NEWSLETTER OF THE ENGLISH HERITAGE RESEARCH DEPARTMENT

RESEARCH NEWS

Acoustic sound mirrors were the 'cutting-edge' early warning technology before World War II - story on page 38

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In this third issue of Research News we report on the progress and preliminary findings of a range of current research initiatives which support the English Heritage Research Agenda and the priorities set out in Making the Past Part of our Future, English Heritage's corporate strategy for 2005-2010.

Developing new techniques, and trialling their application as part of the toolkit for recording, analysis and understanding, is an important strand of English Heritage's Research Agenda. The innovative application of survey methods has played an important part in conservation-led research on Isambard Kingdom Brunel's iron canal bridge at Paddington, and on the inter-war acoustic mirrors at Dungeness on the Kent coast. Other methodological work reported in this issue includes investigation of the effects of compaction and animal burrowing on archaeological deposits, and the potential of geophysical techniques for the identification and monitoring of plough damage, all aimed at defining risks to the historic environment and devising appropriate responses.

English Heritage aims to create a cycle of understanding, valuing, caring for and enjoying the historic environment in England. Research is the key to understanding the historic environment but no element of the cycle stands in isolation and so whatever the primary objective of our research we must always aim to connect with all our wider audiences. The Historic Area Assessment of Queenborough and Rushenden in the Thames Gateway is a good example of how our work meshes with that of partners both regionally and nationally to support Government's broader social and economic agendas and, as with our project on the periphery of Dartmoor National Park and our assistance with the Wye Valley landscape project, local engagement is of integral importance. Survey and analytical work at Hopton Castle, Shropshire, supports a local initiative to enable repairs and enhance access to the monument. The link with the University of Leuven is an international element of our portfolio of training and standard-setting work, and the events planned to mark 100 years of aerial photography are intended to involve as broad an audience as possible in celebrating this milestone for the recording and understanding of the historic environment.

The note on policemen's graffiti in the first issue of Research News has been taken up by the national press with gratifying results which are reported here. Other research by the Survey of London in this issue sheds new light on an office said to have been used by Lenin during his time in London, and on an allegorical fresco of the 1930s. By the time that this issue of Research News is out Andrew Saint will have succeeded John Greenacombe as General Editor of the Survey of London. We welcome Andrew (who is profiled on page 44) back to English Heritage and say good-bye to John with warmest thanks and best wishes for the future.

Christopher Scull
Research Director
Research and Standards Group

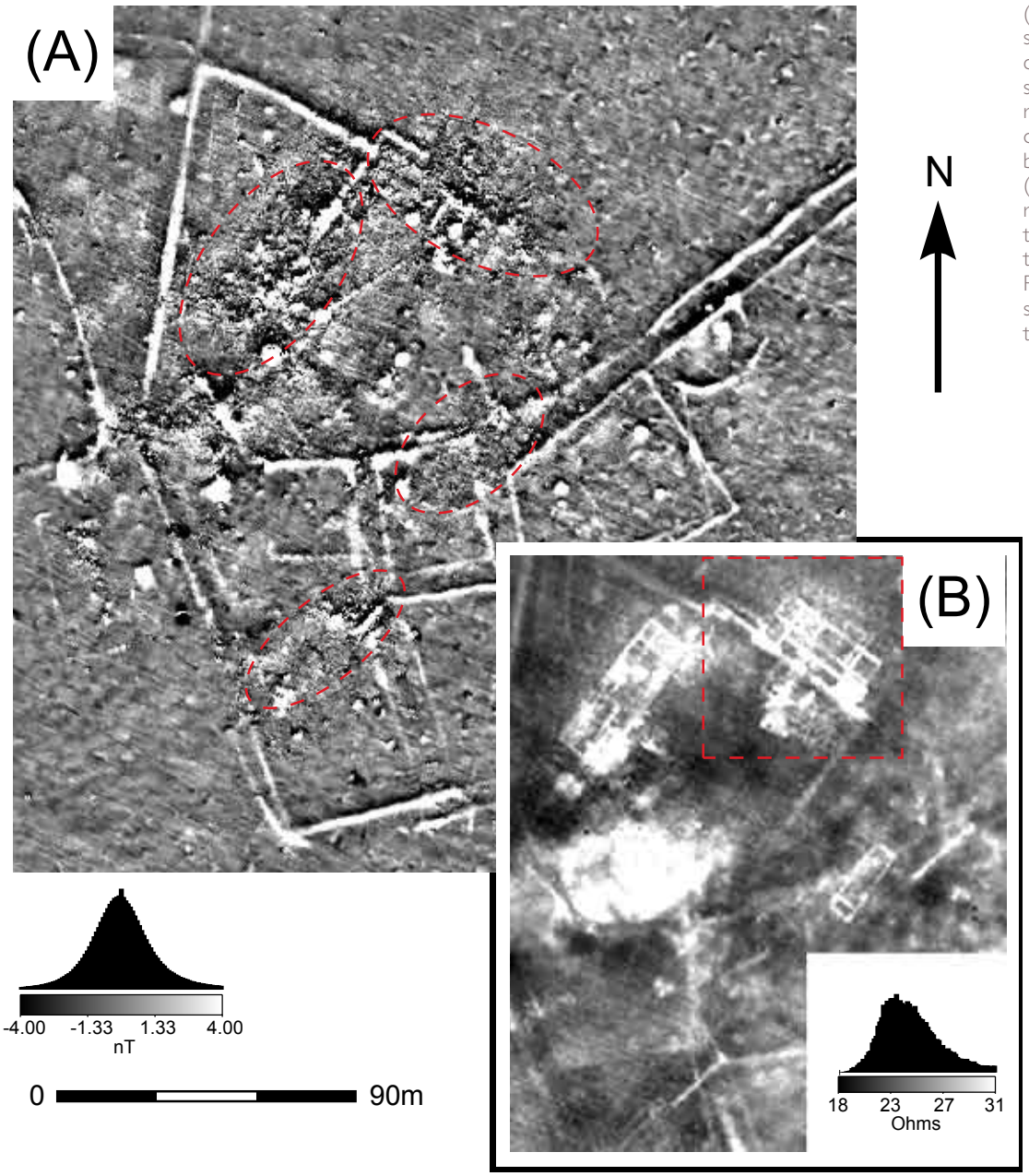
In January 2006 English Heritage Research Department launched a single report series to disseminate the results of its work. The Research Department Report Series (ISSN 1749-8775) supersedes previous report series such as CfA, Architectural Investigation, Archaeological Survey and Aerial Survey reports. A database with full details of all Research Department Reports is available through the English Heritage web site (http://www.english-heritage.org.uk/researchreports) and the English Heritage Intranet (http://intranet/swnap08/cfa_reports_update/Default.aspx).

Geophysical evidence for plough damage

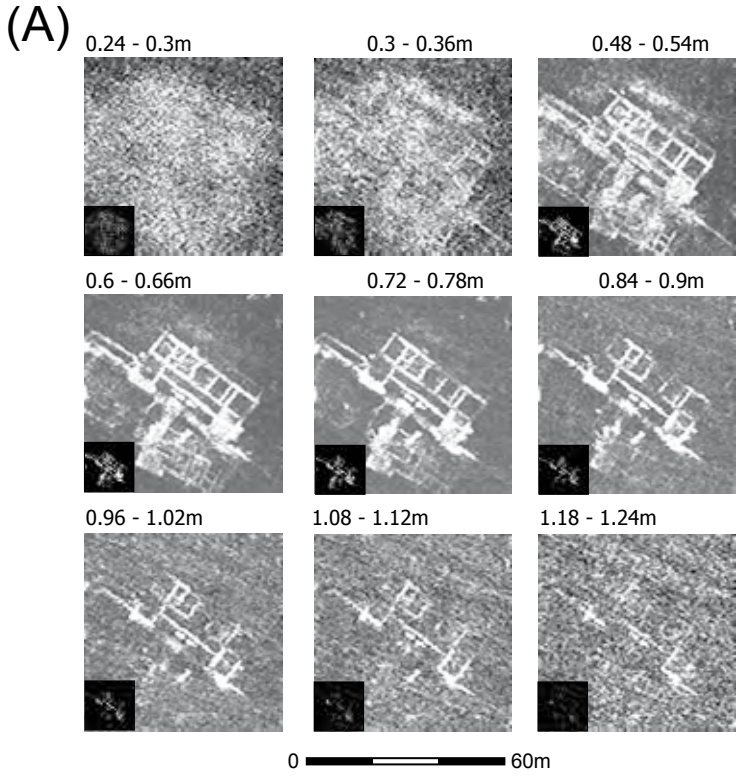
New geophysical techniques show potential for the identification and monitoring of plough damage on archaeological sites and the need to develop mitigation strategies.

Plough damage is one of the greatest threats to archaeological remains buried under arable farmland. Monitoring the impact of the agricultural processes involved is essential to understanding how further damage to the archaeology may be mitigated at a particular site. This may be achieved by introducing physical markers into the soil at specific depths and then monitoring their movement after successive cultivation episodes.

Geophysical survey has often played a complementary role in studies of plough damage, usually to determine whether any



(A) Extract from the high sensitivity magnetic survey conducted at Dunkirt Barn showing the areas of anomalous response due the presence of plough damaged ceramic building material in the topsoil. (B) The subsequent earth resistance survey targeted these areas and confirmed the presence of a complex of Roman buildings, including the suspected main villa building that was also covered by GPR.



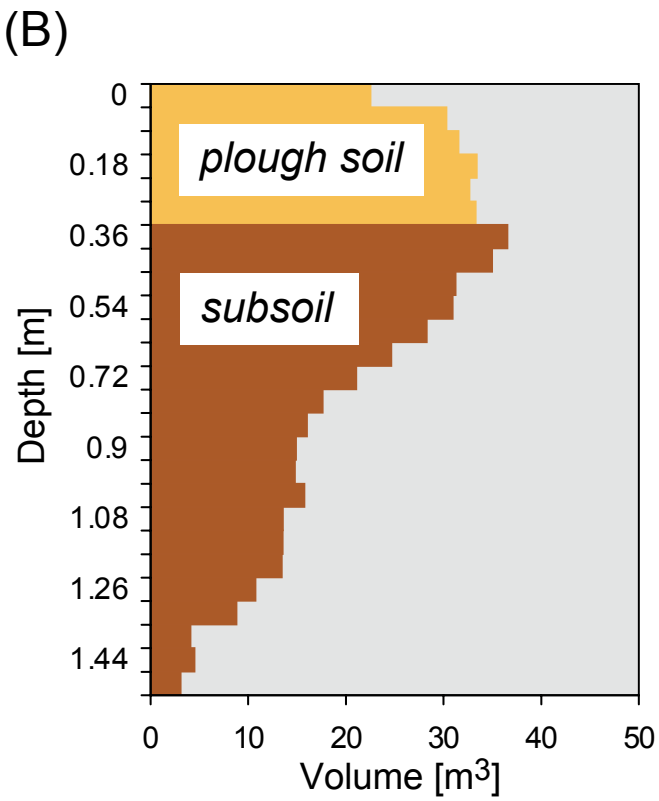
(A) Selected amplitude time slices from the GPR survey over the main villa building illustrating the "cloud" of plough damaged building material present within the topsoil. Archaeological remains appear to be well preserved below a depth of approximately 0.5m. Inset images within the individual GPR time slices show the reduced Boolean data sets used to estimate...

detectable remains are still present at a site. Standard geophysical methodologies, such as fluxgate magnetometry and earth resistance survey are usually applied, as these techniques are optimised for the location of archaeological features at a depth of approximately 0.5m below the surface. The response from the immediate topsoil, where the plough action is obviously most vigorous, is generally regarded as a source of more spurious geophysical "noise" to be suppressed within the resulting data. Occasionally, geophysical evidence for extreme plough damage may be directly observed within magnetic data when a cluster of intense ferrous responses are found, due to shares breaking from the plough as it fouls on buried masonry.

The recent introduction of high sensitivity caesium magnetometers and ground penetrating radar, both conducted at high sample densities, suggests the geophysical response of the topsoil may contain more useful information. For example at Dunkirt Barn, near Andover, Hampshire, the remains of a large but poorly recorded Roman villa were known to be present from 19th-century antiquarian excavations and aerial photographic evidence. Despite the presence of a wide scatter of building debris across this arable site the location and full extent of any masonry remains was not precisely known. An initial high resolution caesium magnetometer survey produced a wealth of archaeological information, mostly ditch and pit type anomalies, but the data also revealed distinct areas of heightened magnetic response from the topsoil. Closer analysis suggested that this response was due to an increased concentration of fired ceramic building materials, roof and floor tiles torn from plough-damaged Roman buildings, where each fragment contains a small yet detectable thermoremanent magnetisation acquired when the material was originally fired.

A subsequent earth resistance survey targeted over the concentrations of plough damaged material in the tops oil revealed by the magnetometer confirmed the presence of a substantial multi-phase Roman settlement with at least three large, masonry buildings. These results, in turn, allowed a Ground Penetrating Radar (GPR) survey to be targeted over the apparent remains of the main villa, in advance of its excavation. One advantage of GPR is the ability to provide a depth estimate to buried features from the time taken for the incident radar wave to be reflected back to the surface. This is often exploited by displaying the data as a series of amplitude time slices where each image shows the variation of reflection strength through successive intervals from the ground surface.

Again, data from the initial GPR time slices recording reflections from the topsoil is often disregarded as it is unlikely to contain any



...(B) the volume of plough damaged material in the topsoil and the total volume of building remains visible to the GPR

useful archaeological information. However, at Dunkirt Barn reflections recorded between 0 and 10ns (effectively from the ground surface to a depth of ~0.3m) reveal a cloud of individual point reflections that, from the resolution of the 450MHz centre frequency antenna used for the GPR survey, are likely to be caused by targets at least 0.1m in size. These dimensions would match the fragments of plough damaged building remains, mainly large flint nodules from the rammed chalk and flint walls of the underlying villa, observed in the topsoil during the survey. This dense cloud of debris has, perhaps, masked the deeper buried archaeology and therefore restricted the use of aerial photographs for identifying building remains at this site.

Beyond a depth of approximately 0.3m the archaeological remains become clearly apparent with the GPR revealing an astonishing level of detail, including a floor plan of the main villa building indicating internal room divisions and doorways. The presence of structural remains below this depth is encouraging, although the identification of anomalies related to the original floor of the villa from ~0.5m suggests it is largely only the wall footings of the buildings that still survive.

The GPR data from Dunkirt Barn is of sufficient clarity to suggest that a semi-quantitative estimate of the volume of building material in the plough soil may be derived, together with a similar estimate of the total surviving remains below this depth. This may be achieved by reducing the data in each time slice to a Boolean map, where the individual pixels represent high amplitude response due to the presence of either plough damage building material in the topsoil or, at greater depths, actual surviving wall footings. The plough soil at Dunkirt Barn appears to contain 184m^3 of building material compared to 358m^3 for the total volume of archaeological remains surviving beneath a depth of 0.3m, a ratio of approximately 51%. Repeat GPR survey after a period of continued ploughing would allow the degree of attrition through mechanical cultivation to be estimated over time or, perhaps, indicate that an agreed cessation of deep ploughing over a site was successfully protecting the archaeological remains.

The survey at Dunkirt Barn demonstrates that where appropriate masonry building remains exist, high resolution geophysical survey can provide a means to identify prevailing patterns of plough damage and indicate the depth to which the archaeology is threatened. Such information could in future assist in developing appropriate mitigation strategies to protect vulnerable archaeology, perhaps being deployed in advance of, or alongside the physical markers.

Neil Linford, Paul Linford, Louise Martin and Andy Payne

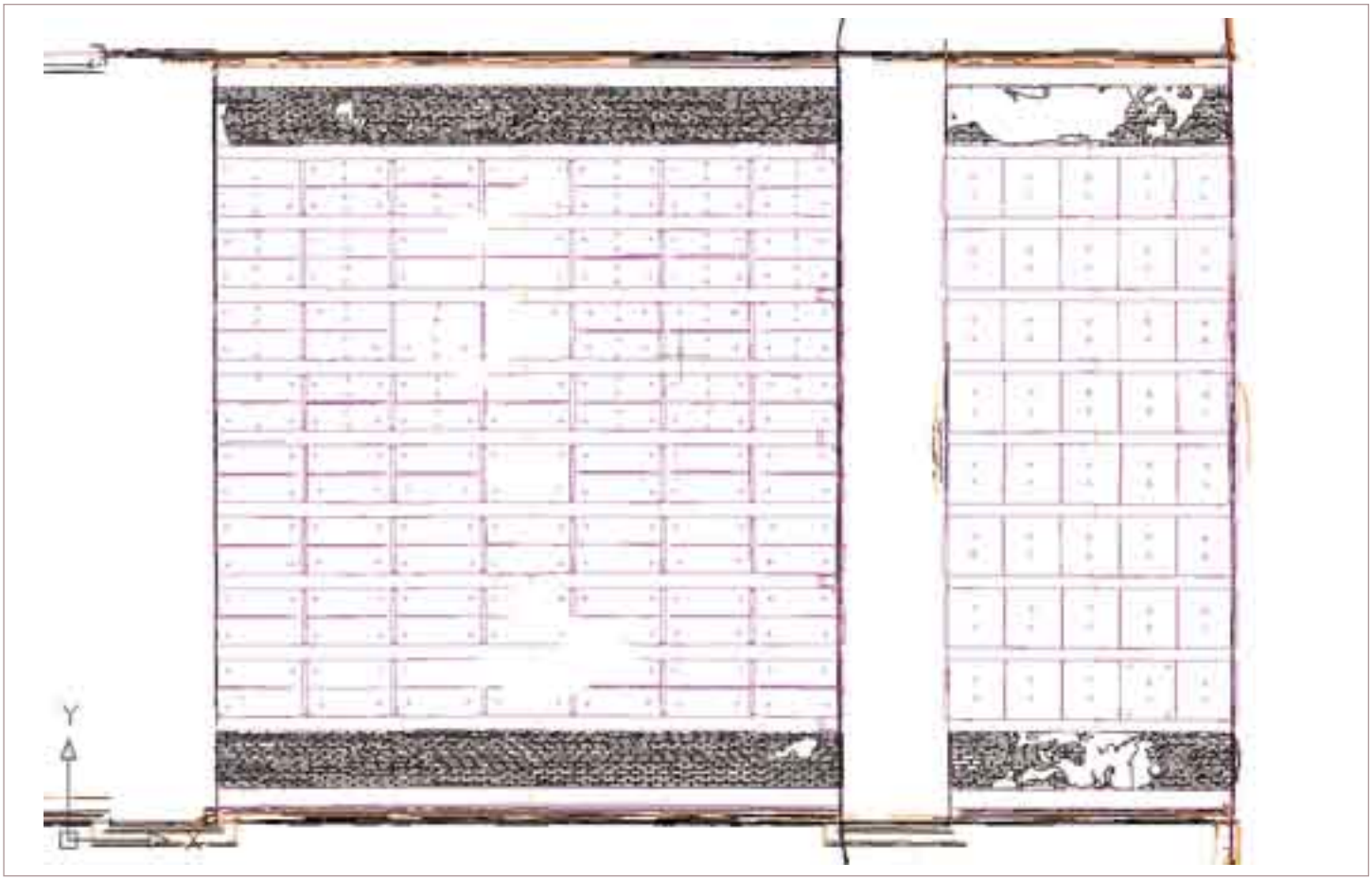
DEVELOPING METHODOLOGIES

Modelling the Bishop's Road Bridge for record and reconstruction

The recording and 3D modelling of Brunel's canal bridge at Paddington will be used in the reconstruction of a rare example of the work of one of Britain's greatest engineers

The former canal bridge at Bishop's Bridge Road (TQ 2648 8159) was built in 1838 to a design by I K Brunel, and spanned the Paddington Basin arm of the Grand Union Canal on the western side of Paddington Station. The bridge was dismantled in advance of replacement in 2003 during works on the Paddington Central regeneration project. The bridge is a rare example of Brunel's use of cast iron for such a structure, and was a fortuitous survival, much of the rest of it having been replaced during upgrading by GWR in 1906-7; the original elegant railings of the canal bridge, probably also of cast iron, were replaced with brick parapets at this time. The bridge was presented as a symmetrical structure consisting of a main span of 35 feet (10.7m) flanked by two smaller spans of 16 feet (4.9m), but that built over dry land was constructed as a brick barrel vault behind the facing brickwork rather than using cast iron beams. The two spans over the canal afforded sufficient width for both the towpath and two barges passing under the main span, with further provision for barges berthing at wharves on the offside under the side span.

The bridge *in situ* prior to disassembly in 2003.



Plan view of the wireframe derived from photogrammetry, showing the visible elements of the structural components.

Measured survey of the structure was carried out prior to disassembly by the English Heritage Metric Survey Team, supplemented by an archaeological report by Malcolm Tucker on behalf of the London Team of the English Heritage Historic Buildings and Areas Research Department. The survey comprised photogrammetry, REDM theodolite observation and analytical drawings to gain as comprehensive a record as possible of the bridge components *in situ*. In addition to survey of the visible parts of the bridge, two trial excavations were undertaken on the carriageway surface of the bridge to elucidate the relationships between the structural components. The production of a 3D model of the structure was undertaken in order to produce a variety of possible end products, including plans, sectional elevations and isometric views as well as exploded views explaining the assembly sequence (which differed between the two spans) and for visualisation purposes when the bridge came to be relocated. The project also afforded an opportunity to refine the process of integrating survey data from a number of different sources in CAD.

Completing the models for most of the structural components was a relatively straightforward process, where the data was available. The shapes of some elements of the bridge components, however, proved more difficult than expected to model using the tools and data available, in particular the bearing ends of the girders of the main span, the shape of which was not entirely successfully resolved in either the hand drawings or the data acquired by REDM. Laser scanning of the problem areas was commissioned to provide enough data to resolve the shape of the object in CAD.

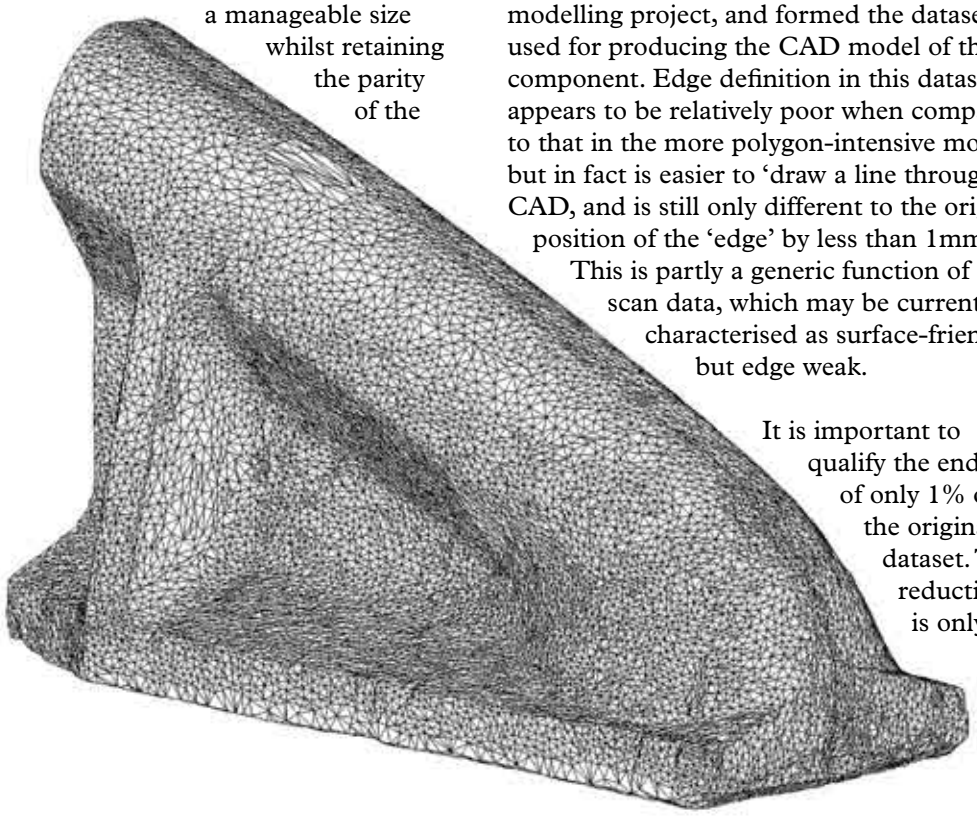
Specification of the scans was in accordance with the 'English Heritage Metric Survey Specification' for laser scan data, with a project brief outlining the requirements of the exercise to the subcontractor (The Scan Team). The bearing ends of two girders, one from each span, were scanned using a Konica Minolta VI-910 3D laser scanner positioned approximately 900mm from the survey subject, giving a surface scan resolution between 0.4 and 0.5mm. Individual scan areas were approximately 300mm x 230mm, and were registered together using an overlap of approximately 40%. The subcontractor using RapidForm software then processed the scans. The collated dataset from the scan of the bearing end of girder 7A from the main span contained nearly 4.5 million (4457797) faces, that from girder 8C of the smaller span nearly 3.5 million faces (3442153). The sizes of the initially supplied

Laser scanning in progress: the improvised shelter is to reduce ambient light levels around the subject.

datasets were too large to be handled comfortably using AutoCAD. This is true with respect to both the sizes of the files generated (a 50% decimation of the data for girder 7A ranged between 43.6MB and 471MB depending on file type), and the density of the data, which far exceeded the relatively lowly requirements of the project. Attempts were made to reduce the data to a manageable size whilst retaining the parity of the model. A series of comparative decimations was undertaken, and the data was reduced further to 25% (1114568 faces), 12.5% (557283 faces), 6.25% (278640 faces), 1% (44582 faces), 0.5% (22290 faces) and 0.25% (11144 faces) of the original model.

The 1% decimation was found to be well within the tolerance limits of the modelling project, and formed the dataset used for producing the CAD model of the component. Edge definition in this dataset appears to be relatively poor when compared to that in the more polygon-intensive models, but in fact is easier to 'draw a line through' in CAD, and is still only different to the original position of the 'edge' by less than 1mm. This is partly a generic function of laser scan data, which may be currently characterised as surface-friendly but edge weak.

It is important to qualify the end use of only 1% of the original dataset. This reduction is only



Decimation to 1% of the original data: still a lot of 3D faces!

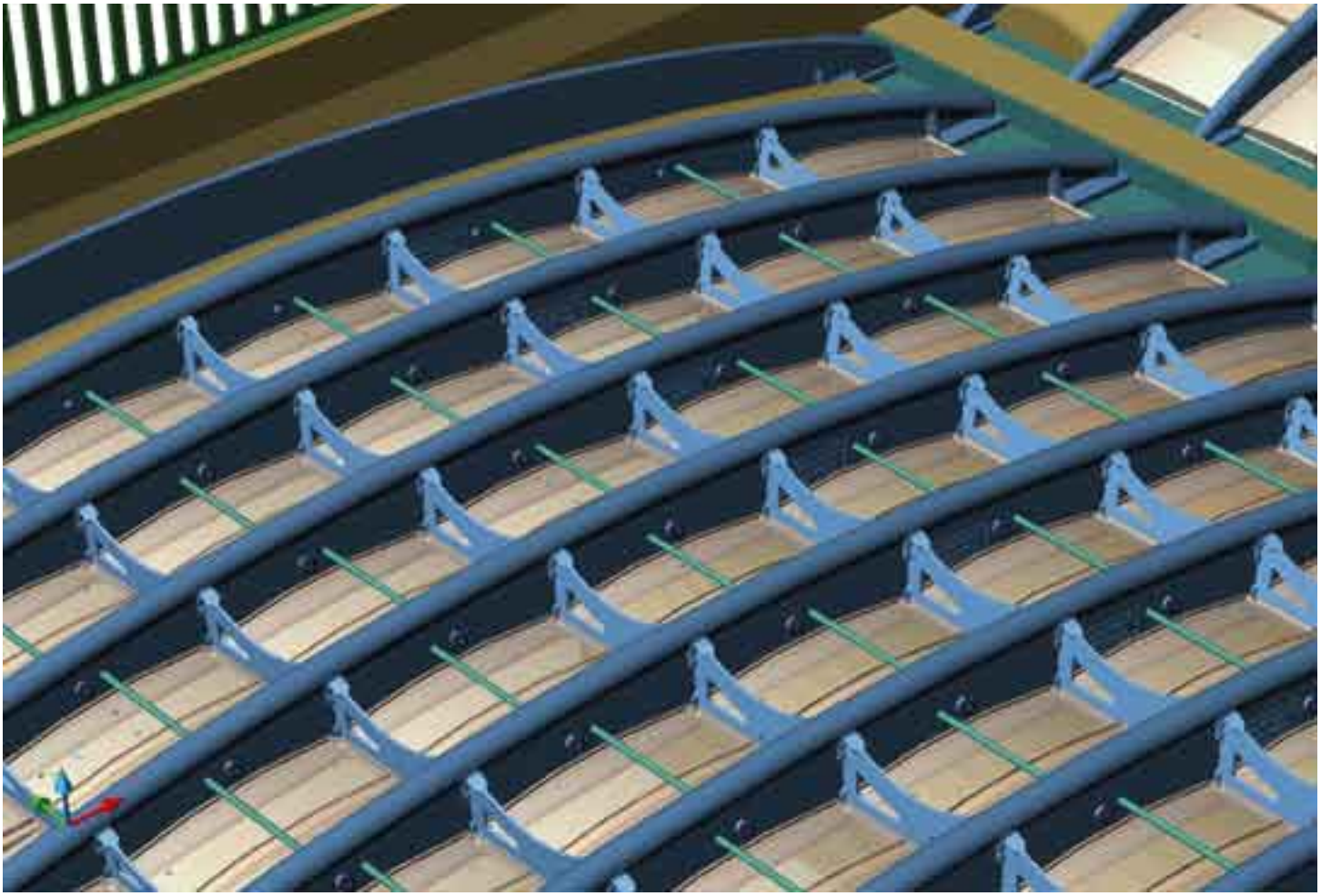
possible if you have a large number of faces to start with – meshing points taken at 1 or 2 cm intervals would not generate a representative mesh, especially with regard to the modelling of the curved surfaces of the bearing end, although it may produce a model with a similar face count. The process is dependant on the algorithm employed to undertake the decimation.

Modelling a structure in 3D requires more information than can be supplied by a single measurement technique, and the process requires the integration of data from a number of sources. The benefits of the 3D modelling process are varied: the fitting of components in a 'virtual engineering' environment like CAD tests the assembly theory and this informs the understanding of the structure, particularly one of this type. The process of inquiry by all teams involved in the project revealed many features of the design of the bridge, including the assembly sequence.

The data sets collated vary in their accuracy, precision and resultant data. The laser scan data is measured at frequencies of fractions of millimetres but is undifferentiated. The photogrammetric end product is more selective (i.e. composed of lines and edges rather than surfaces), and REDM theodolite observations and hand drawing represent an even higher order of selection and abstraction. Integrating this data requires skill in assessing the appropriate application of each data set, focusing on problems integrating surfaces with solids in CAD. Using the tools currently available to us, the scan data has to change format several times during transferral to CAD. Different types of software serve the specialised requirements of different data types, and integration of the two is largely poor. To address this issue, in the light of the increasing use of laser scan data for a variety of project, the Metric Survey Team has recently acquired RapidForm software to permit the in-house handling and processing of laser scanned data.

Jon Bedford

Principal structural elements of the main span.



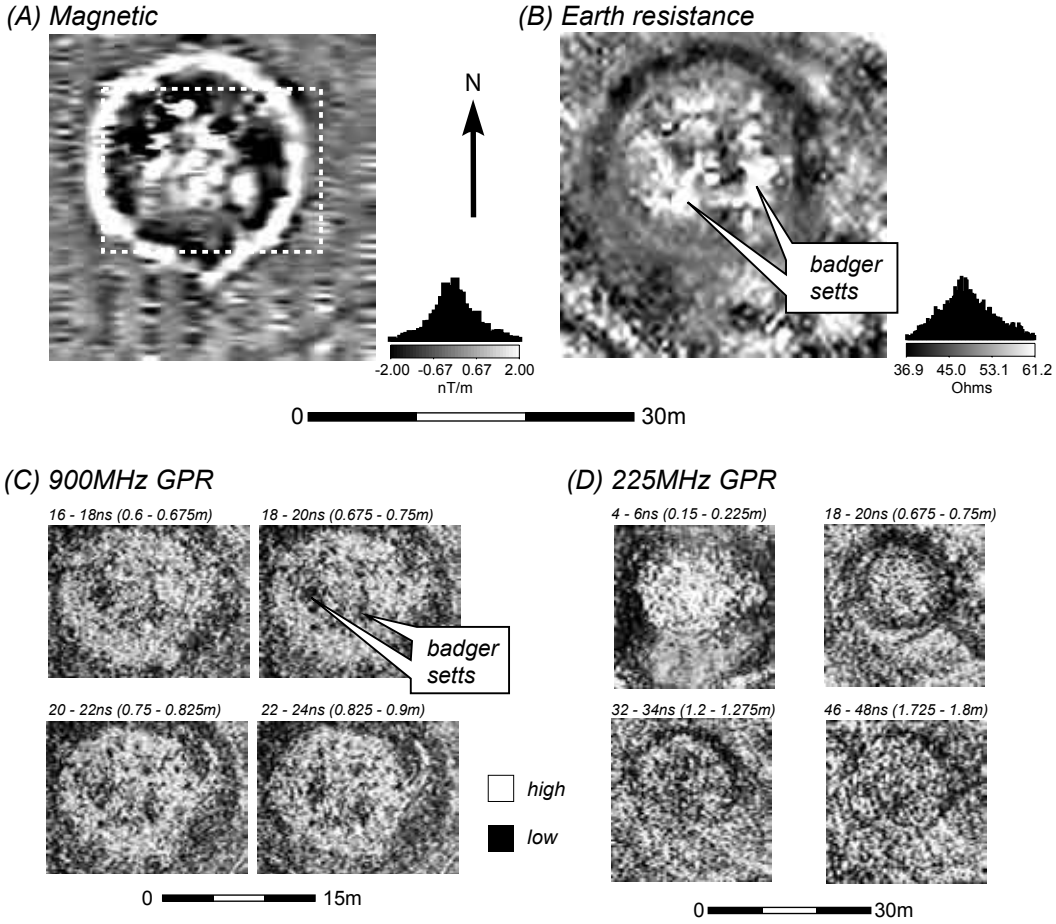
DEVELOPING METHODOLOGIES

Badger-damaged Round Barrows Project: developing recording methods

A project designed to examine the impact of badger activity on prehistoric barrows allowed the development of new non-invasive field techniques, and innovatory site recording methods.

In *CfA News 8* and *Research News 1* we reported on the objectives and some results of this project in relation to a damaged round barrow on Salisbury Plain. During 2005 we investigated a second Wiltshire barrow, this time on the Marlborough Downs. We picked a smaller mound without tree cover or evident damage other than that caused by burrowing animals - although ploughing had affected the surrounding area. This gave us an opportunity to address some methodological issues, notably the potential of geophysical survey to detect animal burrows. We were also able to trial new robotic survey technology with the potential to speed up and enhance recording of finds and contexts. Of course, field methods are not solely about the application of technology: throughout the work at both sites we considered conceptual and methodological issues of recording animal burrows, and monitored fieldwork practice as part of the data-gathering phase of the Revelation project and the development of the Recording Manual. Devised in response to one particular issue, the badger-damage project has contributed to developing fieldwork methodologies in a number of ways.

Excavation at OSA8



(A) Magnetic data from the OSA8 barrow identifying the surrounding circular ditch and (B) earth resistance data showing high resistance anomalies over the two main badger setts. Selected amplitude time slices are shown for both (C) the high frequency 900MHz GPR survey (conducted over a limited area of the barrow indicated in (A)) and (D) the deeper penetrating 225MHz antenna (conducted over the full 30m survey grid).

OGBOURNE ST ANDREW 8

The (Ogbourne St Andrew 8) site is an Early Bronze Age bowl barrow, *c.* 16m in diameter, part of a linear group at the head of a dry valley. Surface traces of the surrounding ring-ditch have been removed by ploughing. Observation showed two badger setts, outliers of a main sett in an adjacent large barrow, and active rabbit burrowing. A licence to temporarily exclude the badgers was obtained from English Nature and the archaeological work was monitored by the Badger Consultancy, Chippenham.

The barrow mound comprised a soil core and an eroded chalk capping which had partly slumped into the ditch. A cut through the centre of the mound, probably made in the 19th century, had removed any primary burial, although the disturbed remains of a sarsen setting suggested a cremation urn had once been placed here. The mound sealed a ring of stake-holes, probably related to the construction of the barrow or the preceding ceremonies, and overlay a buried soil containing a quantity of Beaker pottery and flintwork and a series of ard-marks. The only other significant feature beneath the mound was a tree-hole. More struck flint came from the flanks of the mound and the upper ditch fills, suggesting the site was reused in the later Bronze Age.

Animal activity was widespread, with rabbit burrows common in parts of the ditch and mound core, and badger tunnels generally deeper, going in to the natural chalk where it was slightly softer in the vicinity of the tree-hole.

GEOPHYSICAL SURVEY

An initial geophysical survey was conducted with the aim of delimiting the extent of the barrow, including the location of the surrounding ditch. A further aim was to apply high density Ground Penetrating Radar (GPR) to directly image both internal archaeological features within the barrow and, hopefully, the tunnels and chambers of the badger setts. These images could then be compared with what was recorded during the subsequent excavation.

The initial magnetic survey successfully identified both the circular ditch and some intense anomalies from ferrous litter over the centre of the mound. With the extent of the site defined, a detailed GPR data was collected using 900, 450 and 225MHz centre frequency antenna. The resulting data was highly complex with the high frequency antenna (900MHz) detecting very subtle anomalies in the near surface and the lower frequencies providing a greater penetration depth (to approximately 1.8m with the 225MHz antenna). Further analysis of the data in light of the excavation

One-person survey (the ideal)

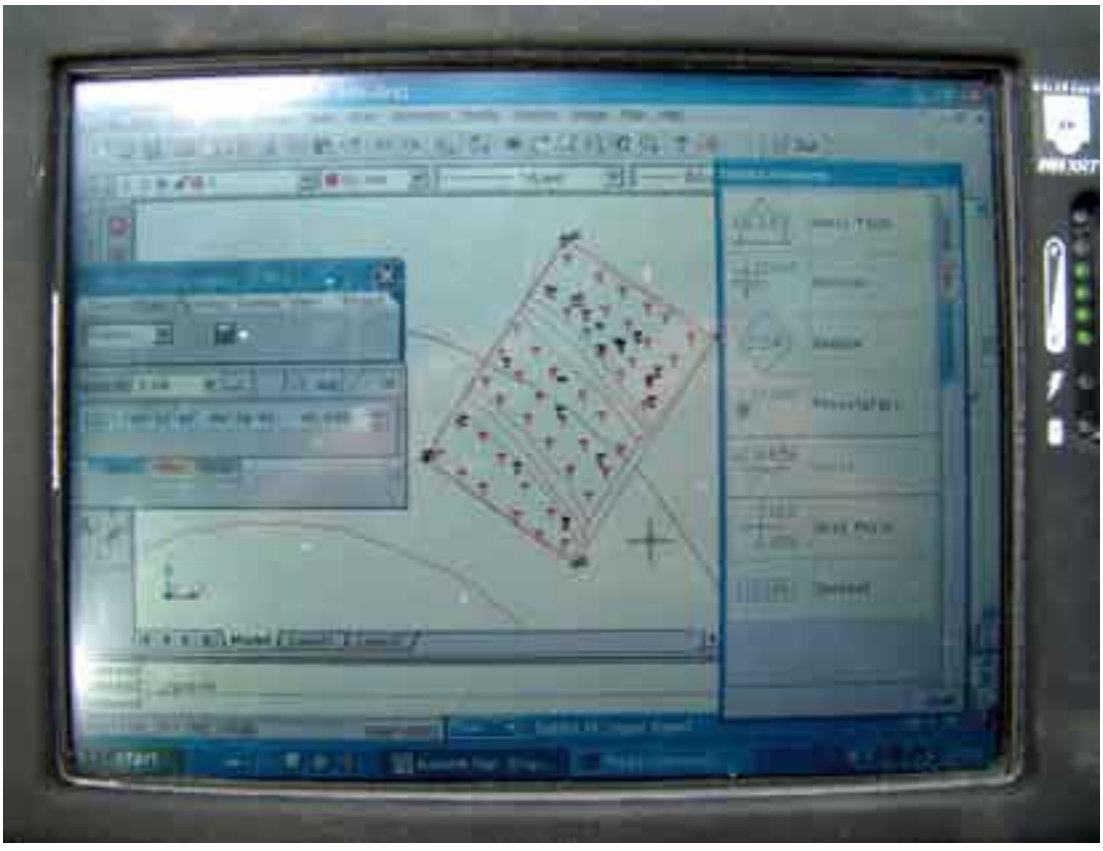
data is required, although it would appear that the 900MHz data has identified the main badger burrows as low amplitude anomalies between 0.5m to 1.0m from the surface. It is of interest to note that these anomalies correlate with high resistance responses in the earth resistance data, suggesting the presence of air-filled voids.

ROBOTIC SURVEY

Robotic survey development aimed to make 3-D data capture faster and more efficient. We wanted to see our survey data as it was captured, so we loaded our existing field computer with the latest version of TheoLT software that links the survey instrument directly to an AutoCAD drawing. Data can be checked for accuracy while it is still there to correct. We also wanted to move the 'business end' of the system out from behind the instrument into the trench. That meant going wireless and using a robotic survey instrument hired for the project courtesy of the Measured Survey Team. We tried Bluetooth because the hardware is small, but it proved incapable on site so we switched to data radios. We needed the measurements in the site's Access database, so we arranged for a custom 'features' palette in TheoLT that not only makes the recording more user-friendly but also generates an Access-ready text file. Future developments will link the drawing directly to a database. Our final development 'wish' – one-person survey – was precluded by the limited ergonomics of the existing kit assembled for the project. However, we did take away lessons for the procurement of the necessary equipment for future use.

RECORDING ANIMAL BURROWS

The usual method of recording disturbances encountered during excavation is as a truncation line on plan and a sketch on the context sheet. However, in this project we



TheoLT screen-shot with user-friendly feature palette. Note CAD drawing in background.

5Recording animal burrows (non digitally!) at OSA8

needed a complete and accessible record of the burrows themselves: (a) in order to allow quantification of the impact of burrowing animals on particular deposits; (b) so that the excavated evidence could be directly compared with the geophysics data; (c) so that the extent of individual tunnels could be measured and the displacement of material assessed. To achieve this, we implemented a parallel recording system for these 'non-stratigraphic', largely negative features alongside the usual single-context archaeological recording. A separate series of levelled plans was created, added to incrementally as elements of burrows were exposed within each archaeological deposit. Meanwhile, separate context numbers were used to record finds and any loose deposits within the burrows. The major task for post-excavation is to link this information back to the archaeological plans and geophysical data. Depending on the success of this exercise, recommendations for the use of geophysics for assessing animal damage will be developed.

MONITORING FIELD PRACTICE

The excavations also supported a project (Revelation) intended to provide a coherent digital information system for the Research teams based at Fort Cumberland. Its first stage included a comprehensive review of our existing information systems and work practice. We needed a thorough understanding of the process of data capture on site, to relate to the model built up back at the Fort. We achieved this using 'participant observation' – working on site while watching and asking questions about how colleagues excavated and recorded. We found that our initial model came largely from a post-excavation perspective. It did not consider the importance of access to data for site staff as they created the records, often using informal notes or asking each other for information. A simple database was therefore used to index and cross reference site records; survey data was added daily, removing the need to copy co-ordinates onto record forms or finds bags. Basic information was thus easily available on site, simplifying recording and checking. In 2004 we also looked at how our recording manual was used. Our observations and suggestions from site staff were applied in our current revision of the manual and led to some new 'crib' sheets (tried out in 2005). The understanding gained is proving valuable in moving towards our aims of increasing efficiency in capturing site data and speeding its analysis and dissemination.

Tom Cromwell, Vicky Crosby, Jonathan Last and Neil Linford

Recording a burial at Barrow Clump

DEVELOPING METHODOLOGIES

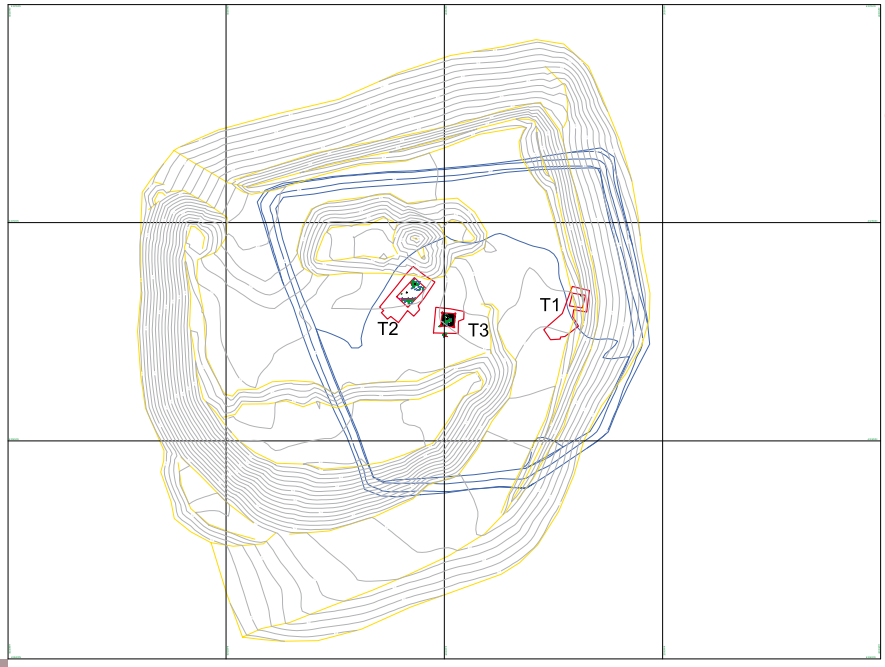
The Soil Stack Project

How much of a problem is the compaction of archaeological deposits by large temporary dumps of soil and the movement of heavy plant? This project set out to find out…

Evaluation in advance of the A1 improvement scheme by Oxford Archaeology North (OAN) revealed the remains of a site initially identified as a Romano-British farmstead. The decision to preserve the site *in situ* presented an ideal opportunity to investigate the potential physical impacts associated with construction and dismantling of soil stacks during road construction as well as measuring the imposed loadings from an increased overburden over a period of some 18 months or more. The road construction contractors, RMG (A1), supported English Heritage in this research.

The site lies in an area of known archaeological significance which includes the Castle Hills Scheduled Ancient Monument and other potential Iron Age and Romano-British settlement sites. Evaluation revealed a building interpreted as a small-holding with a secondary structure, possibly a livestock pen. The enclosure ditches were cut into the underlying Magnesian Limestone, and were revetted with stone walling along their inner faces. More than190 sherds of predominantly Romano-British pottery had been recovered during the course of the evaluation; an unusually large assemblage for sites of this period from West Yorkshire. A crouched burial recovered from one of the enclosure ditches external to the main occupation area suggested a mid to late Iron Age tradition.

Plan of the soil stack. Trench locations in red, soft material contours in blue, final contours in grey



After evaluation was complete and before the site was buried by the soil stack, three earth pressure cells were installed at various locations; two on exposed stone surfaces, the third on top of the fill of one of the enclosure ditches, adjacent to an excavated section. Each cell was carefully laid onto a bed of fine sand, and then covered by more sand to protect it from possible damage from stones within the fill material. The strength of any soil, and hence its response to an applied load, is determined by its moisture content and therefore a piezometer was also inserted into the ditch fill inside a perforated plastic tube; this would supply data on water content and water movement through the soil stack. An armoured cable from each cell was then connected to data loggers which were positioned some 150m away to prevent damage during construction of the soil stack. Initially these were set to record data at 15minute intervals during the early phase of stack construction. After the stack was built the loggers were programmed to collect data on an hourly basis, changing to 10 seconds at one stage when the stack was being dismantled, in order to detect and measure the loading from plant including a towed vibratory roller moving across the site. Overall, data was collected from October 2003 until June 2005.

The archaeology was initially reburied using a soft cushioning material consisting of imported subsoil from the Castle Hills area, to act as a protective layer around the stone structures. This layer was built up to a depth of approximately 200mm above the archaeology using a 360° mechanical excavator under supervision from archaeologists from OAN. The material to form the soil stack was then brought in by 40 tonne trucks and pushed over the area using a bulldozer. Once a depth of 300mm had been reached more material

was added to the stack using heavier plant and compacted using a self-propelled vibratory roller. The soil was compacted in 150mm spits and this methodology continued until the maximum height of the stack was reached, at 8.9m.

After the stack had been dismantled, the area was left for a month before re-excavation. Three potential effects of compression had been anticipated; movement of the deposits, alteration of the relationship between contexts (soft deposits coming adrift from walls and revetments) and fragmentation of finds and environmental remains. Re-excavation showed that none of these effects could be significantly measured.

Because OAN had left survey targets in place, it was possible to compare our survey with theirs. Most of the tags were placed between rocks for photo mosaic purposes, and the variations could reflect either differential pressures around the rocks or perhaps the effects of trowelling away the crust of the OAN surface while cleaning up. Each trench showed a slightly different pattern, which could reflect their different positions within the soil stack, their different deposits or different histories of excavation. The greatest difference was in Trench 3, where the differences ranged from 0.024m to 0.079m. Several stones in this trench also showed definit e evidence of compaction-derived movement that was likely to have occurred during reburial.

This small amount of movement did not affect the intelligibility of the archaeological remains. It was possible to correlate OAN records for individual contexts with the

The soil stack at its greatest height

records of the re-excavation. There were few differences between the two, mostly matters of interpretation and recording style. The relationships between contexts seems to be constant. Charred plant remains and charcoal were not destroyed by covering with the soil stack and remain in good condition. Although the pottery recovered from the excavation is fragmentary, there is no way of judging whether the fragmentation is a result of pressure.

The project offered an opportunity to quantify the physical pressures that archaeological remains undergo during temporary reburial during road construction, and to correlate those pressures with possible effects on the archaeology. The results partly reflect the care taken in the initial stages of reburial and the geological and hydrological particulars of the site. Nonetheless, the extremely low level of impact recorded is very good news.

Sarah May and Ian Panter

Below left: OAN photo of deposits in Trench 3 – note survey tags 130 and 136

Right: EH photo of deposits in Trench 3 after reburial – note survey tags 130 and 136, in place from the original evaluation

DEVELOPING METHODOLOGIES

One hundred years of Aerial Archaeology

During the one hundred years since the first aerial photograph was taken of a British site, aerial survey has become a crucial archaeological tool. We review its history.

The centenary of Britain's first aerial photograph of an archaeological site is imminent, and English Heritage's Aerial Survey team will be taking advantage of it in a number of ways. Fortunately, from a publicity perspective, our first aerial photographs happen to be of Stonehenge.

Currently in preparation are a book and an exhibition dealing with the history of aerial photography and its application within archaeology. The exhibition will be launched at Stonehenge itself during the first week in August, before touring around various museums and other venues. The book should follow in September. Both book and exhibition will be looking at aerial photography from balloons, both military and civilian, during the Victorian and Edwardian periods, before exploring the impact of the First World War on the development of both aerial photography and interpretative mapping. The growth of aerial archaeology from the early 1920s depended largely on pilots with an interest in the past putting their wartime experiences to use in searching out archaeological sites. Crucially, this coincided with the realisation that cropmarks, far from being an occasional product of extreme weather conditions, were actually quite widespread, and that their occurrence could be predicted in particular areas at particular times of year within reasonable limits.

The 1920s and 1930s saw aerial photography making crucial contributions to archaeology, and particularly to prehistory, as particularly distinctive monument types were increasingly recognised on the lighter soils of the Thames Valley, 'Wessex' and neighbouring regions – causewayed enclosures, henges, cursus monuments, ring ditches and so on were all increasingly recognised as cropmarks. Later periods were represented by a variety of enclosure types and, of course, extensive 'celtic' field systems. In the years after World War Two, aerial photography also began to

Below left: Sharpe's vertical view of Stonehenge, taking from a Royal Engineers' reconnaissance balloon, probably late September 1906. (PHS 11816/01)

Right: US Air Force aerial view of part of the Stonehenge landscape. Larkhill Camp is on the right (north) of the photo, while the Stonehenge Cursus can clearly be seen to the left (south). Bottom left, the bend in the Avenue can just be seen. Part of the 'M' Series collection of wartime photographs of England held by the NMR at Swindon (US 7PH/GP/LOC122/1083 24-DEC-1943)

A more recent oblique view of Stonehenge, taken by Damian Grady, and a useful contrast with the 1906 images (SU 1242/446 24-Sep-2005 NMR 24078/18)

have an impact on Medieval archaeology, particularly in the growing field of shrunken and deserted settlement studies.

The experiences of the Second World War contrasted with those of the First in a number of respects, as far as aerial photography was concerned. First of all, the importance of specialist photo interpreters became apparent quite early on, and several archaeologists were drafted in to work at the photo interpretation unit at RAF Medmenham in Berkshire, with some being posted abroad. Included in their number were the likes of Stuart Piggott, Glyn Daniel, Terence Powell, Charles Phillips, George Holleyman, Brian Hope-Taylor and Leslie Grinsell.

The thousands of aerial photographs taken of the British Isles for training purposes during and after the War by both RAF and USAAF today represent an invaluable resource for archaeology. With the majority housed at the National Monuments Record (NMR) in Swindon (along with several other important collections), they frequently captured earthworks which have since been ploughed away, cropmarks sites now destroyed by quarrying or development, or which have never subsequently been photographed, and many other historic landscape elements no longer extant.

Along with new English Heritage reconnaissance photography, the historic collections of the NMR are crucial to the interpretative mapping that lies at the core of the National Mapping Programme (NMP), a project whose results illustrate just how far we've come over the last 100 years.

Martyn Barber

Aerial view of RAF Medmenham, headquarters of Allied Forces air photo interpretation during World War II. Again, part of the NMR's 'M' Series collection (RAF 106G/UK/379/5110 13-JUNE-1945)

NEW DISCOVERIES AND INTERPRETATIONS

Hopton Castle, Shropshire

Survey undertaken to help the presentation of this small earthwork castle revealed a designed landscape and recalled a bloody Civil War atrocity.

Hopton is one of many small earthwork castles in south-west Shropshire. It lies in a narrow valley just at the point where this widens out into the Clun valley and it is effectively in a bowl of low hills. Little is known of its history prior to the Civil War, when it was the scene of a particularly bloody siege. The Hopton Castle Preservation Trust is seeking funding, with the advice of English Heritage, for repair works and improved public access, through the Heritage Lottery Fund. As part of English Heritage's support for the Trust, co-ordinated by Bill Klemperer of West Midlands Region, the Archaeological Survey and Investigation team undertook an analytical survey of the earthworks surrounding the late 13th or early 14th-century great tower, which is the only masonry part of the castle still standing. Our aim was to develop an understanding of the very complex earthwork remains, to put the castle into its wider landscape context and to study the broader history of the site. Simultaneously, Stratascan undertook resistance survey, magnetic survey and Ground Penetrating Radar investigation of the site.

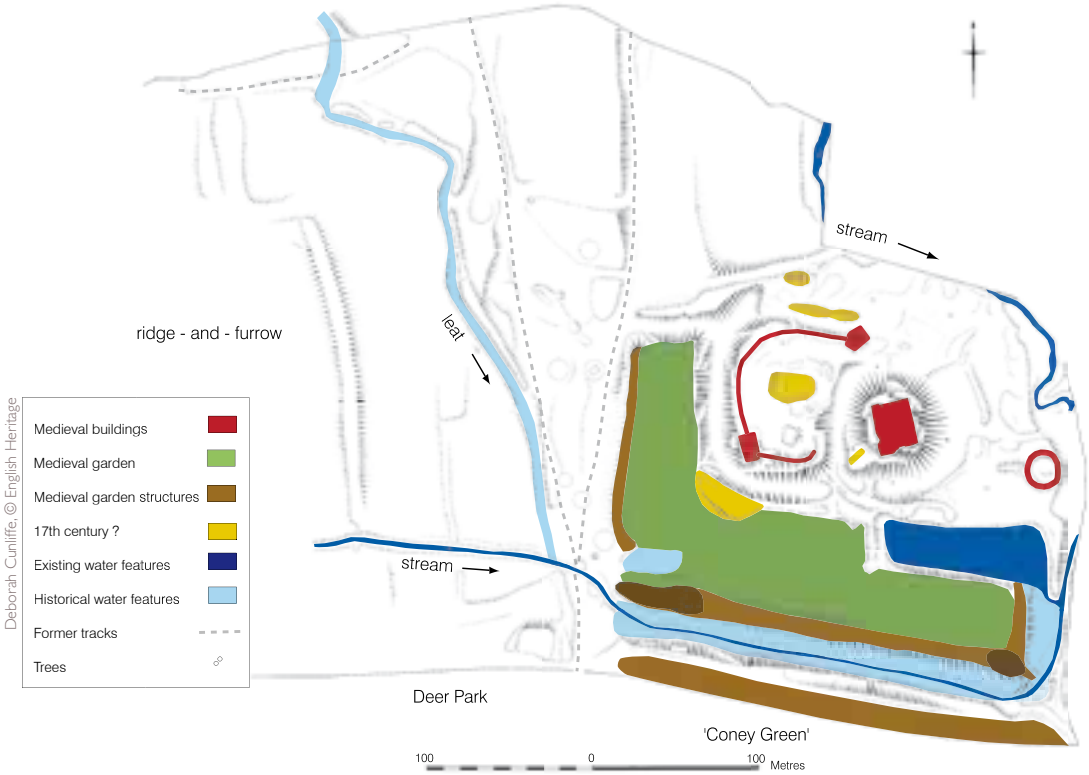
Amy Martin, a student on placement, surveys the Castle with Nicky Smith of the Swindon AS&I team

Mark Bowden, © English Heritage

The most prominent element of the castle is the great tower, built in deliberately archaic style, probably by one of the upwardly mobile Walter Hoptons, lawyers and courtiers, who held the manor until the early years of the 14th century. This tower is suitably raised on a mound with a substantial surrounding ditch. Its masonry is of high quality and its architecture is elaborate, providing a well-appointed suite of private chambers on the south side. The origins of the site are, as with most earthwork castles, obscure. It may have originated, as its superficial appearance suggests, in the 12th century as a motte-and-bailey or ringwork castle. (Interestingly it may also be one of a growing number of castles that are now recognised as occupying pre-existing, and probably prehistoric, enclosures.) Alternatively, it may have been built *de novo* in the late 13th or early 14th century in archaic plan-form as well as architectural style. The 'bailey' to the west of the tower was surrounded by a ditch (the northern arm of which is now filled in) and a curtain wall with at least two towers.

A great tower of such architectural pretension demands, in the light of recent scholarship (at Bodiam and elsewhere), a contemporary designed landscape. Beyond the 'bailey', to the west and south, is an L-shaped compartment partly defined by ponds. These are fed by a leat as well as by a small tributary stream. This has all the appearance of a contemporary formal garden with walks and possibly pavilions. Beyond this again, to the south and west, is 'Hopton Park' and field name evidence suggests that there was a rabbit warren immediately to the south. There was a further deer park to the east, occupying part of Hopton Heath. The layout of this landscape probably involved the creation of a 'correct' approach to the Castle for high status visitors, as required by late medieval social mores, but the details of this have proved elusive.

The footings of a large circular structure lie to the east of the tower near the stream.



Plan of Hopton Castle with some significant features highlighted

Previously this has been interpreted as the corner tower of an otherwise lost eastern bailey but this does not seem convincing. It could be a dovecot, another 'lordly' structure that we might expect to find at a place such as Hopton. Yet another possibility is that this relates to the siege.

In February 1644 Hopton Castle was garrisoned as an outpost to the parliamentarian stronghold at Brampton Bryan, 3½ miles to the south. A handful of soldiers under Captain Samuel More held out against repeated royalist attacks for over a month, steadfastly refusing to surrender. They built makeshift defences, some of which may be represented by the banks outside the north bailey wall and possibly by the circular structure to the east, mentioned above. On several occasions the attackers penetrated the defences but were driven back with huge losses. On 20th March the royalists set fire to the 'brick tower' which More and his men had constructed (possibly at the south-west corner of the 'bailey' ditch?). Believing the 'bailey' to be untenable, More deliberately set fire to the buildings there, including the 'new brick house' recently built by the Castle's owner, the prominent parliamentarian Robert Wallop. This house is probably represented by the large intrusive rectangular hollow in the middle of the 'bailey'. The garrison retreated to the great tower, which the attackers immediately began to undermine near its south-west corner while setting fire to the porch at the north door. The garrison surrendered later that night. Captain More was imprisoned but his second-in-command was stabbed to death. The rest of the garrison were taken to 'a muddy pit' where they were tied up, mutilated and stoned to death. This atrocity gave rise to the ironic phrase 'Hopton quarter'.

Mark Bowden

View of the Castle from Hopton Park, part of its 'designed landscape'. The field under plough in the foreground is named 'Coney Green' on the Tithe Award

NEW DISCOVERIES AND INTERPRETATIONS

Lenin was here

Research by the Survey of London throws new light on an office said to have been used by V. I. Lenin and a 1930s fresco of the coming revolution. Both are at 37a Clerkenwell Green, home of the Marx Memorial Library.

During the 19th century Clerkenwell Green became closely identified with radical demagogy and red politics. Today the chief legacy of this tradition, intellectual and artistic, is embodied in No. 37a, built in 1738 as a school for Welsh boys.

The building, later subdivided, has had a complex history. Its association with radicalism really dates from 1872 when it became the club-house of the republican-leaning London Patriotic Society. From 1893 until 1922 it was occupied by the Twentieth Century Press, publisher of the Social Democratic Federation's weekly *Justice*, and in 1902–3 seventeen issues of Lenin's Russian-language underground paper *Spark* were printed here, Lenin himself correcting the proofs on site.

In 1933, the 50th anniversary of Marx's death, No. 37a was opened as a permanent memorial to the philosopher in the form of a library and educational institute. Though there was no direct personal link with Marx himself, the building had revolutionary credentials enough to make it an appropriate location.

Its appearance today is very different from that of 1933. The ground floor was then divided into shops and business premises, the upper façade had been crudely rebuilt in bare brick, and painted boldly across the front was 'MARX HOUSE, LIBRARY AND

37A Clerkenwell Green

The Lenin Room

WORKERS' SCHOOL'. Transformation came about in 1968-9. Threatened by a scheme to enlarge the Green, the building was saved largely because of the Lenin connection and the façade restored to something like its original appearance. The Historic Buildings Council, uneasy that so little original fabric was left, gave a grant for preserving the upstairs office said to have been used by Lenin.

THE LENIN ROOM

Despite the grant, no-one seems to have looked closely into the room's provenance, yet even a cursory examination should have raised doubts. In 1913, in his obituary of Harry Quelch, manager of the Twentieth Century Press and editor of Justice, Lenin recalled how Quelch had generously 'squeezed up' to allow *Spark* to be produced. At that time, the Press occupied only the first floor and part of the ground floor, and space would have been very tight:

> *A corner was boarded off at the printing-works by a thin partition to serve him as editorial room. This corner contained a very small writing-table, a bookshelf above it, and a chair. When [I] visited Quelch in this 'editorial office' there was no room for another chair.*[a]

Precisely what did Lenin mean: had he worked here, or in the adjoining room, or elsewhere? How did this cubby-hole relate to the much larger 'Lenin Room' of recent times? In 1960 a writer explained that the office was 'somewhat bigger' since Lenin's day 'owing to the moving back of a partition…'[b] But was this anything more than assumption, based on Lenin's reference to a partitioned-off corner?

A survey made shortly before Quelch's death shows that there were just two first-floor rooms, a printer's shop and an office.[c] These can only have been the two L-shaped rooms shown on a plan made in 1924 before the building was converted to an Anglo-Italian Club.[d] Quelch's makeshift office in 1902–3, it can reasonably be assumed, was part of the smaller room,

'The worker of the future upsetting the economic chaos of the present'

perhaps the alcove backing on to the staircase, as this would have been easy to partition off. This alcove was destroyed by the installation of the present staircase for the club, but the basic plan of two L-shaped rooms remained.

So neither the Lenin Room nor Quelch's tiny office existed in 1924 (or in 1913). Was Lenin's room, then, re-created in 1933 as a memorial? After all, some of those involved with the Marx Memorial would have remembered how the building had been, including Quelch's son Tom, who worked there in the Lenin days.

A search of the papers of Robin Page Arnot[e], co-founder of the library and school, produced no reference to a Lenin Room, but did turn up a schedule of the works done for the Marx Commemoration Committee. Of a minor nature only, they included the alteration of a partition in the 'Typists room'. Was this the Lenin Room, and the partition the one referred to in 1960?

About 1932 the former club rooms were briefly occupied by a firm of poster writers, Modern Display Ltd. Pencilled amendments to the plans submitted to the local council by the club in 1924 show several alterations, evidently for Modern Display – they include conversion of the former buffet downstairs to a display artist's workshop. On the first floor, the smaller L-shaped room was partitioned to make an office (the 'Lenin Room') and a store. Lenin was indeed here, but the Lenin Room came later.

THE FRESCO

The Arnot papers cast an interesting sidelight on the fresco, the work of the artist Jack Hastings (Viscount Hastings, later the 15th Earl of Huntingdon). A man with Marxist views at that time, whose wife was the first Treasurer of Marx House, he had learned fresco painting under Diego Rivera. The fresco, which covers what was then the end wall of the Lecture Room, shows Rivera's influence markedly, in style and composition:

the upper portion, with grouped figures of Marx, Engels, Lenin, Robert Owen and other worthies, owing something to Rivera's *History of Mexico* in the National Palace, Mexico City.

It has long been known that Hastings spent some weeks in the autumn of 1935 painting the fresco, which depicts 'the worker of the future upsetting the economic chaos of the present'. A report in the *Daily Mirror* mentioned that 'a plasterer' had come in early each day to prepare the wall.[f] However, according to a Marx House newsletter, Hastings had an assistant, 'Clifford White', and they had together devoted two months to the project, starting at 7 each morning and working as late as 11 at night.[g] A little investigation showed that 'White' must be Clifford Wight, one of Rivera's chief assistants and an artist himself, whose own murals adorn the Coit Tower in San Francisco. Close associates, Hastings and Wight had worked together with Rivera. Hastings' daughter, Lady Moorea Black, has confirmed that Wight was indeed his assistant, doing plastering and paint mixing, skilled activities central to the demanding fresco technique, in which water-based pigments are applied to wet plaster. Wight was probably responsible too for dividing the work into *giornate*, the portions allocated to each day, and for transferring Hastings' cartoon design to the plaster.

Much is known about Wight's work in America in the 1930s, where his wife was painted by Rivera's wife Frida Kahlo. There are many photographs of him, and the Cowboy at Coit Tower is a self-portrait. But his origins and later history remain uncertain. He is said to have been English, born about 1900, and to have trained in London as a sculptor. A former Mountie, he fought in the Spanish Civil War and worked in bomb-disposal in the Second World War, dying in the 1960s. Little of this has yet been confirmed.

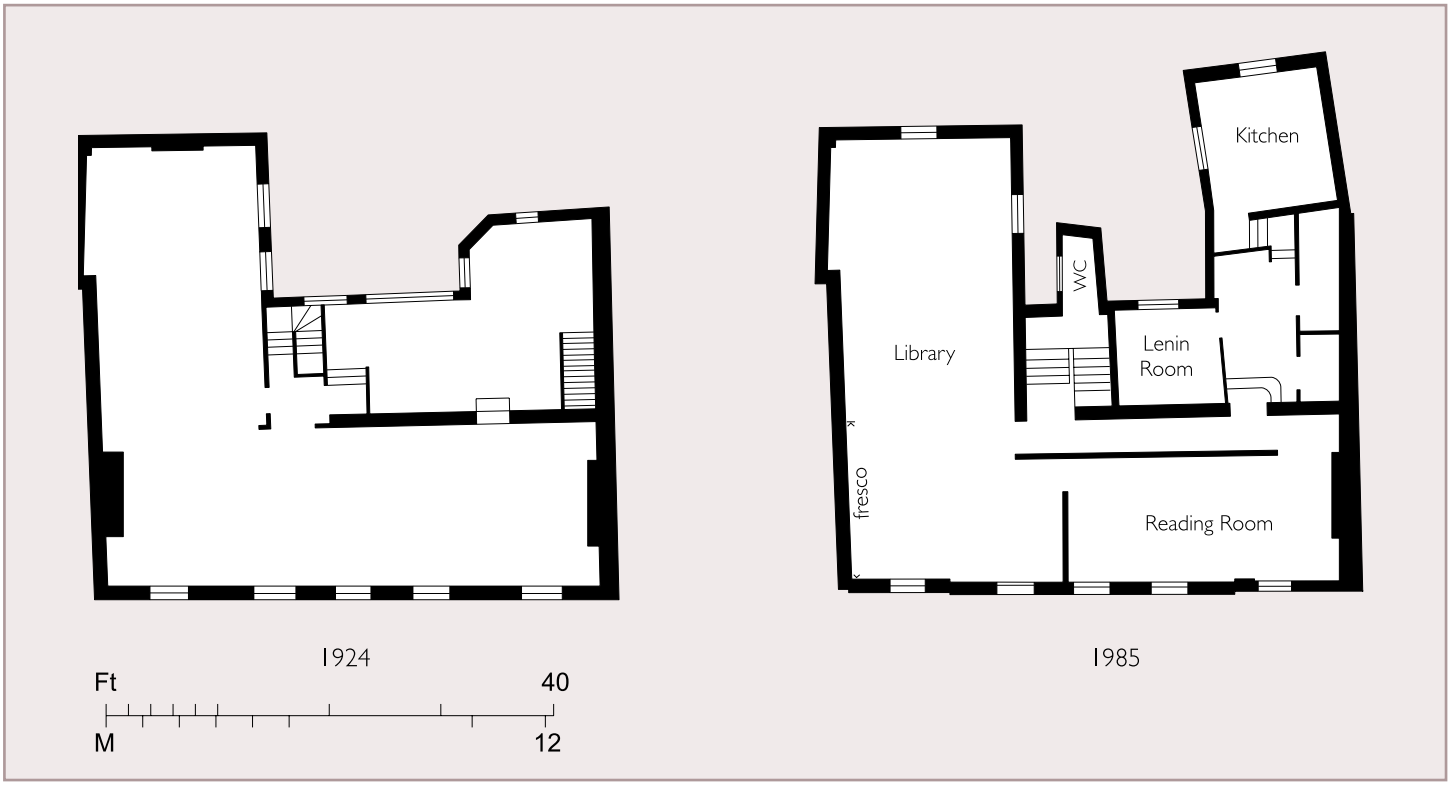
The worker at the centre of the fresco is a powerful, bronzed figure, modelled, according to the *Daily Mirror* report, on 'a Welsh miner' – the plight of the Welsh coal-miners was in the news at the time. Perhaps so, but the figure bears a remarkable resemblance to the mysterious Wight himself.

A full account of the building will appear in the Survey of London's survey of Clerkenwell, to be published in two volumes in 2007.

Philip Temple

a. V. I. Lenin, 'Harry Quelch', *Collected Works*, Vol. 19, p.371, trans. George Hanna.
b. Frank Jackson, 'Lenin in London', in Marx Memorial Library, *Quarterly Bulletin* No. 13, Jan-March 1960
c. National Archives, IR58/42659
d. Islington Building Control
e. Brynmor Jones Library, Hull University
f. *Daily Mirror*, 10 October 1935
g. *Marx House Bulletin*, November 1935, in Arnot papers

Plans of first floor



RESEARCH THEMES AND PROGRAMMES

A 1 B 2

Queenborough and Rushenden Historic Area Appraisal: a heritage-led approach to regeneration

The 'Thames Gateway' development will affect existing historic towns like Queenborough and its suburb, Rushenden. Architectural Investigation carries out a case study.

Queenborough is a small town (population *c* 3,500) on the east coast of the Isle of Sheppey just off the north coast of Kent, and within the recently defined Thames Gateway area of south-east England. At its core is a High Street retaining a medieval church and a significant number of Georgian houses. To the south of the town is Rushenden, a housing estate developed piecemeal from the early 20th century to the 1970s. It comprises some industrial workers' housing but mostly low-rise, low density council houses in a variety of forms and styles. The area between the two is partly occupied by a 20th century industrial estate called 'The Klondyke', built alongside an early planned industrial estate, most of which was cleared in the 1980s.

Queenborough High Street, showing the late 18th-century Guildhall, a buff-coloured brick building with its upper storey containing the Council Chamber supported by four stone Doric columns. The juxtaposition with two-storey brick houses of mixed epochs is characteristic of the High Street's buildings

Queenborough and Rushenden, now rather sleepy places, will see considerable change over the next ten years. A master plan is currently being developed for the regeneration of these areas. This is being advanced by the South East England Development Agency (SEEDA) in association with partners including Swale Borough Council (SBC), Kent County Council (KCC), and Swale Forward, and funding from the Office of the Deputy Prime Minister (OPDM) under the Sustainable Communities Plan. The master plan is being formulated in accordance with guidelines laid out by the Development Framework for Queenborough and the Swale Borough Local Plan First Review prepared by SBC in 2004. It is also integrated with major infrastructure projects including the new A249 bridge and the Rushenden Relief road. This aims to reduce industrial traffic in a residential area, while making connections with new business zones, and is key to opening up the regeneration of Queenborough and Rushenden.

The 2005 English Heritage publication *Growing Places: Heritage and a Sustainable Future for the Thames Gateway* provides a number of Kentish case-studies for heritage informed regeneration. It promotes the role of the rapid area assessments and characterisation studies, such as the recent Thames Gateway Characterisation GIS project, in local planning documents. *Growing Places* identified Queenborough as one of the 40 'historic hubs' across Essex, Kent and East London: these are defined as places with distinctive historic features that could be used as a catalyst for conservation-led regeneration.

An experimental development of six semi-detached houses, based on the military Nissen hut, built by Queenborough Council in 1926

The Thames Gateway Characterisation was 'broad brush' in approach. What was needed for Queenborough was a deeper understanding of the historical development of the town, an in-depth analysis of its built environment, and identification of the historic assets that many may wish to see retained in the new proposals. The Inspector, Peter Kendall, requested a study from the Architectural Investigation Division of the Research Department. Members of the London and South East Team first undertook a rapid assessment of the buildings to identify, as far as possible from an 'eyeballing' exercise, the type, function, date, scale and materials of the buildings. Documentary research led to a fuller understanding of the historical development of the town using maps, municipal records, housing records, private company records, newspaper reports, historical illustrations, aerial photographs and even photographs in the possession of local people.

The new road bridge over the River Swale linking Sheppey to the mainland, with the monumental 1960s road and rail lifting bridge to the right. The new bridge will link heavy traffic to Queenborough's proposed relief road

Queenborough Creek, once filled with oyster dredgers and merchants' boats, is now used by small fishing and leisure boats. To the south of the creek lies as yet undeveloped marsh land earmarked for residential development in the emerging master plan

Queenborough began as a tiny Saxon fishing village but was developed as a 'planted settlement' in the 14th century to support an innovatory castle built by King Edward III. The new settlement was given its charter in 1368, becoming the Royal Borough of Queenborough, named in honour of Edward's wife, Queen Philippa. The castle was demolished in 1650 (ironically not long before the Dutch incursion of the Thames and Medway in 1667), and nothing remains above ground, except for some modern caps over the castle well. (The castle site was the subject of a recent television programme by the Time Team, who identified a massive robber trench.) The medieval parish church, coeval with the castle, survives in the High Street. This is the ancient route that linked the castle to the waterfront, and is now lined with houses dating from the early 18th century to the late 20th century. There is also a fine late 18th-century Guildhall, Queenborough's landmark building, and historically the centre of the town's administration. It is still in use for local government functions.

South of the High Street is Queenborough's defining and delightful natural feature, the creek of the river Swale which has provided a natural harbour for fishing boats and merchant ships for centuries, and is its *raison d'etre*. The town's strategic location, in the Thames estuary at the mouth of the rivers Medway and Swale, gave Queenborough a significance and status that belies its modest size. The town quay was extended in the late 19th century for use by those employed in new industries associated with 'noxious trades'. Copperas extraction had been established in Queenborough from the late-16th century, and superseded by chemical and glue manufacture. Some industrial activity continues around the creek area, alongside the fishermen and leisure boats. Surrounding streets in 'outer Queenborough' comprise early 20th century residential suburbs, mostly workers' terraced houses with overspill Edwardian and interwar private and council housing.

Queenborough quay, renovated by Swale Council in 1988, with the rear elevations of the High Street buildings, including the impressive late 18th -century development, Evans Row

The Queenborough and Rushenden Historic Area Appraisal charts the historical development of the town, and subsequent chapters focus on the High Street, industry and housing, in order to provide a fuller picture. The final section of the report looks forward to the potential impact of new areas of development on the town and its satellite housing estate. The relationship between new and old in Queenborough and Rushenden – how future development will sit within the historic environment – poses exciting challenges and opportunities for those developing the master plan. By promoting an understanding of the forces that shaped Queenborough's development in the past, it is possible to gain a deeper insight into its present form and character when considering future opportunities for its renewal.

The Appraisal will be of interest to those decision-makers – conservation officers, planners and developers – needing a better grasp of its history and legacy. While it remains a charming, picturesque place to the visitor, Queenborough is not a 'chocolate box' Kentish town. It retains evidence of its economic vicissitudes. It still has the low-lying, marshy, muddy topography and gritty industrial aspect that encapsulates its history. It is essential, in the face of much needed regeneration, that something of this sense of place and history that distinguishes Queenborough as a riparian settlement in the Thames Gateway, is retained. The local people want expansion and regeneration: new housing, more job opportunities, better schools, adequate healthcare, additional leisure facilities and an improved transport infrastructure. But they also want to see the character of its historic core and elements of its rich maritime and industrial past retained.

The aim of the report is to inform and contribute to the debate about the future of Queenborough and Rushenden as they face major expansion. By highlighting the significant, sensitive and designated areas, the Appraisal can be used as a planning tool to manage change within the historic environment and, at a wider level, to demonstrate that investment in historic assets directly contributes to the wider socio-economic benefits of regeneration.

Susie Barson and Geraint Franklin

Until the end of the 19th century, Queenborough's industry confined itself to the eastern side of the creek, seen in the foreground of this 1940's AP. In the 20th century, with the establishment of the Rushenden Industrial Estate, industry spilled out onto the reclaimed Rushenden marshes. Today very little remains of this unparalleled period of industrial growth

RESEARCH THEMES AND PROGRAMMES

A 2 C 2 D 1

EXPLOITATION AND WORKING OF METALS

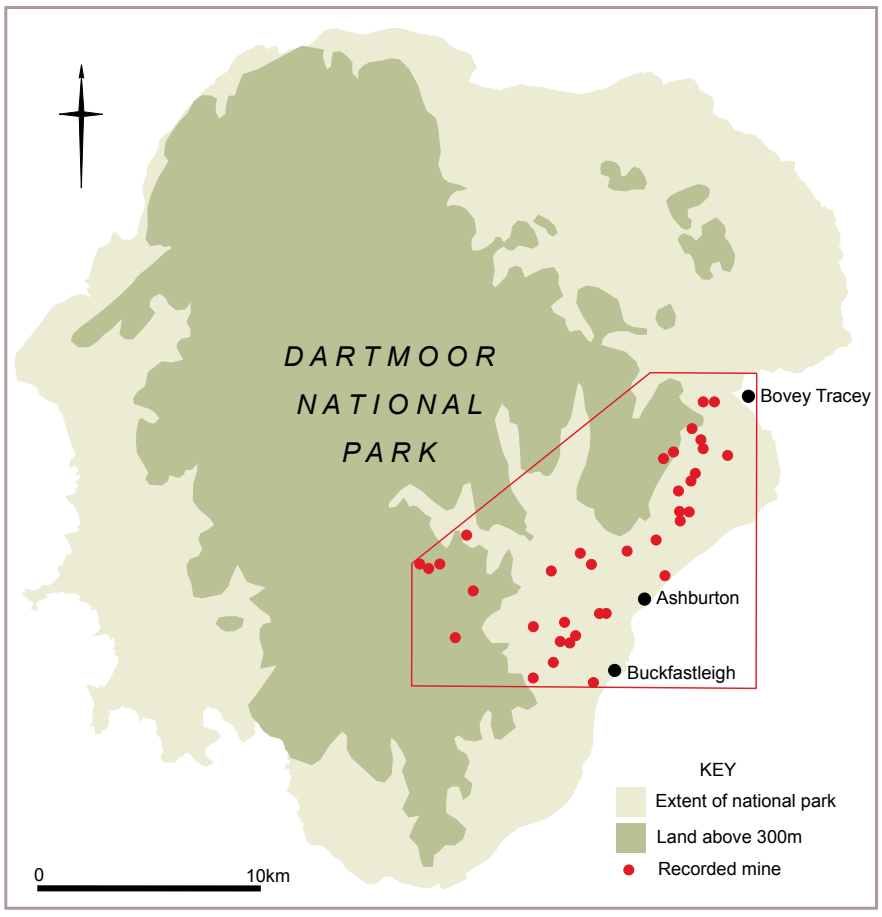
Rediscovering Dartmoor's metal mines

Field investigation is helping to shed light on the importance of metal mining within the relatively unexplored peripheral woodlands of Dartmoor National Park.

The extraction of tin on Dartmoor has a documented history and associated archaeology stretching back well into the medieval period and by the 18th-century tin, together with copper and silver-lead had all become part of a thriving mining industry. Although a good amount of research has taken place on Dartmoor in the past, fieldwork has been confined mostly to the uplands where mining remains are freely accessible and restricted mainly to the exploitation of tin.

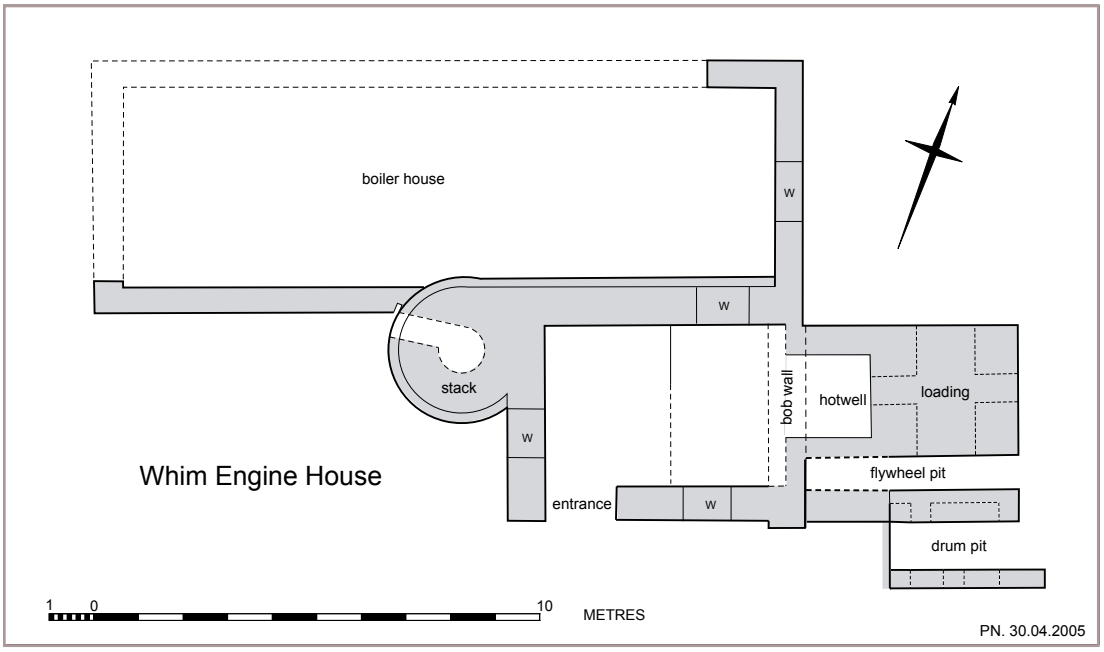
For the peripheries of Dartmoor where tin, copper and other metals have been mined, much less is known. The majority of these mines lie in secluded, private and often wooded areas, where little systematic field investigation has taken place. However, many mines are known from documentation and of these a good number are known to poses field remains. Contemporary photography and documentary record alone can tell us that these were in some instances large, productive complexes and important places of work, employing hundreds of people, often forming the economic heart of small rural communities. Upon abandonment the machinery was removed and the sites left to decay undisturbed to be overwhelmed by trees and undergrowth.

Dartmoor National Park and the extents of the pilot survey



Dartmoor National Park Authority (DNPA) has very little relevant information on these mines, relying almost totally on the Devon Historic Environment Record (HER) where entries for this category of monument in this peripheral location are almost non-existent. An increase in requests for survey and information from the DNPA archaeologists was one reason why an initiative on this theme was deemed a priority.

In winter 2005-6 the EH investigation team based at Exeter began a pilot project examining surface evidence of mining in the Ashburton and Buckfastleigh district. This covers an area of approximately 174 km^2 on the south-east corner of the National Park, and is one of three areas eventually to be investigated. The first aim of the project has been to identify as many mines as possible through desktop survey of published literature followed by field reconnaissance. This has been combined with an exercise to collate primary documentary sources, where available, to help guide fieldwork and aid interpretation. Within the pilot area, a total of 35 sites where field evidence of mining is present have been identified so far and various levels of survey will now be

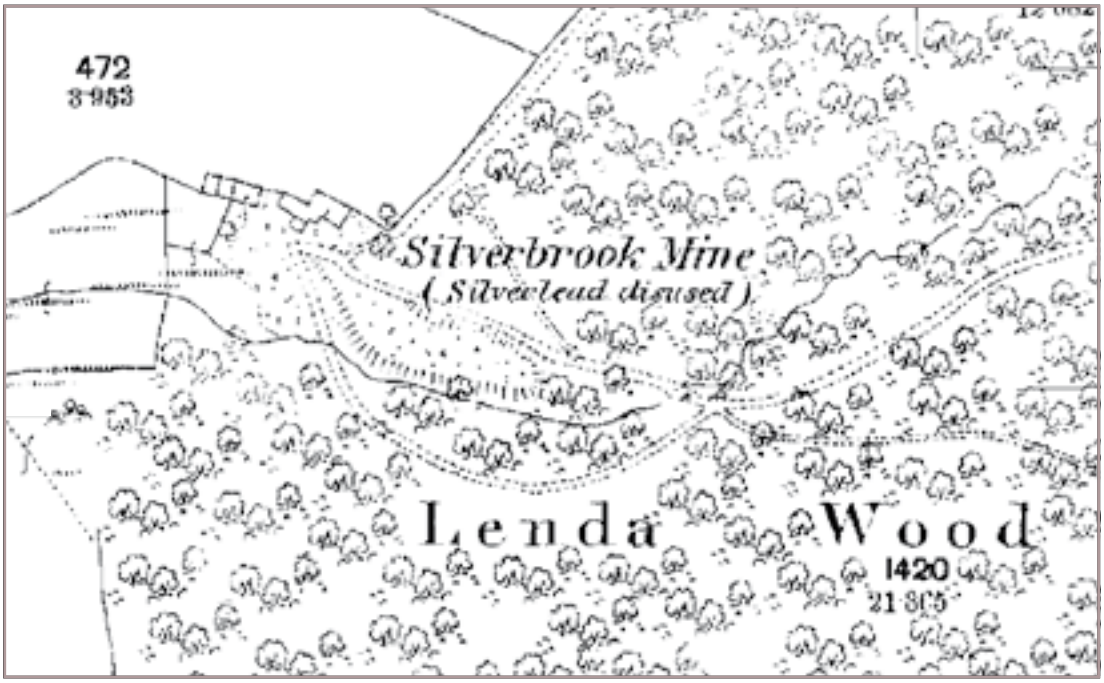


Plan of an engine house at the Buckfastleigh mines. Though the structure is now collapsed, enough remains to interpret its function as a winding or 'whim' house used to hoist material in a nearby shaft

carried out to record them. Several of the documented sites could never have been described as anything beyond a prospect during their working life. Although often having much associated documentation for the short period they operated, which frequently describes their whereabouts, the field remains consist of either a single adit portal or blocked shaft and require little survey beyond noting their position, a description and, where possible, a record photograph. Some mines, usually those

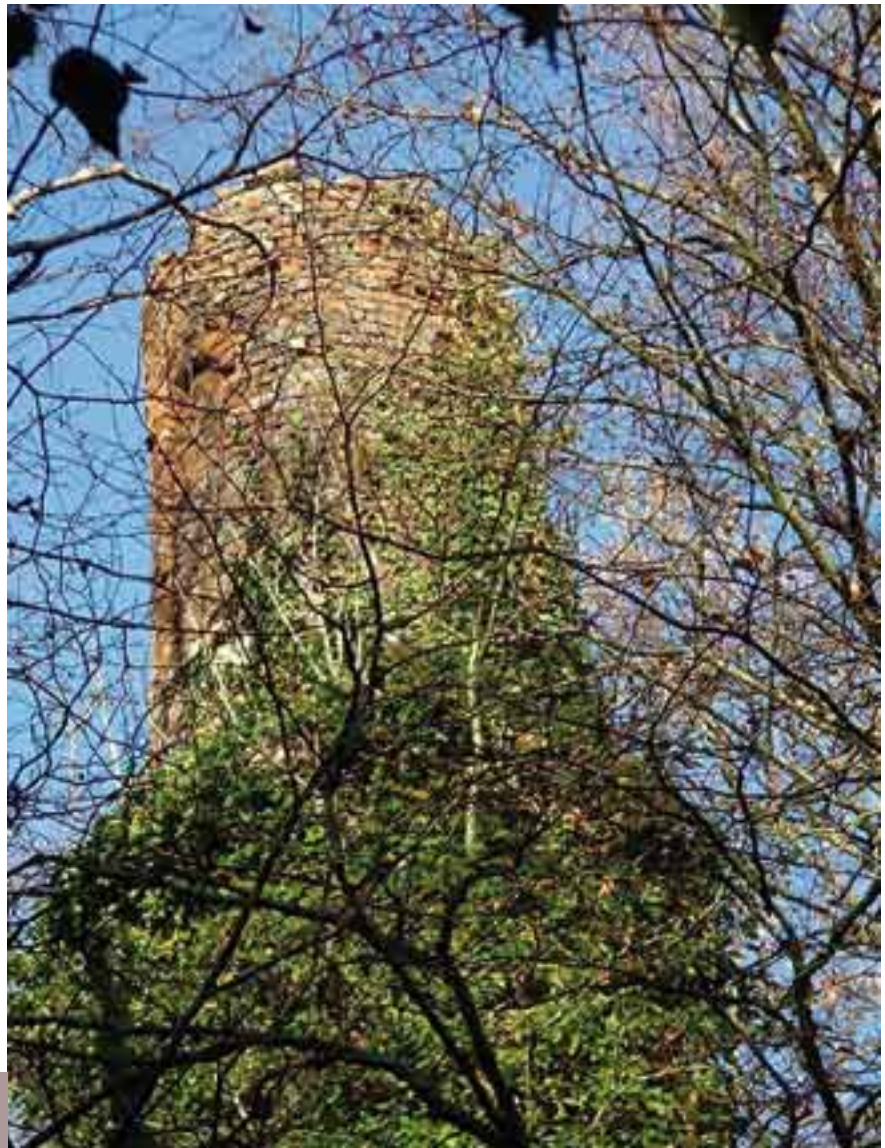
The collapsed remains of the whim engine house at Buckfastleigh mines

Typical OS representation of a disused mine on the 1st Edition 25-inch OS map of 1886



where significant structures once stood, are quite well represented on the OS first edition 25-inch map of 1886-7 and later editions. Although these plans are nearly always incomplete they can form a suitable basis onto which additional material can be surveyed and an adequate depiction of the site's main surviving features may be established through traditional surveying techniques. There is however a significant number of sites where reconnaissance has revealed the survival of substantive and intriguing remains and in these cases the only way to really advance our understanding is to undertake survey. This we are doing at a variety of scales at selected sites.

The ivy-clad top of the chimney at Arundell Mine, Ashburton, built in 1854



The main outcome of this work, apart from the obvious benefits of increasing our understanding of a hugely neglected part of Dartmoor National Park's historic environment, will be a detailed report discussing the significance of the surface remains at both the individual mines and in each district as a whole. Such information will be vital to help inform the increasing number of woodland management plans which are being negotiated on and around the National Park. A more indirect benefit is the raising of awareness among residents in the locality, of an industry where many of their ancestors worked though its material legacy is becoming largely forgotten.

The majority of the sites are within dense, privately-owned woodland with no public access, where only a few archaeologists have trod before yet it has been very refreshing to find how interested and cooperative many of the landowners have been when we have explained what we are doing and why. They

are often highly enthusiastic about the historical aspects of their estate and keen for as much information as possible. This positive contact with such people, who are in effect custodians of these mainly unprotected archaeological sites, is a tremendous bonus.

One important part of the recording process is to report observations on the current condition of the remains; such issues as the state of preservation and stability of buildings and threats from intrusive growth of trees and undergrowth. Having identified problems at several mines it has been possible for appropriate woodland management to take place by both the DNPA, through professional contractors, and by conservation volunteers with archaeological supervision provided by EH staff. At a small handful of mines however, including one large and important example, survey has not been possible because of the density of vegetation. In such cases all that can realistically be done is to flag the site as a priority for attention in the future.

Although only a small EH project in terms of staff commitment, a modest programme of outreach has already been possible, including lectures and guided walks. The highlight of this has been a Heritage Open Day attended by 60 mainly local people in September 2005, held at south Devon's most productive 19th-century copper mine in Buckfastleigh and led by EH staff. The site had already been surveyed by our team with the aid of a partnership grant from DNPA, who had also undertaken woodland clearance at our request. It was a particularly significant event because access to this place, which has some of the most impressive 19th-century mining remains to be found within the National Park, is normally very restricted.

Phil Newman

The interior of an open work or 'gunnis' at a copper mine near Ashburton

A well defined round buddle, where crushed tin ore was concentrated, at a heavily wooded site in the Meavy Valley, near Clearbrook

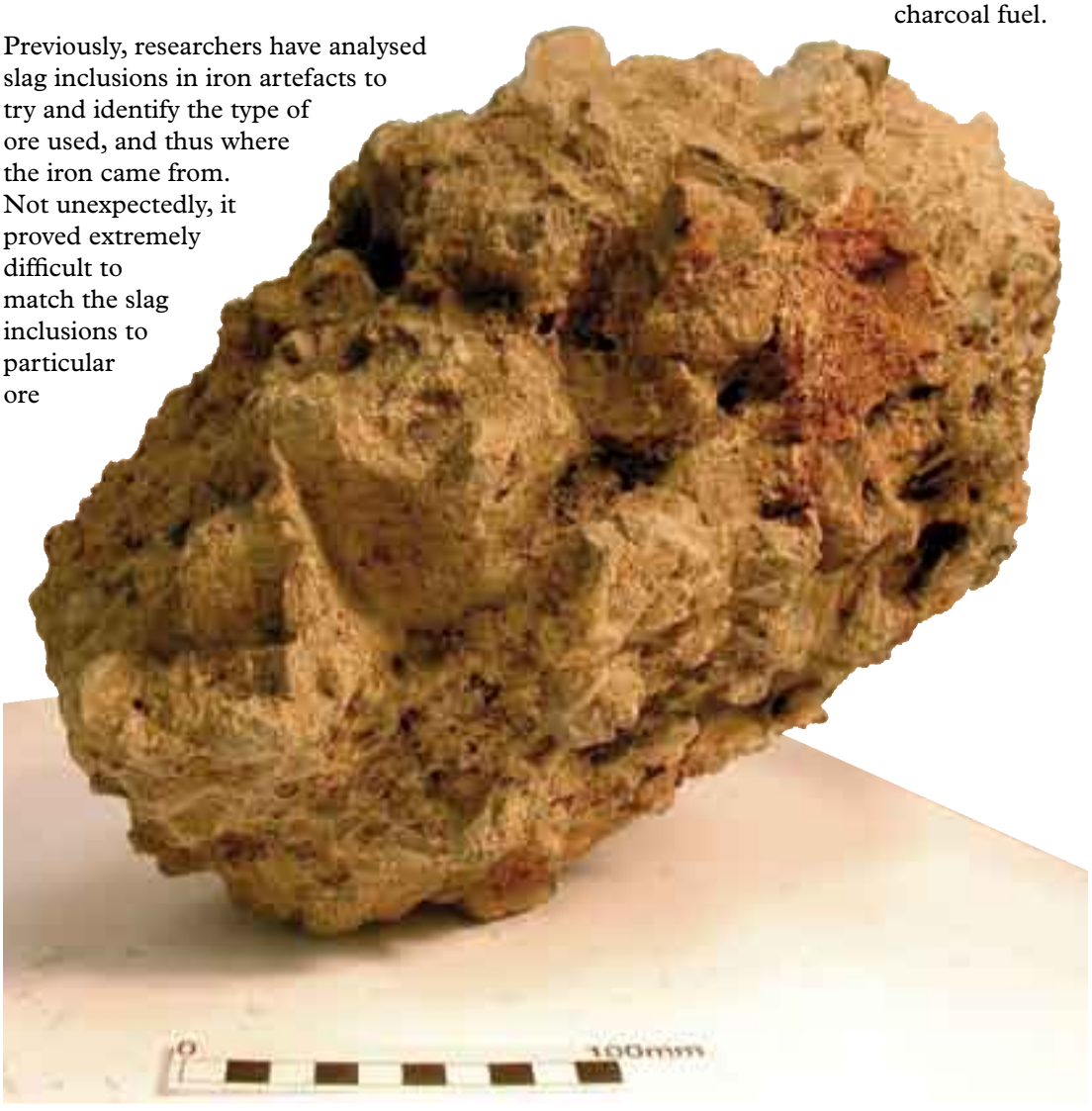
EXPLOITATION AND WORKING OF METALS

Provenancing iron – is slag the key?

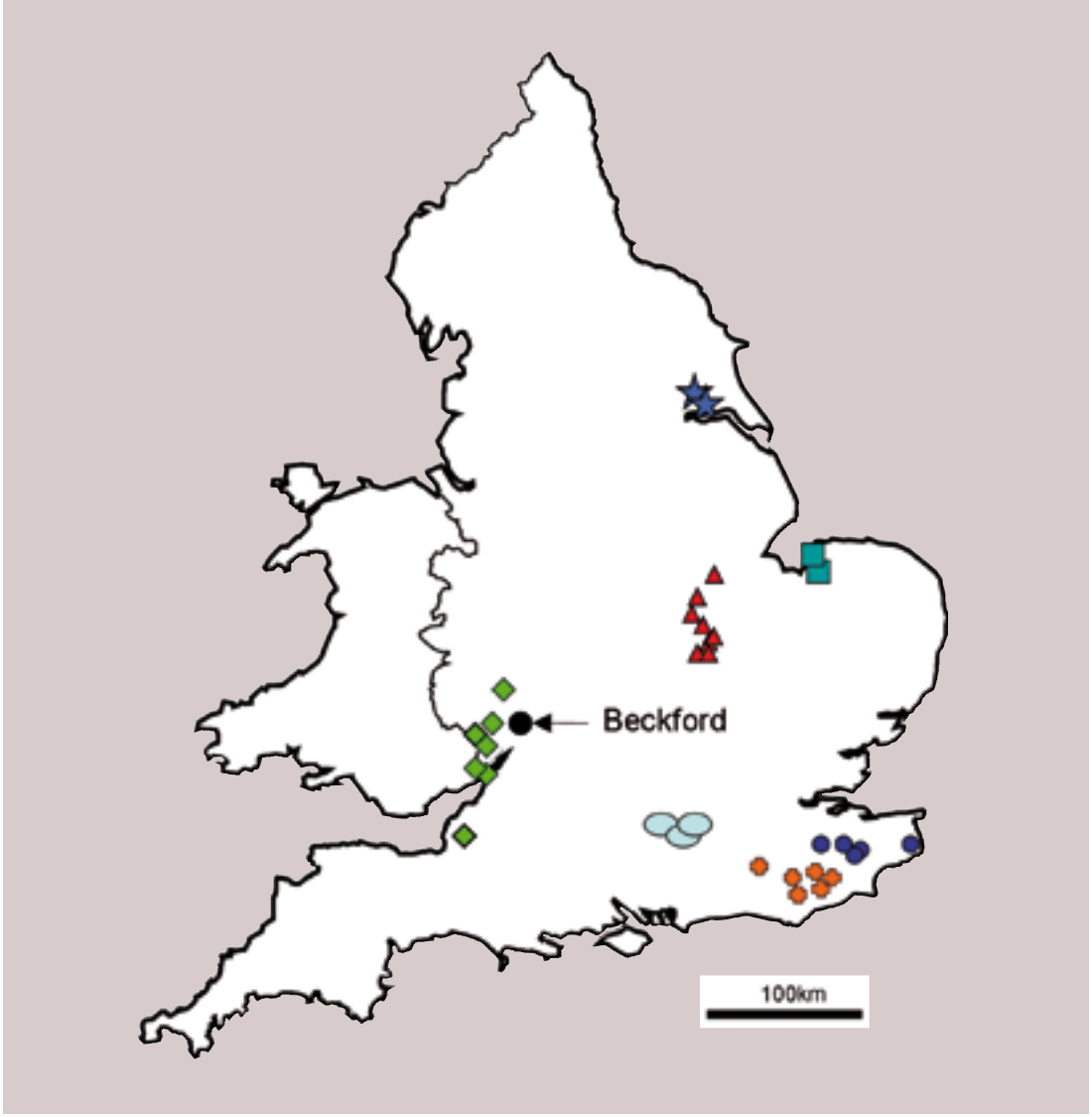
New research on an often underappreciated type of archaeological find shows potential for identifying the sources of iron objects.

The earliest method used to extract iron metal from ore was the bloomery smelting process. Each smelt produced a spongey 'bloom' of iron metal and also waste in the form of a molten slag. Although for the most part the metal and slag separated quite cleanly, tiny amounts of slag would become trapped in the consolidated bloom, and these remained in the iron even after it was forged into an object.

Previously, researchers have analysed slag inclusions in iron artefacts to try and identify the type of ore used, and thus where the iron came from. Not unexpectedly, it proved extremely difficult to match the slag inclusions to particular ore sources. One of the major problems is that iron ores are found all over the country, not just in a few areas. We generally don't know what type of ore was used in different areas or time periods, and have little compositional information on most of them anyway. Another problem is that the composition of the slag is influenced by other materials in addition to the ore used, such as clay from the furnace walls and ashes from the charcoal fuel.



Hidden potential: Detailed examination of slag can help to identify the raw materials, conditions and type of furnace used for smelting. Information of this nature has been compiled for slag from sites across England, enabling regional and chronological comparisons. The 13 kg slag mass shown, from an Iron Age / Romano-British site, collected in a pit with one inclined side (thus the angled base), packed with large pieces of charcoal or wood and also straw (from impressions in the slag)



Map of England and Wales with the sites included in the study shown by seven different types of coloured symbol, according to their regional group. The slag from all of the sites in each regional group shared a similar 'chemical fingerprint'. The hoard of currency bars found at Beckford (indicated on the map) were probably made in the Forest of Dean and Bristol-Mendip region; sites in this regional group are shown by green diamond symbols

In this study, the problem was approached from a different angle using an abundant but under-utilised resource – the smelting slag routinely recovered from archaeological excavations the length and breadth of England. The initial focus was on the Iron Age and Romano-British periods and it was noticed that slags from nearby sites were chemically similar to each other, since ironworkers used local ore sources and built their furnaces from local clay. We could therefore establish a chemical 'fingerprint' for the slag from a number of geological regions. For some regions, the 'fingerprint' was very distinctive, making it more likely that we could identify slag inclusions with matching characteristics.

The method was tested on Iron Age currency bars, which are thought to be a type of trade iron, so named because of a passage from Caesar's account of the invasion of Britain appearing to record the use of iron bars as currency. The bars are different shapes and sizes and have different distribution patterns. For example a hoard of bars found at Beckford, in Hereford and Worcestershire were of a type that tends to be concentrated around the mouth of the River Severn and in Somerset. We found that the slag inclusions in these bars matched the particularly distinctive chemical fingerprint for slag from the Forest of Dean and Bristol-Mendip region, indicating that this group of bars were made somewhere in that area.

Until fairly recently, the smelting slag recovered from archaeological sites was rarely given detailed attention. However, analysis of slag can help to answer many outstanding archaeological questions; ones that we have been unable to answer by other means. We can identify the raw materials, smelting conditions and furnace types that were used (even where no furnace survives), and investigate associated issues, such as how settlement patterns relate to ore sources and the transfer of knowledge and materials between regions and cultures. Ultimately, we aim to explore the production and trade of iron itself. This work will be reported in *Archaeometry* (48 pt 2) later this year.

Sarah Paynter

EXPLOITATION AND WORKING OF METALS

High-speed video of micro-slags

High-speed video shows the formation process of an ubiquitous product of ironworking, frequently found on archaeological sites.

Archaeological evidence for metalworking comes in various forms but one of the most interesting is hammerscale, which forms when a blacksmith forges iron. The sparks that fly off during smithing are actually tiny fragments of slag, and these when cold become hammerscale. They collect on the smithy floor and usually remain undisturbed – until the archaeometallurgists arrive!

We have worked with archaeologists excavating the remains of blacksmiths' workshops to collect samples of hammerscale and have shown that there are two forms: flakes and spheres. We used a number of different methods, including chemical analysis and microscopes, to look at the internal micro-structure of both types of hammerscale in order to work out how it was formed. The flakes are straight-

A blacksmith forging iron. The sparks are hammerscale

forward: they are the skin of the iron that oxidised in the fire and was later dislodged during forging. The spheres are much more problematic but the theory was that they formed during the forge welding of iron (i.e. joining two pieces of red-hot iron together).

So to test this theory, we set up an experiment where we forged iron and recorded the process with a high-speed digital video camera. The figures show a sequence of stills taken from one of the films. These show a thin stream of very bright material coming out of the weld line which then separates into numerous small spheres. We confirmed that the spheres visible on the video are spherical hammerscale by collecting and examining all of the hammerscale after each stage of the experiment. By using novel approaches we have managed to solve a long-standing archaeological problem.

David Dungworth

Right: High-speed digital film captured the following images:

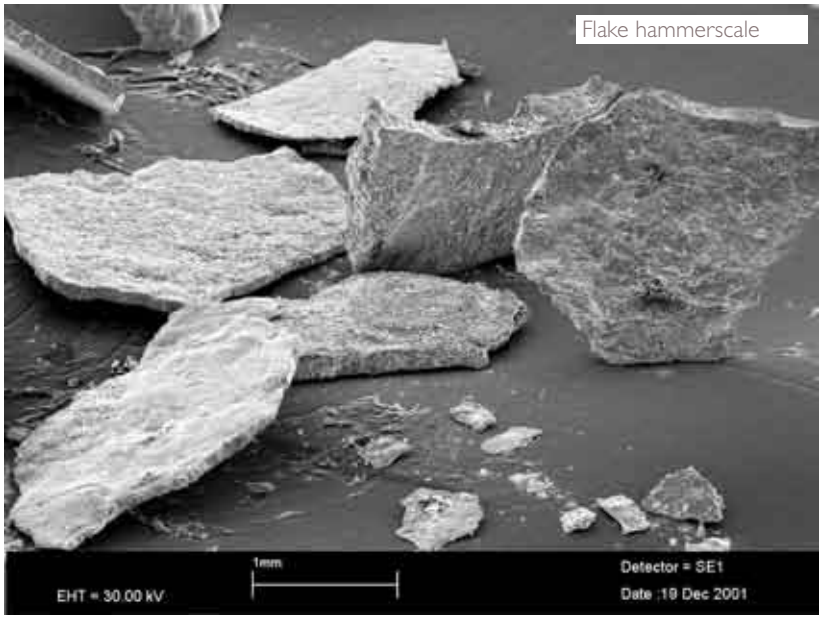
1. Still from high-speed digital film of welding. 0.008 seconds before the hammer struck the iron

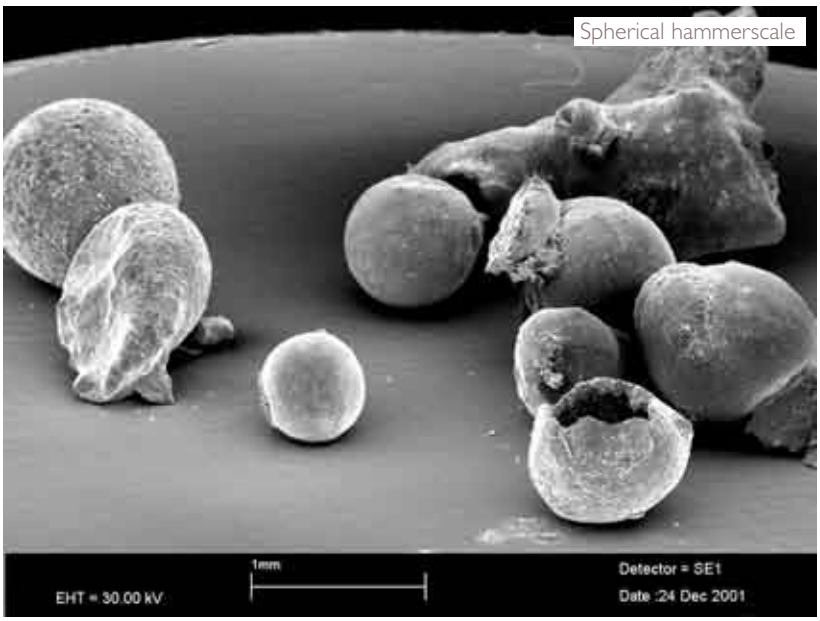
2. Still from high-speed digital film as the hammer struck

3. Still from high-speed digital film 0.008 seconds after the hammer struck

4. Still from high-speed digital film 0.017 seconds after the hammer struck

5. Still from high-speed digital film 0.025 seconds after the hammer struck





EXPLOITATION AND WORKING OF METALS

Roman enamelling

The enthusiasm for enamelled objects in Roman Britain was satisfied by a widespread indigenous industry.

Enamel is basically glass that is fused to another material, usually metal. In Roman times this metal was normally a copper alloy, and champlevé enamelling was a common form of decoration in the North-West provinces. The sunken fields that hold the enamel were cut or cast into small objects such as seal boxes, studs and brooches, and are also found on metal vessels such as ink wells, paterae and bath-oil flasks.

Recent archaeological work in England has confimed the old assumption that enamelled objects were made in the Roman province of Britannia. Material has been examined as part of work on Historic Environment Enabling Programme projects, as well as work towards the recently published volume on Roman brooches *(Research News 2)*. The discoveries include moulds for casting metal objects – with sunken fields designed to take enamel – and raw enamel that would have been used to decorate them.

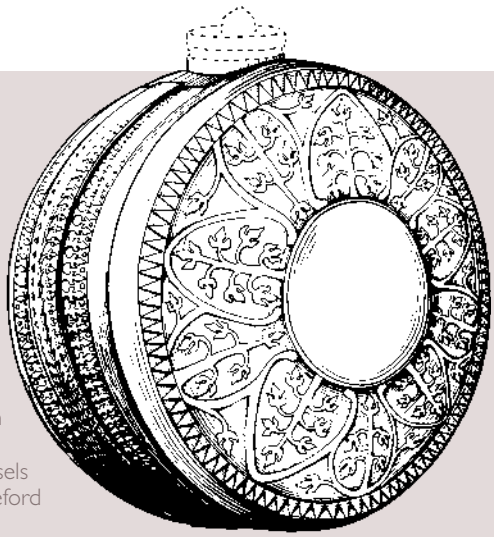
Two large groups of moulds are particularly exciting. Those from Compton Dando on the Mendips are for a range of headstud and T-shaped brooches that can be dated typologically to the later 1st and 2nd centuries. These types are most common in the South-West, so it is good to have evidence that they really were made there. The enamel is present in small fields, often triangular or lozenge-shaped, in a range of colours.

The second group of moulds, now published, is from a late 1st century context in Castleford, Yorkshire and is for making multi-part vessels. At least two vessel forms and 20 different patterns of enamelling are represented. Some of the patterns have small geometric fields while on others the enamel provides a background to reserved metal in curvilinear and foliage designs. No vessels of the main form made at Castleford are known in Britain, but there is one 19th-century find from Pinguente in Istria, now in the Kunsthistorisches Museum in Vienna. A vessel of a different form but with a pattern of enamelling duplicated on the Castleford moulds was found more recently in Nijmegen. It is not surprising that so few complete vessels survive, but what is interesting is where they have been found – either there was a thriving export trade or the craftsman who made them travelled widely in the Roman Empire or, perhaps more likely, they were cherished by their owners who kept them as they moved about.

Another site in Castleford, 300m south of the pit containing the moulds, has produced four

Clay mould for a T-shaped brooch from Compton Dando, with relief on the bow to produce triangular and lozenge-shaped fields in the casting (photo © Bristol City Museum and Art Gallery)

Fragment of a clay mould for a flask. The upstanding design produced sunken fields in the casting that were filled with enamel



Reconstruction of one of the enamelled vessels made in Castleford

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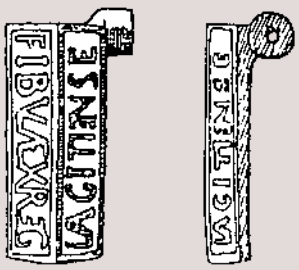
lumps of raw red enamel, probably of 2nd-century date. Their date and findspot means they are not likely to be related to the vessel-making, but possible products for a 2nd-century enameller in Castleford are brooches. In particular there are two metal-detector finds of inscribed brooches, drawn to my attention by Hilary Cool, that say *fibula ex reg[ione] Lagitiensis* – which translates as 'brooch from Castleford'!

It is not unexpected that the only finds of raw enamel are red as this is one of the commonest colours on Roman enamels. However it is not the only colour used, and possible sources for blues, which are also common, and to a lesser extent other colours, would be the glass tesserae that are found only rarely in mosaics in Britain but relatively commonly in occupation deposits.

Justine Bayley

Raw enamel from Castleford.

Enamelled brooch made in Castleford with inscription



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Comment should be sent to Tony Wilmott at:
English Heritage,
Fort Cumberland,
Fort Cumberland Road,
Eastney,
Portsmouth, PO4 9LD.
Telephone: 023 9285 6700
Fax: 023 9285 6701
Email: fort.cumberland@english-heritage.org.uk

AIR RAID PRECAUTIONS

The 'Listening Ears' – a meeting of 'cutting-edge' technologies

Acoustic sound mirrors were the 'cutting-edge' early warning technology before World War II and the development of radar. Their surviving remains are captivating but fragile.

Sound mirrors were developed in secrecy over a 14 year period, and were built at various locations along the south and north-east coastline of England, where they were to form part of a trial early warning system for detecting incoming aerial invasion. They worked by collecting sound waves which were reflected and focused onto a sound collector sited at the 'focal-point' of the mirror. As well as amplifying the sound waves, this microphone could be rotated by a trained 'listener' so as to pick up the maximum sound reflected off the mirror and thereby establish the direction of any in-coming aircraft. Although trials demonstrated the technology did work (as recently proved by acousticians from the National Physics Laboratory, for the recent BBC/Open University Coast series), and could detect aircraft approaching from up to 25 miles away, by the outbreak of the second world war the technology was already being superseded by radar which could provide far greater and more accurate early warnings. A combination of measurement difficulties, compounded by the increasing environmental noise in the area, and the fact that aircraft became much faster and more agile soon rendered the acoustic mirrors redundant. However some features of the technology, including the associated reporting mechanisms, contributed significantly to the development and success of radar.

The most famous examples of acoustic mirrors in England are at Denge on the Dungeness peninsula of the Kent coast, near to the village of Greatstone-on-Sea. Known colloquially as the 'Listening Ears' the site consists of three large concrete reflectors, built between 1928 and 1939, that watch out across the English Channel. This site formed the Government research establishment for the technology where from 1928 up to the outbreak of the Second World War various experiments were undertaken using three different designs of parabolic mirror – one long 200ft curved wall and two smaller 20ft and 30ft diameter dishes. Although the technology did actually work –- the rapid and widespread adoption of radar in the 1930's promptly rendered it obsolete for early warning systems. The site closed in 1937 but its historical significance still survives as all three reflectors are now scheduled ancient monuments. This has provided important legislative protection, particularly in recent years following the commencement of gravel extraction from the huge shingle beaches around Dungeness, although it has not prevented the gradual weathering and deterioration of these reinforced concrete structures through natural decay.

The 200ft, 20ft and 30ft reflectors at Greatstone

The major recent work at the site has focused on first understanding the condition of the structures and the threat to their stability due to the lake formed by aggregate extraction and then on addressing the most immediate risks. As a result and using funds available through the ALSF, the lake edge and access causeway was reinforced using gabions and material was reintroduced around and under the structures to regain physical stability. Where an early attempt had been made to demolish the acoustic wall (supposedly to prevent the warning technology falling into enemy hands in the event of an invasion) damaged concrete buttresses were repaired. Additional funds were secured from the EU through Interreg IIIa and the Historic Fortifications Network. These permitted the main repairs to be completed but also interpretation works to keep open the possibility of eventual public access to the site and works to explore how best to repair the fabric of the structures. Due to their remote location and the age of the concrete, the structures are a ready made test bed for experiments with repair and conservation measures. Such work is increasingly a conservation issue as more concrete structures are recognised for their historic significance.

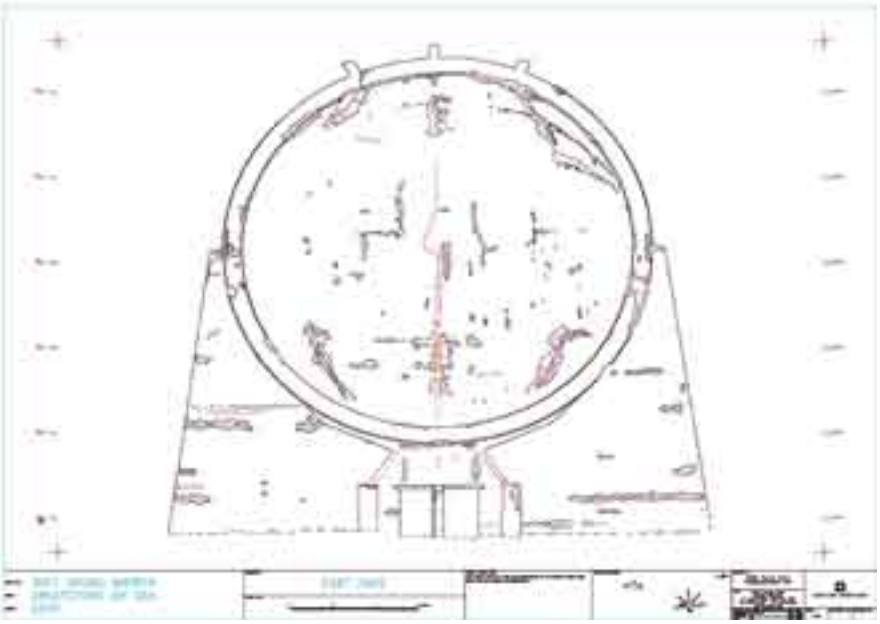
In 2005 an experiment took place to apply cathodic protection to the interior of the 30 foot bowl and this has confirmed that the application of a low current in the reinforcement rods of the concrete will prolong the life of the structure. As an alternative to this intrusive technique experiments took place with chemical inhibitors that are applied to the surface of the concrete. Early results indicate some positive benefit but this needs to be monitored over several years. Finally experiments were made with methods of finishing areas of new concrete repairs to achieve a better match to the appearance of the historic concrete. In order to gauge both the effectiveness of modern repairs and enable monitoring of the structure's condition over time, a baseline record was required.

All survey techniques, be they traditional or modern, possess inherent characteristics that make them more appropriate for application on certain types of structure. For instance 3D laser scanning, with its 'blanket' approach to mass data capture, is more suited to rapidly recording surface information rather than 'hard-edge' detail. On the other hand photogrammetry, through the acquisition

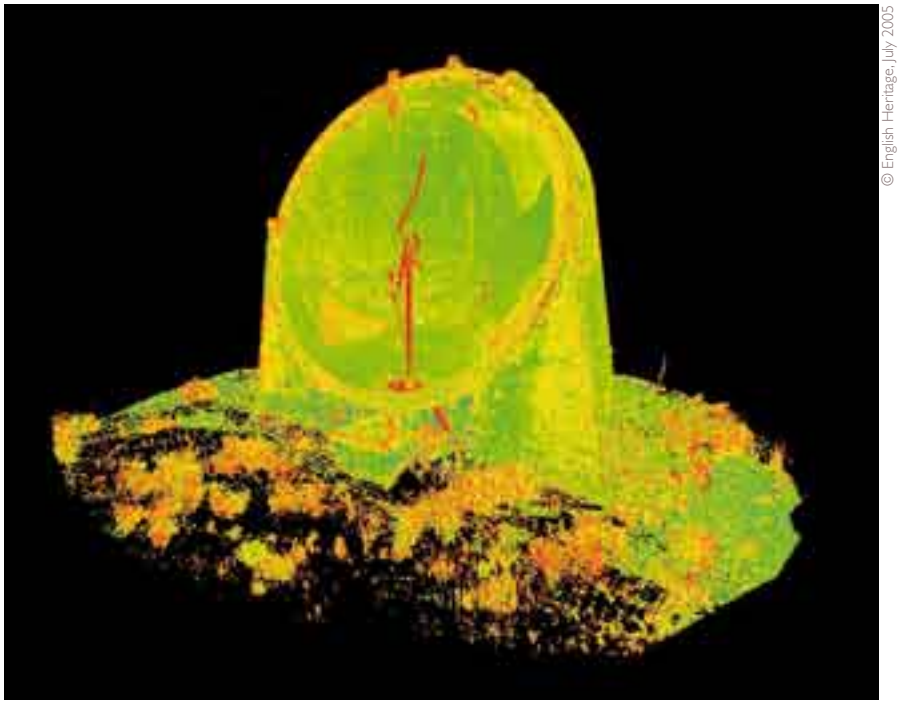
The 30ft reflector at Greatstone

of stereo-photography, is able to provide mechanisms for selectively capturing both edge and surface detail albeit at a much slower rate due to the post-processing requirements. Therefore when faced with the challenge of surveying the Greatstone reflectors, which are now effectively irregular concrete shapes due to the effects of weathering, a combined photogrammetric/ laser scanning approach was deemed appropriate – photogrammetry to provide accurate line drawings of the basic structural outline, including any visible areas of degradation, and laser scanning to three dimensionally record the concrete surfaces.

The photogrammetric survey was carried out in August 2005 by the York based Photogrammetric Unit, part of EH's Metric Survey Team. A total of 156 stereo-pairs were



Photogrammetrically derived line drawing of the East Face of the 30ft sound mirror, Greatstone



Point cloud data captured by terrestrial laser scanner for the 30ft Reflector

captured on site using a combination of both large format, film-based photography (Wild P31 metric camera) and smaller format but high-resolution digital imagery (Kodak DCS Pro SLR/n – 14MPixel). Three dimensional survey control was observed to reference targets, positioned directly on the concrete structures, using the units new Leica TCRA 1203 total station theodolite. Following scanning of the film based photography the line drawings, outlining both the principal architectural detailing and any visible areas of decay, were digitised on one of the units' own Digital Photogrammetric Workstations running BAE Systems SocetSet software. The resultant digital data was formatted within AutoCAD prior to output, as scaled hard copy plots on film, and deposition within the Historic Plans Room, part of the National Monuments Record in Swindon. As EH does not currently own a laser scanner, this element of the survey was carried out using a commercial contractor funded directly by the project budget. Following competitive tendering APR Services Ltd based in Southgate, London were commissioned based on a brief provided by the Metric Survey team that was based upon the draft laser scanning specification currently being derived through the EH-funded Heritage3D project (www.heritage3d.org). Site scanning was carried out over a 2 day period in July 2005 using 2 different terrestrial laser scanners – a Leica HDS3000 and a Mensi GS101 – capturing a specified data resolution of +5mm on the 20ft and 30ft dishes and +10mm on the longer, 200ft wall.

To help minimise the likelihood of voids appearing in the data, three dimensional point clouds were observed from a number of different scanner locations. All observed scans were registered together and referenced to the site co-ordinate system, that was previously determined during the topographic survey of the site undertaken back in March 2003 by EDI Surveys Ltd from Ipswich. The observed point cloud data was post-processed using a combination of Cyclone, Realworks and Polyworks software so as to provide a series of meshed models outputted as OBJ files – an industry standard format for exporting 3D model data.

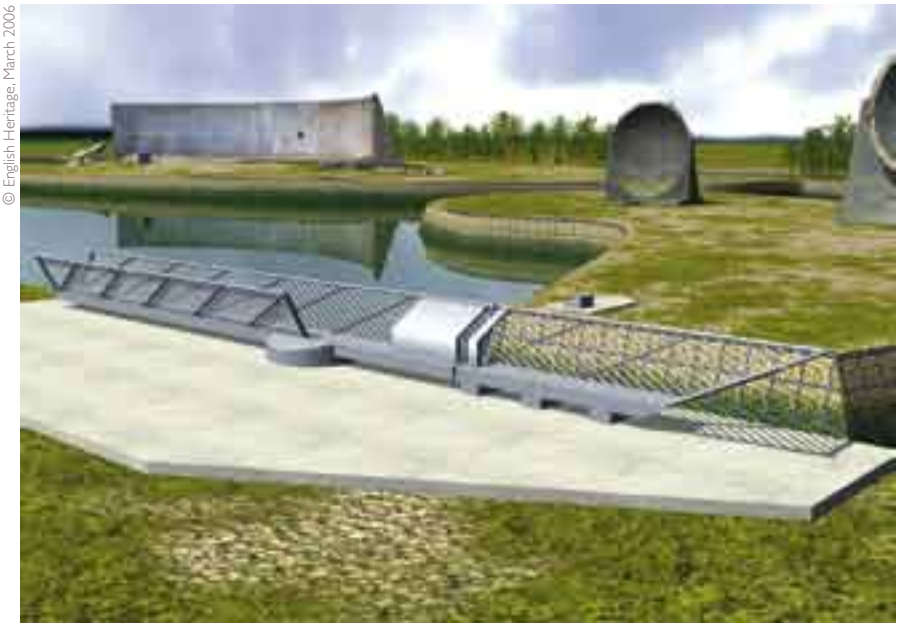
Still image taken from the recently completed 3D animation for the Greatstone 'Listening Ears', produced by Viriditas UK Ltd

As well as providing an accurate and detailed base-line record of each structure, this combination of data had the additional benefit of enabling a computer generated animation to be made for the site. Given the limited public access, the availability of such material will undoubtedly prove useful in providing at least virtual access to such an interesting site. Although the Metric Survey team still retain an in-house 3D modelling capability, given the short timescale and limited availability of additional project funding, it was decided to sub-contract this element as well. Viriditas UK Ltd, based in Wolverhampton, were subsequently commissioned in December 2005 to produce a detailed animation and textured 3D model of the site based on the existing photogrammetric, laser scanning and topographic survey datasets. This work was principally carried out using AutoDesk's 3D Studio Max software, producing a 5MB model file (excluding textures), along with Adobe Photoshop for manipulation of image textures.

Although such a model could theoretically have been generated from just one of the existing datasets, the combination and abundancy of available data/imagery has certainly accelerated the entire modelling process as well as enhancing both the accuracy and quality of the final product. The finished model has just been delivered to EH and although negotiations are still on-going, would appear ideal for dissemination over the web through either EH's own website and/or a local site, such as Kent County Council's Historic Fortifications Network (www.fortifications.org).

The three structures at Greatstone are not the only listening devices sited along the Kent coast as 10 miles further east on the MOD ranges lies the single reflector at Hythe. Built by an entirely different method to the Greatstone examples, it used a metal framework to support a 30 foot reflector bowl shape in concrete. Although now encircled by a substantial chain-link and barbed wire fence, the site is not designated and is rapidly deteriorating due to corrosion of the supporting frame which has allowed a significant amount of the concrete structure to literally drop away.

As with Greatstone a detailed record was requested by the SE region so as to capture the precise shape and alignment of the bowl which, in the event of a total collapse, would



Another still image taken from the recently completed 3D animation for the Greatstone 'Listening Ears', produced by Viriditas UK Ltd

at least allow reconstruction of all or part of the structure. However during project planning it became clear that the MOD, through Defence Estates, had previously commissioned their own record including the application of laser scanning technology. Although access to this data is still under discussion, the level of in-house EH survey was therefore reduced to include just a photogrammetric element. The site work for this was carried out between June and August 2005 followed by a period of analytical plotting from the 54 stereo-pairs, to provide a base-level survey in conventional line-based form.

The legacy of acoustic mirror technology remains in the various concrete structures that still (just) survive along England's coastline. Threatened by natural decay and possible encroachment through environmental exploitation, such captivating structures certainly warrant a high level of recording and protection before they totally disappear from our landscape. Modern survey technologies can aid this through their abilities to rapidly capture both accurate, geometric form and texture whilst three dimensional modelling can present this data in unique and interesting ways. Thus whilst future public access to structures like the Greatstone 'Listening Ears' will remain strictly controlled and limited for the foreseeable future we are now able to look to provide access and tours through other 'virtual' means.

***Paul Bryan** (with contributions from **Peter Kendall and Alan Wright**)*

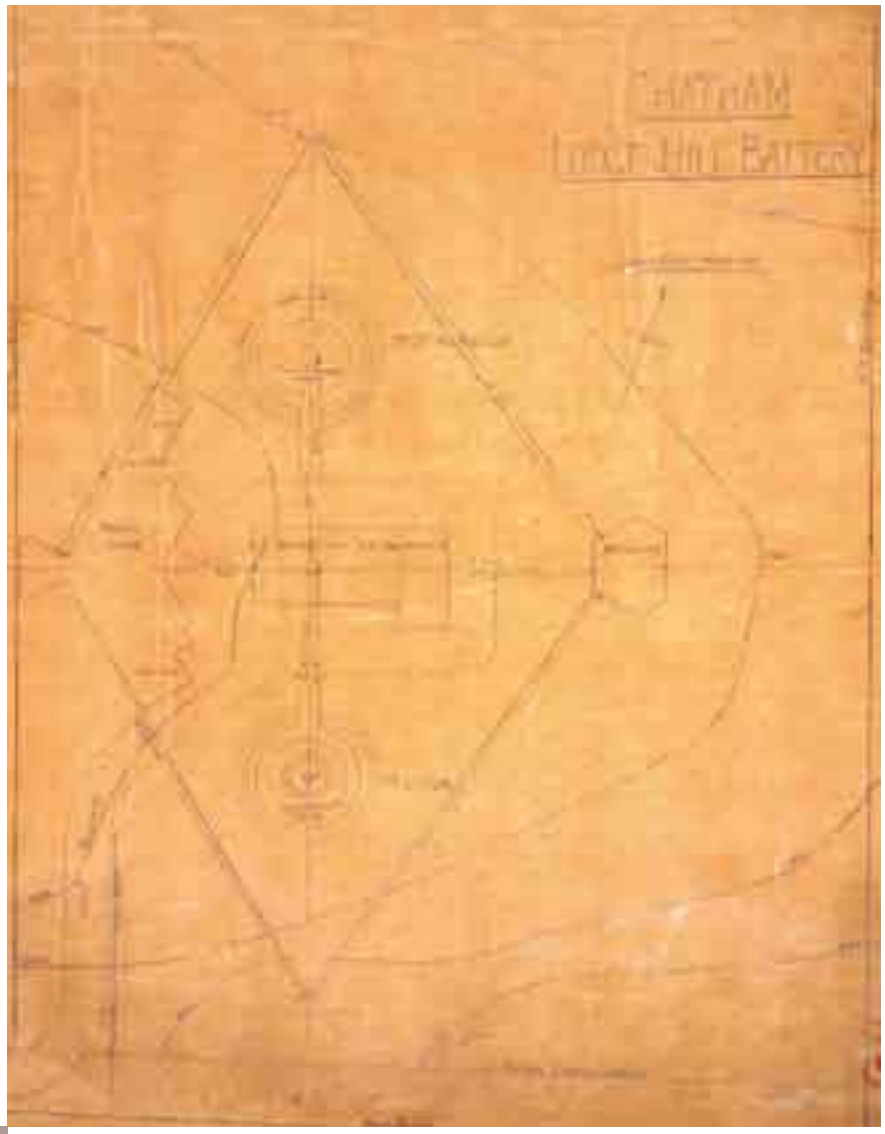
Single Reflector at Hythe

AIR RAID PRECAUTIONS

The birth of Ack-Ack: the battery at Lodge Hill, Kent

Constructed before the start of World War I, the Lodge Hill battery is one of the two earliest purpose-built anti-aircraft batteries in Britain.

Chatham Dockyard is uniquely associated with the birth of the Royal Navy. It was an important base from the mid 16th-century and there was always a great need to defend it, as shown by the disastrous events of June 1667 when Admiral de Ruyter's Dutch forces fought their way up the Medway and inflicted serious damage on the English fleet. From that time defences were constructed around the growing dockyard and its myriad support installations, barracks, military buildings and stores. The defences became very elaborate and, in the 18th century, took the form of a continuous bastioned trace. In the late 19th century, this was largely superceded by a ring of concrete forts further inland, as the range and power of artillery had greatly increased.



Plan of Lodge Hill AA Battery, c1914 (PRO: WO 78/4400/4)

The dockyard is now closed but the Army maintain a substantial training facility at the Royal School of Military Engineering, based in Brompton Barracks and using training areas in and around the Medway conurbation. Like much of the MOD estate, it is being reduced by the disposal of land excess to requirements. This land contains the extensive and substantial remains of military and naval activity in the form of buildings, earthworks and altered landscape, forming a major series of monuments connected with one of the most important naval and military installations in the British Isles.

English Heritage is committed to influencing development sufficiently to protect the best elements of that installation, while also encouraging beneficial and exemplary development which enhances the historic environment. Archaeological Survey and Investigation are working with SE Region to further that goal through a process of negotiation, monitoring and standard setting. Early in 2006, AS&I staff carried out two small but detailed surveys and investigations on important parts of the estate. One is a section of the 18th-century bastioned lines which lies outside the currently-defined area of the Scheduled Monument, the other is a First World War anti-aircraft (AA) battery. The latter is the principal subject of this article.

Lodge Hill is no ordinary AA battery. It is one of a pair which formed the first permanent AA stations built in the British Isles. During 1912 the Admiralty were becoming increasingly worried about the potential threat of aerial bombardment to the huge magazines at Chattenden and Lodge Hill, just north of

Chatham and the Medway. These stored a vast amount of ammunition which was transported to and from another storage facility on the banks of the Medway at Upnor, via a purpose-built railway. During the early months of 1913, emergency measures were taken by establishing two temporary batteries on prominent hilltops overlooking the Thames and Medway estuaries. One of these was on Lodge Hill, a high east-west ridge occupying the watershed between the Thames and Medway rivers, and guns were installed here by April 1913. Given that there was very little experience of anti-aircraft tactics and virtually no specialised weapons, conventional guns were simply adapted and placed on improvised mountings, in this case 6-inch breech-loading howitzers on substantial wooden platforms.

At the same time, development was in an advanced state for the production of a purpose-made AA gun, the 3-inch quick-firer (QF). Plans were made to install two of these guns in two batteries, at Lodge Hill and at the nearby Beacon Hill, closer to Upnor. Work began on their permanent concrete emplacements from February 1913, and all was complete, with guns installed, early in 1914. Until the 3-inch QF entered full production, each battery was at first equipped with just one, the second emplacements receiving the smaller 1-pounder QF ("pom-pom"). Lodge Hill remained in use until the middle of 1916, when AA cover for London and the approaches was re-organised, but it saw action on numerous occasions against German zeppelin attacks.

Lodge Hill battery was carefully designed, forming a diamond shape in plan, defined by a fenced perimeter. Within the fence, the buildings were arranged symmetrically to enable close defence. The circular concrete emplacements were placed to north and south of an ammunition/artillery store, for easy supply and storage of ammunition and spares, with the east and west flanks protected by a war shelter (a pillbox) and a loopholed barrack block, both of which were able to provide small arms fire for close defence along the flanks of the fence and on the wider approaches to the battery.

Today, all of the battery structures are roofed and intact, a remarkable survival due in no small part to continued use, particularly during the Second World War when a Bofors light AA battery re-used the site, but also for farm storage and for various and continuing training regimes by the Royal Engineers. Earthworks in the immediate vicinity of the battery buildings may be connected with both a construction camp known to have existed in 1913, or perhaps with the howitzers installed temporarily around the same date.

Lodge Hill today, showing the ammunition store (at left) and blockhouse (at right)

Research into Lodge Hill and its sister battery on Beacon Hill will continue, focusing on establishing the chronology and history of the batteries, the origin and inspiration for their design, and the rarity of the survival. The authors are very interested in hearing from anyone who knows of surviving remains, or of historic plans and designs, for First World War AA batteries across the British Isles. What is clear is that the Lodge Hill site is not only rare but possibly unique in its completeness, and certainly worthy of protection as a monument of national importance because of its place in the pioneering development and response to aerial warfare in the twentieth century.

Paul Pattison and Sarah Newsome

The north emplacement at Lodge Hill, with the Thames estuary lying beyond it

NOTES & NEWS

A round-up of activities and developments showing some of the scope and variety of projects that are ongoing in the Research Department.

ANDREW SAINT

At the beginning of May Professor Andrew Saint took up his duties as General Editor of the Survey of London. The pre-eminent English architectural historian of his generation and a scholar of international repute, Andrew comes to English Heritage from the University of Cambridge, where since 1995 he has been Professor of Architecture. In fact, for him it is a return both to English Heritage – where he previously headed the London architectural historians, now subsumed in the London Architectural Investigation team – and to the Survey itself.

Before joining the Survey in 1974 as Architectural Editor, Andrew had read classics at Oxford and historical studies at the Warburg Institute, becoming in 1971 lecturer in the History of Art at the University of Essex. During this time he researched and wrote his acclaimed monograph *Richard Norman Shaw* (1976). This was followed by the *Image of the Architect* (1983), which looks at how architects see themselves and are seen by others, and *Towards a Social Architecture* (1987), a study of school building in England after 1945. He was both a contributor to and joint editor of Yale's recent magisterial volume on St Paul's Cathedral. Currently he is completing a book examining the ways in which architects and engineers in Britain, France and the United States have worked together (or failed to work together) since 1660. A prolific and entertaining author of occasional pieces, Andrew writes regularly for newspapers and periodicals, his contributions ranging from a history of the children's playground equipment in a public park in Kettering to an elegy on the demise of the Routemaster bus.

At the Survey, Andrew was instrumental in breaking down the anachronistic division of labour between his post of Architectural Editor, which had formerly been concerned only with the writing of rather arid 'architectural descriptions', and the historians making up the rest of the editorial staff. He returns to the Survey with undiminished enthusiasm for its work and achievements. Of his time at Cambridge he says, 'the good thing about the last ten years is that one learns to be so much more international in approach', and he hopes the Survey will be able to benefit from this wider vision.

Andrew is only the fourth person to hold the position of General Editor of the Survey since it was made a permanent full-time post in 1954. He is pictured here, on the right, with all his predecessors at the launch of *Survey of London Online*.

The present and previous General Editors of the Survey of London, right to left, Andrew Saint, Francis Sheppard, Hermione Hobhouse and John Greenacombe

GEOFFREY CHAUCER SCHOOL, SOUTHWARK

Education is undergoing its greatest transformation since the Second World War, with many local authorities rebuilding most or all of their stock as part of the Government's 'Schools for the Future' initiative. The number of post-war listed schools is tiny, and looks likely to remain so given the pace of change and the denudation of many buildings by ill-considered changes. Geoffrey Chaucer is one of those listed schools, built in 1958-60

to the designs of Chamberlin, Powell and Bon, architects of the Barbican, and listed in March 1993. Now, too, it is proposed to replace most of it with new buildings, leaving only the distinctive assembly hall block. Designs for new buildings have been produced by Future Systems, creators of the Media Centre at Lord's and Selfridge's store in Birmingham.

Faced with these high-powered proposals, English Heritage's London Advisory Committee asked for more information on the school's construction, and its place in the history of school building and its architects' work. The greatest sources of information were a surviving former partner of CPB, Frank Woods, and their engineer, Dr Anthony Flint of Flint and Neill. CPB destroyed most of their practice records, but copious minutes and reports of the London County Council survive in the London Metropolitan Archives. 57 secondary schools were built by this one authority in the years 1945-62, and focusing in detail on one case has helped organise our thoughts on the subject as a whole. Twentieth-century schools in particular are under serious threat, and it is important that we talk to those who designed them while they too are still with us.

Elain Harwood

Geoffrey Chaucer School by Chamberlin, Powell and Bon (1958-60), showing the pentagonal assembly hall with its hyperbolic paraboloid roof of sprayed concrete (Gunite) construction

ILLICIT GOLD REFINING IN A LONDON SLUM?

Recent excavations by the Museum of London Archaeology Service have uncovered cess-pits associated with an infamous 19th-century slum (Wild Court Rookery). A number of crucibles recovered contained traces of gold but the contemporary census does not describe any of the occupants as gold workers. The work was undertaken in order to illustrate how materials science techniques could be extended to study an era that is almost ignored by archaeological scientists. The work complemented our recent work on the use of scientific techniques to understand historic industries and ties in with the new guidelines.

We examined cross-sections of the crucible fragments using a scanning electron microscope. This technique allows us to view the internal structure of objects at high magnifications and also to analyse discrete spots.

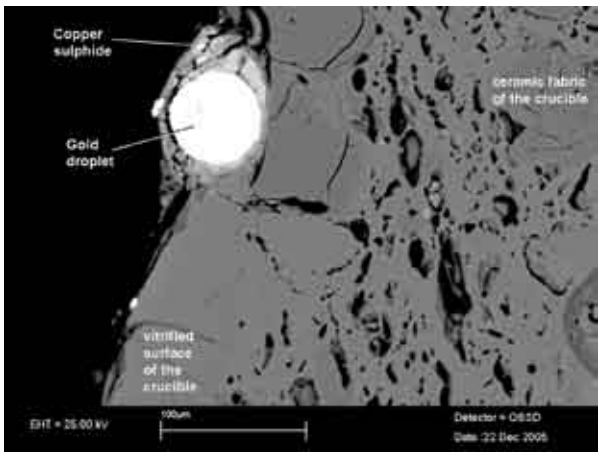
Analysis showed that one of the crucibles had been used for separating silver and gold, but using two different techniques. The inner vitrified surface of the crucible was rich in sodium and chlorine with traces of silver, which suggests the use of the ancient technique of salt parting. When a gold-silver alloy is heated with salt, the silver reacts with the chlorine in the salt and is removed. It appears that this crucible was then re-used at a later date for sulphur parting, since droplets of gold on the vitrified layer are surrounded by thin films of copper and silver sulphides. If a gold-silver alloy is melted with sulphur, the silver reacts with the sulphur leaving the gold behind.

These crucibles were used to refine precious metals using technologies which had become obsolete centuries earlier. From the 13th century onwards, gold workers began to use nitric acid to remove silver from gold and, as a result, salt and sulphur parting gradually went out of practice in Europe. A late 18th-century authority on gold refining said of salt parting,

> The process indeed appears upon the whole to be incommodious, whether considered as a method of purifying gold or of ascertaining its purity; and accordingly, though once in much esteem, it is now rarely practised.
> Lewis 1765: 155

Why were these outdated refining methods used? One possibility is that the crucibles from Wild Court Rookery were used to refine stolen gold. The 'fence' might have avoided using nitric acid so as not to draw attention to their activities.

David Dungworth



Scanning electron microscope image of a cross-section through one of the crucibles. The bright circle is a droplet of gold which is surrounded by a grey film of copper sulphide

Setting up a plane table at the beginning of the survey photograph © Archenfield Archaeology

LANDSCAPE ORIGINS OF THE WYE VALLEY

On the weekend of 4th-5th March, Swindon Archaeological Survey and Investigation team, with staff from Archenfield Archaeology, delivered a training course in basic earthwork survey for local volunteers participating in this community archaeology project. The site chosen for the exercise was a field immediately north of St Dubricius' Church, Hentland, just part of the well preserved historic landscape surrounding this isolated, early church with its holy spring. The weekend's work produced the plan of a hollow way and field system, with some possible building platforms – at least one medieval building is known to have stood on the far side of the church, which is the centre for a network of hollow ways and other tracks.

The volunteers will now go on to record further earthworks at Hentland, as well as other sites in the valley.

Mark Bowden and Nicky Smith

Police Constable F. A. V. Moore (365G)

365G OR MOORE GRAFFITI

The policemen's graffiti on a brick wall in Clerkenwell that featured in the first issue of *Research News* was subsequently the subject of an article in *The Guardian*. This was noticed by a descendant of Constable Frederick Albert Victor Moore, who had been identified as the boldest of the police graffiti artists. Correspondence with the Moore family ensued and they have kindly sent us this photograph of P.C. Moore, looking every inch the model of Victorian authority. His incriminating collar number – 365G – is clearly visible.

PARTNERSHIP IN LEARNING: METRIC SURVEY TEAM AND THE RAYMOND LEMAIRE INTERNATIONAL CENTRE FOR CONSERVATION

The Raymond Lemaire International Centre for Conservation (RLICC) organises an advanced interdisciplinary and international study programme in architectural conservation, aimed mainly at architects, architectural engineers, civil engineers, art historians and archaeologists who intend to specialise in the field of the protection of monuments and sites. It is embedded in the postgraduate programmes of the departments of Architecture, Urban Design and Regional Planning and Civil Engineering of the Faculty of Engineering of the University in Leuven, Belgium. The Centre actively promotes international and interdisciplinary co-operation in its training and research programmes, and maintains strong ties with international heritage organisations, including UNESCO, ICOMOS, the Getty Foundation, and the Council of Europe. Collaborative research and training projects combined with student exchange with these institutions result in an internationally renowned and modern study programme.

The invitation from the Centre to teach heritage documentation skills sprang from the training expertise gained from the Metric Survey Team's delivery of the Measured Survey Summer Schools* from 1989 onwards. The RLICC offers access to a truly unique student base: the international focus means that the skills taught are disseminated worldwide and feedback on the application of metric survey in local projects uniquely validates metric survey practice and procurement. Metric Survey Team supplies a 3-day module on preparing digital data sets for heritage documentation. Involving the use of TheoLt for real-time EDM to CAD work, digital rectified photography with PhoToPlan and (for the first time this year) a live stereo demonstration of digital photogrammetry from photo acquisition to orthophoto generation.

From the first teaching mission November 2001 RLICC was keen extend both practical 'hands on' skill transfer but also procurement skills in documentation; the Team's experience in managing the Framework Agreement for the supply of metric survey is shared as part of the programme. A Partnership agreement

Left:
Students at work in the Groot Begijnhof, Leuven

Centre:
Teaching TheoLT

Right:
Poster for the 2006 Wrest Park Summer School

with RLICC agreed in 2003 for a 5 year term exchanges access to the masters course lecture program at the Centre with the training package and internship places with the Metric Survey Team at English Heritage.

The Centre celebrates is 30th year this year with a special symposium entitled 'Conservation in Changing Societies' and English Heritage is privileged to accept 2 places for professional delegates as part of the exchange agreement.

*This year the summer school is from 27th to 29th June at Wrest Park, Bedfordshire. Contact: sarah.prince@english-heritage.org.uk

Bill Blake

SAWLEY ABBEY

Sawley Abbey in Lancashire, an English Heritage guardianship property, was extensively excavated in the 19th century and again in the 1970s and 80s. The abbey ruins on display to the public are enclosed by a wall, erected around the time of the early excavations when the site first began to attract visitors. An analytical investigation of the site has recently been carried out by the Archaeological Survey and Investigation Team, focusing on the landscape beyond this wall. The work has defined the extent of the outer precinct as well as locating further monastic buildings and the abbey fishponds within it. An extant section of the precinct wall, now used as a field boundary, was also discovered. In addition, the earthwork remains of at least two post-monastic farmsteads were identified within the precinct area. As is often the case, a large post-monastic house was built close to the abbey's claustral range; this had been demolished by 1884 but fragments of it still survive. Maps and field evidence suggest that the first farmstead was removed in the early 19th century to allow the emparkment of the landscape, while the second farmstead was screened from view by a tree-lined boundary.

Abby Hunt

Left:
The eastern part of the post-monastic house at Sawley Abbey

Right:
The surviving section of Sawley Abbey's outer precinct wall

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