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RESEARCH NEWS

The Long Man of Wilmington and Windover Hill – see story page 22

Inside this issue...

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In this issue of *Research News* we report on a wide range of projects being taken forward as part of the National Heritage Protection Plan (NHPP). Sally Evans highlights the role that analysis of aerial photography has played in mapping the historic landscape in the Hull Valley, in the process significantly advancing our understanding of the area in the pre-medieval period. The project has highlighted the extent and rate of damage to archaeological sites, largely the result of ploughing in the post-World War II period. The continuing importance of early aerial photographs taken of a part of the South Downs landscape from 1925 is described by Martyn Barber.

Non-intrusive earthwork survey, often carried out in tandem with remote-sensing, provides a relatively cost-effective way of enhancing our understanding of key sites and landscapes. This approach has been used to great effect to survey Henry V's The Pleasance to the west of Kenilworth Castle and in the recent survey of all the upstanding archaeological monuments within the Stonehenge World Heritage Site. As Mark Bowden and Sharon Soutar explain, this work will inform the interpretation of the Stonehenge landscape in the new visitor centre to be opened later in the year, as will recent conservation of some of the Neolithic and Bronze Age objects to be displayed in it. The latter activity forms part of the wider range of work we undertake, fund, and carry out with others in the heritage science sphere, which, as Gill Campbell outlines, is set out in the new English Heritage Science Strategy.

Science is playing its part in increasing understanding and in the material conservation of our maritime heritage. Mark Dunkley reports on the use of non-destructive ultrasonic thickness testing to identify the condition of metal-hulled sunken vessels, while Dan Pascoe and Angela Middleton outline the recording and investigation of a chain pump recovered from the wreck of the late 17th-century warship *Northumberland*.

Also in this miscellany, Olivia Horsfall-Turner reveals how the results of careful examination of the fabric of the enigmatic Bexwell Barn in Norfolk challenge previous interpretations of its date and original function, and Alison Arnold describes how dendrochronology has confirmed the comparatively early date and completeness of the pews in St Nectan's Church, Hartland, Devon.

This is the last printed edition of *Research News* and special thanks are due to Tony Wilmott (editor) and Vince Griffin (designer) of the newsletter since its inception in 2005. Later this year we shall be publishing an entirely electronic version, perhaps with a different title. It will be expanded to report on applied research undertaken within EH and commissioned by us as part of the NHPP. The e-magazine format will allow us to improve linkages with related EH research reports, serial publications, and NHPP webpages and to better showcase the wide variety of our work in a more accessible way. If you would like to be sent the link to the new e-magazine, and I do hope you will, please email your name and details of your organisation (if appropriate) to ResearchNews@English-Heritage.org.uk.

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Stonehenge's first ever on-site exhibition: conserving the objects for display

In advance of the opening of the new galleries and visitor facilities at Stonehenge later in 2013, a number of Neolithic and Bronze Age objects selected for display have been undergoing conservation treatment.

The artefacts have been selected and loaned from the collections of Salisbury and South Wiltshire Museum, the Duckworth Collection, and The Wiltshire Museum, Devizes. Many of the objects were excavated in the 19th century by archaeologists including Cunnington and Hoare, and already have a long history as museum pieces. As such, most of these objects have undergone historic repairs or previous conservation treatments, some of these at a time before conservation had been established as a discipline. Inevitably some of these early treatments are now failing or were performed in a way that is not considered ethical in current thinking. These objects are particularly interesting as they can demonstrate the history of conservation as a profession, and how attitudes and materials have changed and developed over the past century.

Part of the present conservation work is therefore to investigate historic treatments on the objects. The first step is to examine the objects under the microscope and assess their stability. In some cases conservation materials/or substances can be less stable than the object itself and be at risk of causing damage through its deterioration. For example, an antler macehead was coated with a clear consolidant, and this material is now yellowing and has trapped dirt at the object surface. Where the antler was broken it has peeled slightly and there is a risk that small fragments of the antler will be lost from this surface as the consolidant continues to degrade. From a display point of view this is also making the object appear shiny and yellowed, which is not a true impression of what the macehead would have originally looked like. We are able to remove this old coating and improve both the object's appearance and its stability.

We can also assess stability with X-radiography, which allows us to see cracks or lines of stress, any obscured decoration, and sometimes added materials such as adhesives or solders within the objects.

Conservation materials have been identified with the use of X-ray Fluorescence (XRF) and Fourier Transform Infra-Red

© English Heritage

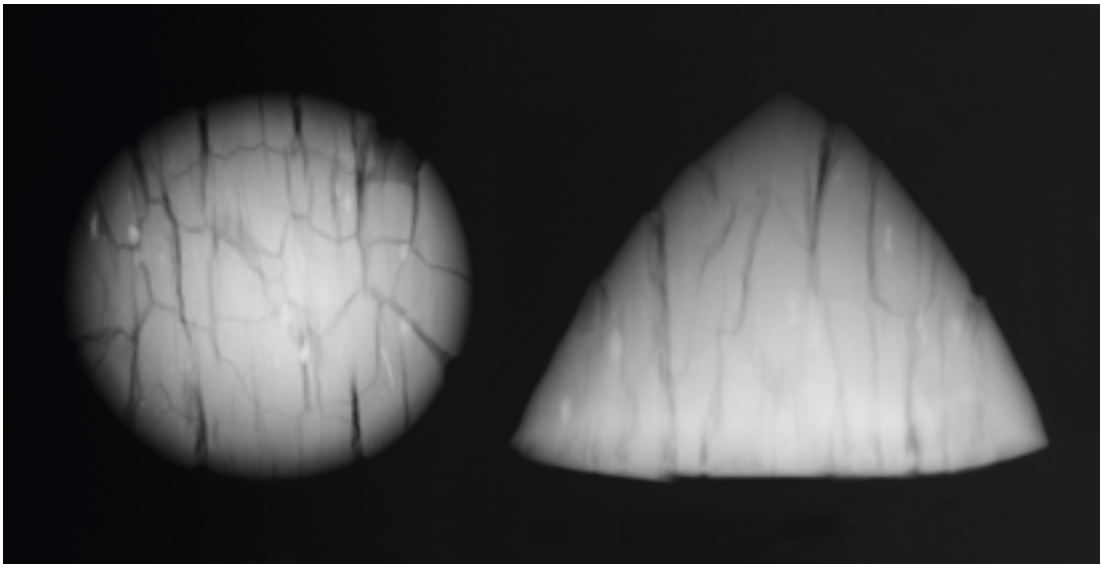
Antler macehead, (a) appearing yellowed due to the discolouration of a consolidant and (b) after recent re-conservation

© English Heritage

Conical shale button and gold foil cover from Wilsford G8 grave group

spectroscopy (FTIR). This allows us to determine what materials have been used historically and therefore what materials should be used now to affect any remedial treatments. For example, the excess adhesive on some ceramic sherds was identified as an animal glue using FTIR, so could be removed from the object using warm water rather than any more powerful solvents. This allows us to apply the principle of minimum intervention and do only what is absolutely necessary to stabilise the objects and enhance their appearance for display.

A combination of these techniques was used for one of the well-known pieces from the Wilsford G8 grave group. This is a conical shale button that was covered with gold foil, with concentric grooves on both and two small holes in the base. The button and cover are now separate and the gold foil has been reconstructed so that the two pieces can be viewed alongside each other. The gold may have been removed from the shale object as a conservation measure, as the shale has cracked and may have expanded and caused the cover to move or crack also. This happens because the shale is sensitive to changes in humidity and will expand and contract accordingly, and at a different rate to the gold foil. The shale button was X-rayed to show the extent of the cracking, which is extensive. A soft consolidant was applied to the button at some point, presumably to stabilise the cracked surfaces. This was tested with FTIR and shown to be a mineral wax, to which a brown pigment has been added to match the original colour. During previous interventive conservation work, a resin was applied to the inside of the gold foil, in order to stabilise the object. The two parts of this object are stable in



© English Heritage

X-radiographs of the Wilsford shale button from above and the side show a pattern of cracking

© English Heritage

A group of flint arrowheads. These required merely gentle cleaning

their current condition, and will be displayed alongside each other, so there will be no work to deconstruct these old treatments or reassemble the object by placing the gold cover back onto the button. However, piecing together the past treatments that have been carried out allows us to pass on a more complete record of the object.

For many of the objects, such as flint tools, animal bones or pottery, it will only be necessary to do some light cleaning, such as removing soil or dust. This allows the objects to be easily interpreted by the visitor without over-cleaning or removing any potentially useful information, such as residues that may have been deposited during the use of the objects.

In other cases the objects will be mounted or lighted in a specific way in order to allow the visitor to appreciate them better, and no conservation work is required. An incised chalk plaque is covered in soil from the burial context and this obscures the carvings and makes it difficult to appreciate them. Removing the soil would jeopardise the object's surface and would be considered unethical. As this is an archaeological artefact, it is entirely appropriate that it should retain this surface. The incised lines can be shown much more clearly by simply casting a low-angled light across the surface than by any amount of cleaning that could be done in the laboratory.

All conservation work is based on an assessment carried out by an accredited conservator. It has been taking place at Fort Cumberland, Portsmouth, under supervision.

Diana McCormack

© English Heritage

Incised chalk plaque (a) Under normal lighting the decoration is not visible, and the surface cannot be cleaned. (b) a low angled light allows the decoration to be displayed without further treatment

Surveying the Stonehenge landscape

The construction of the new Stonehenge Visitor Centre and its new presentation of the monument meant that the landscape of the World Heritage Site had to be re-surveyed to modern standards.

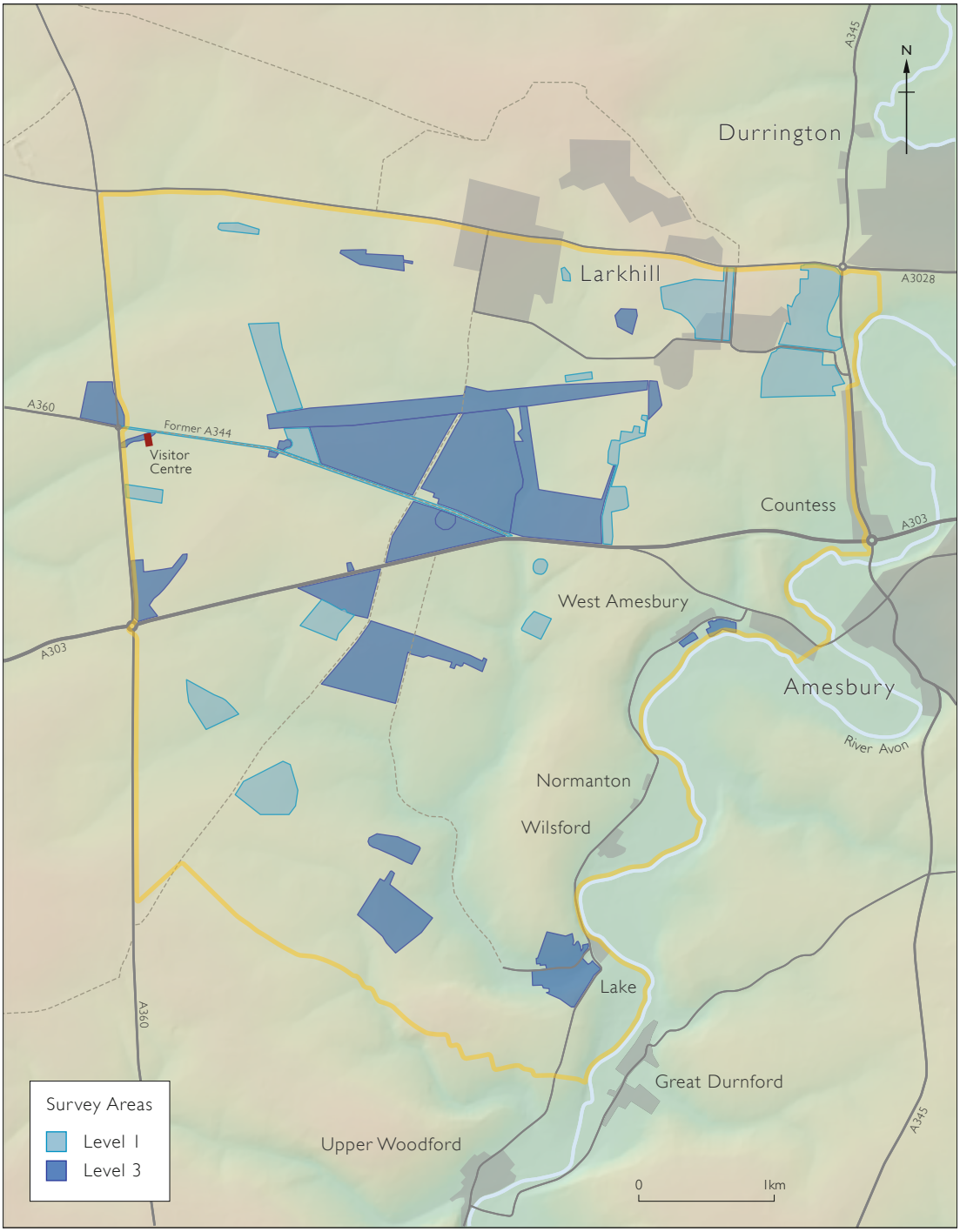
The Stonehenge World Heritage Site (WHS) Landscape Project, started in 2009 by the then EH Archaeological Survey and Investigation Team, was set up to ensure that there is a full and up-to-date record and understanding of all upstanding archaeological monuments within the WHS. Fantastic as it may seem, neither the earthworks of Stonehenge itself nor many of the surrounding monuments had previously been surveyed by archaeologists to modern standards. With the opportunity to re-present this unique monument and its environs to a global audience through the new Visitor Centre, it was vital that this situation was rectified.

We have surveyed Stonehenge itself, the Avenue, the Greater Cursus, all the principal barrow cemeteries and several sites of later date within the WHS in detail; this amounts to just over 15% of the total area of the WHS and includes nearly half (49.44%) of the known or suspected round barrows (i.e. nearly all of those surviving as earthworks). At the same time we looked at the historic buildings in the WHS, and commissioned a laser scan of the stones of Stonehenge (undertaken by the Greenhatch Group and analysed by ArcHeritage) and new photography of the surrounding landscape by James O Davies. The project has involved colleagues from numerous teams within EH (covering aerial, archaeological, architectural, geophysical, technical and photographic survey) and external contractors, and has given training opportunities to a number of EPPIC and student placements. This project has run alongside several university-based projects that have also been studying aspects of Stonehenge and its landscape – notably the Stonehenge Riverside Project, the SPACES (Strumble-Preseli Ancient Communities and Environment Study) Project, and the Stonehenge Hidden Landscapes Project, as well as the recent chronological modelling programme – to mutual benefit.

Anna Komar, an EPPIC placement, surveying slight earthworks on the King Barrow Ridge with a Differential GPS rover

Mark Bowden, © English Heritage

A number of important discoveries have resulted from this project. At Stonehenge itself, the possibility that the so-called 'North Barrow' may be a small henge enclosure and one of the earliest elements of the site has perhaps been one of the most significant observations, but there is also a slight, previously unrecorded mound beneath the south-eastern quadrant of the stone settings. We have demonstrated that this mound is unlikely to be the result of recent disturbance but its significance remains a matter for debate. High resolution GPR survey within the Stonehenge Triangle by Neil Linford, Paul Linford and Andy Payne complements the existing geophysical data

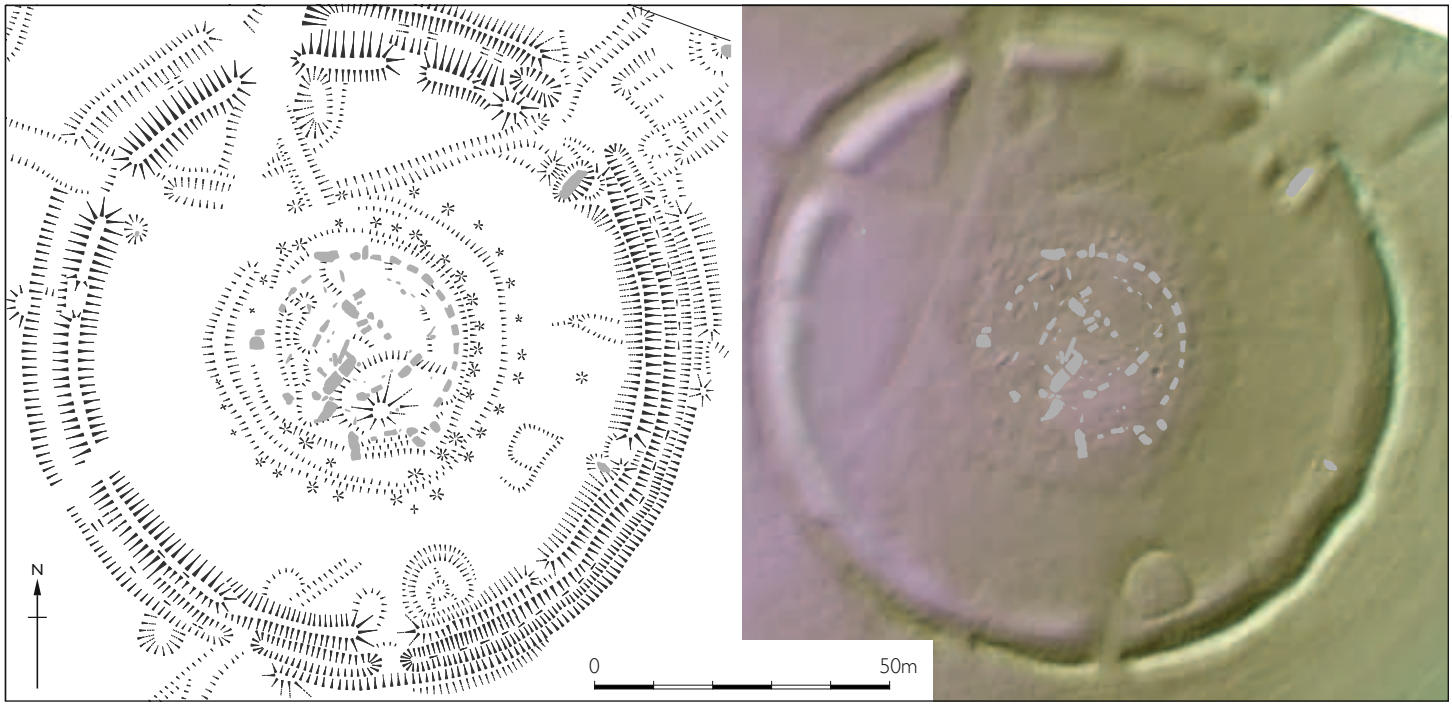


Sharon Soutar © English Heritage

Map of the Stonehenge WHS showing all areas surveyed in detail (Level 3) and more rapidly (Level 1) during the project

and the new earthwork survey. It has added significant evidence for the existence of small early henge monuments under the barrows immediately to the west of the stones, on Stonehenge Down, and further away under Amesbury 50, the so-called 'Wolfhenge'.

Surveys of the barrow cemeteries have revealed details of chronological development, both of individual mounds and of the barrows themselves. At the Wilsford Barrow Group, for instance, one of the least-studied of the Stonehenge cemeteries, it has proved possible, using a combination of antiquarian, field and aerial photographic evidence, to construct a fairly detailed chronology for this disparate barrow group, many of the individual mounds of which have been extensively levelled by modern ploughing. Indeed, one of the more distressing (though not unexpected) discoveries has been the extent to which so much of the chalk downland, which had survived as pasture for centuries or millennia, was damaged by the plough in the mid-20th century, with scant respect shown for the ancient monuments. Happily, there have been significant improvements to the management regime in some of these areas over the last few decades. More land is being reverted to grass through Stewardship agreements and other barrows surviving in woodland are being cleared of trees and scrub.



Sharon Soutar, © English Heritage

Earthwork plan and GPS model of Stonehenge; the GPS data (right) shows that the slight mound under the south-eastern part of the stone settings, observed and plotted on the conventional earthwork plan, is not a figment of the surveyors' imagination. The natural topography falls from west (grey tones) to east (green tones)

The later history of this landscape, so often neglected – understandably, given the pre-eminence of its Neolithic and Bronze Age remains – has been a particular focus of our work. We have studied the medieval village remains at Lake and West Amesbury, and discovered some unexpected survivals in the few standing buildings within the WHS, including an 18th-century aisled barn concealed by its conversion into cottages in the 1930s. The significance of the Arts and Crafts movement of the early 20th century on the architecture of the Avon valley is also notable. The impact of post-medieval emparkment, 'improved' farming practices and route ways – including the turnpikes – have also come under review. But one of the most interesting aspects of the Stonehenge landscape is its important role in early aviation history – from the 1909

Sharon Soutar, © English Heritage

Dave Field, a key member of the project team, explains the relationship of the Avenue, the Heel Stone, and Stonehenge

flying experiments at Larkhill (where some of the earliest surviving aircraft hangars in the world can be found) to the establishment of Stonehenge Aerodrome itself in the First World War. Slight earthworks from the buildings of the aerodrome are still traceable to the south-west of the stones.

The results of the project have been made available in a series of Research Reports (listed on the back pages of this and previous editions of *Research News*) and have been publicised in *British Archaeology* (March/April 2010, Nov/Dec 2012). The main field stage of the project was formally wound up by a Project Board meeting on site in March 2012. A synthesis of the major discoveries and ideas will be published as a fully illustrated EH monograph next year.

Mark Bowden and Sharon Soutar

Sharon Soutar © English Heritage

Air Ministry stone No 6 with the large bell barrow known as the Monarch of the Plain in the background. Although not in its original position, this stone was one of at least 12 marking the boundary of the Stonehenge Aerodrome from around 1917 onwards

The identity of Bexwell Barn, Norfolk

Close fabric analysis and documentary research elucidates the origins of a puzzling building and assists in determining its future use.

Located hard on the road between Downham Market and Crimplesham, Norfolk, stands an enigmatic building. Constructed of a combination of rubble, ashlar and brick, its most striking features are its medieval windows and a porch flanked by two polygonal turrets. Its broad historic and architectural significance is recognised by its designation as a Scheduled Ancient Monument and a Grade-II Listed Building. For several years, however, it has effectively been out of use – a potentially threatening status for any building, even one in secure ownership. Faced with the challenge of deciding what sort of use might be appropriate, the current owners have sought advice from English Heritage. Research has therefore been undertaken into Bexwell Barn's original identity with the intention that understanding its past will constructively inform its future.

Bexwell Barn has been interpreted either as the surviving 15th-century gatehouse of Bexwell Hall or as 16th-century lodgings constructed from post-Dissolution *spolia*. Its listing description characterises it as a 'gatehouse, now barn'. It is hardly surprising that opinion has been divided about the building, as its archaeology is particularly complex and ambiguous, while archival sources are almost entirely silent.

Although Bexwell Barn includes some features of a 15th-century domestic building, close fabric analysis and documentary research suggests that it was in fact constructed in the late eighteenth or early nineteenth century for agricultural use

Olivia Horsfall Turner, © English Heritage

Olivia Horsfall Turner, © English Heritage

The east face of Bexwell Barn is constructed of high-quality ashlar blocks and features a distinctive porch. Although this has given rise to its identification as the former gatehouse of Bexwell Hall, this material is not in situ, and was probably spoliated from another site altogether

The fenestration of the west face has given rise to the presumption that the Barn originally had a domestic function, but the fabric evidence indicates the opposite. In the north wall, there are indications of a wide primary opening, precluding the residential arrangement implied by the fenestration. Furthermore, the windows at ground level are positioned at a height that would make them impractical light sources, and the manner in which they are in-filled suggests that they may always have been blocked. All these elements, not to mention the lack of clarity about staircase provision, flooring-in, and heating, all suggest that the building originally had a non-domestic and probably agricultural purpose.

Another of the Barn's distinctive characteristics is the use of spoliated material. Nikolaus Pevsner and Anthony Emery assumed the fabric to be *in situ* but it is evidently not. Although the windows date from the 15th century, many have been cut down. Likewise, the porch is neither fully coursed in with the building, nor complete, suggesting that part of it has been re-used elsewhere or lost altogether. The arrangement of the ashlar blocks that make up the majority of the east face also show inconsistencies that indicate they have been brought from another site and reassembled.

The quality and quantity of ashlar has led to the suggestion that Bexwell Barn was constructed from ecclesiastical spolia shortly after the Dissolution as lodgings for a manorial administrator. However, in addition to the fabric evidence that argues against the likelihood of its ever having been intended for domestic use, map and documentary evidence suggest that it was probably built in the late 18th or early 19th century.

The earliest known map evidence for Bexwell is provided by William Faden's *Map of Norfolk*, surveyed from 1790 to 1794 and published in 1797. Three buildings are shown associated with Bexwell Hall: a U-plan building (the hall itself) and two further rectangular-plan buildings to the east. Even allowing for the fact that Faden's map is schematic, there is no building that corresponds to the current Barn, or

Olivia Horsfall Turner, © English Heritage

Several of Bexwell Barn's windows have been cut down, indicating that they have been reused. Others are located in positions that would have made them impractical light sources, implying that they were incorporated for aesthetic and historical effect

Courtesy of Warwick Leadley Gallery

Map evidence from Faden's *Map of Norfolk*, surveyed between 1790 and 1794 and published in 1797, shows Bexwell Hall but no sign of a building corresponding to a gatehouse or the Barn

indeed to a gatehouse. The first known map depicting a building that recognisably corresponds to the current footprint of the barn is a plan of Bexwell surveyed in 1832 by J G Lenny, indicating that by that date at the latest, the Barn had been constructed.

Given that the Hall does not appear in Francis Blomefield's 1805 *Essay towards a Topographical History of the County of Norfolk*, it seems likely it was demolished between the surveying of Faden's map and Blomefield's researches – just around the turn of the century. Considering the eventual disappearance of the Hall and the ultimate appearance of the Barn, it may be significant that the Hall is shown on Faden's map in a location that corresponds closely to the current position of the Barn. The possibility that the Barn might incorporate some of the Hall's remains would also account for some of its more perplexing features, including what appear to be two archaeologically coherent garderobes.

The first map evidence of the Barn appears in a plan of Bexwell from 1832 by J G Lenny. Its position on the site of the former manor house hints that Bexwell Barn may have incorporated some of Bexwell Hall's fabric

© Norfolk Record Office, PRA 367, 379x6

The chronology means that there are a number of possible candidates for the construction of the Barn: Thomas Holt (d. 1799), whose family owned the estate from 1713 to 1799; Robert Fellowes I (1742–1829), who owned the estate from 1799 to 1815; and Robert Fellowes II (1779–1869) who owned the estate from 1815 until 1840. If it was undertaken by Holt, then it was constructed right at the end of his ownership of the property, shortly before he died. On balance, it seems more likely that it was erected by the incoming Fellowes family.

The identity and interests of the Fellowes are of some import. Their branch of the Worcestershire Fellowes family had settled in Norfolk when William Fellowes (1705–1775) acquired Shotesham Park in 1731. Robert Fellowes the elder employed Sir John Soane to build the house at Shotesham in 1784. Given the family had more than a passing interest in architecture, it is not surprising that father or son should reuse remnants of Bexwell Hall, and perhaps spolia from other sites, in order to fashion another building. The likelihood that the Barn was created not only for practical use but also as a means of preserving and displaying architectural fragments helps to explain the contradictory fabric evidence. Some of the apparent 'phasing' may not be phasing at all, and the building may have been intentionally constructed to give the impression of a palimpsest.

This research has significant implications for the future of the Barn. A particularly pressing question is whether the building has ever been residential and therefore whether or not it would be appropriate to consider re-conversion. The indications that it has never been domestic have offered a vital steer on this matter. Far from precluding creative solutions for Bexwell Barn's future, this new evidence will help to determine what those might be.

Olivia Horsfall Turner

Investigating a chain pump recovered from the designated wreck of the *Northumberland*

In 2011 English Heritage commissioned the Seadive Organisation to carry out a project to record and investigate a chain pump recovered from the warship *Northumberland* with support from the Archaeological Conservation Team.

The *Northumberland* was a third rate man-of-war armed with 70 guns and one of thirty ships constructed under Samuel Pepys's famous 1677 shipbuilding programme. This was the largest and most ambitious building programme of the time, brought on by an urgent need to strengthen the Navy against the rising powers of France and Holland. The *Northumberland* took part in major and infamous battles of the late 17th century. These battles included the defeat by the French at Beachy Head in 1690, victory at Barfleur/ la Hogue in 1692, and under the command of Captain Benbow the *Northumberland* led the second bombardment on St Malo in 1695. The ship was rebuilt in 1702 and returned to action with a combined Anglo Dutch force at the Battle of Vigo Bay with an emphatic victory over the French and Spanish in the taking of Redondela Harbour in October 1702. The ship's final assignment was to block the French Fleet at Toulon in the Mediterranean before returning home with the Mediterranean Fleet under the command of Sir Cloudesley Shovel. It was during her return when the *Northumberland* was wrecked along with the *Stirling Castle*, *Restoration* and the *Mary* on the Goodwin Sands during the Great Storm of November 1703.
The wreck of the *Northumberland* was discovered during the summer of 1980 and designated in 1981 under the Protection of Wrecks Act 1973. Since 1993 Mr. Robert Peacock has been the Licensee of the site and has been undertaking regular surveys and investigations.

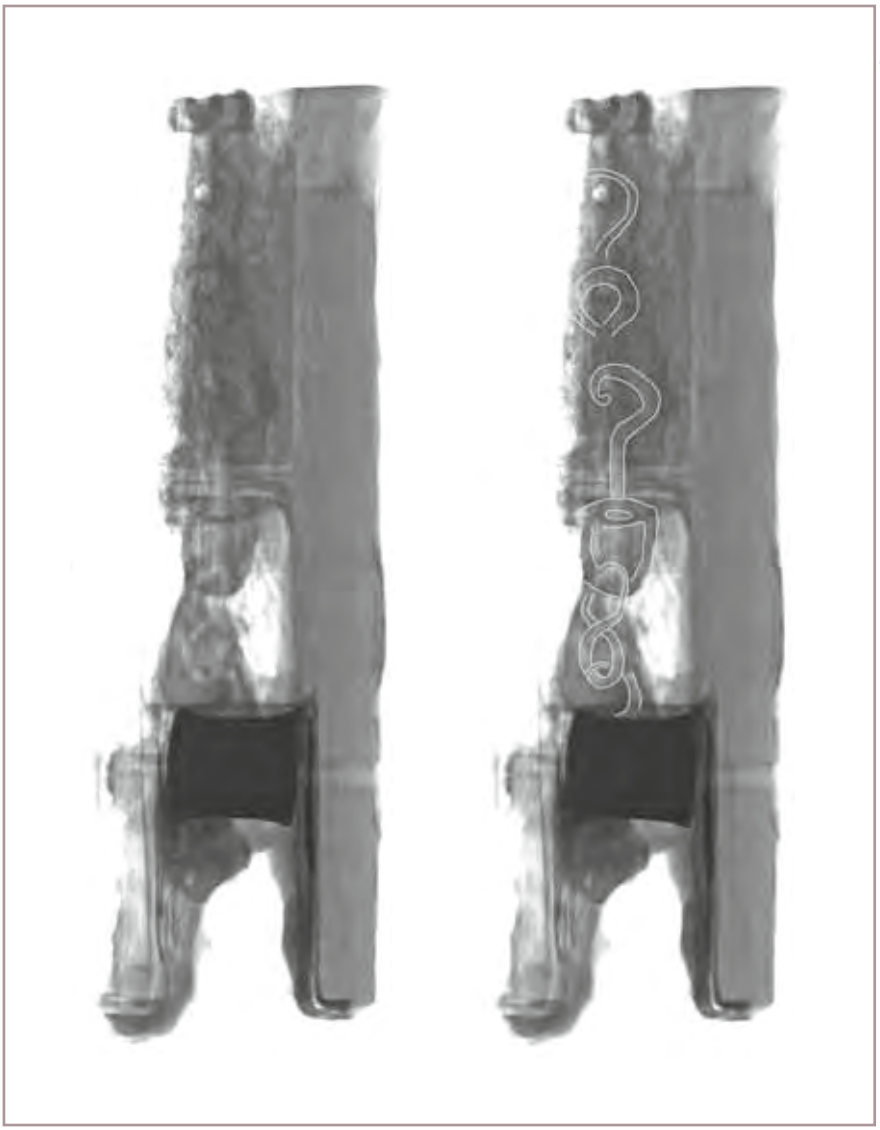
© Seadive

The large fragment of the chain pump

The chain pump was found in 2008 while the Licensee's team was looking for suitable timbers to take dendro-chronological samples. It was located exposed on the outside of the south west side of the wreck mound. The exposed surface of the pump was heavily degraded by the infestation of *Teredo navalis* suggesting it has been exposed for a prolonged period of time. When the significance of the pump was realized it was recovered in two sections under a Surface Recovery License and placed in a container of fresh water. It was apparent from the decay of the exposed surfaces that the pump was at great risk of loss through biological attack if it remained on the seabed. The initial examination of the remains revealed that it was the bottom end of the chain pump, known as the chamber with the remains of the chain and leather valve assembly concreted within the centre of the tube.

a) X-radiograph of the large fragment. The chain, the leather valve as well as the roller and chamber at the bottom are visible

b) X-radiograph of the large fragment. The chain components have been enhanced with white outlines



© Seadive

Pumps were fundamental for the safety of the ship as leaks were inevitable and the bilges would need regular pumping to stay free of unwanted water. There would have been two chain pumps, located behind the main mast. The chambers were located in the well either side of the keelson. A chain on a continuous loop with leather valves located every 30 inches (760mm) would pass up through the tube drawing water upwards. The water would then be discharged back out into the sea via the dales and scuppers on the gundeck.

Although the remains recovered from the wreck are fragments of a much larger piece they contain the most substantial evidence that has been found in the archaeological record to date. Research has discovered that there are contemporary documents of carpenter's stores listing the individual parts of chain pumps and illustrations that show the location of pumps on board. However, the information from the historical record lacks the detail needed to be able to accurately reconstruct the pump and understand how all of the individual components fitted together.

The main objectives of the project were to research the construction and use of pumps on board ships; record and extract the constructional details and the components within the concretion; assess its condition and devise a conservation programme; and finally display the pump at Ramsgate Maritime Museum.

The project has used a number of recording techniques to gain the maximum information with the help from a number of experts in the field of archaeology and engineering. These techniques have ranged from traditional drawing and photographic recording; X-radiography at Fort Cumberland and at Portsmouth Dockyard and the Mary Rose Trust; and high-energy micro-focus CT scanning at the μ-VIS Centre for Computed Tomography at the University of Southampton.

X-radiography was the first method used to extract the constructional details of the pump and assist in the assessment of its condition. Both film and computed X-radiography were used. Despite limitations due to instrument settings, the density of the wood, the concretion and the geometry of the object the results identified the following:

- *The iron chain is heavily corroded and as a result the visible remains were empty shells. This means that the outer shape has been preserved in the corrosion product but the inner core has corroded to different degrees.*
- *The presence of a concave roller at the bottom half of the pump, which would have guided the chain.*
- *Two cavities either side of the roller.*

However, X-radiography did not produce clear or accurate constructional details of the chain and valve assemble or show how these parts fitted together. Therefore, further investigative imaging was necessary to fulfil the objectives of the project.

The project team approached μ-VIS Centre for Computed Tomography at the University of Southampton who agreed to CT scan the remains of the pump. A high-energy micro-focus scanner was used which rotated the pump through 360 degrees, taking thousands of 2D images. These images were then used to construct a detailed 3D virtual reconstruction of the pump. The 3D animated reconstruction was able to virtually peel back the layers of wood and concretion, revealing all the components that were enclosed inside. The results were produced without any distortion and it was therefore possible to record precise measurements of each of the component parts. The 3D animation has revealed that the chain was constructed of S-shaped links with the valves attached every 30 inches (760mm), the valves consisted of three leather discs supported by a single iron saucer attached to a swivel. The chain and valves passed under a roller located at the bottom of the chamber, the inside of which was lined by a thin protective material.

The combination of X-radiography and CT scanning had answered most of the research questions but not all. Due to it's density it was not possible to identify the material type of the roller or the inner lining of the bottom of the chamber without the removal of small areas of concretion. As a result it was decided to selectively clean two areas and attempt analysis using a portable X-Ray Fluorescence (pXRF) for material identification. Concretion was removed using a hammer and chisel until the original surfaces were uncovered. The pXRF analysis confirmed the roller was made from a copper alloy with a high lead content (leaded bronze) and the thin lining located with the bottom of the chamber was wrought iron.

© Seadive

c) 3D rendering of the CT-scan. The wood of the pump tube has partially been removed. The chain (red and blue), the leather valve (brown), the swivel (green), the roller (yellow) as well as the lining of the chamber (grey) are becoming visible

d) 3D rendering of the CT scan. As figure c) but the wood has been totally removed and the inner components are visible

The combined scientific investigations of the pump have provided the details that were lacking from the historical record and as a result we now know precisely how the pump and its components were designed and constructed. The project has also demonstrated the great potential high-energy micro-focus scanning has in the non-destructive recording and investigation of concreted shipwreck material.

The pump is currently in wet storage at Fort Cumberland and undergoing desalination. A conservation proposal is currently being worked on. Following conservation the pump will be displayed at Ramsgate Maritime Museum.

Dan Pascoe and Angela Middleton

Chalk Lowlands and the Hull Valley; a story of levelling and survival

Using aerial investigation & mapping to assess archaeological landscapes in the East Riding of Yorkshire.

English Heritage's Aerial Investigation & Mapping team has recently completed a project to map the chalk lowlands and the Hull Valley in the East Riding of Yorkshire. Analysis of vertical and oblique aerial photographs ranging in date from 1935 to 2011 revealed many exciting new archaeological discoveries but also confirmed a worrying pattern of threat to the historic resource. The project encompassed the valley of the River Hull, from its source to the west of Driffield into Kingston upon Hull, and included the fringes of the Yorkshire Wolds to the north and west.

One of the drivers for the project was the relatively high number of sites that are listed on English Heritage's Heritage at Risk register (which records Scheduled Monuments that are under threat) when compared to the national picture. For example, the Heritage at Risk Register for

Aerial view of the earthworks of Rotsea medieval village, against a background of arable

Dave MacLeod. © English Heritage

2009 noted that the Yorkshire and Humber Region had the highest proportion of monuments at risk of any region in the country. The 2010 register reiterated that fact, stating 'approximately 1 in 6 (17.2%) of England's 19,731 scheduled monuments are at risk, compared with 28% (734 sites) in Yorkshire and the Humber'. Within the area covered by the project, a third of the 48 Scheduled Monuments are classed as at risk, mainly as a result of plough damage, unrestricted plant growth and dewatering.

During the course of the project it became apparent that earthwork survival in general, not limited to Scheduled Monuments, was poor. Analysis of the historic air photographs showed that this loss was largely a consequence of post-war ploughing and enabled a quantification of the rate of this loss. For example it has been revealed that 68% of archaeological monuments that were visible as earthworks on 1940s aerial photographs have now been severely reduced in height or levelled. A further 2% have been destroyed by quarrying leaving only a third surviving as upstanding earthworks to the present day. The historic photographs clearly show the reason for this high rate of levelling since the late 1940s; major land improvements and drainage schemes have allowed many areas previously only suitable for grazing to be brought into cultivation.

Although plough levelling of a site may appear to indicate its destruction, it is important to note that it does not always signify the total loss of an archaeological monument. Although a monument may be totally levelled above ground, sub-surface features may still survive. Furthermore, in certain circumstances arable agriculture can reveal older phases of the landscape as cropmarks. Indeed, this cropmark evidence provided the major highlights of the project, revealing numerous previously unrecorded pre-medieval remains.

Perhaps the most unusual cropmark discovery was first photographed by English Heritage during a reconnaissance flight in 2010. Photography revealed a complex of three monuments at Eppleworth in the form of a round barrow, a causewayed ring ditch and a double pit alignment. The double pit alignment is particularly unusual, consisting of five pairs of parallel pits that differ from the long lengths of double and single pit alignments that form linear land divisions on

Levelled and extant archaeology recorded by the project

Dave MacLeod, © English Heritage NMR 28081/031

Cropmark evidence for prehistoric ritual activity at Eppleworth

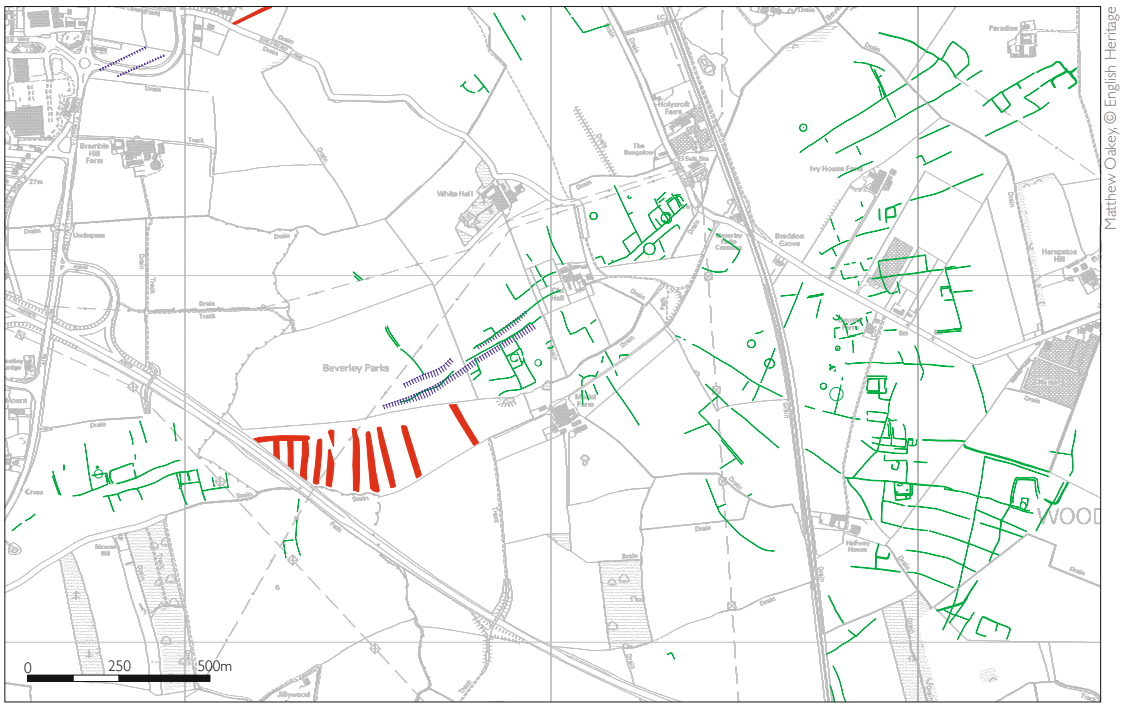
the nearby Yorkshire Wolds and elsewhere. All three features have been tentatively dated to the Neolithic or Bronze age and are thought to reflect ritual activities. Further research in the form of geophysical survey or excavation may prove enlightening.

The cropmark evidence has considerably expanded our understanding of the Iron Age and Romano-British landscape, though the fragmentary nature of the cropmarks in much of the Hull Valley means that it is often very difficult to evaluate how, if at all, the landscape was divided up. Several fragments of double-ditched trackway were identified and these suggest that movement through the landscape was managed. On the periphery of the Wolds the alignment of most trackways indicates passage down into the Hull Valley. Their often sinuous nature is likely to reflect the fact that these trackways respected existing features such as fields or areas of woodland as well as the natural topography.

The most extensive trackway was traced intermittently for a distance of around 1.8km from Beverley Parks to Old Hall terminating on a dry valley that would have provided a natural route up onto the Wolds. This trackway also seems to coincide with the northern limit of an extensive coaxial field system (a field system defined by long boundaries on a common axis) with embedded enclosures, located south-west of Woodmansey. This is of particular significance because coaxial systems are not found on the Wolds but are common in the Vale of York and in South and West Yorkshire. This broadens the extent of known coaxial field systems eastwards from the Vale of York and contrasts with the Yorkshire Wolds landscape where other patterns of land division predominate.

The identification of these previously unknown archaeological landscapes and the analysis of historic and ongoing threats to their survival will be used to inform future management and protection of the heritage resource in the Hull Valley. Further highlights from the project and a full report can be downloaded here: http://www.english-heritage.org.uk/professional/research/landscapes-and-areas/national-mapping-programme/hullvalleynmp/

Sally Evans



Matthew Oakey, © English Heritage

Cropmarks reveal an extensive Iron Age or Romano-British landscape

St Nectan's Church, Hartland, Devon: dendrochronological dating of the pews

Extensive dating of pew wood shows a church layout that has not substantially changed in 400 years.

The impressive St Nectan's Church, sometimes grandly known as the 'Cathedral of North Devon', was largely rebuilt in the fourteenth and fifteenth centuries and has an interior that has been little altered, with its exposed wagon roofs, decorated ceilings, magnificent rood screen, wonderful stained glass windows, and a great many oak pews. The reorganisation and removal of historic congregational seating from churches is an emotive issue and yet so often the significance, both locally and nationally, of surviving groups of such seating is relatively poorly understood. Only a handful of groups of pews have been studied dendrochronologically including those at St Nectan's Church which were analysed following an appeal to English Heritage for advice.

Stephen Hobbs, a local historian, had undertaken a very detailed programme of research a few years earlier on the pews, looking at the design and decorative style of the seats as well as documents relating to them. One such document was a seating plan dated to 1613, apparently drawn up in response to disputes over seating, which lists in columns by rows the names of 313 parishioners and the location within the church of the seats allotted to them, something which was obviously greatly influenced by status of the individual. This provides a clear indication of the arrangement of pews at this time. Thus, in addition to identifying the dates of the various groups of historic pews through dendrochronological analysis, it was hoped to provide evidence as to what extent the seats seen today reflect the 1613 plan, which pew types pre-dated the plan, and whether the differences between pew types was determined by date or by status/location.

The majority of the seating can be divided into two types, those with larger seats and bench ends found in the front half of the church (Type A), and a slightly smaller type in the rear half of the church (Type B). Type A pews in the north and south aisles are

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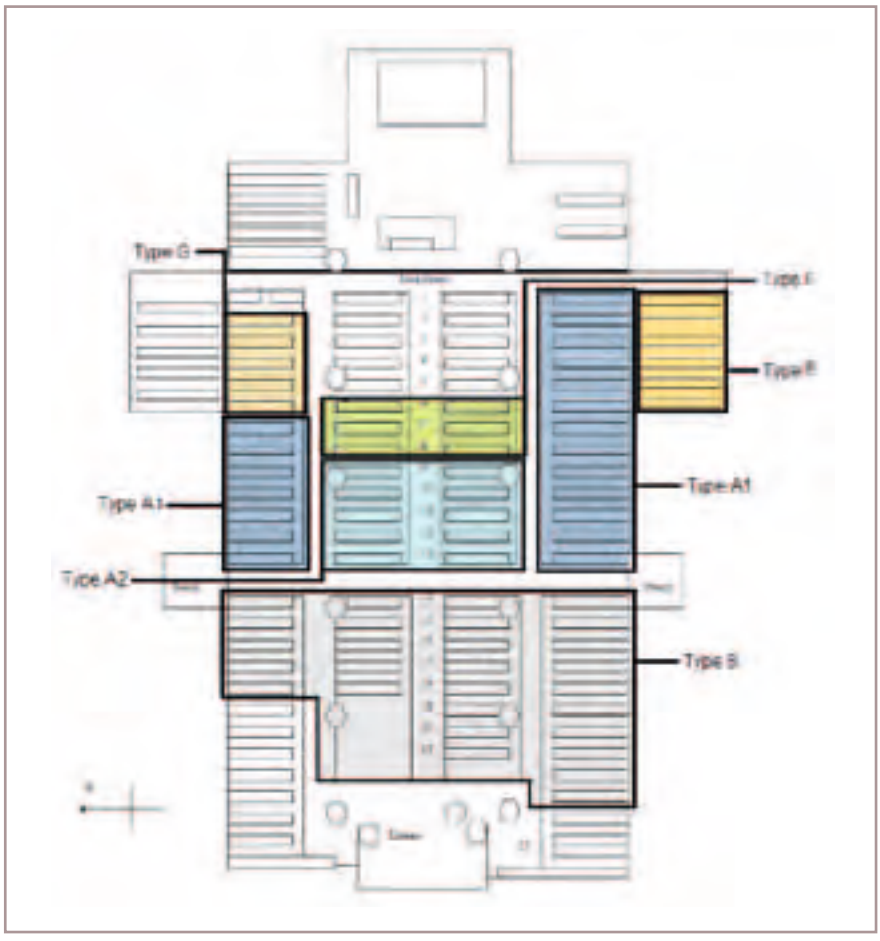


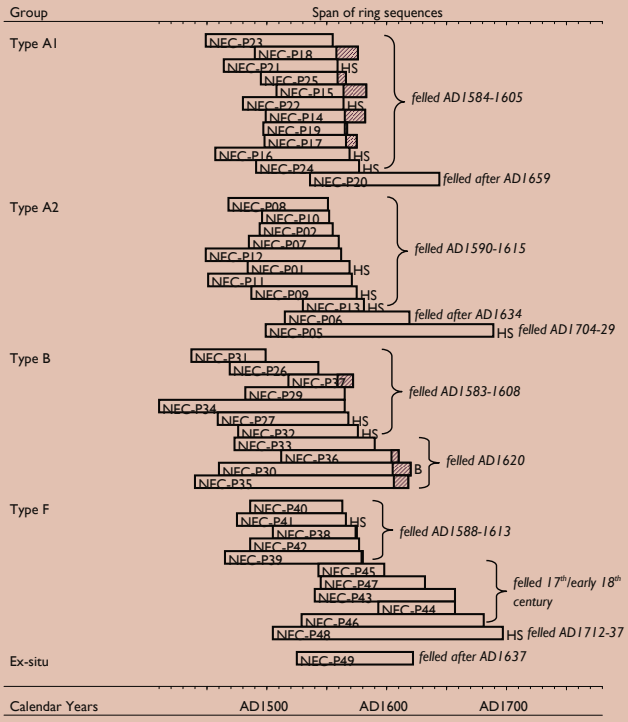
Seating layout from the 1613 assignment showing the distribution of different styles of pews (based on Hobbs)

Two different styles of bench ends seen at St Nectan's Church; Type A1 (Fig 2a) with stopped mouldings found in the North and South Aisles and Type B (Fig 2b) with unstopped mouldings found in the rear of the church

© Alison Arnold

moulded and stopped, whilst those in the nave moulded but not stopped (Type A2). A smaller number, located to the front of the nave also have moulded top rails (Type F). Pews removed from the first five rows in the nave and stored in the boiler room also have moulded top rails. Those in the Stukeley Chapel (Type D) appear to be constructed from at least two different sets of pews; one end being highly decorated and the other plain. At the front of the north aisle are a set of box pews (Type G). There are also some early-twentieth century pine and oak replacements.

Diagram showing the dated ring sequences obtained from the bench ends and the interpreted felling dates for the timbers used



© Alison Arnold

The analysis of pews can be challenging due to the nature of their components and aesthetic considerations potentially precluding the use of the standard method of sampling by coring or the alternative of direct measurement as is applied to art historical objects such as panel paintings. In this instance, following detailed discussion of the dendrochronological assessment, it was decided to restrict sampling at this stage to the sturdy ends of the Type A1/2, Type B, and Type F pews. Unfortunately the Stukeley pews were excluded as they are constructed from fast grown timber considered unsuitable for reliable analysis and the box pews excluded as the elements were too slight for sampling by coring.

Forty-six bench ends from 38 pews were successfully dated, significantly adding to the reference data available for the sixteenth and seventeenth centuries for this area. The majority of these dated pews, which represent all four types analysed, were felled,

and hence used, in the late sixteenth or early seventeenth centuries and all probably pre-date the 1613 plan. There are however later bench ends in all four types: Type B has four bench ends probably felled in AD 1620; Type F has at least one bench end felled in AD 1712-37; Type A2 has at least one bench end felled in AD 1704-29; other bench ends, including one of those in the boiler room, are also clearly post-1613.

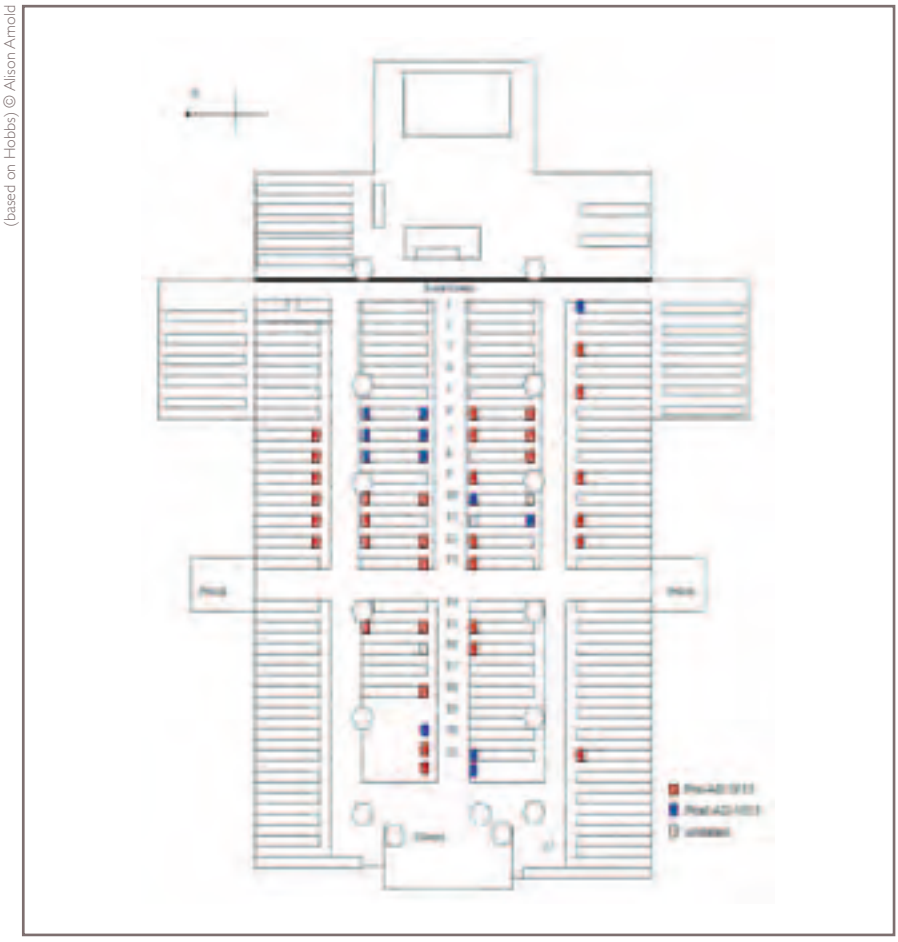
These apparently later pews are not only found at the rear of the nave (nave pew row 20 north), known to be without seats in 1613, but also where the plan indicates the existence of pews in 1613 (eg nave pew row 8 north; south aisle pew row 1). These may well represent repairs or replacements undertaken in the same style as the pre-1613 pews. Conversely, the analysis has also identified a pre-AD 1613 bench end where no pew was shown on the plan (nave pew row 22 north). Thus it appears that, perhaps not surprisingly, some degree of reorganisation has been undertaken since the 1613 plan.

The bench ends at St Nectan's Church have proven to be later than most of the other examples of dendrochronologically dated pews, the exception being those at All Hallows Church, Kirkburton, in West Yorkshire dated to AD 1633. Fifteenth century examples have been identified at St Andrew's Church, Cotton, Suffolk (AD 1476–1501) and potentially at St Brannock's Church, Braunton, Devon (*terminus post quem* felling of AD 1475). The highly decorated pews from the Cornish churches of St Tetha, St Teath, and St Ildierna, Lansallos, have been dated to the first half of the sixteenth century. These last two sets of pews have similar decorated ends to those of the Stukeley pews at St Nectan's Church, thought to have been a gift in AD 1530.

This growing resource of dendrochronologically dated pews highlights the potential to enhance the understanding of the development of constructional and decorative detail of pews. However, in relation to the church of St Nectan, the analysis has underlined the significance of the pews by confirming the conclusions drawn from previous research that the present layout of the seating has survived with only relatively minor changes since the 1613 plan – exactly 400 years ago.

Alison Arnold and Cathy Tyers

(based on Hobbs) © Alison Arnold



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Top: Seating layout showing the location of sampled bench ends and the dating evidence produced from the dendrochronological analysis

Above: The pews in the Stukeley chapel, thought to be the earliest pews in the church but unfortunately unsuitable for dendrochronological analysis due to the fast grown nature of the timbers

‘An interesting collection of ancient remains’: the *Antiquities of Windover Hill* revisited

Photographs taken in 1925 as part of an experiment in archaeological mapping prove useful again in the 21st century.

The recently completed Beachy Head – Lewes NMP project was one of several analysis projects undertaken recently by Aerial Investigation and Mapping staff in the new South Downs National Park.

For one small area of downland, we found ourselves mapping directly from vertical aerial photographs arising from one of the earliest systematic aerial surveys undertaken in the British Isles.

TQ 5403/5 OSV 11241/42590 6 October 1925 © English Heritage. Ordnance Survey Collection

The antiquities of Windover Hill, 6 October 1925 – north to top. The Long Man is here obscured by shadow

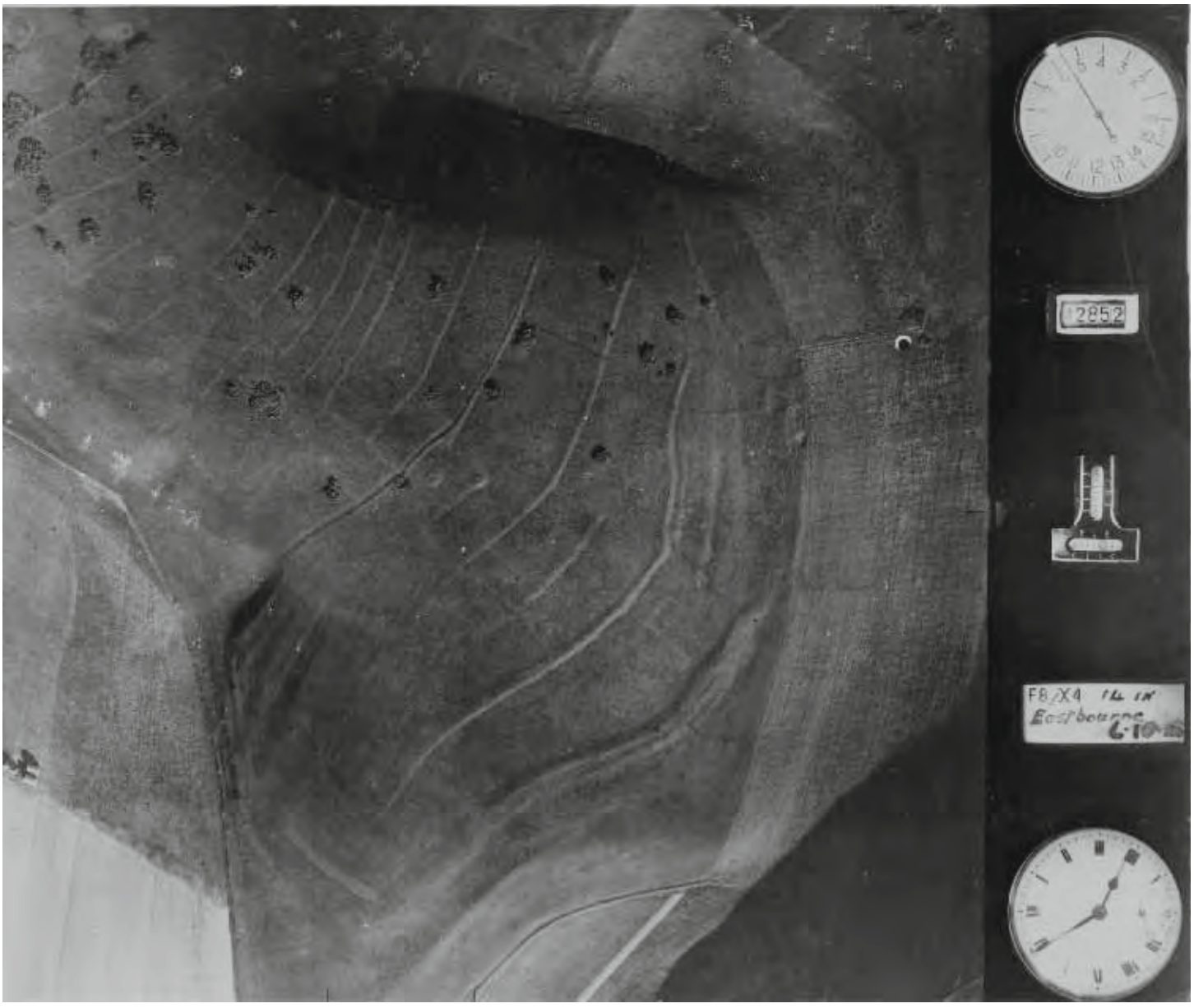
Despite the intensive use of aerial photography during World War I for the repeated mapping of the trenches of the Western Front, after the war the Ordnance Survey reverted to its pre-1914 opinion that the tried-and-tested ground-based survey techniques used for OS map revision left no room for aerial photography.

THE 'EASTBOURNE EXPERIMENT'

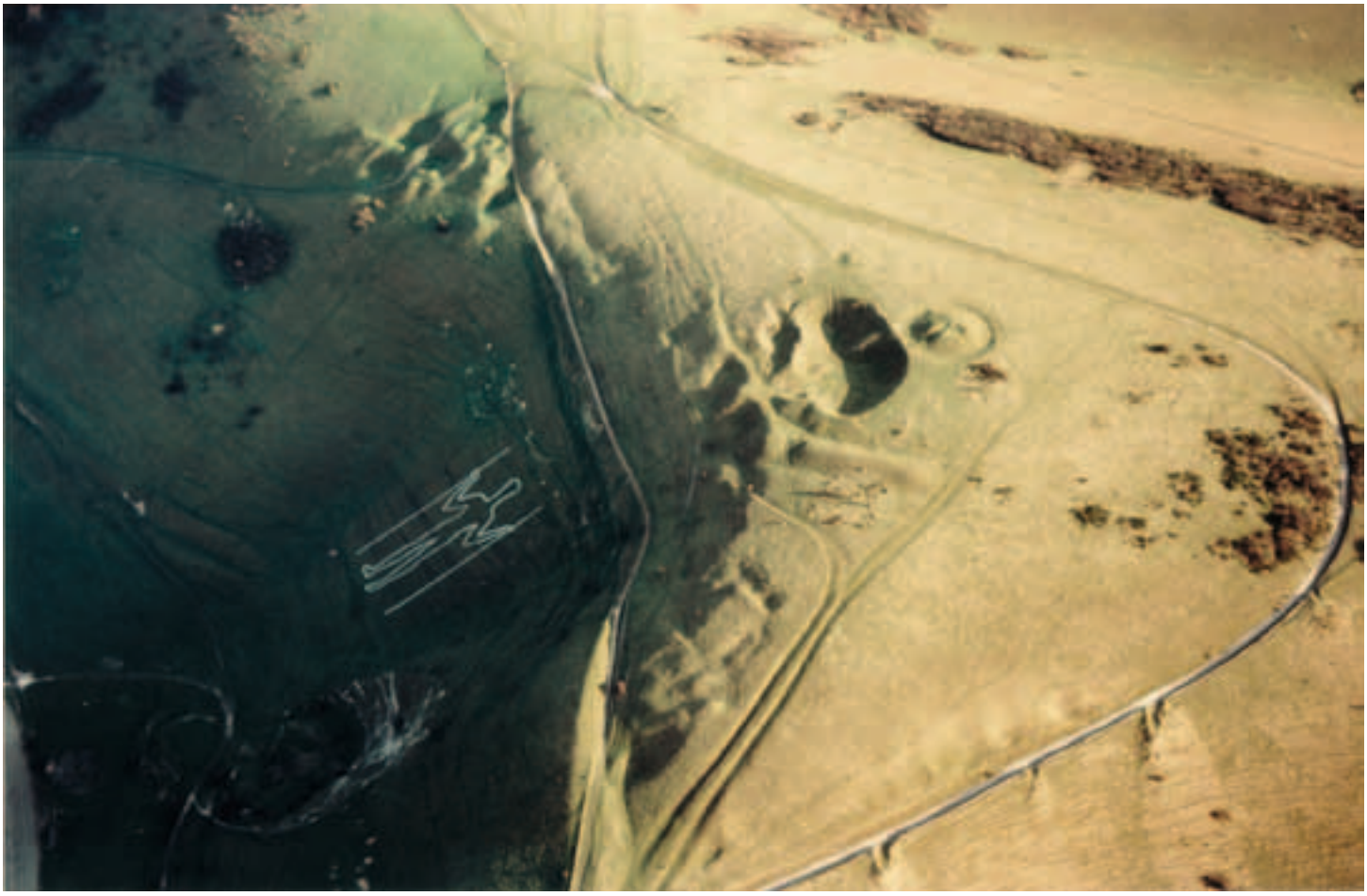
After the war numerous small new firms sought to put wartime experience in photography and mapping to commercial use, placing the OS under pressure to evaluate the technique. The original idea for what became known as the Eastbourne experiment came from one of these, the Aircraft Operating Company (AOC), who also offered their services to do the work.

The Eastbourne area was selected because the OS were about to start a programme of map revision there. This meant that mapping from aerial photographs could be compared directly with traditional techniques, the key concerns being accuracy, speed and – most importantly – cost. Also previous experiments had occurred mainly on flat ground, and coastal areas; the downs near Eastbourne offered more challenging topography. A detailed specification was drawn up and various firms invited to tender in May 1925. The OS would have preferred the RAF, but they were forbidden to undertake government contracts that could be fulfilled by commercial firms.

Later prehistoric fields on Ewe Dean Down, immediately south of Windover Hill, as photographed on 6 October 1925



TQ 5302/2 OSV 11241/42858 6 October 1925 © English Heritage. Ordnance Survey Collection



NMR 15211/20 30 Jan 1995 © Crown Copyright. English Heritage

Long Man and environs from the west in 1995. The suggested long barrow is the long mound adjacent to the large chalk pit just right of centre

Unsurprisingly, the successful bidder was AOC, who were in the process of taking over Aerofilms. It seems to have been the latter who undertook most of the work.

Flying began in June 1925 using a new F8-type camera loaned specially by the Air Ministry. The camera had been designed specifically for RAF use, with overlapping vertical photography in mind. It also used film rather than plates. Various problems were encountered, and both camera and film seem to have been at a more 'experimental' stage than the AOC had been led to believe. One key problem with the camera was that despite being automated, the shortest setting between automatic exposures was 10 seconds. At the scale the OS wanted – 1:5000 – this was too long, so the camera had to be operated manually, which involved someone counting to eight and a half before each push of the button. This meant that the required overlap of 50%. between successive photographs was not always acheived. This overlap had nothing to do with stereoscopy. The OS did not envisage the use of stereoscopes, and at no stage were they used. The military mindset of WW1 – that the stereoscope offered "too much scope for judgment" – still prevailed. The overlap was instead intended to aid the manual rectification and mapping processes being used. A 50% overlap meant that every point would appear on at least two photographs.

The results, from the OS point of view were inconclusive. Using aerial photographs, map revision was faster but more costly than traditional techniques, although areas where costs could be considerably reduced, were recognised and further experiments recommended.

Another post-war innovation was the establishment of an OS Archaeology Division led by OGS Crawford. Crawford's main task was to ensure that appropriate archaeological detail was present and correct on revised mapping. Consequently, a set of the Eastbourne experiment photographs were passed on to him. He noted a number of intriguing sites, and passed prints on to Cecil Curwen, the Sussex-based field archaeologist who was also part of the OS Archaeology Division's network of honorary correspondents.

WINDOVER HILL

Crawford and Curwen were particularly attracted by the block of downland centred on Windover Hill, on the northern scarp edge of the chalk downs about 4 miles northeast of Eastbourne. The best-known 'monument' in this area is, of course, the Long Man of Wilmington, who today comprises an arrangement of some 770 concrete blocks laid out in 1969 over the approximate outline of a turf-cut figure last seen in the 1870s. In 1925 he consisted entirely of whitewashed late Victorian bricks. However, Crawford and Curwen saw a lot more nearby, and Curwen went out to check on the ground, this fieldwork resulting in a paper entitled *The Antiquities of Windover Hill*', published in the Sussex Archaeological Society's annual *Collections* in 1928.

Among the earthworks Curwen wrote about on the downs immediately above the Long Man were two clusters of Neolithic flint mines, a Neolithic long barrow, and some tracks or terrace ways of Roman date. Flinders Petrie had already argued that the Long Man was at least Bronze Age, while the presence of Neolithic sites on the hilltop overlooking the hill figure led both Crawford and Curwen to suggest – initially at least – that he could be Neolithic.

During the NMP project it was found that the 1925 APs offered some of the best views of the earthworks in this area, including the extensive field systems to the south (Curwen took an unusually pragmatic approach to dealing with these – on his sketch map of the Windover Hill area he simply drew an arrow at the bottom and wrote 'Celtic fields' next to it). Although these earthworks still survive in remarkably good condition, there is now considerably more vegetation obscuring the lynchets and barrows from the airborne observer. Mapping from the photographs was far from straightforward, however. As the OS discovered at the time, there is a distinct lack of map control on the downs with which to frame any rectification. Nearly 90 years on, a lot of the things we often have to rely on – field boundaries, agricultural buildings etc – had either changed or disappeared. Consequently, it was necessary to rectify 1940s RAF verticals as an intermediate stage in the mapping process.

NEOLITHIC OR POST-MEDIEVAL

In 2012, it was possible to offer rather different interpretations for the earthworks on Windover Hill, though few of these are new. The existence of anything Neolithic or Roman on top of Windover Hill has long been questioned but the idea that the Long Man is overlooked by Neolithic flint mines and a long barrow has proved remarkably persistent.

The APs available – from 1925 up to the 21st century – show numerous pits dug for chalk and flint extraction along the northern edge of the downs, and it is these that the Windover Hill examples most closely resemble. Indeed there are some very large extraction pits present, one of which contains a lime kiln. The 'Roman' tracks originally identified by Curwen are integral to this extraction, and connect the quarries with nearby villages, farmsteads and, in one example now surviving mainly as a cropmark, with Wilmington Priory to the northwest. The 'long barrow' too seems more likely to belong with these quarries, sitting as it does among spoil heaps and trackways, although further work on the ground would be necessary to demonstrate this.

Placing these earthworks in more recent centuries makes for a more coherent landscape than that originally described by Curwen, although his interpretations made perfect sense within contemporary understanding of the Neolithic and of the field archaeology of the 1920s. Fitting the Long Man within that landscape remains a problem though. A Neolithic date still has its advocates, although the main supporting evidence is, of course, the postulated presence of flint mines and a long barrow. Recent excavations by Martin Bell and Chris Butler showed that there never was a chalk-cut outline here, confirming early accounts of a very slight, ephemeral figure only intermittently visible according to conditions and viewpoint. The original figure may no longer be archaeologically recoverable, while aerial photography records only the bricks and concrete. However, ongoing documentary research plus aspects of the figure's layout seem to support Bell and Butler's suggestion of a post-medieval origin.

Martyn Barber

The Pleasance, Kenilworth: a royal residence and pleasure garden

Earthwork survey undertaken to inform heritage protection has increased understanding of the medieval designed landscape at Kenilworth Castle.

In March 2012 the newly formed Assessment Team (West) was asked by the local planning team to undertake an earthwork survey of The Pleasance, a substantial enclosure which formed part of the medieval pleasure grounds that surrounded Kenilworth Castle. The request was in response to concerns over damage to the Scheduled Monument by badgers, and was intended to help improve on-going management. Earthwork survey was considered the best means of establishing a detailed record of the site and improved understanding in a relatively quick and cost-effective way. Some geophysical survey had previously been undertaken by English Heritage's Remote Sensing team in 2004 but this focused on the central platform only.

The Pleasance sits a kilometre to the west of Kenilworth Castle, in a location that was formerly on the edge of the castle's Great Mere (an artificial lake created by damming the valley west of the castle). It was built by Henry V *circa* 1417-18, and known as 'The Pleasance in the Marsh'. The site is widely accepted to have comprised a detached garden and banqueting house. Previous research has largely focussed on the documentary history of the site, with contemporary chronicles and household accounts providing evidence for a substantial medieval building, at least two towers and extensive gardens. Despite the survival of well-preserved earthwork remains the monument as a whole had never been examined in detail. The earthwork survey requested by the planning team therefore provided the opportunity to investigate the site to a much fuller extent than had previously been attempted.

Facing page: Aerial view of the Pleasance, with Kenilworth Castle beyond

The Pleasance takes the form of a large double-moated enclosure defined by a series of concentric grass-covered banks and ditches, the ditches still holding water in places. These earthworks define a central diamond-shaped platform of just over one hectare in area, configured roughly north-south with the corners aligned on the cardinal points. The size and distinctive form of the enclosure possibly highlight its special role within the castle's extensive pleasure grounds. The Pleasance, lying between the Great Mere and Kenilworth's medieval hunting park or chase, afforded views out over both areas and facilitated access between the two.

The location of the Pleasance was carefully chosen to allow the manipulation of the natural topography, taming nature to create a peaceful retreat that would surprise and delight visitors. The higher ground to the east of the site served to shield the enclosure from view, hiding it from all but the loftiest parts of the castle. Natural springs were harnessed to supply water to the moat, and the mere was used as the principal access to the site with the landward approach also crossing the northern arm of the mere. The Pleasance was therefore surrounded by water – approached from it or across it, and reflected in it – the water supporting imagery and sustaining fish and birds which held their own symbolic meanings in the medieval period.

Previous study at the Pleasance had established the presence of buildings on the central platform (including a substantial banqueting house), and to a certain extent the principal access route, but these represent only part of what was an elaborate, high-status complex. One of the key features of the site was its carefully contrived approach from

Damian Grady, © English Heritage NMR 26228/026)

The Pleasance: 1:1000 scale earthwork survey (reduced)

Sharon Soutar, © English Heritage

the waterside, achieved by way of a sinuous channel leading from the mere into a stone-revetted dock or basin. Today, the sub-rectangular basin is flanked by high broad banks with an almost symmetrical pattern of earthworks on either side, suggesting it was originally lined with a regular arrangement of structures. These structures may in part have served to restrict the visitor's view as they approached by boat, allowing the site to be presented in a series of controlled stages. A sequence of towers and other buildings were strategically placed on the enclosure's broad middle bank and around the edges of the main platform, undoubtedly designed to draw the eye and surprise and delight.

Visitors would have disembarked onto a timber or stone wharf, with a series of structures identified at the southern corner of the enclosure, suggesting access onto the central platform was won from there. A bridge would have crossed the water-filled moat to a tower, a path then leading to an impressive long banqueting house. Beyond this, slight earthworks hint at a regular layout of gardens, with towers on the northern and eastern corners allowing the ornamental space be viewed from above. To the north-east of the banqueting house a hexagonal area of compacted ground was identified through geophysical survey, possibly representing the vestiges of a courtyard or formal garden. Earthwork remains suggest viewpoints were created at the northern and western corners of the middle bank, the broad platform providing views over the garden and out across the wider pleasure grounds.

The archaeological evidence indicates a massive level of investment in the Pleasance, creating a carefully designed and highly symbolic landscape. The modification and manipulation of the natural topography on this scale is well recognised as a notable and recurring feature of later medieval designed landscapes. Although there are other royal sites of this type in England, these are not on the scale of the Pleasance, and thus the main comparators for the site are international.

The principal aim of the project was to provide a detailed survey to inform heritage protection outcomes. However, in undertaking this work far greater insight into the Pleasance has also emerged, providing a

Elaine Jamieson, © English Heritage: Height data licensed to English Heritage for PCA, through Next Perspectives

Reconstruction of the medieval watery landscape. Note the scale of the Pleasance in relation to Kenilworth Castle

much fuller understanding of its form and significance. This improved understanding can itself feed back into heritage protection and site management, but can also be used in a much broader way. For example, the work could help inform interpretation of the wider landscape surrounding Kenilworth Castle, improving the visitor experience, as well as contributing to the ongoing academic debate about the form and function of such sites. It maximises the value and usefulness of English Heritage's work if research undertaken for specific heritage protection outcomes can benefit a much wider audience.

Elaine Jamieson and Rebecca Lane

Elaine Jamieson, © English Heritage

The Pleasance: view of the basin from the middle bank

Ultrasonic Thickness Testing: devising new ways to manage marine heritage

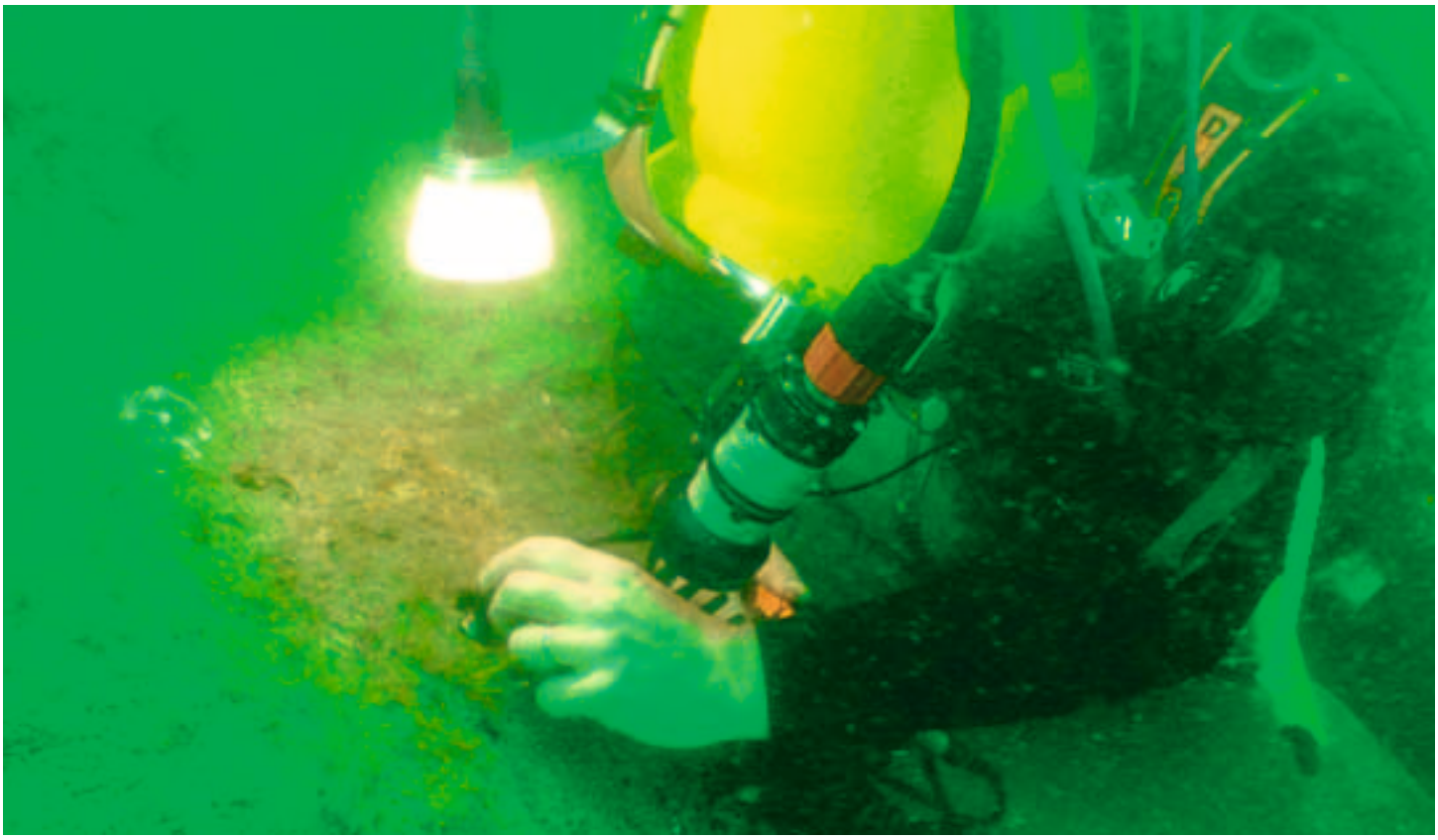
English Heritage's marine archaeologists are trialling new techniques to help understand our recent past.

English Heritage has over a decade of experience in the management of shipwreck sites. This is largely based on managing change to the remains of sunken wooden warships which allowed for the publication of online guidance on pre-industrial ships and boats in spring 2012.

In order to begin to understand the management requirements of metal-hulled vessels, an initial programme of research, ultrasonic investigation and analysis on the remains of two protected early submarines (the *Holland No. 5* and *A1*) began off the south coast during the summer of 2012 This work was prompted by the necessity of understanding the stability of steel hulls of wreck sites without causing damaging and increased degradation.

The *Holland No. 5* and the *A1* are two very early types of petrol-driven submarine in service with the Royal Navy between 1902 and 1911. The *Holland No. 5* sank in 1912 off Beachy Head while the *A1* sank in 1911 in Bracklesham Bay. They were discovered during two independent expeditions, and statutory protection followed respectively in 2005 and 1998. Further historical and archaeological detail about both submarines is available from the online National Heritage List for England. These two boats

A Cygnus DIVE underwater ultrasonic thickness gauge in use



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were chosen for study for they lie relatively close together; previous investigations and damage have been restricted owing to their protected status and, more importantly, information on their construction and hull-thickness was readily available from naval historical records.

Ultrasonic thickness gauges are especially useful for non-destructive measurement of thickness, particularly where access is restricted to one side of a hull only. These gauges are employed in many industrial applications around the world. As they listen for echoes and can measure virtually any material such as plastics, metals, and internally corroded materials, they are ideal archaeological tools. For our research, we used a Cygnus DIVE underwater ultrasonic thickness gauge because of its ease of use and portability. Rated to 300m depth, the Cygnus gauge can be worn on a divers' forearm enabling a valuable free hand when working underwater.

Knowledge of the original metal thickness at the time of sinking is fundamental in assessing the current condition of a metal shipwreck. This enables the total metal loss to be calculated, and provides a baseline for assessing a sites' stability or deterioration. A naval publication from 1979 provides the best summary account of the designs of the two classes of submarine. Records of the Director of Naval Construction (DNC) show that the steel hull plating on both the *Holland No. 5* and *A1* was ½" (12.7mm) thick.

The hulls of both boats are now covered by a layer of concretion (a hard compact mass of corrosion products from iron combined with seawater), colonised by soft marine growth. For the tests, marine growth was cleaned back with a wire brush and a small disc of concretion was removed using a hammer and 20mm chisel to expose solid metal of the hull. The probe of the Cygnus gauge was then held against the hull to measure its thickness and the cavity was made-good with epoxy putty. Investigation on the *Holland No. 5* was purposely limited to a single reading of 6.5mm, while readings on the *A1* of 5.6mm, 5.7mm and 8.4mm demonstrate potential variability of hull thickness. These measurements show the need for numerous readings to be taken across a hull to identify erroneous readings and thickness variability in order to locate areas of instability.

© Mike Hamilton-Scott

English Heritage archaeologists commence fieldwork in the Solent, summer 2012

Using an ultrasonic thickness gauge for the first time as an archaeological management tool in British waters, we've been able to develop a diver-based methodology to monitor metal hulls of historic wreck sites. This will allow us to implement measures where sites are at risk so as to manage the recent past for the future.

(With thanks to Hanna Steyne, Wessex Archaeology)

Mark Dunkley

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The readout of the thickness gauge

The English Heritage Science Strategy (EHSS)

Laying out the English Heritage agenda and action plan for heritage science.

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Capacity, capability and public benefit: One of a series of guidelines that are planned as part of the EHSS .This guidance covers the use of reflectance transformation imaging (RTI), an innovative multi-light imaging technique (see also notes and news for new human remains guidance)

In 2006 the House of Lords Select Committee on Science and Technology (HoLSTC) urged the heritage science sector to work together to develop a national strategy. To this end a steering committee was set up and in 2010 the National Heritage Science Strategy (NHSS) was published http://www.heritagesciencestrategy.org.uk/

The NHSS was informed by three NHSS reports covering the role of science in the management of the UK's heritage, the use of science to enhance our understanding of the past, and a review of capacity in the heritage science sector. The resulting NHSS vision and strategy has two principle aims:

- *Demonstrate the public benefit of heritage science and increase public engagement and support for it.*
- *Improve partnership within the sector and with others by increasing collaboration to help*

© English Heritage

Improving methods: The establishment of a Building Information Modelling (BIM) special interest group within EH is the first step in developing a BIM strategy for EH. Harmondsworth Barn is one site where detailed laser scan data has been produced using our own Faro Focus3D laser scanner

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practice make better use of research, knowledge and innovation and to enhance resources, funding and skills.

In March 2012 the a review of the impact of the NHSS was conducted by the HoLSTC and in July 2012 the Department of Culture Media, and Sport (DCMS) laid its response before Parliament in which Arms Length Bodies (ALBs) were encouraged "to consider their appropriate level of participation in the NHSS objectives".

The English Heritage Science Strategy (EHSS) provides a response to these initiatives and lays out what English Heritage does in the field of heritage science, what we fund and how we work with others. It includes a detailed action plan under three broad headings that relate to the NHSS reports and the NHPP (see Table below) as well as a number of over arching actions.

The EHSS will be published on the internet along with regular progress reports. Already, we have achieved several of the EHSS objectives including the establishment of an EH Science network, which will share information across the EH science community, oversee the delivery of the EHSS and act as a link to the National Heritage Science Forum.

Gill Campbell

Above left: Understanding materials: English Heritage archaeologist Mark Dunkley, preparing to dive and assess the hull of the submarine Holland No. 5, sunk 1912, using the ultrasonic thickness gauge

Above right: Access to information: Portable XRF being used to characterise historic window glass (in this case probably early 19th century from Germany or Bohemia) at Walmer Castle. David Dungworth's article on 'The Value of Historic Window Glass is now open access http://www.ingentaconnect.com/content/maney/hen/2011/00000002/00000001/art00003

Topic	NHSS Theme	NHPP Measure
Understanding materials and environments.	1, 2,	1, 2, 3
Raising awareness of existing techniques, improving methods, access to information and advice.	3, 4, 5, 6, 8	3, 7 , 8 Supporting actions
Capacity, capability and public benefit.	5, 7, 9	Supporting actions

NOTES & NEWS

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

A MID-SAXON PILLORY: CONSERVATION OF TIMBERS FROM BARKING ABBEY INDUSTRIAL ESTATE

In 2010 the English Heritage conservation team at Fort Cumberland initiated the conservation of a waterlogged wood assemblage. The timbers were excavated 1985-1986 at Barking Abbey industrial estate and derived from three wells and a mill-leat.

Claire Tsang, © English Heritage

Right: Loading of the tank. The timbers have been laid out and PEG solution is being added

Angela Middleton, © English Heritage

Below: The pillory timbers after conservation

They were dated using dendrochronology to the mid-Saxon period. Several timbers are thought to be punishment stocks or pillories and were re-used as well linings. mid-Saxon woodwork is very rare, as are pillories, which makes this assemblage not only very important but possibly unique.

In 2002 the timbers were rediscovered prior to the dismantling of a warehouse where they had been kept for wet storage. English Heritage stepped in to save this nationally important assemblage and a recording programme was commissioned. The timbers were subsequently delivered to Fort Cumberland. Prior to conservation all 19 timbers were visually examined, cleaned, photographed, checked against existing drawings and labelled. In February 2010 a scaffolding tank was assembled, the tank was loaded with the timbers and filled with more than 1000l of conservation solution 10% PEG 400 (polyethylene glycol). Every four months, the solution was increased by 10% to eventually reach 30%. The tank was emptied of the conservation solution and the second stage of conservation was initiated using a 30% PEG 4000 solution early 2011.

In July 2011 the first timbers were removed for freeze drying. Because of size limitations in the freezing chamber, 3 separate cycles of freeze drying were needed. Freeze drying all timbers took 14 months. During the freeze drying process timbers were weighed periodically to check their weight loss. Once a constant weight was achieved, the timber was considered dry. After conservation, timbers were given a superficial clean to remove excess PEG. Bespoke boxes were made to pack and store the timbers. The assemblage will be deposited with Valence House Museum. A research report is currently in preparation.

Angela Middleton and Karla Graham

MORE ON MARKHAM MOOR

Markham Moor Filling Station achieved a degree of national celebrity last year when it was listed, following research undertaken for English Heritage's Car Project. The phrase 'hyperbolic paraboloid' was even heard being uttered several times by Vanessa Feltz on prime-time BBC Radio 2! One thing that became evident in the course of the research was how little had been published about the building at the time of its construction. Despite its striking appearance and originality of design, it was not featured in the architectural press, unlike Sam Scorer's other essay in hyperbolic paraboloid roofs, the Lincolnshire Motor Co garage at Brayford Pool, Lincoln. It was therefore with great interest that I read a cutting from *Mercury News* (the National Benzole retailers' trade newspaper) for January 1962, covering the new filling station, sent in recently by Leigh Trevail, one of the many people who gave Kathryn Morrison and myself so much help during the project.

The article was of particular value in giving the rationale behind the filling station. It revealed that Markham Moor was designed specifically as a showpiece to catch the passing motorist's eye. With floodlighting, it would appear, to the approaching motorist, 'as some floating object glittering in space'. The reference to space is significant as it was claimed of many buildings at the time that they were of the space age. The idea for the building came from Ken Hempsall, managing director of A. H. Turner Ltd, which owned the filling station. The canopy was built in less than four months and the article noted that Hempsall was waiting for the cement to cure so that the canopy could be painted in the new National colours of white, yellow and blue in time for the year's season. It was constructed by an unspecified Doncaster firm and consumed some 150 tons of cement in the process of making the reinforced concrete, which was cast on the spot.

The intention was for the canopy to be but the first step in the creation of a service area with a sales office and a motel, entered via the filling station, to follow. A sales kiosk was built but the motel appears never to have come to fruition and the space under the canopy, formerly occupied by the petrol pumps, was eventually filled with a Happy Eater restaurant, which, in turn, became a Little Chef. This eventually closed and the building remains empty awaiting a new use.

John Minnis

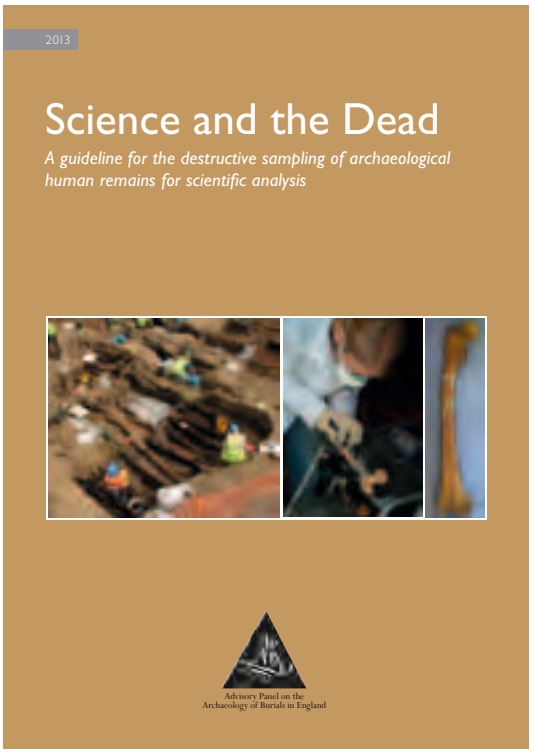
NEW GUIDELINES ON HUMAN REMAINS

January 2013 saw the publication of *Science and the Dead: A Guideline for the Destructive Sampling of Archaeological Human Remains for Scientific Analysis*. This document aims to provide a framework to help organisations responsible for archaeological human

Markham Moor Filling Station

Right: Cover of new human remains guidelines

Far right: Flyer for the Measured Survey for Cultural Heritage summer school



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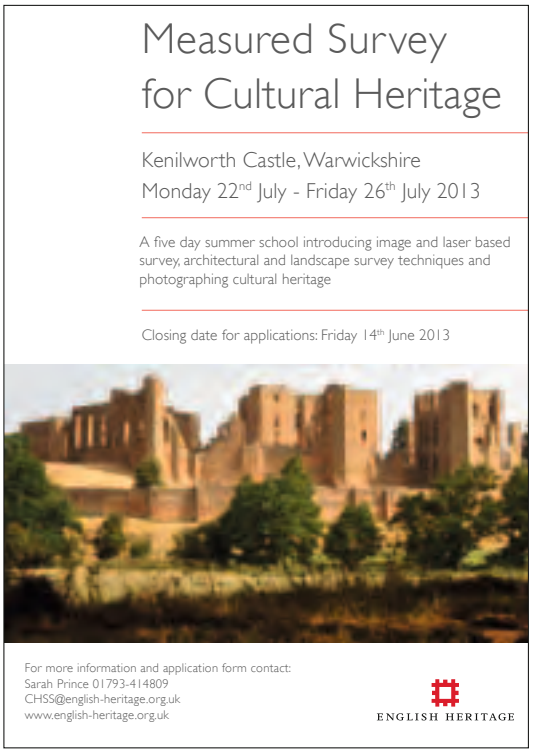

Phil Sinton, © English Heritage

remains in responding to requests from researchers for removal of bone or tooth samples for the purposes of scientific analysis. Its audience is those in museums, archaeological field units and university departments responsible for curating archaeological human remains, and also clergy and others responsible for burial grounds who are receiving an increasing number of requests to exhume historic burials for research purposes. The document describes some of the pertinent legal, ethical and scientific considerations involved. The guideline is published by the Advisory Panel on the Archaeology of Burials in England, supported by English Heritage. It is available as a free download: http://www.archaeologyuk.org/apabe/

Simon Mays

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Cover of new English Heritage Publishing Catalogue

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(Continued from back page)

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