben Höhe position was destroyed by a 27,000kg charge.

At 7.30am the 34<sup>th</sup> Division attacked but failed to capture La Boisselle and suffered 6,380 casualties, the heaviest divisional losses of the day. The two mines had destroyed parts of the German front line, although the Germans had withdrawn from Y-Sap.

The infantry attacking at Lochnagar had suffered from having to advance further owing to the need to pull back from the front line because of the mine. The mines did not significantly contribute to the capture and may have impeded the ability of the attackers to keep up with the artillery barrage. La Boisselle was eventually captured by the British 19<sup>th</sup> Division on 4 July.

Y-Sap crater bordering the Roman road was infilled in 1974 whilst the crater under the Schwaben Höhe can still be visited. Today it is better known as the Lochnagar Crater, named after the British communications trench from which the tunnel was commenced.

#### Work begins

During spring 2011 an Anglo-French team was recruited, forming the La Boisselle Study Group. A constitution was formed and contract signed with the Lejeune family. One of the group's first tasks was to clear trees and scrub from many of the craters. Only then would it be possible to determine their size and shape and, coupled with archival research, ascertain when and by whom they were created. Aided by a steadily growing band of volunteers, team members cleared the two largest craters and a number of smaller ones.

Prior to any archaeological work we arranged for a geophysical survey to take place in order to ascertain the potential of ordnance contamination. Having worked



Clearing trees and scrub from mine craters in the summer of 2011

with Bactec International, specialists in explosive ordnance, EOD, bomb disposal and landmine clearance on various projects over the previous fifteen years (most recently on the Livens Large Gallery Flame Projector dig at nearby Mametz in May 2010), their assistance was sought.

In June 2011 a Bactec team conducted a geophysical magnetometry survey across sections of the site, focussing on the areas behind the French/British and German front lines. No Man's Land, mainly comprising deep mine craters, was not be surveyed at this time.

Magnetometry is one of many tools employed by ordnance clearance specialists. It is used in conjunction with additional 'layers' of geophysical techniques, which when combined give the clearest picture of what lies beneath the surface. The first 'layer' is archival, utilising trench maps, plans and documents. Next, Linesman – a system of plotting wartime trench maps by means of a GPS interface – is employed. Only when these layers have been completed should magnetometry be undertaken. Each layer cannot give appropriate levels of detail on its own; only when they are combined can an overall picture be ascertained.

During this time we invited Robert Hall from BBC News to report on the project. Robert has covered previous digs we have worked on including the flame-thrower at Mametz and Vampire Dugout near Zonnebeke. A full day of reporting on *BBC Breakfast News*, *News24* and radio followed along with an article on the BBC website which had over a million hits.

This publicity generated many requests to help from volunteers as well as numerous enquiries from television production companies. We had been working with the BBC for some months already and soon after received a commission to make a BBC documentary. Every aspect of the project has been filmed and the documentary will be aired on *BBC Four* in January 2013.

## Archaeology

Having obtained authorisation from the Directions Régionales des Affaires Culturelles (DRAC), the first tranche of archaeological work took place in early



October 2011. Aided by many willing volunteers and working closely with GEIOS, French archaeologists and the Service Déminage, we focused on a number of key sites.

British and German trenches both within the site and beyond the boundaries towards the Lochnagar crater were marked out with flags, yellow indicating French and British positions, with red for the German front line. This exercise was invaluable in understanding the location of the site within the wider landscape of battle.



Detailed view of the British section of Glory Hole.

Front lines and trench names were marked with sign boards. Both the French and British trench names were given and in the case of the French names, the soldiers after whom the trenches were named. Some 21 French, British and German shaft heads were also marked.

In addition, panels showing the locations of 38 French and British miners whose remains still lie in collapsed tunnels were placed on the surface directly above (or as close as possible) to their underground positions. When photographs of the men were available, these too were included on the panels. In the case of the French, casualty report forms were reproduced. Once archival studies are completed the same exercise will be carried out for the many German tunnellers who still lie beneath the site.

Archaeology was carried out by qualified archaeologists under the direction of Anthony Byledbal. The archaeological objective for the week was to explore two mine entrances (X Incline and W Adit) and sections of their associated trenches. This was to establish their design and construction, an aspect that was either not recorded in British war diaries, or for which the relevant documents are missing or lost.

On our first site visit we had found a collapse leading into the tunnel system. A small hole had appeared leading to a sloping incline running down to a depth of approximately ten metres underground. A tunnel branched to the left which led to a shaft chamber.

The route was narrow and tight but included soldiers' graffiti and a poem written in pencil on the chalk wall. By comparing our hand-drawn sketch plan with French and British tunnelling plans we were able to conclude that the collapse had occurred near the entrance to a British tunnel named X Incline. The shaft chamber reached contained W Shaft which sank a further 15 metres down through the geology.



The original collapse into X Incline photographed in early 2011. This has now been opened up completely X Incline was one of five similar features which British records state were commenced in September 1915 immediately behind the front line, which at that time skirted the crater lips. This particular entrance originated in Quémart Street, a communication trench originally constructed by French troops, which later became front line.

The tunnellers' objective was to sink an entrance gallery to a depth whereby tunnels might be driven beneath the level of German workings which were approaching dangerously close to the British front line. It proved impossible to locate the junction of the incline and Quémart Street as a result of the archaeologists uncovering a mass of materiel in the tunnel entrance consisting of rum jars, jam and condensed milk tins, Maconochie and bully-beef tins (British), bottles (French and British), pickle jars, bullets, and some more personal items such as a silverplated hip flask. In addition large quantities of wellpreserved and hazardous barbed wire fragments, apparently French, and an original iron picket were also found here.

The careful extraction of the artefacts meant that progress was slowed. The area above the shallow 'throat' of the gallery close to where it joins the trench had apparently collapsed. It may in fact not have had solid earth head-cover but some other form of splinter-proof protection such as elephant shelter sections or heavy timbers. Once this protection decayed or was removed, the surrounding geology would have readily caved in and filled the gallery.

The large artefact collection found here may have been rubbish produced and discarded by the occupants of Quémart Street, or detritus collected and dumped by landclearers in the postwar period. The area was eventually cleared by the archaeologists, revealing much of the collapsed gallery entrance beneath.



Vertical timber supports (legs) were still in evidence but in a severely decayed state. The original floor level of the shallow gradient leading to the steeper 40-degree main slope of X Incline had been created by a series of sandbag steps. These, studied alongside the narrow and low gallery dimensions, showed that spoil was being carried from the workings by hand rather than with a trolley run on rails.

At the point where the gallery begins its steeper descent, the dimensions of the timber support frame (known as a sett) were 0.84m wide at the base (the sole), 1.12m high (legs), and 0.45m wide at the roof (cap). British tunnellers did not work on X Incline for long. Although the workings were abandoned in favour of W Adit, the galleries were kept open as alternative escape routes. Some of the workforce were employed in the sinking of 50-foot vertical shafts from chambers at the 30-foot level.

W Adit was driven in March 1916 to create improved access to W Shaft. It greatly facilitated removal of spoil from the shaft which itself enhanced access to the 80foot-deep mine system. By the sinking of further shafts this level was extended to a depth of 100 feet (30 metres), so vast quantities of spoil would have had to have been removed via the W Shaft route. The water table was reached at just over 100 feet.



Excavated entrance to X Incline. The tunnel is gated and locked. Sandbags have been used to stabilise the walls

In order to reopen W Adit its location first had to be identified on the surface. This was done by using a Geophone, the original device developed in 1915 for underground warfare. Team members inside the gallery, i.e. underground, were in contact with their surface colleagues by field telephone. They were requested to tap on each gallery wall respectively, and the sound was located by Geophone and plotted on the surface by stones. Despite a complete lack of experience by the operator, the method proved highly effective, producing an error of only forty centimetres. The gallery was quickly found. Its upper section was found to have collapsed along a length of approximately seven metres from where it originated in Scone Street, a British communication trench. This failure too may have been as a result of the removal of timber or steel splinter-proof protection.

The remnants of heavy upright timbers were found, indicating that some form of cover is likely to have been present. It is certain that large amounts of earth were piled on top of this most vulnerable part of the Adit to form deflection and burster courses against the effects of shell and mortar fire.

The gallery of W Adit was considerably more roomy than X Incline, being 1.80m high and 1.45m wide. The slope was much more gradual than X Incline, running at 11 degrees. In the centre of the gallery there were clear vestiges of the tramway that had been fitted to facilitate the extraction of chalk spoil produced by the driving of the 80- and 100-feet systems and their associated features. The tramway was of a typical sleeper and rail pattern and appeared to have been fitted with wooden rails. As well as spoil removal it would have been used to carry timber down to the shaft head – and of course explosives for the many charges blown underground during the period of active mine warfare.

The opening of the W Adit was required not only to provide safe access to W Shaft chamber but also to produce circulation of fresh air through the galleries connecting the two entrances. Opening both entrances created a natural flow, with X Incline forming the downcast feed and W Adit the upcast vent.



View from W Shaft chamber in August 2011. X incline and W Incline join from the top left whilst W Adit is running to the right

With access and ventilation thus improved, a Go-Pro HD camera was lowered down the 50-foot shaft in order to ascertain the structural integrity of the square-cut unsupported chalk walls (approx 1.5m square) and conditions at the foot. The images revealed that the shaft was in an excellent state of preservation along its entire visible depth. At the base, debris fallen from the area around the shaft collar and the roof of the chamber

reached a depth of 3–4 metres, blocking access to the two galleries that emanate in roughly east and west directions at the 80-foot level at the foot of the shaft.

Although the site was open to all during the excavation phase, special open days were held on 8 and 9 October. As well as dedicated tours on the surface, the excellent state of W Adit allowed the Group to take small groups of five visitors at a time safely underground as far as the W Shaft chamber. The *portes ouvertes* on Saturday 8 October was dedicated to the people of La Boisselle and the wider Albert region.

In a large military tent an exhibition was created with maps, plans, panoramas, photographs and artefacts. Fortuitously, a large group of visitors from Brittany were in the area for the rededication of the refurbished memorial at Ovillers to the French (Breton) 19th Infantry Regiment, who held the trenches at the site until July 1915. Family members

were for the first time able to visit the site where their antecedents had served.

Other visitors included distinguished French archaeologists, Commonwealth War Graves Commission staff, personnel from the DRAC, and regional politicians. The Group was especially pleased to welcome the descendants of two British tunnellers who served at La Boisselle, one of whom died underground and is buried at nearby Bécourt. Sunday 9 October was a day for the general public and we were delighted to welcome many visitors from the UK, Germany, the Netherlands, Belgium, Canada, USA, Australia and New Zealand.

#### Winter 2011-2012

Winter months are traditionally quieter on the battlefields and offer the chance to complete the required crater clearance. Much effort was made on the archaeology of the original floor of W Adit, exposing the tramway system. Once this had been recorded archaeologically a wooden duckboard walkway was installed along 30 metres of W Adit. This would not only protect the original 1916 floor but also facilitate the removal of spoil from the chamber during the next phase of operations.

Archaeology continued at the bottom of the steeper 1915 'X Incline'. Finds included a well-preserved sandbag wall, a long and intertwined length of steel-reinforced rubber air hose with brass fittings, and an axle made by H.C. Slingsby with rubberised wheels at each end. When it was first uncovered, we hoped it would be a small miner's truck. However, as it was excavated it soon became evident that it was too long for use in mine galleries, its length being considerably wider than the tunnels. The base of an oil lamp, a mess tin, and an empty tin of 25 Meadowland cigarettes were also uncovered. The scene at the 30-foot level around W Shaft chamber was confusing. Over the past 95 years, small falls from the



Extract from 179 Tunnelling Company Mining Map showing a small section of the Glory Hole. Reproduced courtesy National Archives Ref: WO153/904

roof have altered the chamber's shape so it resembled that of a bell. Owing to the sheer quantity of material deposited we also believe that spoil from the lower levels was dumped in the chamber and associated tunnels prior to the start of the Battle of the Somme in July 1916. As the offensive was planned to advance the British line ever eastward there was no need to transport the spoil to the surface. The tunnels and shaft chamber made an ideal halfway-house as a dumping ground for spoil from the lower levels.

In March 2012 we spent a few days inspecting and surveying parts of W Shaft chamber in order to determine dimensions for a steel safety cage which was to be specially fabricated to sit over W Shaft. A key sponsor, Danny Gunner, manager of Lynx Engineering (Kent) Ltd., joined us. Lynx were sponsoring the fabrication, transport and erection of the structure, as well as providing safety equipment, winches and lighting, and briefing and training for working in confined spaces.

The logistics of designing and installing a rectangular steel frame into the irregular shape were discussed in detail. The dimensions of W Shaft were reconfirmed (1.8m square) in order to ascertain the necessary size for the steel collar which would form the base of the cage. It was also calculated that up to 40 metric tonnes of spoil needed removing from the chamber area to allow for archaeology, shoring and bracing to take place. Only after these areas had been made safe and the steel cage constructed would it be possible to attempt a descent of the shaft.

Whilst the engineering and logistics operation required to conduct this operation took up our minds we were still very conscious of the remarkable opportunity presented and the environment we were working in. Ongoing archival work provided us with details of tragic events around W Shaft in autumn 1915.



## W Shaft

In October 1915, 179 Tunnelling Company began to sink a series of deep shafts in an attempt to forestall German miners who were steadily approaching beneath the British front line. At W Shaft they went down from 30 feet to 80 feet and began to drive two counter-mine tunnels towards the Germans. From the right-hand gallery the sounds of German digging grew steadily louder. Company Commander Capt Henry Hance ordered a chamber to be prepared for an explosive charge.

On 19 November Hance spent six hours listening there. He estimated that the Germans were fifteen yards away and ordered the chamber to be loaded with 6,000 pounds of explosive. This was completed by midnight on the 20–21 November. He hoped that he would not have to blow the charge immediately. Just over 24 hours later however, at 1.30am on the 22nd, the Germans blew their own charge.

A massive quantity of carbon monoxide gas was released by the explosion. The air rising up the shaft to the surface was so poisonous that within one minute two canaries lowered down were dead. A trained rescue man wearing breathing apparatus descended the shaft and at the bottom found two miners dead. There was so much gas that no one could have survived. The bodies of six miners who had been working below could not be recovered until the system had been flushed out with clean air.

Twenty-four hours later the bodies of three men were found: William Walker, Andrew Taylor and James Glen. Both the right and left tunnels were collapsed: the German blow had detonated the British charge, which explained why the blast had been so powerful. The wrecked tunnels were gradually reopened, and later a fourth miner, Robert Gavin, was recovered. These four men were all Scots, from Fifeshire, Glasgow and Edinburgh.

The bodies of two other tunnellers however, John Lane and Ezekiel Parkes, were never found. They had lived less than a mile away from one another in Tipton, Staffordshire; both were skilled and experienced miners. Parkes, aged 37, was a pike man, and Lane, 45, a hewer or face worker. Miners prefer to work alongside men that they know and trust, and Lane and Parkes had been either working at the face or on listening duty. Their bodies still lie 80 feet beneath the Glory Hole.

#### May 2012

A seventeen-day dig was planned in which we were joined by over two dozen volunteers. Work began on Monday 30 April with the erection of two new tents to be used for storing archaeological finds and to act as a workshop. Further clearance work continued at the foot of X Incline. Our main surface focus was a larger sondage between X Incline, the Granathof and W Adit entrance. Topsoil was removed over a 50m x 30m area encompassing W Incline, Scone Street and Quémart Street which revealed clearly the outline of trenches. Work began on opening a section of Scone Street as well as clearing around the covered entrance to W Incline. Dug in September 1915, the steeply sloping incline was the most direct route down to W Shaft chamber. With X Incline and W Adit already excavated, W Incline was the last of the three entrances linked to W Shaft to be opened.

It was immediately apparent that this entrance had been more extensively used than X Incline, the walls being smoothed by passing traffic and dirtied by soot from candlelight. Finds included a box of gun-cotton explosive, lengths of three-inch reinforced air hose which hung on brackets on the wall, small lamps and assorted foodstuffs including toffees.

There were also a number of complete sandbags filled with what was originally wet chalk. These had been brought up from the lower levels and dumped in W Incline prior to start of the Somme offensive.

Next to W Incline was a pump-room cut from the chalk. Records showed this was the location of a specially constructed room where air was manually pumped down to the lower levels. During clearance three small and rather unusual finds were uncovered: a small pink, mounted gemstone, quickly followed by two decorative brooches.

## Bretons at the Granathof

A concerted effort was made on uncovering what we believed was a surviving corner of the 'Granathof', the ruins of an old courtyard farm that had long been present at the site. Results were spectacular with walls and a brick floor of the stable block uncovered.

Using French maps sourced from archival research we discovered one of the first trenches, dug through the stable block to the forward French trench. Many artefacts including large quantities of French and German small arms ammunition have been found at this spot.

Looking down W Adit in March 2012 – spoil removed and floor duckboarded



Owing to the ferocity of fighting here it was almost inevitable that we would uncover sets of human remains. Two such sets were uncovered near the southeastern corner of the Granathof. Whilst most of the farm is now a crater field, early surveys suggested that a substantial portion of this highly symbolic structure might still survive, protected by the fallout from mine explosions.



The first set of remains was found near an early trench that had been driven through the stable block; unfortunately this man was unidentifiable. The small collection of bones was carefully excavated and removed by a qualified archaeologist. No identifying artefacts, other than French line-regiment buttons, were found with the remains.

The second soldier was found by Peter Barton during work on the walls of the adjacent farmhouse. There was present an 1881-model identity disc which carried the name 'BIDEAU'. His casualty form confirms his name as François-Marie Bideau of the 118th Infantry Regiment, killed at La Boisselle on 27 December 1914. The disc also bears his call-up year and recruiting region, with the regimental number on the reverse side. The region is Tréguier, a port in Brittany. Found alongside were buttons, a toothbrush and small pieces of leather – possibly from personal equipment. It required five days to complete the exhumation.



Granathof – an early French trench driven through the stable block. The brick stable floor is evident. Both sets of human remains were uncovered in this area.

The War Diaries of the French 118th Infantry Regiment and 11th Army Corps, and also the history of the 13th Wurttemberg Pioneers (German), enable the events of 27 December to be pieced together.

After the loss of the farm on Christmas Eve, the Germans tried to retake the position on 27 December with a grenade attack by infantry and pioneers. Determined to hold the line, the French had amassed a large amount of artillery. The farm buildings were at this time held by the 3rd Company of the 118th Regiment commanded by Lieutenant de Castel. After a heavy bombardment by trench mortars, the Germans advanced from their trenches some sixty metres away with fixed bayonets. According to the war diary of the 118th Regiment, the Germans came forward with right hands raised, signifying surrender, until, nearing the French, some amongst their ranks threw melinite bombs. The attack was repulsed at bayonet point, but was followed by another heavy German bombardment, which itself preceded another grenade attack half an hour later. The French then bombarded La Boisselle and the German artillery batteries, reporting that this fire combined with that of the infantry defeated the assault.

De Castel's Company was now very tired, having held the position for three days. It was therefore relieved by a company of the 65th Regiment later in the day. Sandbags, logs, improvised grenades and coils of wire known as *réseaux Brun* were brought up to reinforce the farm. The German fire gradually lessened and by the end of the day quietened down. Losses to the 118th were one officer wounded and approximately forty casualties to other ranks. Amongst the German casualties were two pioneer officers killed.

Soon after the discovery of the remains of François Bideau, Claudie Llewellyn made contact with the family in Brittany and also the *Mairie* (town hall) of the soldier's home town. Other family members have been traced and it is anticipated that François Bideau will be buried in a French cemetery in a named grave with family present.

### WAdit

Efforts underground were equally rewarding. Over the first week an estimated forty metric tonnes of chalk spoil were cleared from W Shaft chamber. The duckboard floor laid on W Adit earlier in the year was extended further. Working in Petzl safety gear provided by another key sponsor, Lyon Equipment, spoil was cleared from the area around the 50ft vertical W Shaft. This enabled Danny Gunner's bespoke steel safety cage to be erected over the shaft. Bolted and welded together, it provided a secure working area with steel mesh floor.

Work continued installing electric winches and a 'sentry box' for us to stand under when at the foot of the shaft. Peter Barton was the first to descend, assessing the integrity of the vertical shaft walls. The first two metres proved to be unsafe with sections of the wall coming away when tapped. The shaft collar has now been shuttered with timber and later this summer will be filled with concrete, linking the steel cage to the shaft itself. Until this is complete the 3–4 metres of spoil at the shaft foot will remain.



Francois-Marie Bideau, 118th Infantry Regiment, killed at La Boisselle on 27 December 1914 Once again, hundreds of visitors came to the site. Once the steel safety cage in W Shaft was in place we were able to take visitors underground safely. We were joined by Phil Giles from Pan 3Sixty who took a number of panoramic images above and below ground. These are now available as a fully interactive 360° virtual tour on our website.

#### The next stage

We have just returned from three open days held over the 1 July commemorative period in which we showed over a thousand visitors around the site. Underground work will continue in the autumn with the clearance of spoil from W Shaft and initial exploration of up to 3km of the British tunnel system.

Self-contained Breathing Apparatus has kindly been provided by Siebe Gorman, manufacturers of the wartime Proto breathing apparatus worn by British tunnellers. These will be essential for the 'break-in' to the lateral galleries from the shaft where there is a real chance that carbon monoxide and methane will be present. Surface archaeology will focus on the Granathof. A full topographical and LIDAR survey has also just started, the results of which will be published on our website.

All of our work had been funded from our own pockets and through donations by friends, individuals and site visitors. We are now working with a number of sponsors and are organising corporate funding to provide an ongoing funding stream, not only for archaeological work but for the extensive



Peter Barton is lowered down W Shaft to ascertain the integrity of the vertical walls, May 2012

archival work required in British, French and German archives.

#### Visitors welcome

When on site we welcome visitors but please be aware that access underground is dependent upon breaks on the continuous work that will be going on below. Further details of the project and open days plus images, videos, email contacts and a dedicated 'Donate' page with PayPal can be found on our website www.laboisselleproject.com. Thanks to my fellow team members in the La Boisselle Study Group for the information provided above.

## Meet our Day Meeting organiser – Chris Rayner

Chris Rayner joined Sub Brit in June 2007, becoming a Committee member in April 2012, and is our Autumn and Spring Meetings organiser.

Chris is from Kent, and grew up with an interest in old buildings from an early age. His father was an architect and Saturdays typically involved site visits and measured surveys that Chris would help him with, the best of which involved derelict buildings, large cellars or roof spaces reached by sketchy ladders. His father would regularly get him to measure the most unstable parts of a structure or hold the tape under a unstable beam, and even being run over in his teens by a contractor working for his father didn't reduce his enthusiasm.

Another lifelong interest was mountain and ice climbing, although since a bad accident a few years back trips to the mountains are invariably now only to the underground spaces. He studied architecture in the UK and then as a post-grad in the USA, where a highlight was walking onto the Berkeley campus on his arrival and getting hit by a gas grenade thrown by riot police.

He retains a fondness for America despite this, helped by periods working in construction in Alaska. His boss would quell labour disputes with a handgun and would check his workforce wasn't slacking by low-level overflights – until his pilot quit after being ordered to fly up from Montana with some sheets of Styrofoam insulation taped to his wings. Less entertaining periods working in practices in Canada and the Middle East followed, and a half-year travelling round



Central America on village buses looking for Mayan and Aztec temples in the jungle. Travelling through El Salvador and Nicaragua during a period of civil war taught him that it was a good idea to research a place before you visit it. Another lesson, probably not transferable to SubBrit's activities, was that when climbing volcanoes at night in border areas crisscrossed by drug smugglers' paths, it can be safer to turn your head-torch off.

He came back to the UK in the 1980s, and now lives with his family in Sevenoaks, where he started his own design practice with a particular interest in repairs and alterations to historic buildings, which has included defence structures.

He became involved in SubBrit via his interest in forts and the complex underground structures beneath them, and also through work-related quarry visits to Chilmark and the Bath area.



## Replica WWII Operational Base Constructed at Coleshill Richard Alexander

This is an article about a volunteer project by members of Churchill's Underground War Archaeology Project, in partnership with the National Trust, to build a replica OB at the Trust's Coleshill Estate near Swindon in Wiltshire. **The planning** 

In brief, OBs were underground bunkers (Operational Bases) that the British Resistance (called the Auxiliars) would have worked from to sabotage the occupying force had there been a Nazi invasion. Rather than go into great depth on the history of these units and their OBs in this article, I would suggest anyone unfamiliar reads Stuart Angell's excellent articles in recent copies of *Subterranea* (issues 29 & 30).

The initial concept of building a replica OB at the site in Coleshill was the idea of Liza, the National Trust's education officer at the site. The existing OB, originally

used for training at Coleshill during WWII, was rediscovered some years back and excavated by members of RMARG (Ridgeway Military & Aviation Research Group). In recent years it has been used as part of the estate's education programme.

Being an original OB, on a unique site, having myriad visitors traipsing through each year was perhaps not the best way to preserve it. In 2011, Liza submitted a bid to the Heritage Lottery Fund for funding to renovate the guard house, and to build a replica OB as part of a living museum. The bid for funding was successful so the next task was to apply for planning permission, and from there to build the bunker.

The proposal to build it with a volunteer workforce came about as a result of a chat over lunch between myself and Martin and Linda Dixon. After that lunch, whilst at Coleshill as part of the ongoing archaeological works, I approached the Trust and offered the assistance of the 'Churchill's Underground War' team, which they eagerly accepted.

Initial plans were drawn up by the National Trust based on the original OB on site. These were submitted to the local Council's planning department, along with a copy of the original structure plan from the National Archives in Kew, and also copies of pages from the contemporary (1936) Royal Engineers Field Manual.

The overall objective was to build the OB as authentically as possible, with as close to the original materials as practical, whilst making some concessions to fit in with current building requirements.

Some changes to the original design were agreed. Modern corrugated sheeting today is much thinner than that available in the 1940s. To ensure that the structure would be safe, it was agreed that the sheeting would receive a coating of concrete, and that gabions would be placed along either side prior to backfilling.

We know from the archaeological work done at the OB on site that many structures were built by just laying



concrete direct onto the soil. However it was agreed that we would lay the concrete on top of a hardcore base, blinded by sand, and topped with a damp-proof membrane. Other than these changes, the OB has been constructed broadly in line with original designs, and using materials that would have been available in the 1940s.

#### **Building begins**

After some initial meetings, work started over the Easter weekend in April 2012, with the aim of being ready for official opening at the estate Open Day in September. Ground cover and vegetation was removed, the area was marked up, and topsoil was excavated by hand with shovels.

After the first weekend of digging by hand, on the Tuesday a mechanical digger removed the rest of the soil. Had we dug the entire site by hand, it would have taken the five of us about two weeks; as it was, in that first weekend we shifted just over three cubic metres of soil. Unfortunately with an age range for our volunteers of between 40 and 70, we were not strapping young Royal Engineers, so appreciated the mechanical assistance!



The site in April 2012 shortly after work started

For anyone wondering, yes, there were mechanical diggers in the 1940s – in the UK they were first available as steam-powered diggers in the late 1800s, and then later as petrol-driven diggers, some of which were designed for digging anti-tank trenches during WWII. Whilst the Royal Engineers may or may not have used them for OBs, the technology did exist at the time.

We mostly worked weekends, alternating one weekend on, one off. The next few weekends were spent laying hardcore, which was brought in on wheelbarrows from a nearby field, then sand blinding; and finally the concrete, again wheelbarrowed in. On the day we laid the concrete we shifted three tons of concrete by wheelbarrow with three people – we just finished laying it before it set too much to work with.

During the early stages of the project we were plagued by deluges of rain in what turned out to be the wettest April in the last one hundred years. Six working days into the project, in mid-May, we started with the bricklaying. Plans didn't state what type of building materials to use, and existing OBs are variously built of brick or block work. We used engineering bricks, again, which have been in manufacture since the 1800s.



By mid-May bricklaying had started

Within the team of volunteers we had varying previous experience of bricklaying, and after some practice we were averaging in the region of 120 bricks per person per day. During this period of work one thing we learnt was that the speed of work was restricted by the number of people who could safely fit in and work on the site at any one time. If there were more than five people on site, it became too crowded to work – meaning that the amount of work was limited to how many bricks five people could lay in a day.

By the beginning of August brickwork was mostly up to six feet high. At this point two of the team disappeared to go and excavate at a Neolithic archaeology site at the Ness of Brodgar in Orkney. Whilst they were away the rest of the volunteer team began fitting the corrugated roof.

In late August the building officer from the local council came to inspect and was happy for work to continue. During the first weekend of September the final adjustments were made to the corrugated roofing, and we were ready to complete the brickwork.



Bob and John in the completed OB



With time cracking on towards the Coleshill Estate open weekend, there was some spare capacity in the National Trust's Land Team at the estate, and they gave us some assistance with the brickwork.

## The official opening

Media interest in the OB and the open weekend started picking up, with articles in *Oxfordshire* magazine, and *Cotswold Life*, followed by coverage on BBC local news. The weekend of 15–16 September arrived, and with it the open weekend. The OB was not quite completed, but the basic structure was there for all to see. Bob Millard, now 89 years old, who was an Auxiliar trained at Coleshill during the war and a member of the Bampton Patrol, officially opened the OB, and around twelve hundred visitors took a tour of it.

To date, with volunteers working every other weekend, the project has taken just over five months. Contemporary records show that construction of the original OBs could have taken as little as three weeks, or as much as four months.

Now the structure is almost complete it will need kitting out. Replica grenades and a Fairbairn-Sykes dagger have been made by Roger; various donations of equipment have been received – including a Primus stove – and we are still looking for a WWII Elsan toilet if anyone happens to have one!

The entrance hatch will shortly be created based on original designs identified during archaeological work on site. The escape hatch will be created by hiding it behind



Former Auxiliar Bob Millard performs the official opening

a replica phone box. After backfilling, some basic replanting will be done over the top of the structure; this will be based on a flora survey carried out by Bob and John during the project.

### What we learned and what's next

Some of the reasoning behind our motives for offering to help on the project were so that we could learn more about the practicalities of building an OB. Some of the immediate learning is that speed of the build would have been restricted by the number of people who could reasonably work the site at any one time.

We know from records in the National Archives that the Royal Engineers in some instances were taking four months from start to finish to complete an OB, and that like us their progress was hampered by rain making the site unworkable. Also, a surprisingly large quantity of materials needed to be provided without being spotted.

David Lampe's book *The Last Ditch: Britain's Resistance Plans Against the Nazis* suggests at the time that this was tackled with cover stories, rather than making an attempt to hide what was going on. The quantity of soil removed was too large to temporarily conceal, although, when backfilling, much of the soil went comfortably back in place leaving a relatively small quantity of soil to 'lose'.

Spoil was backfilled to 70cm above the top of the OB giving sufficient soil depth to allow plant life to repopulate – this left a gentle swell in the land, but nothing too obvious if you don't know it is there! The biggest initial camouflage problem is the large area of bare soil.

As Britain was never subject to a German occupying force, OBs never saw action, and were never occupied for more than a few nights as part of training. As our next project, we are hoping to carry out some experimental archaeology in the form of a modern-day Auxiliar Unit living in the OB for a period. We will use this to assess the suitability of an OB as accommodation if they had been pressed into action.

## Acknowledgements

This project owes a debt of gratitude to many – particularly all the volunteers who came and pushed wheelbarrows and carried and laid bricks come rain or shine for many weekends throughout the summer – particularly Bob, John, George, Roger and Jan. We are also indebted to the community in Coleshill village for making us feel welcome. And finally thanks to Liza from the National Trust for making the project happen, and Martin from Sub Brit for the suggestion of carrying it out as a volunteer-led project.

### Further information:

#### www.coleshillhouse.com

www.nationaltrust.org.uk/buscot-coleshill-estates/history



## Liverpool Overhead Railway's Southern Extension of 1896 and the Dingle Tunnel Paul Wright

It might seem a little strange to see an article about an overhead railway, or elevated railway as our North American cousins would say, in a journal dedicated to the study of underground places but the Liverpool Overhead Railway (LOR) was unique in many ways, not least of which was that this overhead railway actually had a southern terminus that was underground.



The LOR was a muchloved line on Merseyside and is still spoken about frequently, even by many people who were not even born when it closed. In the new Liverpool Museum a section of the line with an LOR motor coach on it forms one of the main exhibits.

It is not surprising therefore that there have been many books and articles published about the line and it is not my intention in this article to go over the same ground. I intend to concentrate on the southern extension which was the section of line that was underground. However, some basic history of the line is necessary so that readers can better understand why it was built.

#### Major port

By the second half of the nineteenth century, owing to its position on the east bank of the Mersey close to the Irish Sea, Liverpool had become the second city of the Empire. It was a major seaport and docks had spread from the original town centre both north and south covering a distance of over six miles.

A roadway which became known locally as the 'Dock Road' – although it was never actually called that, there being different names for different sections – ran parallel to the docks and acted as the main artery for trade. A railway was even laid along it by the dock board at street level. The road had become seriously congested as early

as the 1850s, so much so that the idea of creating an elevated railway above it was proposed as early as 1852 but came to nothing. The idea was resurrected again in 1877 when the Mersev Docks and Harbour Board proposed a line. Their idea was for a single line with passing loops but it was rejected as it was felt it would not have enough capacity.





In 1888 a group of local businessmen formed the Liverpool Overhead Railway company. They obtained the necessary powers and appointed two engineers, Sir Douglas Fox and James Henry Greathead, to design and build the line. Work commenced in 1889 and the line was built as a double-track railway above the track of the Dock Board's railway. It was mounted on an elevated iron structure that carried the rails sixteen feet above street level.

Concerns about fire in the dock system led to the LOR company looking at alternatives to steam locomotives for traction. They decided upon electricity which as a form of power for railways was technology that was still in its infancy. A conductor rail to carry the electricity was laid in the centre of the each track. Three-coach electric multiple units (EMUs) were bought for the line.

There was a formal opening ceremony on 4 February 1893 with full public services starting on 6 March 1893.



The extension south to Dingle involved building a 200ft lattice girder bridge over the CLC. The bridge is seen here with the tunnel mouth on the far side. By the time this photograph was taken the original Herculaneum Dock station had been demolished.

In its original form the line ran between Herculaneum Dock in the south and Alexandra Dock in the north, a distance of just under six miles.

### **Extensions** planned

The line was an immediate success when it opened in 1893, and it was not long before the first extensions were planned. The first extension was north to Seaforth Sands and opened on 30 April 1894.

At the southern end, Herculaneum Dock was close to the residential area of Dingle, but inconveniently located for its residents. To serve Dingle, and thereby increase revenue, the LOR decided upon an extension into the residential area which was at a much higher elevation than the docks. The only way that an extension into the Dingle area could be achieved was by tunnelling. Work started on the 'Liverpool Overhead Railway Southern Extension'.



Inscribed above the portal are the words LOR Southern Extension and the date 1896. The portal being at an elevated position shows the height of the overhead railway structure which at this point crossed over numerous sidings that connected to the Cheshire Lines Committee Railway's Brunswick Goods Depot. The tunnel portal was cleaned as a feature for the Liverpool International Garden Festival of 1984. Photo Nick Catford This southern addition required a new station to be built at Herculaneum as the alignment of the line had to be altered to turn eastwards away from the river; the old station was retained as a carriage shed. The actual extension line consisted of a short section of elevated line, a 200ft lattice girder bridge, required to carry the LOR over the Cheshire Lines Committee Railway (CLC) goods depot sidings, and a tunnel °-mile in length that was called Dingle Tunnel.

This was a brick-lined double-track tunnel mostly cut through sandstone. At the western end it crossed over a CLC tunnel dating from 1864 that was also called Dingle Tunnel. The clearance between the two was only 33 inches and required intricate engineering works. At the eastern end of the LOR tunnel was Dingle station.

The LOR Southern Extension and Dingle station opened on 21 December 1896. At street level the Dingle station was on the western side of Park Road close to its junction with Dingle Lane. The station building was a three-storey brick structure whose canopy extended over the pavement. On the ground floor were the ticket office and a kiosk; on the first and second floors were offices. At the rear of the building a pedestrian subway led down to platform level.

The subway connected into a large 163-yard tunnel which connected to the double-track Dingle Tunnel (through which the line ran to Herculaneum) at its western end, and to a short dead-end tunnel, 123ft in length, at its eastern end. The end-wall of the deadend tunnel was bare sandstone; it was left unfaced because the LOR had plans to build an extension further out into the Liverpool suburbs – which never materialized.



The pedestrian subway that led down to the station at Dingle seen from just below street level. The logo of the LOR is carved into a sandstone block above the subway entrance. This was the only access to the station and in later days to the Roscoe Engineering garage. Photo Nick Catford





Both the Dingle LOR and the Dingle CLC tunnels are shown crossing on this 1:2,500 OS map from 1908. To the west of the LOR tunnel there was a large CLC goods depot at Brunswick. It had connections with sidings at Herculaneum Dock which the LOR had to cross, the solution being a 200ft single-span arched bridge which was the longest on the system.

From the point where the pedestrian subway entered the large tunnel, passengers crossed a single line by an iron footbridge; this connected to a flight of stairs down to an island platform, 28ft wide and 170ft long. The curving platform had two faces and was provided with a ticket collector's hut and waiting shelters.

At the western end of the platform, just beyond the ramp, was a signal box with a 23-lever frame built by the Railway Signal Company. There were two sidings, one on either side of the main line to the west of the box, extending to the double-track portal of the Dingle tunnel. At the time of opening Dingle station had trains every few minutes to Seaforth Sands. Trains entered the station on the northern platform; passengers would disembark, and the train continued into the dead-end tunnel, east of



Looking east along the island platform at Dingle station in the 1930s. A LOR electric can be seen to the left. This platform was mostly used by arriving trains. They then ran forward into a dead end tunnel, performed a reversal and came back into the station to stand at the platform to the right. The track layout at the station did allow trains to depart from either platform without having to run into the dead end tunnel. At the far end of the platform the steps that linked to the pedestrian subway which in turn led up to the street can be seen.

the station. It would then reverse and run into the southern platform to become the next Seaforth Sands service.

Dingle had not only the railway line serving the underground station, but also a service operated along Park Road in Dingle by the Liverpool Corporation Tramways Department. Because of this Dingle station also became an interchange facility with many passengers changing between trams and trains. It took only twelve minutes from Dingle to Pier Head station in the city centre, close to the ferry terminals.

However on 16 November 1898 Liverpool Corporation introduced electric trams to the Dingle route. They were much quicker than the horse-drawn trams they replaced and, although not as fast as the LOR trains, they did run through the shopping district of the city, making them very convenient for the residents of Dingle. The introduction of the electric trams had an adverse effect on the station's passenger numbers.

## **Disastrous fire causes fatalities**

On 23 December 1901 an incoming train from Seaforth Sands, due to arrive at Dingle at 5:32pm, caught fire owing to an electrical fault in the rear motor. The fault stopped the train in the tunnel 80 yards from the station. The driver, Robert Ashbee, tried to restart the train, but this caused arcing which set fire to the wooden body of the

rear coach. A strong westerly wind was blowing straight into the tunnel, and the draught fanned the flames. All three coaches of the train were quickly engulfed, and the train was completely ablaze within twelve minutes.

There were 29 passengers on board, in addition to the driver and a guard, Charles Maloney. The driver and guard attempted to extinguish the fire in its early stages, but they were unsuccessful. The passengers were evacuated, effecting their escape along the track, then out via the station.

At platform level there were three LOR employees, Thomas Rendell (the station foreman), William Owen (a signalman) and J C O'Brien (a car cleaner). Rendell and O'Brien made their way





towards the train to assist the driver and guard. Once it was clear that putting out the train fire was hopeless, Rendell ran back to the platform and telephoned the booking office asking that the current be switched off. This was done about ten minutes later, but it simply plunged the station into complete darkness, which did not help matters.

By this time lethal, pungent smoke had started to fill the station. Realizing what was happening the remaining people in the station attempted to flee. The last three to escape successfully were the signalman, William Owen, a boy called Gough and a Mr. Stewart. All three passed out when they reached the booking hall. The driver, guard, foreman and car cleaner were all suffocated to death along with two passengers.

Despite the fact that the train was 80 yards away, the fire managed to spread to the station. It did so by first taking hold of a stack of wooden sleepers and then leaping to a train stabled in one of the sidings; it spread from here to the station and completely burned it out. The fire brigade was summoned but there was nothing they could do as the access subway was filled with deadly smoke.



Looking east along the island platform at Dingle station on 10 April 1955. A train of modernised LOR stock is waiting to depart for Seaforth & Litherland. At the far end of the platform the steps that led up to the underground subway that linked the platform to the street level booking office on Park Road can be seen. Photo by D J Norton

The fire had killed six people and resulted in the station being out of use for more than a year. In a Board of Trade Accident Report, it was recommended that passenger stations in tunnels should have as little timber in their construction as possible: stone and iron should be used instead. In rebuilding the station the LOR followed this advice.

#### Further extension

On 2 July 1905 the LOR opened a further extension at Seaforth Sands which provided a connection to the Lancashire & Yorkshire Railway (LYR) network. From this date LOR trains had as their northern

terminus Seaforth & Litherland station on the LYR Liverpool and Southport line. This provided an even greater range of interchange possibilities for passengers and the service continued to run at a high frequency.

On 2 February 1906 the LYR introduced a through service between Dingle and Southport. To operate it the LYR built special lightweight EMUs designed for operation both on the LOR and LYR systems. By summer 1906 there was an hourly service. In the same year a service was also introduced between Dingle and Aintree Sefton Arms (on the LYR's Liverpool and Preston line). The Aintree service was not a success and was discontinued in September 1908. Twice a year, however, the service ran for Jump Sunday and the Grand National horse races.

The Dingle and Southport service was withdrawn in August 1914 as it was not generating the receipts that the LYR had hoped for. Through tickets between Dingle and Southport were still sold, but passengers were required to change trains at Seaforth & Litherland.

By this time the LOR was carrying millions of passengers every year and many of them were passing through Dingle station. The line was used by dock labourers, sailors, shoppers and businessmen as well as tourists. The LOR soon realised that the commanding high-level views from their trains of the docks and the ships were an attraction; they therefore provided day-tickets allowing passengers to alight and board trains at any of the stations along the line, with unlimited travel. Locally the line became known as the Ovee or the Dockers' Umbrella – the latter name referred to the fact that dockers would walk under its structure in inclement weather to avoid the rain.

## WWII brings severe damage

As a major Atlantic-facing seaport, Liverpool had been crucial to the war effort during the Great War, and the LOR had played its part by moving millions around the dock system. In the Second World War it was called upon to do so again, but in this conflict Liverpool found itself directly in the firing line. Between December 1940 and January 1942 Liverpool was heavily bombed by the Luftwaffe; the worst periods of bombing were in December 1940 and May 1941.




The western end of the LOR Dingle tunnel at the point where it crosses the former CLC Dingle tunnel. The clearance was so tight at this point that the rails had to be laid on longitudinal timbers which can be seen inset into the tunnel floor. To the left there is arched brickwork which also denotes the site of the Dingle CLC tunnel. Photo Nick Catford

The LOR suffered badly and was hit many times, and some of its stations were destroyed. Being underground Dingle escaped unscathed, but during this period there was severe disruption to train services. Because it was an essential transport network for the docks the line was patched up each time it was damaged, and trains were reintroduced as quickly as possible. Racing at Aintree stopped in 1940, and did not resume until 1947.

After the war the LOR was as busy as ever. There was a boom in trade at the docks, and the railway reaped the benefit. The Grand National was run again on 29 March 1947 – it was moved to a Saturday whereas before the war it had been run on a Friday – and trains operated between Dingle and Aintree Sefton Arms for the first time since 1940.

#### The LOR avoids nationalisation . . .

The railways of Great Britain were nationalised on 1 January 1948, but the LOR remained independent. In the early 1950s the LOR offered tickets to Pier Head from Dingle more cheaply than the corporation tramways; large posters were displayed on the station building advertising the fact. For the Grand National on 26 March 1955 the LOR ran nine trains from Dingle to Aintree Sefton Arms; the fare was one shilling single, or two shillings return.

In 1955 an engineering survey was carried out on the iron structure of the LOR. It was discovered that the deck plates on which the tracks were mounted were severely corroded, owing both to the effects of the weather and of smoke from steam engines operated on the dock railway beneath the LOR. The plates needed to be replaced within a few years, and the cost was estimated at £2 million.

### ... but not closure

The LOR did not have the funds to carry out the work and, although the line was still carrying millions of passengers every year, complete closure of the line was proposed. Suggestions were put forward for saving the line, including taking it into municipal ownership, but none was successful, and the line closed completely on 30 December 1956.

The last departure from Dingle station was at 10:03pm. The last arrival pulled into the station just over half-anhour later. It was full of passengers who had taken the opportunity to ride on the last train; they were slow to leave the station, preferring to linger in a vain attempt to prolong the life of the line. After they had finally dispersed the station inspector telephoned Seaforth Sands to ensure that the 10:03pm departure had arrived there. As soon as it was confirmed that it had, a switch was thrown. The live rails and signals ceased to have power, and the station lights went out.



At the west end of the station platform the Dingle tunnel continued as a wide tunnel for a short distance as seen in this view. The reason for this was that there were two sidings at this point, one on either side of the line. In later years one of the sidings was removed. The fire of 1901 spread more rapidly because of a train that was stabled in one of the sidings. Photo Nick Catford

At 8:45am the next day (Monday 31 December) the current was switched on again and a staff train was run from Dingle to Seaforth Sands; a further service departed in the afternoon. Over the coming weeks trains were transferred from the southern end of the line to Seaforth. On 23 September 1957 demolition began, and the overhead structure was taken down; the process was complete by January 1958.

#### The tunnel finds other uses

Dingle station, being on the underground section of the line, survived the demolition, although it had been quickly stripped of its rails. The station was sold to a rope manufacturer who used the underground part as a works. In the 1960s the site was taken over by a car repair company. They demolished the street-level building and made alterations to the underground section, which included creating a ramp down to track level so that cars could be driven in.



In 1977 the Dingle Tunnel and station site was purchased by Roscoe Engineering. They were a specialist and general motor car repair and maintenance company. Roscoe had what was arguably one of the most unusual workshops in the country. Access for vehicles was via the former pedestrian subway from which the stepped sections had been removed.



Looking west from the buffer stops at the end of the dead-end tunnel that had been used by LOR trains as a reversing point. On arrival at the station, they deposited their passengers and then ran into this tunnel. They then reversed and went back out to the opposite platform where outbound passengers would have boarded. When the southern extension was built, there were plans to extend the line as an underground railway further into the suburbs of south Liverpool. For that reason the end of the tunnel was left unfaced. Photo Nick Catford

Within the station area there was a building which housed their office and on top of which was a customer car park. A further ramp led down to what had been track level. Most of the workshop facilities were in the short dead-end tunnel that lies to the east of the larger station tunnel.

One of the fascinating aspects of the Roscoe site was the collection of old cars that built up over the years in both the station part of the tunnel and further west in the double-track tunnel. Covered in dust, many of these cars became time capsules from the 1970s, 80s and 90s.

The Roscoe owners and staff also had an interest in the history of their site and they gathered many artifacts from the LOR days including conductor-rail insulator pots, track clips and even an electric train axle-box. Other remains from the LOR days included buffer stops in the short tunnel and from the sidings. Roscoe even painted the buffers so they could be more clearly seen.

#### Tunnel collapse means the end

I visited Dingle Station on 16 March 2012 and was made very welcome by Roscoe Engineering. I intended to go back and explore further into the Dingle Tunnel itself but that was not to be because on 24 July there was a massive collapse of the station section of tunnel. Hundreds of tons of sandstone fell into the station site and it was a miracle that nobody was killed or injured.



Looking east at the Dingle station site after the catastrophic collapse of 24 July 2012. The collapse left the rest of the tunnel at the station site in a perilous state and its future looked bleak at the time of writing.

Roscoe's staff managed to get out, but residents of the streets above had to be evacuated. Several houses were left in such a dangerous condition that they remain empty at present and will probably have to be demolished. It is not yet known why the tunnel collapsed but it is thought that it may be due to the dry conditions of the winter months followed by a period of very wet weather. The sandstone may have been made unstable due to these factors.

The responsibility for any repairs to both the tunnel and properties above it lies with the Roscoe Engineering insurers although engineers from Liverpool City Council have an involvement as there are residential streets above. Despite initial hopes that the situation would be resolved quickly, by November 2012 the insurance company had still not undertaken a full survey and several families were still living in temporary accommodation. The most likely outcome will be infilling of the tunnel.



In November 2012 houses above the collapse still remained empty. Photo John Fogg

The western portal will probably remain visible as it has done since the line's closure but sadly another piece of underground history will disappear. Thankfully many photographs have been taken so future generations will be able to see just what the tunnel looked like.





Dingle station site before the roof fall. This view is taken from roughly where the western end of the Dingle station platform would have been looking east. The ramp seen to the left was an addition after the station had closed. Originally steps led from the platform to the pedestrian subway. Photo Nick Catford



Fighter Command HQ, Bentley Priory. A O C in C's viewing cabin on the upper level of the Air Defence Operations Centre bunker in mid 1971. Photo from Air Defence Radar Museum at Neatishead





Cult and culture collide at Fontanelle Ossuary, carved into a hillside above Naples. Local people still come to ask favours from the souls believed to be inhabiting the million or so skeletons, stacked against the walls.



The partially flooded Operations Room in the Fighter Sector Operations Centre at Barnton Quarry in 1999. Photo Nick Catford





Three staggered entrances to The Grove LMS air-raid shelter near Watford can be seen in this view. There were originally four blocks of air-raid shelters at The Grove but this is the only block to survive. Photo Chris Rayner



The fully restored interior of the Cuckfield ROC post in Sussex. Photo Mark Russell





A safety team of four at the top of W Shaft at La Boisselle in France look after team members working at the shaft foot. There are three kilometres of tunnels accessible from this one shaft alone. Photo from La Boisselle Study Group



Overflow weir on the main east - west intercepting sewer (left) under the Albion Hotel in Brighton. In times of flood, water flows into the overflow sewer at a lower level (right). Photo Nick Catford



# Dark Places – Excursions beneath Naples Merryn Walters

## Prelude

Imagine this: an exploration of cholera-ridden Greco-Roman cisterns used as underground shelters during WWII. Fourthand fifth-century catacombs, and a million plagueridden souls laid bare in an ossuary on the outskirts of a city suburb known as the Valley of Death.



Was it Virgil, or Goethe, who said, 'See Naples and die'? Your author Emm doesn't know. But she's visited the city a number of times, trying to find out.

As the Berlin Wall came down, I began picking up a taste for *pasta al dente* in Italy. Four years on, I'd spent much of the time collating a list of *rifugi antiaerei*, *fortificazioni della seconda guerra mondiale, citte sotterranea, bunker antiatomici,* and *catacombi* that was longer than the Appian Way. You probably don't need to be familiar with the native form to understand these Italian references but, just in case, a rough English version would be 'air-raid shelters, WWII fortifications, underground cities, nuclear bunkers, catacombs' and anything else that's more-or-less under the surface.

Twenty years on, and a metaphorical map records many Italian underground and military sites. A chance remark in 2009 from the depths of a dank crypt in the heart of Milan pulled the plan for Another Big Trip sharply into focus: 'Of course, most of Naples is built on a network of tunnels and catacombs that were used as shelters in WWII, y'know. Built by the Romans, not that they ever did anything for us. Easy to visit, though...'

# The journey begins

It's no surprise that some of these underground sites have been made highly accessible and given the 'Get-yourtickets-here' treatment. Universally, there are good examples of underground-tourism and there are bad: in Italy it's a decent mix of both, with the pinch of commercialism being kept reasonably under control. The preservation of artefacts is balanced precariously against the lure of tourists' Euromillions but, in general, the Italians play the game. I mentioned two of the sites in Naples to Tony Page (hereafter TP) and, with no more than a brief scrum at the gate, easyJet gained a few points on the FTSE. Our lodgings were within easy walking distance of our rendezvous with Salvatore: the genial grey-haired host and official 'guardian' of our first site visit, a flush of Greco-Roman cisterns that were used as air-raid shelters during WWII. Salvatore speaks no English but his capacity for hand gestures is impressive and ribald humour translates through even the coarsest barrage of Neapolitan dialect.

He's also passionate about underground spaces and fixated with expanding an empirical hold on the tunnels and cisterns that belong to his family by default – access to them is after all through his garage! Visitors to Naples can be guided through a three-acre labyrinth of cisterns, air-raid shelters and galleries that exist underneath his house, connecting – eventually – to 436 (yes, for the purposes of clarity and our Editor's sanity, that's four hundred and thirty-six) underground shelters.

And at this point, perhaps, a word of explanation is due. To date, very few of the accessible underground sites in Naples receive funding from official sources, relying instead on tourism and private sponsorship to pay for preservation or more exploration instead. Some seven hundred caverns, galleries, aquifers, catacombs and tunnels have been examined, and there are an estimated two million square metres of underground space still to recover – although the vitriol and contempt the 'guardians' exhibit for each other's commercial enterprises is worthy of immortalisation by Dante.

Our host has been extending his excavation for some time and his knowledge of *mediterranea sotterranea* across the city is impressive. Sadly, Salvatore's ability to communicate that wisdom in English sits right alongside my familiarity with Inuit idioms. His efforts comprise just two phrases, "Look, look!" and "*Si*, *si*, you remember?". Luckily, both expletives are appropriate in context. He's keen to impart as much data as possible – historical, anecdotal, statistical, geological and geographical – and starts 'the talk' before we reach the entrance to the site. Don't panic. I'll translate.



More excavation. Of the 436 shelters that existed in WWII, this is one that continues to be excavated today

#### Some history

"Naples was founded in the ninth to eighth centuries BC as a Greek colony, known as Parthenope. Situated halfway between the two volcanic regions of Mount Vesuvius and the Phlegraean Fields, Neapolis ("new city", Naples) was eventually conquered by the Romans in the fourth century BC." Salvatore pauses. "Then there were a few Spaniards. We had a bit of a war." He shrugs



One of only five entrances / exits to this labyrinthine complex of underground tunnels in Naples' most fashionable quarter

and dismisses the next century of history with a hand gesture. "After that, we became Italians ... " - and that, he deemed, was enough context to narrate the 300yard trek along a dark Neapolitan backstreet paved in pyroclastic flow, in, through a low garage door, to a broad flight of stairs leading down into the first cistern.

These stairs have been cut into a type of stone that's known locally as tufo – consolidated ash that's been ejected from vents during eruptions of Vesuvius. We know it as tufa or volcanic sandstone. It's porous; it's highly resilient; and yet it remains comparatively lightweight, which makes it easy to transport and ideal for use in building work. Almost every house in Naples has tufo in its foundations, and most buildings in this area (the Spanish Quarter) have supporting walls that have been standing tall for over four hundred years.

Descending over forty metres, we're now in an 'auditorium' at the foot of the stairs: it measures about fifteen metres by thirty, and is lined with rows of white, plastic, garden chairs. Salvatore moves to take centre stage, and makes a departure from describing local geology to start on history. I'll paraphrase: The Greeks founded the city as a colony in about the ninth century BC, with the aim of maximising its military potential (natural harbours) on the west coast. But there's no river in the area, which is something of a paradox in the evolution of conurbations this size, as no river in the area means no fresh water supply. However, the Greeks already knew a thing or two about aqueducts and water storage, and, right now, he says, we're sitting in the middle of a cistern that was cut specifically for storing fresh water to be used by the nobleman's house above us. Craning our necks, we can make out a well-shaft that rises, up, through the helical twist of the staircase. The upturned funnel shape of the space we're sitting in takes on a more meaningful form.

After a couple of brief skirmishes, he continues, one with Hannibal, the other with the Samnites, Neapolis became a Roman colony and a greatly respected seat of Hellenistic culture: villas, theatres and temples; public baths and new aqueducts. The most famous, here, in this area, is the Serino aqueduct. It runs 96km in length over and underground – TP raises an eyebrow – although there's very little that's accessible now but what does remain, drops 366m in altitude from its source at Acquaro-Pelosi to fill the *Piscina Mirabilis*, a freshwater reservoir to the west of Naples that was built to provide the Roman imperial fleet with drinking water when they docked at Portus Julius. The *Mirabilis* was, and is, 15 metres deep, 72 metres long and 25 metres wide holding about 12,600 cubic metres of fresh water at a time.

Salvatore gestures at the cavernous interior of this cistern as a comparison. "That's nothing. These spaces, these cisterns and their connecting galleries, under the city? They were also filled by that water flow, branching out from the Serino aqueduct. Surveyed so far, and from what few records we have, we think there are about one million cubic metres still to explore." He stands up, moves his garden chair to one side, and promptly disappears through a crack in the wall. He's spry for his age. Squeezing through the *cunicolo*, a narrow channel in the rock face, we follow him as he canters from one cistern on to the next.

He slaps the skirt of grey cladding on the wall of this next room: "Roman concrete. The rooms we're in were formed naturally to begin with, worked on by the Greeks to create the cisterns, and then expanded by the Romans to supply the increased population living above. But in a cistern that's located in an aquifer - a porous layer of rock - the problem isn't getting water in, it's how to stop the wet stuff from getting out. This concrete lines the cisterns to a uniform height," - he points out the line of cladding, running round the room at about two feet in height - "and it's made of tufo and calco [chalk] and lime and water. Of which there was plenty." He laughs at his own joke. "So where we're standing now, we're about six metres above the original floor of this Roman cistern. Further on, we'll be standing on a level that's exactly halfway between the original floor and ceiling ... "

# Graffiti ancient and modern

Suddenly the composition of the floor beneath our feet is less interesting than the rest of our surroundings. TP points out the etchings on the wall – real, Roman graffiti – while Salvatore uses a spotlamp to illuminate more up-to-date examples of urban art: a stylised portrait of Mussolini, a bouffant 40's flick on the profile of a buxom woman and, suddenly, the walls are alive with the shadows of WWII. "I'll get to those in a minute," Salvatore says, casually dismissing the etched sketches as though they were backstreet daubings. He gallops off up a short flight of stone stairs, leaving TP snapping away furiously. Ducking down into another narrow *cunicolo*, about thirty metres



long, we hear the history lesson continuing over the Neapolitan's shoulder: "In the mid-1200s, Naples grew up and up and up ... and these cisterns became a primary source for building materials during that growth. All that tufo. see? Good for building." The gallery jack-knifes sharply to the right. "The Spaniards arrived in the mid-1500s and.



The scale of these cisterns has to be seen, to be understood. Salvatore points out yet more evidence of WWII *artisti* 

both as a form of taxation while they were defending their recent conquest and a defence against any uprising, they banned the import of new construction materials to the city."

He grins mischievously. "We also banned kissing in public in 1562. That was an offence punishable by death, and no one took any notice of that law, either. We just dug deeper, here, underground, and used the quarried stone to build better, more magnificent and more splendid buildings." Lots of hand gestures ensue, and there's much gesticulation as we spill out into another cavernous void. "We ended up with some of the finest internal plumbing in the empire at the time..."

He reflects for a moment. "It was an impressive city. But," he wags his finger, "we also started to think a bit more about how much material we were taking *out*, and started taking better care of the cisterns and the water that was going *in*. 'Noble houses', those that we built with the quarried stone, were easily identified by their yellow or red external walls, the number of wells they had and the quality of the water drawn up through them. Here, above us, this house had three separate watersources..." He points up to the ceiling, where three well shafts drop down twenty metres above our heads. "This was a big house; two apartments, servants' quarters, and water on tap in every room."

The story of cistern development continues as fast as we career helter-skelter through the galleries – some of which are only passable sideways-on – up flights of stairs and down, through corridors narrow and wide, and out into more cisterns. We've lost track of how far we've walked, taking in the 'underground road signs' at every junction.

Salvatore explains vividly how 'well-guardians' spent their days underground 300 years ago, making sure that watercourses ran without hindrance from cistern to cistern, serving one noble house then the next; how they muddied the water if 'wages' were delivered late, via the well-shaft, from the houses above; and how the reputation of more than one Lady of the House was sullied by money changing hands – in person – in the middle of the night.

Looking carefully, you can see it's still possible to scale the internal walls of these wells using handholds and footholds cut into the tufo. When asked whether he's been up and down himself, Salvatore shrugs, "Once, maybe. My knees won't let me do more than about fifteen metres now. And," he coughs, apologetically, "I am 68..." By now the walls are littered from floor to ceiling with WWII graffiti, and TP is taking pictures like Snowdon on speed. Salvatore careers through another chapter of history to try and catch up with him: "We used the water that was in here right up until the middle of the nineteenth century, but in 1885 there was a terrible outbreak of cholera. The water that filled this network of underground spaces was a foul, infected liquid - viral death, really. And as a result, of course, the water system was abandoned to be replaced by the pipes we have today. By 1968, the sewers had also decayed to a point of no return - and during their replacement, we opened up that cistern there," he points at a low-lit void to one side, "from which we excavated the rest; it's taken forty years. We have volunteers, and we take everything out by hand."



Is this looking up or down? Up - the hand/footholds enabled a 'well guardian' to rise, upwards, and collect his wages from the Noble House above. That wasn't all he collected in the middle of the night, believe you me.

There are buckets and ropes on the floor to evidence this. "But we'll never finish it." He claps his hands together. "However, back in the early 1940s, a greater number of people had a much more important reason to be committed to this cause: clearing these areas, taking out the rubbish that had built up to that point, so that these passageways and rooms could be used as shelter from the bombs dropping above us. Look, look!" And he's gone again.

### From cistern to shelter

Having ducked through yet another low corridor, Salvatore points out a row of shadows on the wall – five imprints showing where a row of toilets stood, seventy years previously; in another cistern, the porcelain units and rotting wooden cubicle frames still exist. In one chamber, a discreet cubicle has been set aside for a couple that were married here during WWII. The inscription on the wall names them as Anna and Renzo, dates the event as 20 October 1943, and wishes them good fortune on their wedding night.

We see areas filled with debris from the Neapolitan blitz and then, in contrast, more recent rubbish mounds appear – dating from 2004. "*Imbecille*." It needs no translation – idiots have lifted a manhole cover in the street above and tipped waste materials into the convenient space below. He changes the subject, and begs to show us the porcelain light fittings and original electrical wires that run the length of each connecting tunnel (two systems, one for normal use and one during blackouts); taps on the wall and more and more graffiti. Poems, epigraphs; names and dates; prayers; salutations.



Toilet cubicles (dating from WWII), can be seen at the top of these stairs. At this point we are 40m underground – so septic drainage becomes a gravity-fed nightmare

Construction of cisterns took on architectural heights – and then WWII electrical installations took form, at a reasonable level



The 'runaways', around which 'guardians' of the cisterns ran, can clearly be seen. The floor here is four metres above its original level. Buckets for drips? No. Excavation, old style.

The main thoroughfare above us, Via Toledo, played host to *stylisti* of the era. The result is that much of the graffiti on these walls has a less than amateur feel to it: these are confident etchings, that have been drawn with a keen sense of perspective. There's far, far more to take in here than our brief three-hour excursion will allow. In total, the Ministry of the Interior lists 616 addresses in the city that had entrances to underground shelters. Salvatore's impressive network of underground spaces is accessed by just five of those entrances, for about four thousand people at a time.

He brings us to another room: a dark void with a low ceiling, about twenty metres long by five metres wide. Indicating that we should stand with our backs to the wall, he puts his finger to his lips – and turns off the light. The sound of silence, true silence, is not something that's heard often. A minute passes. TP's convinced that he can hear the rumble of traffic up above. "No," Salvatore wags a finger, then taps his head, "sono i timpani." Ear drums. With no reverberation in the atmosphere, the ear enhances its sensory capacity to the point that blood, flowing through the auditory canal, creates a noise. "We've also proved that asthmatics suffer less when they're down here. It's always 17 degrees, with about ninety percent humidity all year round. And we know that blood pressure can be lowered if you sit here in the dark for long enough." He nods, solemnly. "Medical fact." But if the auditory senses are being enhanced, so are the olfactory capabilities. There is a distinct smell of roast chicken in the air. "Si, si - pollo ai spiedino!" Salvatore chuckles and shines his torch up at a flight of stairs, leading to an iron door. Peter, the chicken vendor, has a cellar door that opens down into this cistern. We scale a flight of stairs, cross a courtyard, peer into one of the well shafts we'd been peering up at, and find ourselves (surprise, surprise) just outside the street-entrance to a chicken-on-a-spit shop. It's a predictable punchline with a Neapolitan twist. Welcome to Italy.



# The Valley of Death

It's 0900, and we've been deposited at the entrance to the Basilica of San Gennaro, where we have an appointment with Antonio who has better English than an Oxford don – a welcome relief for me after translating coarse, double-entendre, Neapolitan dialect during the previous day. Antonio is our guide to the catacombs in this area of the city: Fontanelle. It's a public tour but we have him to ourselves today for a five-hour tour of two catacomb sites and an ossuary.

"We call this the Valley of Death tour," Antonio explains, leading the way down a flight of open stone steps to a gated entrance set against a hillside. "In this area, the city sprawls extensively through a natural cleft at the foot of two hills – Capodimonte and Colli Aminei." He unlocks the heavy wooden door and ducks inside to enter the Catacombs of San Gennaro. They are impressive, by anyone's definition of a catacomb experience. West Norwood may be interesting, but in terms of scale it's like comparing jumpers-for-goalposts with Wembley Stadium.

The gallery we descend to has irregular walls lined with about a hundred five- to six-feet-long rectangular niches. At the foot of the stairs, an area has been cordoned off with hazard tape. There are some familiar-looking depressions in the floor. "Bones," says Antonio, nonchalantly. "About two thousand years old, still in excellent condition. We dug them up yesterday." TP starts to frame a shot – but Antonio stops him. "No flash, please; I can explain why, you'll see it for yourself in a moment.



Catacombs of San Gennaro. Niches in the walls, niches in the floor, evidence of internment – on at least three levels – dating back to the fourth and fifth centuries.

"Arcosolium is the name given to burial repositories that are typical of the third and the fourth centuries. It's a large niche with an arch above it: the marble tomb covering was placed horizontally, and they usually served as the burial chamber for entire families. These tiles, and these paintings," he gestures at a graphic showing candlesticks on either side of a haloed saintly figure, "are nearly two thousand years old. So, no flash. Please."

It's frustrating. And – although TP can correct me – it's partly the reason for some of the photos here being less

than perfect in their resolution or quality. It's a shame, but TP and I both follow his request. The frustration is compounded by a group of well-heeled visitors that we meet shortly afterwards, being shown around by *Il Direttore* [The Boss] who has what can only described as a lethargic attitude to enforcing the same rule...

# **Multi-storey catacombs**

"The Christians didn't use the term *catacomb* originally," Antonio explains. "Greek in origin, it means 'near the hollow', and was used by the Romans to define caves that had been used for *tufo* extraction and subsequent conversion to burial chambers along the Appian Way." Antonio takes us through into gallery after gallery of empty niches, narrating the religious significance and archaeological course of events as we go. "The majority have been stripped by grave robbers over the centuries." And the recently excavated remains discovered where we came in? Not much in the way of artefacts, they were paupers' graves.

These catacombs are on three levels; there are over two thousand burial niches here, including the tomb of San Gennaro – the legendary headless wonder and guardian of the city – and the religious depictions show not only the historical development of the site, but also the reasons for its use.



San Gennaro – catacombs that are labyrinthine, extending to house over 2,000 bodies.

A 50-metre passage marks a fascinating transition in architectural styles: imagine – starting the excavation of a tunnel by creating a ceiling that follows a Norman arch, and then, as you tunnel back, fifty metres or so, into the cliffs, the arch peaks and forms a perfect Gothic arch ... pointed with a jointed apex. And then there's the vaulted ceiling, twenty metres under ground level; three levels of excavation beneath our feet; the unique baptistry gouged out from the floor; example after example of tiled mosaic decorations dating back to early Roman times alongside early iconography showing apostles.

By anyone's measure, some of the religious depictions and the wall art in these underground vaults is contentious, and therefore worthy of preservation as a tool for future learnings: female priests are shown as being contemporary in a time when, according to the



Vatican's greater teachings, they weren't considered to be intellectually adept enough to read the scriptures – let alone teach them.

# Neapolitan street-life

By now, we've been in the catacombs for nearly an hour. Antonio guides us out, through a sparsely furnished church hall, and into the courtyard of this area's local hospital complex. We walk along the edge of a district known as Spaccanapoli: urban chaos. Washing flaps noisily everywhere; baskets of provisions are hauled up and down by ropes to the top floors of grimy tenement buildings. Every butcher's shop has half a sheep's head in the window, and the squid that we can see, on an upturned bucket in a doorway, was caught freshly this morning in the Bay of Naples.

There isn't an undented body panel to be seen among the Puntos parked akimbo on the pavements. Scooters zing up and down one-way streets in both directions, with two – or three – passengers dressed in the finest Neapolitan fashions; wall shrines, one every fifty metres, are adorned with decaying flowers, votives, and curled and faded pictures of favoured saints. Religion is everywhere; poverty is underfoot – this is a place where people wait for time to go by.

At the end of the street is the entrance to Fontanelle cemetery, hiding behind a nondescript iron gate that's been cut into overhanging sandstone cliffs. As we walk, Antonio narrates. "By the sixteenth century, Naples' population explosion had created a, perhaps, somewhat foreseeable problem. We no longer had a place to bury our dead. The solution was to create mass graves here, at the foot of Colli Aminei, in what was then a natural cave. The remains were buried in shallow depressions to start with, but by the mid-1600s we were seeing the fallout from plague deaths, and the number of bodies that needed to be interred exceeded the rate at which they could be buried. So they just left them here, in piles." TP has been taking in the size of the ossuary, cut into the cliff face. An open trapezoid some twenty metres in height with vertical niches still shows how the higher levels were



The religious iconography may be of little comparative interest, until you place it in context. A 2,000-year-old underground 'sermon' to the people.

reached by the more athletic builders. And then he sees the skulls. "There are about a million of them," says Antonio.

### **Skull-duggery**

There they are, in line after line; row after row. Some are set into marble or wooden (or even cardboard) 'houses'. Our guide explains, "In the nineteenth century, just after the cholera outbreak, floods washed what was left of the bodies out into the streets. The remains were collected by the locals and brought back here to the cemetery – where they were stacked, so that the bones would not move." Tibias; fibulas; scapulae; ribs; even the odd spinal column.

The word 'macabre' is an injustice to the spectacle, which goes on for about eighty metres, back into the cliff, and lines every sheer wall of the ossuary. "By the time we'd seen war break out, at the beginning of the twentieth

> century, this had become a place of refuge and worship: there was a kind of affinity for the people here, with the skeletons of their loved ones."

> We're taking in the votives, saints' pictures, dates, inscriptions and pleas etched into the skulls' 'houses'. Antonio continues, "People would come to ask for a favour, or that a prayer be granted by their 'adopted' skull – particularly during World War II, when hope meant everything. And if there was no response, there was no blame: they'd simply adopt another skull – and another – and another – until something did happen!"



Taking light from the equivalent of a fourth-century AD Velux window ... this area is still used for (un)common worship today.



Antonio explains that the 'adoption' process was allowed to continue until the early 1970s, when modern decencies crept out of the shadows, in the guise of sense and sensibility. All skull worship was banned. Except, of course, for the small bunch of fresh flowers that we can see sticking out of a skull's eye socket – and the odd pieces of small change; and the little Postit notes, and the postcards of saints ...

This is another case of cult and cultural overload: a daunting spectacle of calvary crosses, a headless waxwork; a couple of skeletons – literally – spooning in



Until you see this 'in the flesh', you cannot comprehend the emotional and – for the local residents – spiritual draw of one million skulls

a glass-topped coffin; a skull that weeps and is always damp with moisture (despite the skulls on either side being bone dry) ... and in the background, all three of us are being discreet and ignoring the old woman in black, who's come to lay flowers next to a soul she's never known.

### San Gaudioso

It's time for more catacombs. And if the description of the next tour seems brief – take it only as a reflection of the fact you can become 'catacombed out' in a remarkably short period of time.

The Catacombs of San Gaudioso are about ten minutes' walk away from the ossuary: it's another amble through backstreets that you wouldn't want to walk alone. We go into the Basilica di Santa Maria, and Antonio unlocks a set of iron gates that reveal steps, leading down into an open area paved with black and white hexagonal marble slabs. He points out those alternate stones that have death's heads etched into them, "These, you can lift up to drop bodies through." Uh-huh. Of course you can.

In one corner of this sunken room, a doorway leads through to another cool and silent labyrinth of catacombs. The floor is wet in places and Antonio guides us into a tunnel where catacomb niches strike a chord of familiarity once more. Except... here, set into the wall beside us, is a spinal column. And half a skull. And there, on the other side of the wall are 'potholes' – carved as toilet-like recesses into low shelves – on top of which, Antonio explains, corpses would be carefully positioned until their body matter liquefied and ran down, through a septic channel, leaving just the skeleton behind.

Behind us, there are more niches and mosaics dating back to the fourth and fifth centuries, and evidence of the interment of African missionaries – at a time when, supposedly, religion had yet to embrace the Saracen spirit. It's another hour before we emerge into the sunlight again, and have an opportunity to consider everything that we've seen in a short space of time. In addition to the sites above, we sneaked in a very public tour of another WWII shelter, and dropped in at an underground Greco-Roman theatre, the extent of which is unknown, and further excavation of which is still being negotiated

# **Return to Civilization**

Over the last twenty years I've travelled backwards and forwards many times in search of the less well-known underground cities and defences that litter the Mediterranean landscape, and I've discovered three things about the country I used to live in and thought I knew so well.

It offers 'Sub-everything' on a truly magnificent, almost incomprehensible scale. In the main, it has very little regard for a nanny-state attitude to health and safety, and – like Italian cuisine – the underground scene is as diverse and professional, in some cases, as it is focused and amateur.

There's something here for all tastes, and in all guises of sense and sensibility. From groups that meet once a week in Rome, to explore underground sites dedicated to arts and culture, to characters that camp out for weeks at a time, mapping underground World War II defences.

There are organised events, and clubs or associations in almost every city with large numbers of active members. Equally (and for my preference) there are individuals living in the countryside, for whom a *passeggiata* – a gentle stroll – on a Sunday afternoon comprises a threeor four-kilometre amble along cool tunnels, stopping off at a favoured machine-gun post to admire the view over a valley along the way.

Without spending twenty years creating that metaphorical map of such outposts though, my recommendation is simple. Go. See Naples – and live!

All photos by Tony Page.



# RAF Bentley Priory Nick Catford & Bob Jenner



The history of Bentley Priory, northwest of London, can be traced back to the early Middle Ages when the first priory was dedicated. By the time of the Domesday book (1086), the priory, which was the only monastic institution in the Manor of Harrow, was occupied by an order of Augustinian friars.

At the time the first priory was dedicated, the majority of the area was in the Manor of Harrow. The rest of the land in which the priory now stands was in the area held by the Count of Mortain and known as Stanmore Magna.

# **Early History**

The first priory is believed to have stood further downhill than the present building, probably close to Priory House on Clamp Hill, with a separate chapel on Harrow Weald common. It would appear that a small agricultural hamlet existed in the shadow of the priory chapel.

Apart from a short list of Priors from this period in *The Victoria County History of Middlesex*, the only other reference to the priory is in *Chronicle* by Mathew Paris who was a monk and chief copyist at St Albans. He mentions under the date 1248 the story 'Of the miserable death of the Prior of Bentley'; apparently a hayrick fell on him whilst he was inspecting it.

Another early reference to the priory can be found in The Harrow Rolls of 1512. These state that "The Priory was built in honour of St Mary Magdalene, and the Archbishop of Canterbury beyond memory gave the Priory with all its lands to the Priory of St Gregory without the wall of Canterbury."



Bentley Priory in 1928. During WWII the whole building including the clock face on the tower was painted in camouflage colours

When the Priory's religious days were over, it passed through various hands until it was ultimately sold in 1766 to James Duberley, an army contractor. He is thought to have pulled down the original priory building before having a more imposing house built on the estate on a higher point of the ridge, its present site.

In 1788 James Duberley sold the Priory to John James Hamilton, the 9th Earl of Abercorn. The following year the earl, having been elevated to marquess, made extensive alterations to the house and park and commissioned Sir John Soane, one of the most preeminent eighteenth-century architects, to extend and refurbish the house in a more lavish and sumptuous manner, which is what we see today.

The Marquess lived at the Priory as a true nobleman entertaining many political and literary celebrities including Pitt, Wellington, Canning, the Lords Liverpool and Sidmouth, and the poets Wordsworth, Moore and Campbell. Sir Walter Scott was a frequent visitor in 1807, spending much of his time in the summerhouse which was built on an island in the lake.

In 1846, Dowager Queen Adelaide, widow of William IV, leased the Priory and moved in two years later. By this time she was quite ill from dropsy, and on her arrival apparently found the stairs too much to cope with. A suite of rooms was prepared for her on the ground floor and it was in these rooms that she would receive her niece Queen Victoria, and Prince Albert, during their visits. After Adelaide's death, the Priory was rarely used until the estate was bought by Sir John Kelk in 1863. He was an eminent Victorian engineer, probably most notable as the contractor for the Albert Memorial.

In 1882, the Priory was bought by Frederick Gordon, of Gordon Hotels, who converted it into a residential hotel. To bring customers to his new hotel, Gordon resurrected an earlier failed proposal to bring a railway to Stanmore by promoting his own Harrow and Stanmore Railway Bill; his line was authorised in 1886 and Stanmore station opened in 1890.

Despite the new railway, the hotel was not a success and Gordon tried unsuccessfully to sell the Priory in 1895; Gordon and his family lived there until his death in 1908. The Priory changed hands yet again and reopened as a girls' school for seventy boarders. After WWI the school failed during the depression and closed in December 1924.

# Arrival of the Royal Air Force

Bentley Priory remained empty while new uses for the site were being considered. Eventually the estate was split up, with the Priory and forty acres of land being sold to the Air Ministry in March 1926. Ninety acres, including the farm in front of the Priory which formed



part of the green belt around London, was bought by Middlesex County Council and the remaining 130 acres was sold to a syndicate that intended to develop the land for housing.

The first unit to occupy the Priory – from 26 May 1926 – was the HQ Inland Area, which transferred from Hillingdon House, Uxbridge and controlled 21, 22 & 23

Groups, responsible for Training and Army Cooperation and forming part of the Air Defence of Great Britain. In the interwar years the RAF was rapidly expanding and with it the need for an air defence system to protect the UK from the approaching threat from Europe. Bentley Priory was soon to play a pivotal role in our air defence strategy.



Air Marshal Sir Hugh Dowding

A massive reorganisation of the RAF in 1936 led to the creation of Bomber, Fighter, Coastal and Training Commands from the existing Air Defence of Great Britain. In July 1936 the Inland Area, which was now Training Command, moved to Market Drayton in Shropshire. HQ Fighter Command relocated to Bentley Priory from Hillingdon House (RAF Hillingdon) on 14 July 1936 under the command of Air Marshal Sir Hugh Dowding (later Air Chief Marshal Lord Dowding of Bentley Priory, GCB GCVO CMGO).

# The Observer Corps

In July 1936 the Observer Corps moved to RAF Bentley Priory from its original location at RAF Hillingdon, along with Air Marshal Dowding.

The Observer Corps was one of the cornerstones of Dowding's air defence system and he said later in his despatch after the Battle of Britain: "It is important to note that at this time they (the Observer Corps) constituted the whole means of tracking enemy raids once they had crossed the coastline. Their work throughout was quite invaluable. Without it the air-raid warning systems could not have been operated and inland interceptions would rarely have been made."

In appreciation of their efforts during the Battle of Britain, the Observer Corps was granted the title 'Royal' by King George VI and became a uniformed volunteer branch of the RAF from April 1941 for the remainder of its existence. Throughout its service, the Royal Observer Corps was commanded by an RAF Air Commodore, each of whom served a tour of between three or four years.

The Corps was created to provide a system for detecting, tracking and reporting aircraft over Britain. During World War II it was complementary to and often replaced the radar system in that it provided an 'over land' element while radar handled the 'over water approach' requirement. Initially the Observer Corps' presence at Bentley Priory included only the small headquarters staff of a dozen officers and support staff.

### The build-up to war with Germany

Following the development of RDF (Radio Direction Finding) Radar in the early 1930s, research became centred at Bawdsey Research Station in Suffolk (later RAF Bawdsey). On completion of the first three Chain Home stations at Bawdsey, Canewdon (Essex) and Dover (Kent), exercises were held to evaluate the efficiency of the scheme.

It soon became apparent that with just three stations, the experimental operations room was overloaded and confused with conflicting reports. Squadron Leader Hart, the RAF officer attached to Bawdsey Research Station for RAF personnel training, instituted an experimental filter room in the old stables to resolve this problem. Manned by scientific officers, it was an immediate success, so a second purpose-built filter room was built in January 1938 reporting to HQ Fighter Command Ops Room at Bentley Priory, 11 Group temporary Ops room at RAF Hillingdon (Uxbridge) and Biggin Hill Sector Operations Centre (SOC).



The temporary operations room in the Priory ballroom; the tops of the three tall windows on the south side overlooking the terrace can clearly be seen. The wooden construction of the balcony supports is also clearly visible. The large map

on the left of the balcony depicts the air-raid warning regions. This position is where the warnings are given from

The next exercise in August 1938 which increased the number of sectors to include North Weald and Hornchurch was also a success and broadly set the future programme.

In May 1938, locations for operations rooms for the new Groups, 11 Group at Uxbridge, 12 Group at Hucknall and 13 Group at Kenton (Newcastle) were selected and in June 1938 Fighter Command and Group Operations Rooms (to be underground) and all Sector Operations Centres (above ground) were authorised and to be ready by March 1939.



1938 was to be a very eventful year for Fighter Command. In August, the Fighter Command temporary Filter Room (known as temporary special intelligence room) was, on transfer from Bawdsey, to be established in two basement rooms of the Priory, becoming operational by mid-December 1938. Approval was given in September for the construction of a new, underground Operations and Filter Block to be ready for use by March 1940.

The Fighter Command Operations Room was situated in the Priory ballroom, a high ceilinged, round-ended room. An 'L' shaped balcony of wood and scaffold was erected along the west and north wall, overlooking a large map table depicting most of the UK. Behind the ballroom, the round picture gallery and billiard room housed the Command Telephone and Teleprinter Centre.

In the meantime, on 20 May 1939, the temporary Filter Room in the basement was moved up into the dining room adjacent to the ballroom and of similar height. Another gallery was constructed to overlook the filter table whilst a doorway was knocked through the wall at gallery height to permit access between the two rooms at gallery level.



The Supreme Commander of the Allied Expeditionary Force Gerneral Dwight D Eisenhower, accompanied by senior air commanders watching activities in the Operations Room at Bentley Priory on 27 January 1944. They are (left to right) Air Chief Marshal Sir Arthur Tedder (Air Commodore-in-Chief and Deputy Supreme Allied Commander SHAEF), Air Commodore Hart, Major General William C. Butler (Deputy Commander-in-Chief Allied Expeditionary Airforce), General Eisenhower, Air Vice Marshal W.B. Callaway (Senior Air Staff Officer ADGB)

and Group Captain E.H. Stevens.

When the Chain Home Low (CHL) stations became operational in November 1939, their plots were passed via their parent CH Stations to prevent overloading the Filter Room.

The Battle was controlled from the Group Operations Rooms and implemented by the Sectors whilst being overseen by Command. The Groups also controlled the Barrage Balloon organisation and the operations of the Army AA Gun sites. The National Air Raid Warning system was also maintained at Fighter Command HQ at the Priory.

Throughout and following the Battle of Britain, further radar stations came on line and the chain eventually extended to

cover the whole UK. This put a huge strain on the Filter Room – the lack of physical space for plotters and the lack of GPO telephone lines led to demands that filtering be devolved to Groups. This Dowding refused and it became one of the causes of his dismissal on 18 December 1940, the main factor being the failure of night defence success.

Staffing levels at the Priory had increased dramatically – in December there were 667 RAF Personnel, 380 WAAF and 379 Army ranks; by February 1941 this had increased to 799 RAF, 518 WAAF and 588 Army.

In June 1940 a small subsidiary filter room was established in Plymouth to cater for the new southwest

Aerial view of the bunker. The main entrance is in the centre below the pillbox. From there a covered way led to the Priory, out of view to the left. The emergency exit is top centre to the right of the Nissen huts.

In March 1940 the new underground Operations and Filter Block opened. Apart from the ops and filter room, the block accommodated the AOC in C (Dowding), the Senior Air Staff Officer (SASO), the Air Staff, Duty Intelligence Officer, PMBX, power and air filtration plant, coding and cipher facilities and rest rooms.

## The Battle of Britain

This then was the centre from which ACM Dowding oversaw the Battle of Britain. The 18-strong Chain Home radar station network together with the Observer Corps reported directly to the Filter Room, which having filtered and clarified the conflicting information told the resulting 'clear tracks' to the Operations Room next door and to the Groups as well as the Sector Operations Centres.





#### BENTLEY PRIORY OPERATIONS ROOM (SEPTEMBER 1954) drawn by Nick Catford

radar stations coming into operation. This moved to the HQ of 10 Group at Box by July 1940; similarly, another temporary filter room was opened at 9 Group HW at Preston.

In December 1940 the decision was made to devolve filtering to Group HQs, and the Fighter Command filter room at Bentley Priory became the 11 Group (Uxbridge) Filter Room. The underground filter blocks were to be built in the vicinity of the new underground operations blocks to which was added a hardened communications block. This programme was not complete until September 1941. The Air-Raid Warning control was devolved at the same time.

The new filter rooms were 9 Group at Preston, 10 Group at Box, 11 Group at Bentley Priory (for Uxbridge), 12 Group now at Watnall, 13 Group at Blakelaw (for Kenton at Newcastle), 14 Group at Raigmore, Inverness and 82 Group for Northern Ireland. In July 1943, 13 and 14 Groups amalgamated at Raigmore.

For the rest of the war, numerous changes were made in staff, accommodation, buildings, huts and units as befits a major command HQ. However, little affected the Ops/Filter world until August 1943 when the Filter Room was suddenly required to vacate its underground home for a semi-sunken structure, topped by a Nissen hut, built in the back garden of a mansion house halfway up Stanmore Hill.

This was where it or its successors remained until the function ceased in the late 1950s. The now vacant filter room was required for senior officers planning the forthcoming invasion of Europe. Indeed it was to this Ops Room that the first reports of a successful landing were made to a waiting Winston Churchill and King George VI.

On 15 November 1943, Fighter Command changed its title back to a previous one of 'Air Defence of Great Britain' for the duration of the invasion before becoming 'Fighter Command' again on 15 October 1944. The Bentley Priory and bunker scenes of the 1969 film *Battle of Britain* were filmed on site and not in a studio.

### The Dowding System

Air Marshal Dowding played an important role in designing the systems which were essential elements of the Control and Reporting System which became the cornerstone of the UK's air defences and are known today as the 'Dowding System'. The system he developed gave the controllers the best chance of ensuring that they could always respond to incoming raids by scrambling squadrons to intercept them before they reached their targets. This rapid flexible reaction was essential as there were insufficient aircraft and crews to mount standing patrols.

Externally the whole Priory building, including the clock face, was camouflaged by spraying it with brown and green paint, and many of the windows were blacked out.





This is the permanent underground operations room in the bunker in 1940, clearly built for purpose with far better views of the map table. The plotters are now using electronic rods to move table symbols. The headphones they are wearing are connected to the tellers in the Filter room next door who are relaying the now clean track. This information is concurrently told to both Group and Sector HQs.

Some of the more important offices were protected with sandbags and dugouts were excavated in the grounds. There was, by necessity, some damage to the building including the demolition of the conservatory which was replaced by wooden offices.

At that time Bentley Priory was a non-flying base but with frequent high-level meetings taking place there an airstrip was soon desirable. The Air Ministry did not give this the same priority, stating that it would take six months to build two 300-yard strips.

Air Commodore David 'Batch' Atcherley, who had taken on this project, was disappointed but not surprised by this response. He immediately approached the Americans who took just four days to lay two cinder strips in a 'T' formation just to the south of the bunker. A Bellman hanger was also provided adjacent to the mess building.



The main entrance to the bunker in 2007. This is the only part of the bunker that has been retained. Photo Nick Catford

### The ROC postwar at Bentley Priory

Fighter command was the first RAF operational command to show a real interest in the need for nuclear burst and fallout information. It was required for the Air Defence Commander in the Air Defence Operations Centre at Bentley Priory in order that effective operations could be planned and conducted during and after a nuclear attack.

They had to know which airfields were free from damage or had been damaged by bursts, and which were free from the threat of fallout or, if they were threatened, the estimated time of arrival of fallout. From this information it was possible to deploy fighters to safe airfields so that they remained available for use in the next air battle. Aircraft already airborne had to be diverted if their base was damaged, under fallout or threat of fallout. In 1955 the detection and

reporting of nuclear blasts and fallout was first introduced. By 1965 the aircraft role was no longer needed, and the Corps now formed the field force for the United Kingdom Warning and Monitoring Organisation (UKWMO) until both organisations were disbanded after the Cold War ended. In March 1965 it was proposed that a joint Home Office/ROC headquarters should be established at Kestrel Grove, Stanmore. Co-location of headquarters proved impossible and Kestrel Grove which the ROC would share with Military Air Traffic Operations (MATO) was derequisitioned and the Corps found itself remaining at Bentley Priory.

By 1968 the ROC headquarters consisted of an Air Commodore, nine full-time ROC officers and around fifteen MoD civilian support staff. The ROC officers, several of whom lived in, took a full and active role in the life of the officers' mess.

In 1977 a Nuclear Reporting Cell (NRC) was established at the Priory; this was manned by a team of twenty ROC personnel and all training was competed in the bunker under the control of No 11 Group RAF.

The ROC team was under the control of an NRC officer, and was set up to report nuclear burst and fallout information to an RAF tanker cell which was also based in the bunker. The nuclear burst and fallout information was plotted on a large vertical screen (Display A) by the NRC team; this screen was in full view of the ADC Air Defence Commander (ADC) who was situated on the balcony opposite the ROC cell.





One of two chiller plant rooms in 2007. The compressors (top) and receivers (below) compress refrigerant gas which is then used in the heat exchangers either for chilling recirculated air in the bunker or for cooling large electrical components. The chiller plant cools water, which is then used in a radiator in the air system to cool the air. Photo Nick Catford

The NRC team were on duty at all ROC exercises which simulated a nuclear attack on the UK. These exercises would involve all the ROC Posts, Groups and Sector controls, and the purpose of the NRC team would be to plot all the information and then sift any threat that was relevant to the RAF 11 Group stations. The Air Defence exercises continued until 1985 and the ROC exercises continued until 1989.

HQROC Bentley Priory was based in a standard RAF block building which was the first building on the right side of the main drive when entering the base. The HQ occupied all of the ground floor and part of the upper floor; 11 Group RAF had the rest of the second floor.

HQROC had two main departments, Operations and Administration (Ops and Admin), staffed by full-time staff officers and civilian staff. Most officers had a 2/3 year tour at HQ. By the 1980s the HQROC staffing had been reduced to around 25 people in total. The senior staff were an ROC Commandant (a serving RAF Air Commodore) and a Deputy Commandant who was an Observer Captain, the Senior ROC full-time officer (latterly this post was renamed Chief of Staff).

There were five full-time operations personnel in the bunker. They were a Senior Operations Officer (SOpsO) who was an Observer Commander; Operations 1 (Ops1), an Observer Lt Commander (renamed Ops Comms in 1985); Operations 2 (Ops2), an Observer Lt Commander (renamed Ops Training in 1985); Operations 2A (Ops2A), an Observer Lieutenant (renamed Ops Training 2 in 1985); and a cartographer which was a civilian post.

Apart from making policy on operations and administration matters for the whole Corps, there were little actual operations carried out at Bentley Priory. During national exercises all staff officers dispersed to various Group and Sector HQs as 'evaluation teams'. The Commandant and Deputy Commandant tended to have a roving role during exercise visiting various Groups and Posts.



The entrance to the new plant bunker in 2007. Photo Nick Catford

All new equipment was commissioned, inspected and tested by the ROC Ops team at Bentley Priory prior to deployment for testing in the field. All operational manuals were commissioned and written by staff officers with additional technical support being drafted from the Groups when needed.

### The ROC is stood down

During the refurbishment of the bunker from 1982, the NRC cell along with the air defence staff were moved to a temporary above-ground building. They continued to hold ROC and RAF air defence exercises until the 10,000-member main field force of the ROC was stood down on 30 September 1991. The Corps was dismantled following what was described by the Queen at the Royal Review as "the end of the Cold War", and linked to a Government press release that referred to "possible future developments and improvements in automated nuclear explosion and fallout detection from remote sensors".

After stand-down a reduced ROC contingent remained at Bentley Priory under a revised RAF structure. Only the Nuclear Reporting Cell (NRC) elements of the Corps remained in service, working alongside major armed forces headquarters, and they entered a new and highlyuncertain phase.

Reduced to less than three hundred members in total over the whole UK, the retained NRCs now found themselves tasked with the daunting challenge of providing a comprehensive Nuclear, Biological and Chemical (NBC) warfare analysis and warning service for the Military Home Commands, on a reserve-manned basis as NBCCs but without the previous flow of data from posts and controls. The NRC team was now confined to a corner of a room in the bunker with a desk, teleprinter and telephone.

The team's new role was to report all nuclear, chemical and biological threats to all RAF 11 Group stations; this was done by calculation in the NRC cell and also direct reporting from chemical sentries in the field. This was evaluated and passed direct to the RAF via the teleprinter and computer terminal links within the bunker.





Two standby generators were installed during the 1980s refurbishment. Prior to that there was an external brick-built standby set house. This was demolished in 2010. Photo Nick Catford

From 1991 onwards the 'Remnant Elements' became a single reserve, Directly Administered Unit within RAF Strike Command (RAFSTC). The position of Commandant ROC became a secondary appointment for the Senior Air Staff Officer (SASO) of No. 11 Group RAF at Bentley Priory. All members were required to remove their original ROC Group designations from their RAF uniforms, and to accept moves towards a change in conditions of service during any Transition-To-War (TTW) that would make them effectively members of the Royal Auxiliary Air Force (RAuxAF), with protected rights, and closer links were made with the warappointable flights of the Royal Air Force Volunteer Reserve (RAFVR).

Despite having successfully built upon the extensive NBC reporting trials, undertaken with the RAF Regiment and meeting full NATO standards and evaluations, the conclusion reached by the MoD was that retention of the Corps in its NBC Cell role was "desirable, but not essential in the existing format". As a consequence, the remaining part-time members of the ROC were stood-down on 31 December 1995. Headquarters ROC at RAF Bentley Priory finally closed on 31 March 1996.

# Fighter Command after WWII

After the war, the Priory remained in RAF hands and settled down to a quieter existence; personnel were reduced to peacetime levels, with immobilisation a priority. The numerous requisitioned buildings were returned to their owners. This was to be short-lived however as on 10 March 1947 a fire was started in an ante-room to the officers' mess, and damage amounting to some £20,000 was caused to offices above and adjacent.

Restoration and rebuilding were completed by 28 June to coincide with a parade to mark the eighth anniversary of the WAAF attended by the Duchess of Gloucester. In 1948 the Berlin Air Lift signified the start of the Cold War. In January 1949 operational command of the Royal Auxiliary Air Force passed to Fighter Command from Reserve Command with full control following on 1 November 1949. At the end of WWII, 9 Group was disbanded on 18 September 1944, to be followed by 10 Group on 2 May 1945 and 13 Group on 20 May 1946 leaving only 11 Group at Uxbridge and 12 Group at Watnall intact. A review of Fighter Command Control and Reporting Organisation by Group Captain Cherry resulted, eventually, in the 1951– 1957 Rotor (radar) programme. One outcome was to reduce the number of Groups to two.

By April 1953 Fighter Command looked like this: Fighter Command HQ at Bentley Priory, 11 Group HQ at Hillingdon controlling Southern Sector HQ at Rudloe Manor (Corsham) and Metropolitan Sector HQ at Kelvedon Hatch (Essex); 12 Group HQ at Newton (Nottingham) controlling Northern Sector HQ at Shipton (York); Eastern Sector HQ at Bawburgh (Norwich); Western Sector HQ at Langley Lane (Preston); and Caledonian Sector HQ at Barnton Quarry (Edinburgh). The station strength was increased in April 1951 when the Central School of Aircraft Recognition opened. Plans were also made in April for modifications to be made to the underground operations block at the Priory to accommodate future automatic equipment. The A O C in C rejected this proposal and instead asked the Air Ministry for a completely new bunker to house the operations room and defensive radio warfare elements whilst the existing bunker continued to be used by the GPO and signals equipment, traffic office, PBX etc. This new bunker was not built and the old one was adapted to fit the new role.

1953 saw a general modernisation of the UK defences and a new unit, Air Defence Operations Centre (ADOC), was opened on 23 February administered by Fighter Command. It would provide the Air Defence Commander with facilities to direct and coordinate air defence operations and advise the sector operations rooms accordingly.



A bank of air filters adjacent to the air conditioning plant room in 2007. Photo Nick Catford

When the ADOC operations room was modified (in situ by June 1960), the old filter room / DWR plot next door was floored over with the upper room becoming an intelligence room and the lower room an electronics apparatus office with some 44 racks of electronic



equipment. The new ADOC operations room (depicted in the colour photograph on page 37) has the previous open gallery replaced by glass-fronted cabins with the AOC in C's executive suite 'The Bridge' being fitted with leather armchairs. This overlooks the now electronic tote. By the time the bunker was closed this room also had the well floored over and it was just another office full of computers.

In August 1953 another new Fighter Command unit, 80 Wing, came into being at Bentley Priory. This took over three radio countermeasure squadrons, to be controlled by ADOC. Command and control of all ground radio warfare facilities now rested with Fighter Command.



After decommissioning there was little left in the bunker apart from plant and empty rooms. The is one of the computer suites built into the lower level of one of the ops rooms. Photo Nick Catford

During the early 1950s reconstruction and refurbishment took place in the Priory, with a new conference room above the repaired ante-room in 1953 and the following year the mess kitchens and dining room were enlarged. September 1956 saw the Movements Liaison Section of the Centralised Filter Plot at Hill House move to the Priory allowing the derequisition of Hill House. On arrival, it became the Metropolitan Raid Recognition Centre (MRRC); this inappropriate title was changed on 1 April 1957 to Metropolitan Air Defence Notification Centre (MADNC).

In December 1957 the Southern Air Defence Notification Centre at Rudloe Manor closed with the function moving to Bentley Priory which now became ADNC (South) subsuming ADNC (East) in February 1958, this time without a change of title. From 1 October 1958 ADNC (South) was disbanded and its functions were devolved to each of the Air Traffic Control Centres (ATCC) at Uxbridge, Gloucester, Watnall, Preston and Prestwick.

#### Strike Command is born

On 30 April 1968 Fighter Command was amalgamated with Bomber Command to form Strike Command. Initially Bentley Priory was retained as the administrative headquarters for Strike Command but this function moved to High Wycombe in 1972. Bentley Priory then became HQ 11 (Fighter) Group. In March 1971 the ADOC was moved to new accommodation at High Wycombe but the Bentley Priory one was retained as a standby facility to be available at an hour's notice.

It was also proposed that the Officer and Aircrew selection at RAF Biggin Hill should move to the Priory and Stanmore should close. All these plans required a large Officers' Mess and in 1974 the Department of the Environment ordered a thorough investigation into the Priory building. Their findings were extremely disturbing – the spread of dry-rot in the timbers meant that the only safe parts of the mess were the kitchens and dining room, and these would only last until March 1975 when they too would have to be closed.

The decision that the mess would have to close came at a particularly bad time as, some four months earlier, the Royal Air Force Association had been given permission to hold a Fighter Command commemorative ball at the Priory and invitations had already been sent out. Given the serious concern about the integrity of the building's structure, it was decided to use marquees for the majority of the function; the lower floors were temporarily strengthened.

The ball was, of course, a resounding success and caused HM the Queen Mother, who had a long association with the mess, to be particularly interested in the Priory's future. It was from that night that the campaign to save the Priory really began and it was eventually decided that the Priory building should be renovated at a cost of approximately £1 million. Most of the paintings and other valuables were taken to RAF Quedgeley for safe storage, and Cubitts, sub-contractors of the Department of the Environment, started work.



During the 1980s refurbishment a lift was installed between the two floors. Photo Nick Catford

### Another fire

On the evening of 21 June 1979, smoke was seen coming from the Priory. The London Fire Brigade fortunately arrived in good time to fight the fire. Unfortunately, the electricity had not been switched off and as the firemen advanced to the seat of the fire, they were surrounded by great sparks and had to beat a hasty retreat. The firemen spent the next morning damping down the smouldering remains and looking for the cause. It was quickly established that the fire was an accident and not arson.



The fire devastated most of the main staircase, but luckily jumped over the Adelaide Room, by- passing the Rotunda, but destroyed the rooms down the other side, including the Dowding Room. Initially, this fire was thought to be the final tragedy; however, after legal ramifications were resolved, Cubitts' insurance covered most of the cost of rebuilding and renovations went ahead at a cost of approximately £3.1 million.

In 1979 plans were prepared for a new UKAIR Permanent Static War Headquarters at High Wycombe. After almost a decade under care and maintenance, the bunker at Bentley Priory was refurbished and extended to provide a reserve, alternative site to High Wycombe. This task was completed in 1990.

During the reconstruction of the underground control centre at Bentley Priory which included flooring over the well, a completely new underground bunker was constructed in 1983/4 when a new plant bunker was built alongside the old bunker. At over twice the size of the original, it contained new standby generating plant, air handling and filtration equipment, decontamination services and secure EMP power and communications.

Another new unit, Systems Development Centre (SDC) was formed on 1 April 1983 and was joined in September 1984 by the RAF Regiment training evaluation staff from Catterick. The SDC was itself joined in September 1985 by the computer experts of the UK Air Defence Ground Environment (UKADGE) from Wattisham. In January 1986 11 Group's title again changed, this time to 11 (Air Defence) Group.



The picquet post just inside the main entrance to the bunker in 2007. The stairs on the right lead down to the lower levels. Photo Nick Catford

#### Closure

RAF Bentley Priory was latterly home to the Defence Aviation Safety Centre, Air Historical Branch (AHB) and RAF Ceremonial. There was no enduring operational use for the base, however, so the Ministry of Defence released the site as part of its Greater London estate consolidation project, Project MoDEL (Ministry of Defence Estates London). This despite the fact there was a significant lack of military accommodation in the London Area.



The final closure ceremony on 30 May 2008

Project MoDEL is making a major contribution to the consolidation of the Defence Estate in Greater London through the delivery of three key outputs: the development of an integrated 'core site' at RAF Northolt; the relocation of the London-based units; and the disposal of surplus sites. Accordingly DASC, AHB and RAF Ceremonial relocated to RAF Northolt in 2008 following the completion of their new accommodation. A total of £180 million of the £300 million released from Project MoDEL has been invested back into RAF Northolt.

A final dinner was held for the Battle of Britain veterans in July 2007 to celebrate the role of the Priory building and those who worked in it in preventing Hitler's planned air invasion of Britain in 1940. The sunset ceremony was carried out by the Queen's Colour Squadron and there was a flypast by the Battle of Britain Memorial Flight and a Eurofighter Typhoon. The salute was taken by the Station Commander Squadron Leader Phil Reid, the Chief of the Air Staff Air Chief Marshal Sir Glenn Torpy and Air Commodore (Ret) Pete Brothers, Chairman of the Battle of Britain Fighter Association.

The final closure ceremony took place on 30 May 2008, when the RAF ensign was lowered at RAF Bentley Priory for the last time. The station officially closed the following day, and all remaining units moved to RAF Northolt.

# After Closure

Following the closure of the RAF station the site was handed over to Defence Estates, who in turn passed it to the prime contractor for Project MoDEL, VSM Estates, a company formed by developers Vinci and St Modwen who are responsible for developing proposals and the subsequent disposal of the site to developers who will realise the scheme.

Under supplementary planning guidance agreed in 2007 by London Borough of Harrow, the site will include a museum open to the public in the main rooms of the house, recording and interpreting the history of the site and in particular the Battle of Britain and Cold War heritage.

The plans were put on hold in 2009 as a result of the economic climate, although in 2010 it was agreed that the museum would go ahead and be run by the Battle of Britain Bentley Priory Trust, with support from another charity, the Prince's Regeneration Trust. The latest plans for the site include the conversion of the Grade II\* listed mansion into luxury flats, above the proposed museum.



The Cold War bunker was surveyed by English Heritage, who concluded there were other examples of similar bunkers across the country in better condition.

Members of Subterranea Britannica visited the site in 2005 and 2007. It was noted that the actual structure of the WWII bunker remained, the walls, ceiling and floors were intact but the two wells looking down to the map tables had been floored over. The modifications to the bunker consisted of a large (larger than the original



Demolition of the bunker is underway in March 2008

bunker) plant and air handling plant room with standby generator room, and a new surface entrance. The bunker had new modern ceilings and lighting along with computer flooring. The room layout had also been altered and was not recognisable as the original.

# Efforts to save the bunker

Despite the lack of interest from English Heritage, VSM Estates' plan to demolish the bunker was strongly opposed by some local people and in particular the Stanmore Society. Their chairman wrote to Harrow Council's planning committee in March 2010 in a last-ditch attempt to stop the demolition, objecting "in the strongest possible terms". He said: "We can see no point in spending thousands of pounds destroying something which in the 1980s cost millions of pounds to (re)build. This is a unique building in Harrow and should be preserved intact. We appreciate that no intentions exist at present to open the building to the public but this view could change at some future point." The appeal fell on deaf ears.

The reasons why the bunker could not be saved had previously been stated by Guy Gusterson, the regional director of St Modwen Properties.

He said, "With the task of marketing the Priory estate, there is a responsibility to ensure the bunker does not create a hazard as it is located in the grounds where both residents and hopefully the many visitors to the proposed museum can walk around. At present it costs around £80,000 a year just to keep the water pumps running (due to the high water table) to stop flooding and the air-conditioning functioning to supply clean air. It is not practical or financially affordable to meet today's requirements associated with publicly accessible buildings, i.e. lifts for disability access, safe means of escape, mechanical and electrical enhancements to comply with Building Regulations etc.

"If the warrens of underground corridors on three levels are just allowed to flood due to the high water table, in the long term (approximately 50 to 100 years) the water will slowly erode the concrete and metal reinforcing and the structure will collapse. Without the very high cost (that the Museum Trust could not afford long-term) of continual pumping, the structure will fill with water which will become stagnant and create an environmental issue.

"The MoD is obligated to ensure that the bunker does not become a future liability which could cause damage or injury. They have investigated a number of ways of achieving this and the above strategy has been deemed the most suitable.

"The VSM plan is to remove the layer of earth covering the bunker, and with some difficulty break through the reinforced roof and remove the walls down to just above floor slab level. The concrete will be crushed and used to backfill the structure after the floor slabs and upstands have been punctured to allow for ground water to naturally make its way unobstructed. This will ensure ground water does not get caught in pockets and stagnate. Following which, earth will be backfilled to create a similar mound as is currently there and the existing main entrance including blast door and retaining walls kept in situ so as to retain the historical external appearance of the bunker."

In March 2010 the bunker was filled in, leaving only the exterior doors and walls.

Sources: Radar in Raid Reporting. Signals Vol IV. Air Ministry 1950

History of RAF Bentley Priory and Stanmore Park. John F Hamilton 1997

The Source Book of the RAF. Ken Delve. 1994

Air Defence of Great Britain. John R Bushby 1973 Dowding and HQ Fighter Command. Peter Flint 1996

One Women's War. Eileen Younghusband. 2010

Attack Warning Red. Derek Wood. 1976

The Battle of Britain, Then and Now. After the Battle. 1987

An illustrated history of RAF Bentley Priory. Command Media Services (given to visitors to RAF Bentley Priory)

David Ross & John Simmonds - Former observers from Bentley Priory; and Wikipedia



# Sub Brit in Sussex for the Weekend – September 2012 Chris Jones

# Friday 14 September

The traffic on the M25 was worse than usual so we arrived just in time at TQ473291 near Crowborough and went straight into our first visit of the weekend, Crowborough/Kingstanding Aspidistra and Regional Government Headquarters (RGHQ) site. We were greeted by Mark Russell for Sub Brit and Dave Metcalf of Sussex Police at this 1942 transmitter site, which became a RGHQ 6.1. Acquired by Sussex Police in 1996, it is now a centre for sensitive training exercises – we much appreciated being allowed access for our historical interest.



The main entrance to RGHQ6.1. Photo Adrian Armishaw The site covers 35 acres in the Ashdown Forest and is a Site of Special Scientific Interest (SSSI), which attracts teams of conservation volunteers. The SSSI has frustrated proposals to demolish the buildings and though secure and largely intact, the less important surface buildings are now decaying. Exmoor ponies are used to break down gorse on the site, home to the rare silverstudded blue butterfly.

Concrete bases and anchor blocks for the guy ropes were visible in the gorse, marking the positions of the transmitter masts. After the safety and security briefing, we passed by the aerial allocator building – a circular brick tower – entering the site at dusk.

Plans for counter-battery work in radio propaganda were evolving before the war, but by 1941 there were increasing concerns about the Lord Haw-Haw propaganda emanating from the Reich. As usual in times of crisis, it was case of finding solutions that were lying around. The US company WLW and its energetic and innovative Powel Crosley Jr. had already proven a large transmitter but run into licensing problems. The visionary Crosley went on to pioneer facsimile transmissions from 1939. Dissatisfied with his 50kW radio station, Crosley persuaded RCA, General Electric and Westinghouse to build a 500kW transmitter. At the time, the iron cores for the reactors (transformers) and the glass rectifier tubes were the largest ever made. Somehow, Crosley persuaded the Federal Communications Commission to grant him a short licence for W8XO, as an experiment. Once W8XO was safe and reasonably stable, Crosley secured a commercial licence. Radio WLW went live on 2 May 1934 and was very profitable. It could even be received in London. Not surprisingly, fifteen other stations applied for 500kW transmitters. All were declined.

By 1938, complaints about interference from Radio WLW were intense. Congress demanded that the Federal Communications Commission impose a 50kW limit, which was implemented and Radio WLW had to be de-rated. In the meantime, presumably for competitive advantage, WJZ Radio had already commissioned an updated version of W8XO from RCA. Now there was nothing to do but put it in storage.

But over in Britain the leading radio scientist, Harold Robbins, heard about the mothballed equipment and in 1941, quickly devised a scheme with the Ministry of Economic Warfare. RCA helpfully uprated it to 600kW and sold it for £116,000.



100 Kw shortwave transmitter installed during WWII The British chose Ashdown Forest because they were uncertain how far they could broadcast. Canadian engineers started excavating the chalk for the bunker using some bulldozers and small dumpers, but otherwise with limited machinery. Constructing the bunker involved six hundred civilian labourers and was completed in a remarkable six weeks.

Dave's archive yielded some photographs of progress, including the construction mishaps. Of course, the British had a proven design for all the supporting services. The transmitter generated a great deal of heat and the amplifiers and modulators were cooled via a distilled water manifold. The large vertical risers we saw connected turrets on the surface to a ventilation plant, which forced air through huge mercury arc rectifiers.



Presumably off-grid, power was from one of the largest generating sets of the time, driven by a horizontallyopposed Crossley Premier oil engine. This 16-cylinder machine delivered 3,500 brake horsepower and was reported to shake buildings a mile away.

As usual, there were late changes. They realized they needed space for a tuning housing and an earth-covered blockwork room was added atop the four-foot-thick roof of the bunker. Nonetheless, taking the transmitter from approval to commissioning in nine months was an impressive achievement – especially by modern standards.

The station was named Aspidistra in July 1942 and was fully operational on AM medium wave by November 1942. It transmitted from three point-mounted 110m lattice masts, restrained by guy wires. Crucially, operators could adjust the broadcast frequency from ASP1 extremely quickly. Two 100kW General Electric P100A transmitters were added.

But from January 1943, ASP1 did more than smother the enemy radio stations with the British version of events. ASP1 was a strategic weapon, used to convincingly impersonate the Reich. Transmitters here posed as the official German military radio stations *Atlantiksender* and *Soldatensender*. Using selected recordings, Aspidistra broadcast convincing but misleading news bulletins and announcements – they even used the exclusive German teleprinter facsimile, *Hellschreiber*.



This tunnel is the emergency exit from the later RGHQ. It is the only part of the original Aspidistra complex that remains unaltered. Photo Adrian Armishaw

# War in the air

After the Germans realized that British bombers were using German radio transmissions for direction finding, they would stop broadcasting if they knew a raid was coming. ASP1 exploited the gap in the German broadcasts and was so powerful that when German stations tried to resume, they were drowned out. The British also overlaid false ground control instructions. When the Germans responded by using music as code for raid destinations, ASP1 briefly snatched control, diverting the night fighters. Aspidistra was continually responding to German announcements as the Germans tried to regain their authenticity, distorting these as well and generally spreading confusion. Bomber Command was to lose 55,573 aircrew during WWII, a 55 percent rate of loss. Averaged over the whole duration, a British bomber aircraft would survive just fourteen missions; naturally estimates circulate about how many British crews were saved by Aspidistra, simply by wasting German time and resources. The other price of the war was that Allied bombing killed somewhere between 305,000 and 600,000 civilians.



Kingstanding acquired twelve more medium wave and shortwave installations. After the War it site hosted the Diplomatic Wireless Service and some BBC broadcasts. By then it had accumulated 35 masts – the veterans have found thirty of these. It also gained a

Logo of the Aspidistra radio station

new power house with Napier Deltic generator sets.

After serving for forty years, on 28 September 1982 the ASP1 transmitter was turned off by the same Harold Robbins. Few seemed interested in the historic significance of the equipment. Very little was saved, although there are some transmitter parts at Orford Ness. Dave is a dedicated enthusiast, regularly meeting the veterans. Parties wade through the gorse and bracken looking for concrete, Dave painstakingly negotiating an agreed site history, which he relayed to us. But we have to conclude that Aspidistra would not have materialized but for Crosley's ambition and innovation. WLW advertised rather prophetically, just as WWII began:

"... Eventually we believe that every home will be equipped to receive sound, facsimile, and television."

# We go underground

Converting and extending the bunker to form a RGHQ started two years later and was a £6m project. It could house up to 120 people, self-contained for three months. Circuit charts suggest it was finished in 1987. Considered redundant by 1992, it was sold for just £120,000.

We went down the ramp through the entrance to the three-level nuclear bunker extension. We passed what must have then been state-of-the-art CCTV cameras. It's ironic to think that CCTV is now ubiquitous, and our buildings are specifically designed to be defensible. The steel-cased concrete doors had seals but were designed to resist disorder rather than blasts. Through the decontamination area, we stepped back into the 1980s. Sussex Police bought the site complete with all contents, including the food supply. The kitchen looked perfectly ready to resume its original purpose. Apart from stripping



out the 90,000-litre water tank – borehole and mains water supplies were provided but potable water was only available at one lockshield tap – the bunkers have hardly changed. The 1987 conversion is little-worn and very well looked after, impressively dry, apart from the odd expansion joint between the phases of construction. The smell and feel of the spaces were good, because some of the HVAC systems are still run to control damp.

Into the typical PSA plantroom, well-sized and fullyoperational on its original electronic controllers, banks of traditional air-handling plant and Dunham-Bush splitsystem chillers – the condensers located outside in one of the voids around the core areas and likely a feature of the original bunker, discharging through exhaust turrets on the surface. All the major RCLG plant was dutystandby and still under a full maintenance contract. Adjacent was the RCLG generator room. Into the bargain, Sussex Police acquired thousands of litres of diesel fuel, which they condition, watching its value increase. The old water-tank room was now some kind of tactical training room, complete with new kit bags.



Dave Metcalf talking to us in the generator room. Photo Adrian Armishaw

We entered the transmitter hall that used to house the three coupled transmitters for ASP1 – the room is lined and rendered and was later converted to a command centre. Despite the intrusive 1980s ductwork you could see that the original architect specialized in designing cinemas. We climbed another ramp and left through the original entrance; by now it was very dark.

The Alexandra Hotel in Eastbourne was friendly and reasonable and after a stroll along the seafront to see the lights of the pier, we retired.

### Saturday 15 September

Breakfast was good and we gathered for roll-call to board the coach. Sam, our driver for the weekend, thought our subterranean interest was weird, but she got us to Brighton briskly with impeccable gear-changing.

So it was a good day at Black Rock as we boarded Volk's Electric Railway. Mr. Volk's grandson lived in the road where I grew up. Like his grandfather he had a white

beard, and sported a cloth cap and cane. Like Crosley, Magnus Volk was a vigorous technologist who opened the 1.25-mile line in 1883.

Medical opinion even thought the world's first electric railway would enhance the purifying effects of the sea. With a two-foot gauge, it ran from the Swimming Arch by the entrance to Brighton Aquarium back to Chain Pier. Originally it terminated at Paston Place but a 1930 extension took it to Black Rock, which rendered Paston Place as a halfway point. Here there is a servicing shed, sidings and a passing loop and power installation.

In 1940 Brighton Corporation took control and the line is now operated by Brighton & Hove Council, with technical and historical support from Volk's Electric Railway Association. Originally, the running rails carried the traction power, which came from a dynamo coupled to a gas engine in Volk's Paston Place generating station, built into the cliff. Improving the 50V to 160V DC, a third rail was added later.

The carriages used today are simple with sliding doors, and well preserved. The paneled bodies are carried on wooden underframes with one driven axle. At the stately 6mph required for a heritage railway, we motored along the seafront, Linda clinging resolutely to the handbrake wheel. Over a patchwork of tracklaying styles, we trundled past the halfway complex and arrived at the Aquarium terminus.

In exchange for refurbishment and another shortening of the line at Black Rock, a new station building at Aquarium provided an entrance and the power intake for the Southern Water drainage scheme, which we heard about later. Once on the platform there was nothing else to do but change ends and trundle back, our siren marking the crossings. On a brightening morning, the units had warmed up by now and smelled of warm greasy iron and hot resistors, reminiscent of Southern Region.

Volks Electric Railway has seen a variety of rolling stock, some of it written-off in the last war. The 40-seaters we rode call on about 8HP and although identical, some of the units are known to go faster than others – the best ones can reach 12mph.

After a short walk from Black Rock through the crowds, we gathered beside gentle waves lapping rusting pier caissons, backed by a sparkling bright horizon, with someone's trainers decorating the corporation lamp post. It was a beautiful morning, but we were going down the drains.

### Another move underground

Southern Water have 13,700km of sewers and have been running the Brighton Sewer tours for over fifty years. Our guides were technicians with many years of experience in the sewers under Brighton. The smell at Arch 260 had the quality of ammonia mixed with seasoned manure, but it soon became less noticeable.



After instruction, entry control and donning our PPE, Southern Water tested the gas and evacuation alarms before we went inside. Intercepting sewers from Brighton and Hove meet those from the London and Lewes Roads at this point, so if there is a storm, the junction fills extremely quickly from either direction.

We watched Southern Water's introductory DVD, hosted by bathing-machine entrepreneur Martha Gunn, which brought to life the expansion and patronage of Brighton and Hove, all thanks to the railways. By the 1860s, the population had overloaded and often misused the storm drains. Ironically for a health resort, this brought serious inshore pollution, despite extending the outfalls. As in London, something had to be done and it led to new sewers discharging to three new outfalls along the front.



Brighton & Hove intercepting sewer in 1939. It shows the meeting point of the London Road and Lewes Road Valley sewers

After 44 miles of new sewers had been laid, they still overloaded in storms and sewage ran over the weirs to sea. A further project that included pumping encountered unexpectedly large volumes of groundwater, but established 7.25 miles of properly-sized Victorian sewers, complete with ventilation stacks and later, improved pumps.

Higher environmental standards of the modern era led to a £300m Southern Water project in 1995. New sewer tunnels were machine-bored 11km to connect a new, covered treatment plant at Peacehaven with a new outfall. They needed to attenuate the peak flows and 30 metres beneath the beach is the largest attenuation chamber in Europe. In a bore of six metres, sediment is cleared by drive-in machines, and this 4.8km storage chamber overflows to the sea but was unfortunately not part of our visit.

As the DVD finishes, we realize that Martha has great cultural significance for the Southern Water guides; they gravely recant her warning that she will be keeping an eye on things. There are rumours of fatalities when the sewers were built and later we did hear that one experienced operative told of being pushed out of a spur tunnel – twice – emerging as white as a sheet.

We entered via a staircase. The tour is well-lit and at some points we could see through vents to the street. If you ever wonder how the roads get clean, imagine how all kinds of material – even largish items – collect in the sewers. Some of it is quite gruesome and the police need to pick it up.

The sewers are a cathedral of red engineering brick, crafted with elegant curves, junctions formed like the bifurcated intakes of jet aircraft engines. Some elaborate parts have bridges. Sound in the tunnels has a long reverberation time. Rushing water is punctuated by occasional bangs from the overflow flap valves and in heavy storms, these tunnels can fill in fifteen minutes.

> The original escape passage is now concretelined, but in the round and egg-shaped sewers, the brickwork is polished and clean right to the bottom. The clever Victorians worked out that an egg-shape not only maintains self-cleaning velocities at low rates of flow, but also causes oscillations that break up the solids. The main round bores have good headroom and are in excellent condition. Accretions from groundwater leakage – it is counterproductive to try to stop these – are quite limited.

> We reached a vertical cylinder which couples four circular sewers to a main trunk; it has a new connection punched through to the storage chamber under the beach. As we moved on we began to see smaller branches with just enough height for crawling. The largest chamber we saw was at the junction of the Lewes Road Valley and London Road sewers,

about seven metres high where there is the only modification to the original Victorian brickwork, three extra courses on the weir.



Overflow chamber under Old Steine Gardens for Brighton & Hove intercepting sewer. Beyond the overflow weir seen at the end of the chamber this sewer diverged, one arm running along London Road as far as the railway viaduct and the other running along Lewes Road. Photo Nick Catford



# **Underground** problems

As the overflow passed across the weirs, the Victorians placed bars to break up solids so that they would be less obvious near the beach. Syphon pipework was added to this chamber to provide an emergency water supply in the last war. Groundwater ingress and gritty sediments, no longer cleared by the regular overflows to sea, both significantly exceeded allowances in the 1995 design and our guides are now brought in to advise technical meetings. But universally, the biggest problem is what people put down drains.

Solvents are a particular risk and in 1987 there was an underground explosion in this area. Our guide stressed that every drip of domestic grease matters – it is not just the restaurants. In the branches the constant film congeals like dripping candle wax until bergs are snapped off by high flows. Entering the trunk sewers, grease floats along to gratings and weirs trapping other material, which causes most of the trouble. Manual labour is still required to clear it out; operatives often standing chest-deep in the flow – they are not allowed to clip on – skating around on a polished curving floor to guide the hose from the vacuum tanker. If you fall, just close your mouth and resurface.

This was an excellent tour and the general public were intrigued as we emerged from a 2.5 metre barrel up onto the street. We then returned to the arch to clean up.



The tour ends with a short ladder climb up to a manhole in Old Steine Gardens. Photo Richard West

We walked across to the Town Hall. A wedding was gathering in the portico. Inside the 1834 building we were led over the mosaic floors under the central light well to the Police Cells, two floors below ground.

Until 1967 this was the police station and fortunately, the cells were largely mothballed in their original state. We heard that when the railway arrived in 1840, Brighton quickly gathered a reputation for crime; including a series of murders involving bodies, trunks and railway stations between 1927 and 1934. Brighton became known as the "Queen of Slaughtering Places".

Boulting's *Brighton Rock* film of 1947 even opens by explaining that it portrays times past, but the film did not foresee the later Mods and Rockers. Being on a lower

ground floor, the womens' cells had some natural light, whereas the men's cells were in the basement.

They were restored by volunteers in 2005 and converted into a museum for the Brighton Police. One corridor is in white enamelled brick, complete with a well. Exhibits included a forensics model of the Grand Hotel after the IRA bomb (1984); and among the ceremonial truncheons, photofit kits, radios, lamps and uniforms were the white summer helmets unique to Brighton – withdrawn on amalgamation of Brighton's police into Sussex Constabulary in 1967.



Brighton police cells. Photo Tony Mould

The museum has collected a wealth of police paraphernalia, historical treasures and artifacts, not just from Sussex either. On the lower level, the lavatories, complete with tiling, the lead plumbing, basins on lead brackets and one of the water closets have remarkably survived almost intact. The exhibits were extensive and interesting. Lacking due cause or any other volunteers, members locked up the Sub Brit Treasurer and retired to the seafront for lunch.

# John Smiles' restoration project

Sam steered, at times shunted, the coach through the narrow lanes, passing Herstmonceux observatory. We arrived at a farm to visit Wartling Rotor Bunker. The Pevensey Levels have been an ideal home for radar as well as grazing Borrowdale Greyback sheep. There was an East Coast Chain Home station after 1939 and higher up, in a field at Wartling, a Ground Control Intercept station in caravans was deployed in 1941. Housed in permanent structures after 1943, RAF Wartling ended the war guiding fighter intercepts for 380 German flying bombs.

The arrival of the Cold War led to Wartling's being selected as a ROTOR station. From 1949, the immediate threat was the Soviet version of the Superfortress, which had the range at 400mph to drop atomic bombs. Replacement of wartime radar in exposed surface facilities was suddenly urgent and the 39 ROTOR bunkers could scramble fighters direct from their bases.

On the east coast these were fully underground. Construction of this ZUN Type R3 ROTOR for Ground Control Intercept duties started in 1951. The bunker is fully underground on a hillside above Pylon Farm and the Pevensey Levels. Joining an existing brick-built Happidrome, its reinforced concrete box was 61 metres long and 37 metres wide.

The roof and floor are three metres thick, although not designed to survive a direct hit. Despite 24-hour excavations and most likely due to groundwater ingress, Wartling was finished in 1955, two years late. The brick Happidrome was then obliterated. Power supplies came via a remote generator house. John Smiles and his team have been clearing the vandalism debris and pumping out floodwater. They had laid on a three-phase generator and ran up a large attackwarning siren. Access to the bunker was down the escape shaft riser and stairs; the new owner will not allow access via the original tunnel ramp, now closed with brickwork. The bunker has two levels. Sub Britters who went down report that the colour scheme has a two-tone wartime flavour, the bunker having many purpose-designed cellular compartments and cable trenches. Blast doors, steel



The two-level operations room at Wartling. Before the bunker was dewatered in 2004 this room was flooded to a depth of 12 feet. Photo Nick Catford

Rotor identification panel before removal in the 1980s. Photo Sub Brit collection

The station had a crew of 120 and eleven different radar installations. These included two Type 14 units and a Type 54 on a 60-metre tower, backed-up by the Type 7 from the existing site. In 1956 the revolutionary Green Garlic or Type 80 radar – which could see 320 miles – arrived at Wartling and by 1958 the station supervised all UK airspace south of the Thames. The Type 80 was served by a tower and surface bunker, now a residence.



The upper spine corridor after clearance by the restoration team. Photo Adrian Armishaw



Martin Dixon presents John Smiles with the original identification panel. Photo Bob Clary

staircases and some of the services, control panels and switchgear are left, but all the major plant has gone, apart from shell-and-tube heat exchangers.

Quite a lot of wood and panelling were used in the original build. The observation gallery overlooked the Operations Room, some eight metres high, containing a circular well for the Kelvin Hughes projector. This large equipment



on the floor below processed photographic slide film that had been exposed to a single radar sweep. It projected the developed film image via mirrors up to an opal glass plotting table in the Operations Room. Before the era of digital processing, the projector was about a minute behind real time.

The lower level is still partly under water. After clearing detached equipment the team is reaching the limit of what more can be done to restore the bunker. The Sub Brit website and Dick Barrat's www.RadarPages.co.uk hold more information and a video of the interior was posted on YouTube in March 2012.

John Smiles estimates that ROTOR, a £4 billion stopgap, was equivalent to today's Trident programme. Advancing radar technology quickly made the stations obsolete. Once equipped with Type 80 radar, selected sites became Master Radar Stations. After only two years' service, the other ROTOR stations were no longer needed. Displaced by the Marksman/Linesman network, all Master Radar Stations closed in mid-1960s – RAF Wartling in 1964. It was sold off by the PSA in 1976.

To thank John and his team for their significant efforts, Martin Dixon presented them with the original R3 Perspex signboard dating from 1952.

Returning to the hotel, Saturday night's dinner was full service. One reliable member diligently turned out in a bow-tie. Paul Sowan addressed our technical meeting before we retired to the bar for the usual inconclusive debate on matters subterranean, economic and political.

### Sunday 16 September

I awoke at 05:00, the heating not having a special programme for Sundays. After breakfast we travelled under a grey sky to Newhaven, arriving as the ferry en route for Dieppe prepared to leave harbour. Our destination: Newhaven Fort on the hill above.



Newhaven Fort and harbour. Photo by Clarissa

Adhering to recommendations of a Royal Commission in 1859, Lord Palmerston ordered these defences – and many others – as a response to the threat of invasion. Again, we enjoyed an introductory film, dramatized and hosted by the fort's designer and architect, Lt John Charles Ardagh. He was just 22 when appointed, with only three years in the service. Ardagh realized that the usual practice of flattening the cliff-tops overlooking the harbour and setting out elegant geometric patterns, like a stately garden, would not be as good as concealing the fort position in the cliff-top. Construction started two years late and the fort took seven years to build, finishing in 1871.

Ardagh was innovative, making extensive use of concrete and using steam lifts to raise shingle from the beach. Major excavations were undertaken by 250 men, horses and steam power. Rising from the ditch, concrete battering took the ramparts up and over the arched brickwork spaces leaving them exposed within a large sloping quadrangle. Emplacements were arranged above and below the cliff and row after row of chimneys somewhat give away the defensive position.



Test firing one of the guns at Newhaven Fort in the 1930s Armament included the self-concealing and slow-firing 9-inch Moncrieff guns, which were finally removed in 1890. But as his film ended, Ardagh had to admit that armoured naval vessels, new guns and the risk of airborne attack quickly rendered his revolutionary design obsolete. After periods of neglect, the fort was refitted for the First and Second World Wars; ultimately the largest weapons being two 6-inch naval guns.

### Air Sea Rescue becomes vital

In World War II, the Port of Newhaven launched the illfated raid on Dieppe. It then served as a base for the 24<sup>th</sup> Motor Torpedo Boat Flotilla and the 28<sup>th</sup> Air Sea Rescue Unit.

The Germans began the war attacking convoys in the Channel. British commanders assumed that the dense shipping would rescue any pilots who were forced down. This was a necessary assumption, because in contrast to the efficient German *Seenotdienst*, the British had just 18 launches – and most of these were tenders for flying boats.

The grim reality in 1940 was that ditching would invariably be the end for any British aircrew, unless, like enemy crews, they were lucky enough to be picked from the sea or the refuge buoys by launches and floatplanes, all laid on by the *Seenotdienst*. Worse, the Hurricane and Spitfire did not even carry a life raft. Having lost so many



pilots to the Channel, Air Vice Marshal Park ordered ground controllers not to direct fighters over water.

In July 1940, an incident suggested that Heinkel He59 rescue aircraft were gathering reconnaissance – contravening the Geneva Convention. Dowding as Commander-in-Chief ordered pilots to shoot down the white-painted floatplanes. The Germans responded with armament and camouflage. In desperation, one New Zealand pilot borrowed a Walrus floatplane from the Fleet Air Arm and in the summer of 1940, saved 35 aircrew – Allied and German.

Historians now estimate that in 1940, some two hundred aircrew were needlessly lost in the Channel. The popular belief is that the German decision to attack London rather than the fighter airfields was the deciding factor in the Battle of Britain. But some historians maintain that the battle had already been decided. Since eighty percent of British pilots were lost once forced down over water – compared with fifty percent losses over land – much more significant was the German decision to abandon attacks that were forcing the British to engage them over the sea.

The critical shortage of pilots and losses over the Channel led to a summit with Air Marshal Harris in February 1941. The British Air Sea Rescue Directorate was formed and Newhaven Fort became a mess facility for the 28<sup>th</sup> Air Sea Rescue Unit. Simple lighting and radiators were added in the counterscarp galleries adjoining the ditch around the fort, but the launch crews had also painted murals which we were to see.



Stairs down to the lower levels. Photo Adrian Armishaw

The Army left the fort in 1962 when the galleries were more like a lower ground floor. Someone accepted dredging from the marina basin and the spoil filled the ditch and seeped into the galleries. The condition of Newhaven Fort was then made worse by abortive development and the site also offered an open invitation for damage and graffiti. Extensive restoration by the local authority began in 1982 and the site is now well-restored, run by Lewes District Council. Today it contains a valuable and wide-ranging museum which absorbed far more time than we expected.

# Art for art's sake

Led by young and enthusiastic guide Phil, we descended the stairs into round-arched voids, 15 metres below ground level. The ditch was defended by rifle and caponier loopholes served from a slate-floor mezzanine, supported on iron. To purge the fumes, the galleries had natural ventilation cavities in the walls, rising to the chimneys. As we moved on, the arches looked and smelled increasingly damp, echoing well.

We were to see remarkable decorations, painted specially for a Christmas party in 1946. The marine paint is still hanging on, but noticeably deteriorating compared to photographs from the 1970s. Later parties in the arches either respected or ignored the paintings, instead dotting graffiti in candle soot onto the soffits. In the first rooms, the lower walls show many types of Air Sea Rescue launches, with essential air cover from de Havilland Mosquitos – a helicopter was added later.

Speeding over RAF blue water against skies painted in roundel yellow are all kinds of launches: Vosper Type 1, Thorneycroft, Deans Marine with AA turrets, and the Whaleback. These were all created with stencils, special details and numbers being added by brush. Some were numbered below 100, others over 1100. The British finished the war with six hundred launches and apparently the size of the fleet was deliberately exaggerated this way. Maybe this was to dispel the earlier history, as well as trying to confuse the Germans. But the next room was very different, demilitarised – clearly intended to be much more intimate.



One of the many boats painted for the 1946 Christmas party. Photo Adrian Armishaw

The undersea life here included a whale, some kind of shark, rays and an elegant mermaid above a treasure chest. In the dim light, you could imagine the sound of the band welling through the tunnels; imagine celebrating the end of wartime service in lightly-armed, wooden launches full of petrol, pausing to remember those who were missing; you could imagine being greeted by the picture on the door, a shapely, confident-looking woman



elegantly holding a cocktail glass – and feel for their hopes of meeting a partner for peacetime. Phil told us that one veteran says he did meet his wife-to-be that night. The murals peel and fade, but that must have been one very special party.

We passed more of them, arabesque buildings painted in roundel red, leaving via the tall corridor under the ramparts that connects the chain of arches. Above these on the higher ground behind the cliff are underground stores, the magazines and a laboratory. There was a separate corridor for placing enclosed lamps that would shine through windows into the magazines. Inside, the tunnels are whitewashed and in good condition.

At the cliff edge are brick emplacements still containing armament, but looking fragile compared to even the smallest defences on Jersey. A staircase once led to the foot of the cliff where there was a moat and more positions. Among the exhibitions in the arches there's one about the Blitz; but also a moving art-deco tribute to Britons involved and lost in the Spanish Civil War. Life stories of these poorly-equipped volunteers were absorbing. Even if they survived, skills and achievements were unrecognized on their return for British service. Just outside, the museum's bugler was in action; I persuaded her to play *Sunset* and it sounded out clearly over the quadrangle.

# Cuckfield's restored Royal Observer Corps post

The fort café provided an excellent lunch and then we got back on board our coach. As the Sub Brit charabanc arrived in Cuckfield, Sam artfully negotiated the tight car park. Cuckfield has a neat little museum. The civil volunteers had opened the museum especially for us, while groups waited their turn for the ROC Post. It had drawings of the Cuckfield Workhouse, showing a surprising amount of heating and generating plant. But one wall held an art deco frieze, carvings in teak proudly depicting the motorcars and simple tools of yesteryear. Dated 1937, I knew it could only have adorned the entrance to a Caffyns Garage. Meanwhile Paul Sowan happened upon an old print with vital clues about how they formed a railway cutting in Buckinghamshire.



Members gather round as Mark Russell tells us about the Cuckfield ROC post. Photo Adrian Armishaw

The grassy byway led us past the church to a small field nestling between premium residences and a wood. Sub-Britters were gathered in a small wire compound around the entrance riser to the ROC Post. Advice was being exchanged about maintaining concrete, how to repair cracks and slight differences they had found in the supposedly standard designs, rather like a gathering of classic car enthusiasts.



The interior of the restored ROC post. Photo Mark Russell Sub Brit has a wealth of background information about the ROC and these small Cold War posts. In short, the ROC relied on civilian volunteers all the way from 1925 to 1995–96. Mustered to counter the Zeppelin threat, in the closing stages of WWII the ROC gave direct instructions to Hawker Tempests intercepting flying bombs. In the Cold War, the ROC was to provide immediate measurements on the location and magnitude of the detonations from any nuclear attack. The ROC Posts, 7.6 metres underground, would perhaps give the crew just enough protection for that rather brief purpose. Cuckfield ROC post has been beautifully restored by Mark Russell and team. By the shaft was a Villiers portable generator and a Secomak portable siren. We entered the manhole onto the fixed ladder. The compartment was spotless, smelling clean and fresh. The crew of two had about as much space as a small caravan and until much later, dim battery lighting.

Mark has gathered a lot of the technical equipment – presumably not the radiac calibrators. As well as the drawings and signs, all the period housekeeping items were there too, like the candleholder, two Elsans and a supply of brown loo paper. It seemed complete in every tiny detail and ready for action, right down to the logbooks, an ROC tunic and the wall plaque.

Passing the Cuckfield Workhouse – now a premium residence – we rejoined the coach. This was now the official end of the weekend but thirteen of the 44 attendees were able to stay on for an additional day of visits on Monday. Two sites were planned, both in the seaside resort of Hastings; the first of these was the West Cliff Railway. Although this doesn't sound



underground, for much of its length it runs through a bricklined tunnel.

# Monday September 17

Hastings boasts two cliff railways, but the West Hill Railway is both the oldest working example of its type, and the most inconspicuous. Unlike its younger neighbour, the East Hill Railway, it is not immediately visible when walking or driving through the modern town due to its unique design. Almost the entire length of the railway travels through the cliff as opposed to over it. There were two other railways constructed in this manner, one at Broadstairs in Kent and one at Clifton Rocks in Bristol, but they have long since ceased operation.

The line was conceived to carry passengers from George Street, on the promenade, to the ruins of Hastings Castle at the top of Castle Hill. Construction of the West Hill Railway commenced in January 1889 but met with considerable local opposition, resulting in the work taking much longer to complete than originally envisaged. This, in turn, increased construction costs by over fifty percent and was almost certainly responsible for the original owners, the Hastings Lift Company, going into liquidation in 1894.



For much of its length the West Hill lift runs through the cliff in a brick-lined tunnel. Photo Adrian Armishaw

Built by Messrs A H Holme & C W King of Liverpool (who subsequently built the Snowdon Mountain Railway), the railway was of a funicular type, comprising two parallel lengths of track running on a 1: 2.9 gradient, and rising some 170ft (51.5m). Some 402ft (121.8m) of the track's total length of 500ft (151.5m) is enclosed within an 18ft (5.4m) x 19ft (5.7m) cylindrical tunnel, constructed from 1.75 million bricks.

In common with most railways of this type, the two cars were joined by wire cables and controlled by winding gear situated in the upper station. Messrs Waygood & Company of London (later becoming part of the Otis Group) supplied the equipment. The George Street entrance building was constructed by Elliot's Patent Stone Company, and the whole project was overseen by a local firm of engineers, F & J Plowman. The cars are of a box-type construction, mounted on a triangular frame, and were supplied by the Midland Railway Carriage & Wagon Company. Each car could carry 16 people, 12 seated and 4 standing. Winding gear for the carriages was initially powered by a Crossley Gas engine, then replaced with a Tangye diesel engine in 1924, and is now run by an electric motor that was fitted in 1971.



Sub Britters in the West Hill lift car. Photo Adrian Armishaw

# Local attraction

Mr Wilson Noble, MP for Hastings, opened the West Hill Railway on 25 March 1891. Following the financial problems of the Hastings Lift Company, the Hastings Passenger Lift Company acquired the railway in 1894, maintaining it until they sold it on to Hastings Borough Council in 1947. To mark the railway's centenary year, the line was fully refurbished in 1991 and continues to take passengers up to the ruins of Hastings Castle, and to the 'Smugglers Adventure' located in St Clements caves which were to be our next port of call.

St Clements Caves are named after the nearby parish church of St Clements – they are both natural and manmade. Originally there was a series of fissures made by earth movements which were subsequently enlarged by men who had a use for the soft white sandstone. This may have been used for building purposes but no information about its use has been found.

The caves have a rather interesting history. The first written reference is in 1786 when an old couple are described as living in the caves after being discharged from the workhouse for bad behaviour. Certainly sandstone was excavated before the end of the eighteenth century, for in 1812 they were described as 'closed', as certain elements in the town were using the caves for



'gambling and horseplay'. They were forgotten for many years, until in 1825, a Mr Scott, who owned the land, was excavating a site for a garden seat. Suddenly his pickaxe disappeared and the caves had been rediscovered.

Mr Scott opened the caves to the public in 1827, and later they passed into the hands of one of his employees, a Mr Golding. He excavated a new passage as a means of entry and also made a new exit. The caves were visited by the Prince and Princess of Wales in 1864 and by Prince Albert and Prince George Frederick of Prussia in 1873.

# WWII air-raid shelter

The caves are very spacious and well ventilated. They formed a natural air-raid shelter for many Old Town families when bombing began in 1940. The caves were kitted out with five hundred bunk beds and a new entrance was knocked through into Croft Road. Local people ate, slept and generally lived as an underground community. A fully equipped medical centre, sick bay and dining hall were also added and an official inspector from the Civil Defence Commissioner remarked that it was "the best air-raid shelter in the country". After the war, Hastings Borough Council granted £1,000 to convert the caves to a dance hall.

Since 1989 St Clements Caves has been the location of a very British type of attraction, a combination of wax museum with life-sized figures, dramatic lighting and eerie sounds. It is suspected that the caves were once the haunt of smugglers, and creeping silently along these mysterious sandy passages, with their unusual coloured lighting, one would not be surprised to come across a long-forgotten hoard of contraband.



St. Clements Cave c.1940

In parts of the caves, hidden in niches and alcoves, are a series of carvings of historical figures and animals. Of special interest are the Dordogne-type reindeer, but needless to say these are quite modern. Certainly the rock is soft enough to make it easily worked by a sculptor.

The caves have always been very popular with local people, at one time housing an underground restaurant while the main hall was used as a ballroom – the caves echoing to the beat of pop groups, when once they might have been hiding the muffled voices of smugglers.

After a long and exhausting weekend it really was now time to say goodbye and head for home. As usual, it had been an excellent weekend with a diverse group of Sub Britters. Many thanks to Mark Russell, Martin and Linda Dixon, John Smiles, the staff at Newhaven Fort, Sam the driver and the many others who made it happen. Notes on St. Clements Caves from Tony Oldham

# Update on funding requests Mark Russell

Following on from the last edition of *Subterranea*, Sub Brit still has funds available from the recent Gift Aid returns for help on underground-related projects

So far, funding has been granted to Gavin Saxby and his team who are in the process of restoring the ROC Group HQ at Craigiebarns in Scotland. The committee felt that this is a worthwhile project and should have our support. A sum of £1,000 has been donated towards the carpeting of the bunker and to judge from recent photos we have seen of the site, the restoration is really starting to take shape in this exciting project.

We hope to be able to organise visits to the site for Sub Brit members in 2013. More info and updates as we get them!

There is still funding available. All suggestions will be looked at; in addition to restoration and preservation work like the Craigiebarns project, we will be happy to consider educational and research projects and relevant publications as well as useful innovations such as signposting at underground sites.



The funding request form can be found on the Sub Brit website here:

http://www.subbrit.org.uk/docs/reqfund.pdf

Requests for funding will be considered at the next scheduled committee meeting.

Please send your completed form to Mark Russell's home address below

(not the address on the request form):

22 Queen Street, Emsworth, Hampshire PO10 7BL.



# Railway Air-Raid Shelters in WWII Chris Rayner

During the Second World War the four great railway companies of Britain, like many similar undertakings and branches of government, looked for countryside locations where they would be less likely to be a target for bombing. The London, Midland and Scottish (LMS) Railway company relocated to The Grove, a country house near Watford, and former seat of the Earls of Clarendon (it's now a luxury hotel and golf resort).

Staff were given very little notice of "Project X", as the move from Euston was codenamed, and the move was completed in the first three days of September 1939, neatly concluding before the declaration of war on Sunday 3 September.



The overgrown entrance to the Long Eaton shelter



The air-raid shelters probably followed on from this. A December 1941 site plan shows at least four blocks of air-raid shelters of different shapes and sizes. The only surviving block is longer and thinner than the others and has a familiar plan of passages laid out in square blocks with linking passages – as seen at the Littlewoods air-raid shelters on the recent Liverpool Sub Brit visits day (October 2012). This elongated layout with multiple entrances was very suitable for its location beside a scatter of huts which included barrack-type dormitories.

there are some less common features - the precast concrete barrelvaulted panels roughly mortared together, the neat white-painted bay numbers on a square black background, the remains of timber benching. But the most remarkable feature is the entrances formed of descending precast concrete rings and resembling a 1930s radio, which has echoes of expressionist architecture of the age. This design seemed to be a one-off, until I found similar air-raid shelter entrances cropping up at various locations around the country.

Inside the air-raid shelter

For example, at Long Eaton to the southwest

of Nottingham. The shelter here is very overgrown and comprises a small single compartment with a stepped entrance one end and an escape hatch at the other. The strange arched entrance is almost identical though.

A clue to its function is on the other side of the path where there are remains of old railway tracks. This site was part of the Toton marshalling yard, at one time one of the largest railyards in Europe due to local coal, iron and steel, including the nearby Stanton Ironworks. One of the company's well-known products was the Stanton


shelter, a very familiar precast concrete air-raid shelter type seen on derelict wartime airfields. The proximity of the railway yards, at that time part of the London, Midland and Scottish Railway, suggests the existence of a special LMS casting which may at one time have been a very common sight on their network.



The entrance to the Colne shelter with descending concrete rings

Mytholmroyd, eighty miles or so to the north near Halifax in West Yorkshire, also has a surviving shelter. It is well hidden in woodland and flooded with knee-deep foulsmelling water, as I discovered when the sturdy box I was standing on to take photos gave way.

This was by another LMS marshalling yard although much smaller. A local resident told me about how his father as a young teenager used to help the shunters collect stray wagons, jumping on loose wagons and braking them.

Across the Pennines at Colne in Lancashire is a more skeletal one, allowing one to see how the pieces fitted together. It stands on the site of the old carriage sidings

and sheds of a once large railway site at the eastern terminus of the old East Lancashire line (absorbed by the LMS Railway under the 1921 Railways Act). As in the case of Mytholmroyd, the output of the nearby cotton mills was the reason for the railway activity, and thus the need to protect key workers.

# Few survivors

These are the only survivors so far found, although others have been previously sighted at rail yards along the LMS network but may have since been demolished. The pattern was not the only one used by the LMS, as the more conventional brick-



The entrance to Mytholmroyd shelter

walled, concrete-roofed shelters at Edge Hill in Liverpool (illustrated on the Sub Brit website) show, and their selection may have been very specific, such as to provide protection for small scattered groups of railway workers in open areas with no other protection.

The modernist architecture of the times may have been behind the unusual entrance shape, but it could well be that there was no reason other than a desire to create something of the age, a little different and something that was exclusively of LMS origin.

The shelters' performance in wartime is not known. Those at The Grove appear to have been little used except in practice drills, but the well-known Norman Wilkinson painting of the air raid on the LMS marshalling yard at Willesden (in the National Railway Museum) well portrays the risks of working along the enemy bombers' highways.

Thanks to Nick Catford, Chris Iles and Paul Wright for background advice; all photos and plan are by the author.



Inside the Grove, the remains of the longitudinal benches are seen



# The Barnton Quarry Restoration Project

### **Grant More**

In Scotland, the long-awaited restoration of the Barnton Quarry Sector Operations Centre (SOC) and ROTOR R4 bunker complex is now well under way.

### History of the site

The Barnton Quarry complex, in Edinburgh's western suburbs, consists of two distinct buildings, which are interconnected, but were unrelated in their purpose and function.

The surface building is a former RAF Fighter Command SOC. The SOC was built by the Air Ministry before WWII and was used during the war as an active Fighter Command operations room, with the focus very much on defence of the Scottish East Coast. The building consists of 38 rooms with a total floor area of just under 1400 square metres.

The general arrangement of the building is a number of offices off a central spine corridor, with a large auditorium which is built over two floors. This room was originally used as the central Fighter Command operations room during WWII. The SOC was used for storage after WWII and was fully maintained up until 1987.

The subterranean portion of the complex is a former threelevel RAF ROTOR R4 bunker, built in 1952. It is located to the north of the SOC, effectively in the end of the quarry now occupied by the local council's Roads Department. The bunker consists of fifty rooms over three floors with a total floor area of 2040 square metres. The key feature of the bunker is a central operations well which is open in the centre of the building across all three floors.



Barnton Quarry Fighter Sector Ops Centre plotting room in the 1980s before the building started to deteriorate. Photo from Sub Brit collection

The bunker history can be broadly split into three periods. The bunker was originally built for the RAF as the Sector Operations Centre for coordinating Fighter Command response to UK airspace intrusion by Russian long-range nuclear bombers. Barnton Quarry was tasked with defence of the Caledonian (Scottish) sector, a role which the bunker hosted from 1954 until the end of 1958.

The ROTOR radar system comprised geographically distributed radar sites, linked by GPO telephone to the Sector Operations Centres. The incoming information was plotted within the operations well and commanders in control cabins around the operations well would make decisions regarding movement of the fighter response. Focus at this time was still very much on the defence of the country from Soviet nuclear attack.

Around 1960, ownership of the (now vacant) bunker transferred to the Scottish Office and the building was refitted as a Regional Seat of Government. This involved the flooring-over of the operations well and the conversion of the bunker to what was effectively a secret underground office.



The SOC operations room after pumping and debris removal The focus in the era was very much on maintaining government in the aftermath of a nuclear attack. The bunker would have held 350 to 400 government staff, should this have been necessary. The bunker was disposed of by central government in 1983, transferring to local government which retained the complex on a care-and-maintenance basis until 1989, when it was sold to a private property developer.

The complex was then transferred between property developers, with little success in developing the site commercially. A fire, likely started by vandals, swept through the R4 complex in 1993, severely damaging the interior and burning out the floors added in the RSG period. The site has been derelict since the fire and many years of vandalism and theft have left the buildings in a poor condition. Today, the site is little more than a shell.

In all, six Sector Operations Centres were opened in the UK. Four were purpose-built to a very similar design, Barnton Quarry being one of them. The other three purpose-built SOCs, Shipton (near York), Bawburgh (near Norwich) and Kelvedon Hatch (Essex), were either heavily modified or reconstructed to suit the evolving purposes and plans of government.

In the case of both Shipton and Bawburgh, the 10-feet thick reinforced concrete roof of the bunkers were removed and an additional floor added, along with additional internal reconfiguration. In the case of Kelvedon Hatch, the bunker is presented in the RSG configuration. Barnton Quarry is the only bunker in the world where the unique R4 ROTOR Sector Operations Centre configuration exists.

## Restoration

The restoration plan is split into two phases: (i) to recover the derelict SOC and repurpose it to return a viable revenue stream, and (ii) use the revenue stream to part-fund the non-trivial cost of the R4 renovation. The R4 plan is to present it as a public museum and educational venue.

So far, we've spent the last eleven months restoring the SOC. The plan is to take all buildings in the complex back to the shells, sandblast and steam clean, then start the restoration from scratch.

The entire SOC has been pumped and stripped of all rotten fittings and debris, asbestos has been safely removed and lighting installed. Generating equipment is running 24/7 to light and power the tear-out until we get the new 3-phase feed on site from the power company. We have been working to bring a new 100kVa generator set and its custom-made containment building on-site.

One of the key aspects of the project is 24-hour on-site security staff. We have brought accommodation on-site and we have a full-time security guard.

The major focus at the moment is to replace the SOC roof – all 1200 square metres of it. We've JCB'd off the bitumen and reshuttered the edges of the entire roof. We now plan to apply a modern bitumen equivalent to seal the roof. The race is now on to coat the roof before the hard Scottish winter sets in. We've built a huge tent to allow us to treat 50 square metres at a time, but it's slow progress! We have to dehumidify and heat the tent for two days before applying the compound.



SOC roof showing the new concrete pours, shuttering and roofing compound over the operations room

We've also been recovering the original WWII sewerage ejector. The maintenance and wet pits had been backfilled with diesel from the original generator tanks and fly-tipped rubble. It took us two weeks of backbreaking work to find the plant in the hole, which we've now exposed and removed for restoration. We hope to have the original kit back in the hole shortly, performing the original job it was intended to do.

### Museum planned

It's a small (but dedicated!) team running the project and our goals are very much aligned with the interests of Sub Brit. The team are keen to lever our experience to maintain historical accuracy for the R4 museum.

Our project manager is very keen to respect and preserve the history of the ROTOR bunker, while making the necessary commercial revenue from the site. He's thorough, driven and very much focused on completing the restoration.

We haven't touched the R4 yet. We'll get down the tunnel and start work there when we've got the SOC in a stable state.

We're looking for help from Sub-Brit members and we're building a list of helpers (thanks to the guys who have already volunteered, we will be calling on your skills very shortly!).

We'd like volunteers to get filthy. There a lot of rubble to shift and steam cleaning to do. The team have a tight budget and will gratefully accept manual help. We'd also like historical consultants to come forward. The team are keen for us to exert expert influence on the content of the R4.



Our new 100kVa generator set. This is us stripping the unit in Montrose before transporting to Barnton Quarry

#### Help needed

Eventually, we'll have the need to exhibit. Unfortunately, Barnton Quarry has suffered at the hands of scrap-metal thieves over the years and has a lot of period features missing. The team have requested our help to locate bits which belong in context. This is a job for the future, but we'd like to plant the seed in case anyone decides to scrap a ROTOR-period compressor between now and then! We also need blast doors as three of the original four have been stolen. If you know where some may be, please let us know!

Images, data, plans and memories. The more we have the better. We have amassed a lot of the above, but the more we have, the better chance we have. We specifically need original photos of the R4 ops room. We've got one 1955 image from Kelvedon Hatch, but it's not nearly enough for us to use for planning. Any further images would be greatly appreciated.

As you'll be aware, it's a massive project and it will likely be 2014/15 before we see fruit. Please contact me at grant@barntonquarry.org.uk if you would like to get involved or offer expert assistance.

Watch this space for future updates.



# FROM THE ARCHIVES World War I air-raid shelters in Dover, Kent Extracted by Paul W. Sowan

During World War I Dover, on account of the strategic importance of its harbour and of its nearness to France, was bombed both from German zeppelins and from fixed-wing aircraft. A history of the town during the 'Great War' that was to have ended all wars, but didn't, was published by Alfred Leney & Co. Ltd, a local firm of brewers. This informs us that the first bomb fell in the morning of 24 December 1914 (hardly a good omen for a happy Christmas!), with many more to follow. It also contains brief details and two photographic illustrations of what are referred to as 'air-raid refuges', one of which (illustrated) was in the vaults under the Phoenix brewery buildings, and another (also illustrated) in the Oil Mill 'Caves' in the chalk cliffs behind buildings (since demolished) in Snargate Street, just to the west of the railway's Harbour Tunnel on what is now the Dover Priory to Folkestone line. 'Caves' in Trevannion Street, the (? road) tunnel in the Western Heights fortifications, and the 'crypt' (police cells) under the Town Hall were also used. The site of the former oil mills at the foot of the cliffs is in what was later called Limekiln Street (in effect a westwards continuation of Snargate Street): the street name obviously offers an explanation for the original purpose for which the 'caves' were excavated. The mills probably extracted vegetable oils from crushed seeds. Trevannion Street does not appear in a modern street atlas for Dover, but may well have been what has subsequently been renamed East Cliff and its continuation Athol Terrace. Older members of Subterranea Britannica will remember visiting the street-level chalk 'caves' here at the foot of the cliffs under Dover Castle during a Study Weekend some years ago.

The Oil Mill 'Caves', entirely man-made, are amongst Dover's less well-known subterranean sites, and are extensive, intricately varied on several levels, enigmatic, and fascinating. At the town end they communicate, via a doorway and a few steps down, with the Harbour Tunnel, where electric trains can be watched passing to and fro! There are numerous (now blocked or locked) entrances at street level, at the rear of what is now a petrol filling station, and a few more dotted about at higher levels in the cliff. The street-level caves form a small network of high, wide chalk tunnels. From these a smaller series of even higher and wider tunnels, of what might be described almost as cathedral-like proportions, leads the visitor through to the way into the railway tunnel. Curious steeply sloping low tunnels allow access to higher levels in the cliff, where larger excavations accommodate what appear to be open-topped concrete-lined tanks, and one or two openings in the cliff face allow views out over the Western Docks. Little seems to be known about the history of these higher levels, although World War II water-tanks seem a plausible explanation, with the small steep access tunnels provided primarily as routes for pipes. Progress around the whole system is hindered by numerous inserted brick partition walls, which have to be climbed over, although at one point on the street-level it is possible to crawl through a hole made by persons unknown.

The photograph in Firth's book (facing page 86) shows a large group of adults and children in one of the high-ceilinged street-



level tunnels, along with a bench, what looks like a home-made bed, and some sort of small barrow or hand-cart. There is a single naked electric light bulb suspended between two of the tunnel walls. Judging by the standing adults shown, the ceiling (out of the shot) it at least 20 to 25 feet above floor level. The relevant text, in pages 91 - 92, tells us that ...

The largest and most secure of these [air raid refuges] was ready made to hand. At the back of the old Oil Mills, in Snargate Street, are large caverns excavated out of the solid chalk under the Western Heights. These penetrate the cliff to a considerable depth, and as their broad and lofty chambers lead out of one another and are well provided with exits and entrances, they are as well ventilated as caverns can possibly be. Wooden benches were fixed along the walls; separate caves were set apart for men and women; and order was kept both by voluntary helpers and by detachments of soldiers from the adjoining factory, which had been turned into a rest barrack.

The group shown in the photograph is of adults of both sexes, but predominantly children.

On some nights thousands of soldiers and civilians took shelter in these caves, waiting until the "All clear" signal was sounded, and a considerable number of the more nervous people from the poorer houses in the neighbourhood regularly used these caves as their night quarters. Every evening, as soon as the gates were opened, they appeared with their children, bringing bedding and chairs wherewith to make themselves comfortable for the night. Once inside they knew themselves perfectly safe, with hundreds of feet of chalk above them as a solid protection against bomb or shell.

As the old oil-mill buildings are stated to have been in use as barracks, it can be assumed that the higher-level tank caverns and steeply inclined pipe tunnels were not functionally associated with the factory unless they pre-dated World War I. It seems more likely that these higher-level additions to the system were made in World War II, and were perhaps some sort of freshwater storage system for supplying ships or adjoining premises, or perhaps laid on for fire-fighting purposes.

SOURCE: FIRTH, J.B., c. 1920, *Dover and the Great War*. Dover: Alfred Leney & Co. Ltd: 131pp+plates.



# Clapham South Deep-Level Shelter Martin Dixon

During World War II, provision of public air-raid shelters was an important factor in minimising civilian casualties of German air raids. Before the beginning of the war, a policy was announced of not using tube stations as shelters, due to the lack of toilet facilities and the perceived danger of falling onto the line. After heavy bombing raids in early September 1940, there was pressure to change the policy but the Government stood firm.

## Tube stations as shelters

Despite this, Londoners took matters into their own hands and took to tube stations in their thousands. In the face of this, the Government did an 'about turn' on 21 September and made tube stations an acceptable location to shelter from the Blitz. Many stations were equipped with bunks, chemical toilets, canteens and other shelter paraphernalia. One estimate is that 170,000 people used the tube for shelter during the war.

Ironically it wasn't enemy action that caused the greatest tube shelter tragedy; in March 1943 a crowd entering Bethnal Green station for shelter panicked on the stairway and a total of 173 people lost their lives in the ensuing crush.



In November 1940, work began on a set of deep-level tunnels to be used as protected shelters, built beneath existing tube stations. The original vision was that these tunnels would be linked up postwar to form a deep-level high-speed tube line, relieving congestion on the Northern and Central lines. The eight shelters completed were at these stations:

- Belsize Park
- Camden Town
- Goodge Street
- Chancery Lane
- Stockwell
- Clapham North
- Clapham Common
- Clapham South

Shelters were also planned at St Pauls and Oval, but neither was completed. Nor, of course, did the proposed deep-level tube line ever get constructed.

#### V1 Attacks

Initially the plan was for the shelters to be used by the Government (eg Goodge Street was used by General Eisenhower) but with the coming of the V1 attacks, some of the shelters were opened as public shelters. Each site had two parallel tunnels, 16 feet 6 inches in diameter and up to 1,600 feet long. A dedicated entrance and escape shaft were built, along with connection to the existing station above. The tunnels had two decks and could hold a massive 8,000 people each.

#### Sub Brit lends a hand

One of the sites opened in July 1944 as a public shelter was Clapham South and it was with both surprise and pleasure that Sub Brit was recently approached by Iain Boulton of Lambeth Council to help produce interpretive signage for the site. Few councils publicly recognise their underground heritage but it is clear that Lambeth is an exception. What makes Clapham South even more interesting is that it has an intriguing postwar story to tell.

To help solve the labour shortage that followed the war, immigrants were sought from across the then British Empire. The ship *MV Empire Windrush* arrived from Jamaica in 1948; astute viewers may have noticed that the *Windrush* featured in a cameo role in this year's Olympic Games opening ceremony. As there was limited accommodation for the five hundred immigrants, many of them were housed in the Clapham South deep-level shelter.

The nearest labour exchange was in Coldharbour Lane, Brixton, and as a result many of the Jamaicans found employment there. The deep-level shelter was therefore a key factor in making Brixton a prime centre of West Indian culture and settlement. The tunnels were also used in 1953 to house Commonwealth troops who were in London for the Coronation.



Photo Nick Catford

#### **Clapham South today**

All of this history – and more – is now there for all to read on a display board outside the entrance to the deeplevel shelter. As well as helping write the story, Sub Brit has contributed photos to this display.



We have also (for the first time) produced a scannable barcode that will route a smartphone directly to the Sub Brit website feature on Clapham South. Thanks to Nick Catford and Richard Seabrook for all their considerable work on this.

Of the eight completed deep-level shelters, Clapham South retains more signage and bunk beds than the others. The importance of the site is clearly recognised as both the tunnels and the two entrance structures are Grade II listed. These sit neatly alongside the current Northern line station designed by famous architect Charles Henry Holden (1875–1960) which also has listed building status. As such the future integrity of this important subterranean complex is hopefully guaranteed. It is perhaps ironic that a shelter built to provide protection to Londoners is now itself protected!

## Can You Help?

Many underground structures are difficult for the public to see, understand and appreciate. The model of working with local councils to help interpret and celebrate this aspect of heritage about which we are all so passionate is one which the Committee is keen to extend.

If you have ideas of sites that would benefit from interpretive signage – especially if you are willing to do some 'legwork' and approach the local authority or site owner, then please let the committee know (secretary@subbrit.org.uk).

# Ice-House at Painshill, Surrey Linda Dixon

On a cold wintry day in January, we spotted that there was free entry to Painshill Park, just off the A3 at Cobham in Surrey. The gardens at Painshill were created by Charles Hamilton in the mid-1700s as pleasure grounds, with little attention to the building of a grand house. We set off to explore the grounds, clutching the leaflet to guide us.

We had a lovely walk round, looking at all of the follies – maybe a dozen of them – and admiring the views of the lake. An underground experience beckoned at the Grotto, but sadly it wasn't open, though we could peer through a barred 'window'. The fantastic crystal and limestone structure has recently been restored and the grotto is open on summer weekends. Finally, we came to the ice-house, bearing right off the main path, and nestling under a small mound covered in trees.

## What are Ice-houses?

Ice-houses (or ice-wells) were built before the days of refrigerators and all good country estates could boast one.

The 'house' itself would be constructed of stone or (more usually) brick, often in an egg shape, with a passage, usually facing north, to allow access for putting the ice in and then getting it out later. The ice-house was usually underground, often under a little hillock, planted with trees to provide shade. Ice was harvested from a nearby lake during the winter and taken to the ice-house for storage





over the summer, usually packed between layers of straw for insulation. The ice was used during the summer by the gentry, either to preserve meats, or to make ice-creams and sherbets or to cool drinks.



Painshill ice-house is close to the lake – so it's clear to see where the ice would have come from! It's nicely maintained; we entered through a standard small passage, facing northwest and about 20 feet long and about 6 feet high. Along the passage can be seen the remains of three internal doors, designed to improve insulation. There is a grill across at the end of the passage, but we got a good view of the circular ice-well, constructed of brick, tapering inwards and dropping about 7 feet to the bottom. The ceiling is nicely domed and all is in good condition.

The ice-house is well worth a peep if you are in the area, and on a summer's day the landscape is lovely to wander round and admire the follies, climb the Gothic Tower to admire the views and maybe even have a picnic on the hill.

For more information see:

www.painshill.co.uk

BEAMON, Sylvia P. and ROAF, Susan, 1990, *The Ice-Houses of Britain*. Routledge.

Bulletin of the Surrey Archaeological Society, 176, 1982.

# **Discounted Cotswold Shopping**

Cotswold Outdoor have granted Sub Brit members a 15% discount on their products (excluding sales and special offers). The details are included in a letter on the website at

www.subbrit.org.uk/docs/discount-cotswold-outdoor.pdf If you are not able to access the website, then please contact us with an SAE for a copy of the letter.

The discount code can be used in any of their 58 stores (there is a barcode on the letter), and for telephone and online orders.

\*\*\* Please do not share or abuse the code as this may lead Cotswold to withdraw it which would be a great shame and spoil things for the rest of our members. \*\*\*

Here is an introduction from David Hague of Cotswold:



"Cotswold Outdoor are proud to be a supporter of such a prestigious organisation as Sub Brit. As most of your members are aware, Cotswold Outdoor is a multi-award winning retailer with numerous thriving stores located nationwide. Not only are we proud of our knowledgeable staff, but our stores stock one of the most comprehensive ranges of outdoor clothing and equipment in the UK. With a huge range of footwear, waterproof jackets and fleeces, tents, sleeping bags and outdoor accessories, we offer one of the best selections of clothing and equipment right on your doorstep.

Whoever you are and whatever you need, when you shop with us you can be assured of expert, award-winning service and advice that comes from 40 years of experience in retailing. We're really looking forward to welcoming you to our store, online or over the phone soon. I hope that our discount helps your members purchase the right kit and equipment as they continue with their important and valued pastime. We are passionate about giving the right advice and recommending the right clothing and equipment so you can have peace of mind while out in (or should that be under!) the field."



Angel station in 1924



Swiss Cottage station in 1935

# Answer to question on page 19

Five stations on the London Underground take their names from local pubs: *Angel, Elephant and Castle, Manor House, Royal Oak* and *Swiss Cottage.* 

