NEWSLETTER OF THE ENGLISH HERITAGE RESEARCH DEPARTMENT

RESEARCH NEWS

Understanding 'The Great Tower' at Greys Court, Oxfordshire - story on page 3

Inside this issue...

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Welcome to the new English Heritage Research Department newsletter

Recent organisational changes within English Heritage have brought together a number of activities under single management: archaeological science, archaeological fieldwork, historic buildings and landscape investigation, aerial survey (including the National Mapping Programme), the Survey of London, and many recording specialists including illustrators, surveyors and photographers. Although these teams do not carry out all of English Heritage's research work, the new department does represent the biggest single concentration of researchers in the organisation and possibly the sector.

We are also strongly committed to training and outreach and have already begun developing a wide-ranging programme of work. As well as promoting public awareness and enjoyment of the past by participating in events such as National Archaeology days and the Festival of History, we provide teaching courses, drawing on the huge pool of in-house expertise, and create opportunities for other professionals in the heritage sector to gain first-hand experience by working alongside our own staff. We will report on the most interesting of these in the Notes & News section.

Corporate restructurings can appear from the outside to be boring, navel-gazing affairs, but we hope you will see a positive outcome in the improved scope and focus of our work. Responding to demands from the sector and observations from DCMS in their last quinquennial review, we now aim to provide even more relevant and better programmes of research targeted on the needs of the historic environment, to increase cross-disciplinary and cross-team working, and to improve our dissemination.

Research News supersedes the popular *CfA News*, which reported on the work of our archaeological teams at Fort Cumberland (Portsmouth), and reflects the work of a wider group of specialists engaged in different aspects of archaeological and built environment research across the country. In time, its scope will be expanded to include an even broader picture of English Heritage's research activities, usefully complementing the more thematically organised and policy orientated *Conservation Bulletin*.

I hope you enjoy this issue.

Edward Impey
Director of Research and Standards

Research News appears three times per year.

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Greys Court, Oxfordshire: the contribution of analysis and recording to the understanding of a property in care

New investigation at this important National Trust medieval property has completely changed our understanding of this building and its status, and will form a sound basis for its future management.

The Research Department's Architectural Investigation Division has completed a commissioned survey of Greys Court, a medieval and Elizabethan courtier house, owned by The National Trust. The project was initiated after the Trust sought the specialist skills of English Heritage staff to address their particular research requirements for the property, where it was recognised that a limited understanding of the house and its enigmatic ruins was restricting potential conservation, education and visitor initiatives. The project team devised a comprehensive, multidisciplinary, approach, with the aim of explaining the present form of the buildings, towers and walls, establishing their dates of construction and principal phases and placing them in context with one another and the times in which they were built. In conjunction, the grounds and surrounding parkland were the subject of an archaeological assessment, by colleagues from Archaeological Survey and Investigation, aimed at understanding the development of the wider, landscape setting.

Greys Court is situated at Rotherfield Greys, in the Lower Chilterns, four kilometres north west of Henley-on-Thames. In the medieval and Elizabethan periods, it served as residence to a succession of courtiers, including John de Grey (1300-1359), Lord of Rotherfield, one of the original Knights of the Garter, the powerful Lord Lovells, who owned the property for much of the 15th century, and Sir Francis Knollys, courtier to Queen Elizabeth I, who served as Warden to Mary Queen of Scots. However, from the early 17th century Greys Court went into decline, and until the 1930s was used intermittently as a residence and a source of rental income, chiefly at the hands of the Stapleton family. In 1937, the estate was purchased by Sir Felix and Lady Brunner, who gifted the property to The National Trust in 1969.

Before the start of the project, the remains of the medieval house were thought to comprise

'The Great Tower': one of the medieval towers built by the Lords of Rotherfield. The upper stages were rebuilt during the post-medieval period

Greys Court House, the main front, dating from 1573-74, built as part of Sir Francis Knollys' remodelling of the upper court.

four stone and flint towers and a curtain wall, built in connection with a licence to crenellate, granted to John de Grey in 1346. The survey revealed a far more complex story, overturning the accepted theory of one phase of embattlement and identifying six principal medieval phases. It demonstrated how a substantial fortress-style residence emerged through the adaptation and consolidation of an earlier group of buildings, including hitherto unrecognised remains probably dating from the late 11th to the late 12th centuries, and that the surviving curtain wall was, in fact, built in two major phases, probably during the 13th and 14th centuries. The second phase, associated with Greys Court's distinctive stone and flint towers, marks a pinnacle in the evolution of the medieval house, the ruins of which continue to exude a sense of power and authority, symbolising the aspirations and ideology of the de Greys. Later medieval phases, identified through the project, differ in character, using brick and timber-framing and reflect a concern for superior domestic provision within the curtilage of the earlier walls. One example is a timber-framed, jettied, wing, now encapsulated within the later house. Dendrochronology produced a felling date of 1450-51: identifying this as an addition by the Lovells, whereas, previously, it had been attributed to circa 1500, after the Lovells' tenure.

The Elizabethan 'Well House' and south-west tower, dating from 1586-88

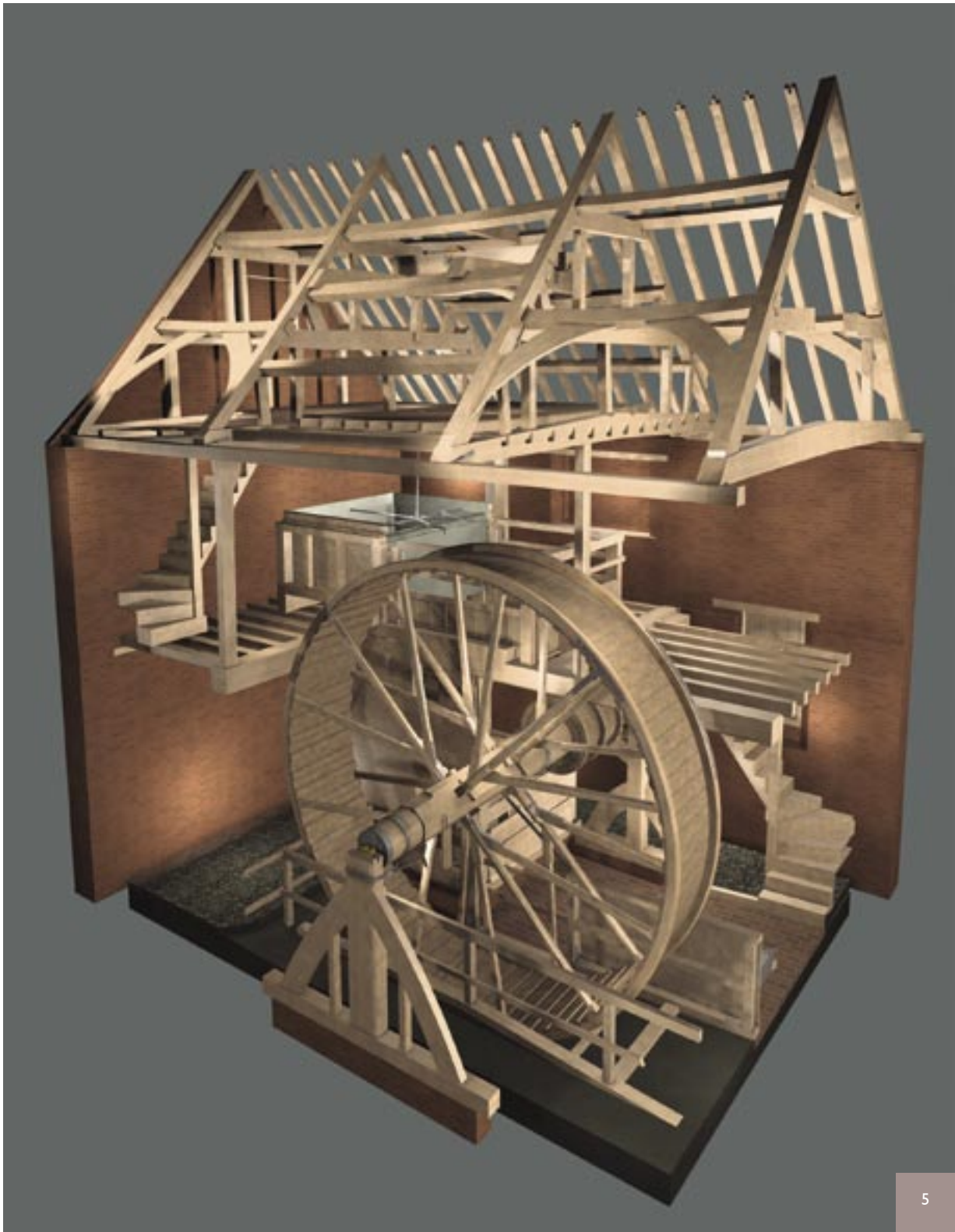
During the mid-to-late 16th century Sir Francis Knollys embarked on an extensive remodelling of Greys Court. The survey revealed that Knolly's work was the result of a series of building campaigns, and provided accurate dates for most. It demonstrated that his work post-dated Queen Elizabeth's accession in 1558, reflecting the fact that Knollys, a devout Protestant, was in exile during Queen Mary's reign. Interestingly, the results dated the earliest phase to 1559 – a year after Knollys' return to England. This was followed by the construction of a brick, flint and stone range that represents a reinvention of the medieval upper court. Dendrochronology allowed this block – which now forms the bulk of the present mansion – to be placed correctly in the site chronology. Previously, this one range had been perceived as the entire house, with a putative date of circa 1600,

and interpreted as a comparatively modest residence built at a time when Greys Court was no longer an important courtier residence. In contrast, sampling produced a felling date in the winter of 1573-74, and along with building analysis identified the range as just one wing of the great house – one of the earliest phases of enlargement and aggrandisement at the peak of the Knollys' prominence at Court. Interestingly, Elizabethan Progress records show that Knollys entertained Queen Elizabeth at Greys Court in 1574, prompting a belief that this range may have been built in anticipation of a Progress visit.

One of the most impressive survivals of this period is the 'Well House', dating from 1586-87. With its contemporary donkey wheel – the largest surviving animal-powered water-drawing mechanism in England, it is a stunning piece of 'vernacular engineering', exemplifying the ingenuity of its time. The exceptional nature of the 'Well House' and its unsuitability for conventional photography necessitated an advanced approach to recording, producing a complex 3D CAD model in which the form and construction of both building and mechanism are portrayed in an accurate, versatile and visually-realistic medium. The Trust hopes to use this as an interactive interpretative tool, possibly on-site and/or via the Internet.

The survey has utilised the various techniques of measured survey, photographic recording, 3D CAD modelling, historical research, dendrochronology, archaeological landscape assessment and buildings analysis to redefine the significance, history and meaning of Greys Court. This new understanding will be used as the basis for a comprehensive revision of the guidebook, and, for years to come, will inform the management and care of Greys Court, serving as a resource for enhancing peoples' appreciation and enjoyment of this special place.

Barry Jones



Sectional view of the 'Well House', derived from the 3D CAD model

Oldbury Castle, Wiltshire: reinterpreting a great Iron Age hill fort

Three research teams combine to shed light on the significance attached by Iron Age builders to Bronze Age features in the landscape, as well as on the increasing rate of attrition on the monument over the last 50 years.

Oldbury Castle is the largest and probably the most complex of all the Iron Age hill-forts on the Marlborough Downs.

MAGNETOMETER SURVEY

A fluxgate magnetometer survey was carried out in 1996 as part of the Wessex Hill-forts Project, a study of hill-fort interiors in the region. This revealed the presence of a previously unrecognised internal ditch visible as a positive linear magnetic anomaly dividing the northernmost third of the hill-fort from the remainder. This may represent part of the course of a boundary ditch pre-dating the construction of the hill-fort, or a further indication that the fort developed in several distinct phases (as earthwork survey shows) involving the expansion or retraction of the enclosed area at different times. A possible parallel is Cadbury Congresbury (Somerset), where an internal rampart constructed across the centre of the original hill-fort is associated with post-Roman reoccupation.

In the eastern and northern sectors of the fort, up to 20 faintly visible circular anomalies may indicate the positions of round timber buildings defined by outer ring-gullies. Overlapping suggests that these

Fig 1. The hill-fort, white horse and monument. NMR SU0469/41 (15834/08) 29-OCT-1997 © English Heritage

Fig 2. Geophysical survey in the western part of the hill–fort, using a Geoscan FM36 fluxgate gradiometer

buildings were constructed in successive phases. Abundantly scattered amongst the ring-gully structures, defined by positive magnetic anomalies, are more than 150 pits. The areas containing the pits and ring-gullies cluster to either side of an east-west road corridor (defined by an absence of magnetic anomalies) running from the east entrance towards the Cherhill Monument. Occupation appears to decrease in the southern and western areas, but differential preservation or greater down-slope soil accumulation could be obscuring further features in these areas.

ANALYTICAL EARTHWORK SURVEY

A request from the National Trust for survey in advance of repair works gave an opportunity to add detailed understanding of the earthworks to the knowledge of the interior gained by geophysics and the broader view from aerial survey. Among the earliest constructions on the hill are linear ditches; the one to the south-east was newly identified by this survey. The first phase hill-fort occupied the angle between two linear ditches joined by a curved, east-facing façade. The hill-fort was subsequently 'developed' by extending to the south-west and by the construction of an outer rampart and ditch (though this is unfinished) on the east and south.

Why the hill-fort should originally have been constrained by the pre-existing linears is a question of great interest. It is not merely for convenience – the ramparts could have been constructed anywhere on the hill. The implication is that the linear ditches had significance for the hill-fort builders. This is true of other hill-forts laid out over the junctions of linears, such as Quarley Hill (Hants). It seems as if the later Bronze Age significance of these hilltops where linear ditches met was encapsulated by enclosure in the early part of the Iron Age, even though

Fig 3. The geophysical and earthwork plans, with a suggested phasing for the main earthworks

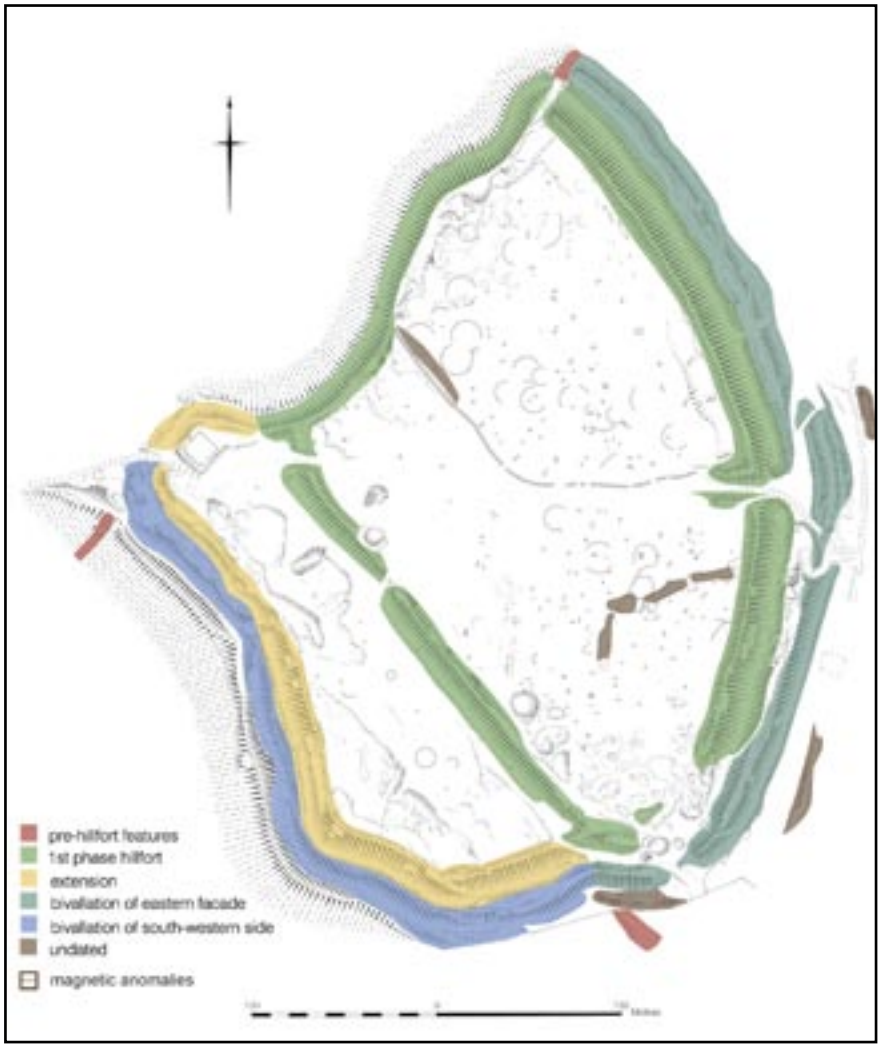


Fig 4. Earthwork survey of the hill-fort interior in progress, with the Cherhill Monument in the background

the linears themselves lost their importance. The original builders went to great trouble to provide a massive regular façade on the eastern side of the hill-fort with an elaborate central entrance. Principal entrances facing east are a common feature of southern British hill-forts. An impressive approach and an element of symbolism were at least as important as considerations of defence.

NATIONAL MAPPING PROGRAMME

The archaeological landscape around the hill-fort has been interpreted and mapped from aerial photographs as part of the Avebury World Heritage Site NMP project. The hill-fort lies in a broad landscape which has been shaped by man from the Neolithic period onwards. This is exemplified by the numerous quarries, probably excavated over thousands of years, which extend south-east from the hill-fort. The inhabitants of the hill-fort lived in an area full of landmarks from the past, in particular numerous late Neolithic and Bronze Age barrows. In later prehistoric times the hills were divided by extensive field systems and boundaries. Reorganisation may be indicated by the Roman road which cuts across earlier field systems on North Down.

Intensive agricultural use in the Medieval period and later is signified by terracing on Calstone Down. Sheep enclosures across the coombes to the immediate east of the fort, and scattered dew ponds, indicate relatively recent use of the hills for grazing. The aerial photographs also illustrate the full extent of

Fig 5. Oldbury Castle and environs (North to bottom of frame). CPE/UK/1821 frame 3072 04-NOV-1946 English Heritage (NMR). RAF Photography

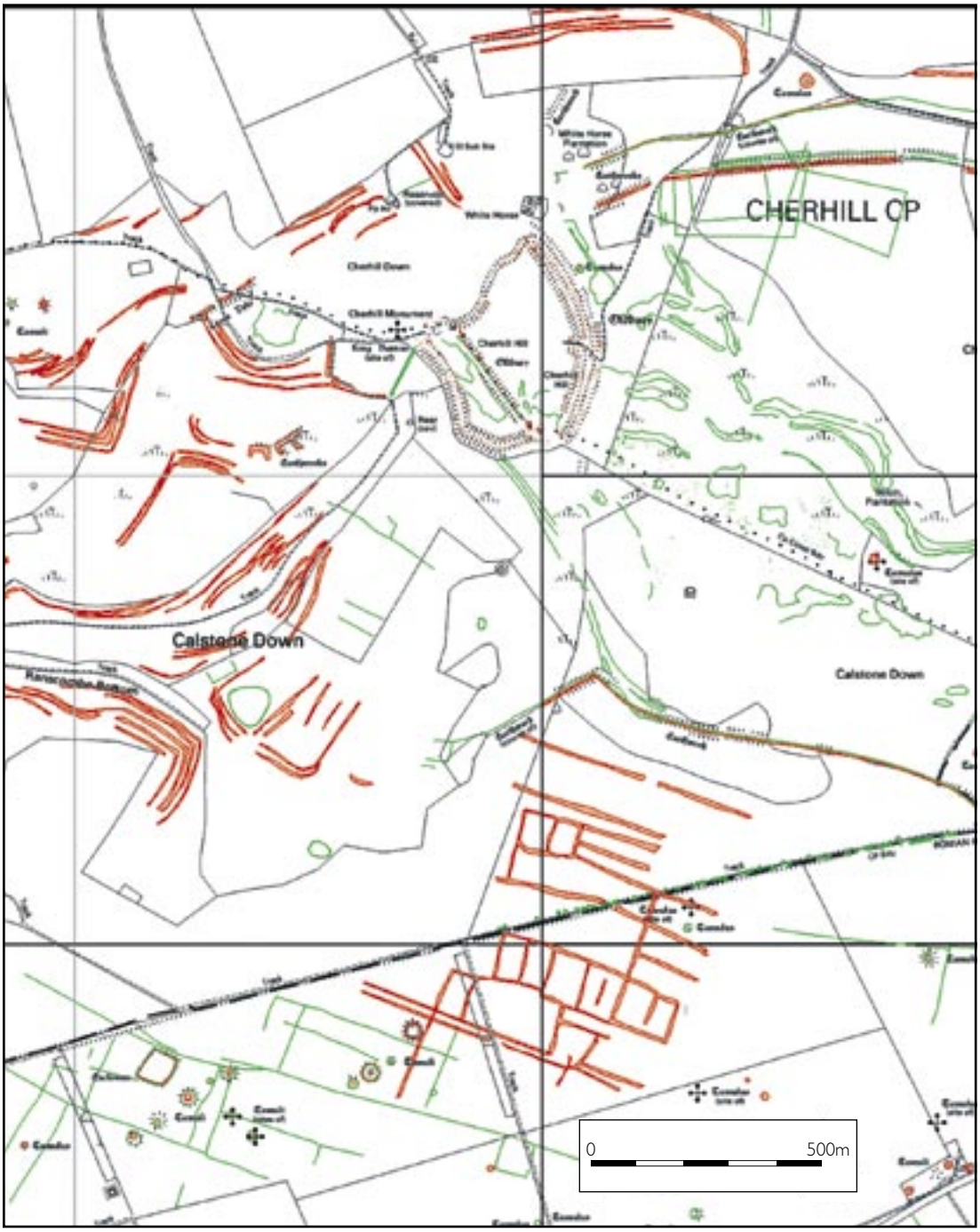


Fig 6. NMP mapping of archaeological features visible on aerial photographs, in the vicinity of Oldbury Castle, ditches in green, banks in red

the early twentieth-century airfield, just to the north at Yatesbury, of which only a few buildings now survive.

The greatest changes to this archaeological landscape have occurred in the last 50 years. Because of recent arable cultivation much of the archaeological context of the fort can now only be seen on aerial photographs. The NMP mapping has interpreted and collated this information which can now be used to target further research.

CONCLUSION

The new evidence, from geophysics, analytical earthwork survey and aerial photographic investigation, has fundamentally changed understanding of Oldbury. The combined results elucidate the hill-fort's complex story within the long history of human activity in this area.

Mark Bowden, Andy Payne, Helen Winton

A pellucid fruit of the fire: Scientific investigation of glass

How work in Ireland is helping the interpretation of poorly surviving sites in England; how glass analyses are shedding light on levels of specialisation in Roman glass production; and how results help to track experimentation on the route to the invention of lead glass.

The Technology section undertakes wide-ranging research into glass and its manufacture, from the prehistoric period through to the 19th century. Some of these results have been reported in *CfA News* (Silkstone: Nos 4 and 5). Here we present results from four recent major projects on glass.

Fig 1. The glasshouse at Shinrone during excavation

THE SEVENTEENTH-CENTURY GLASSHOUSE AT SHINRONE, CO. OFFALY, IRELAND

In the late 16th century, glass workers from Lorraine and Normandy came to England, bringing with them a new glass-working tradition. The glass was better quality than the English medieval variety, and analyses have since shown that it had a different composition, termed high-lime, low-alkali (HLLA). In 1615 the use of wood fuel in glass-making in England was prohibited but in Ireland restrictions were not introduced until 1641. Members of the French glassmaking families left England for Ireland and wood-fired glass furnaces flourished there during the first part of the 17th century. Remarkably, one of these, complete with part of its superstructure, and dated to the first half of the 17th century, survives at Shinrone, County Offaly, Ireland (Fig 1). Two seasons of excavation have been carried out at the glasshouse by Caimin O'Brien and Jean Farelly, who have also researched the documentary evidence relating to glasshouses in the region.

Samples of the glassworking waste, crucibles and furnace recovered in the excavations, plus a number of surface finds from the nearby site of a contemporary furnace, at Glaster, Lusmagh, were analysed at Fort Cumberland. The waste glass from Shinrone was all HLLA glass, similar to that produced from the late 16th century in England. As all of the waste from Shinrone was compositionally similar, it was possible to identify which glass products from the

assemblage were made at the site, and which were not (Fig 2), demonstrating that both window and vessel glass were produced at Shinrone. The Glaster furnace also produced HLLA glass but the composition was subtly different, allowing glass from these two sites to be distinguished. The results also provide information on the raw materials used (likely to be ash from oak wood and sand), the temperatures achieved in the furnace (in the region of 1300-1350°C) and the refractory materials used in the construction of the furnace and crucibles. Shinrone offers a unique opportunity to investigate the technological developments introduced by French glassworkers in late-16th-century England and subsequently in Ireland as so much more survives than on English sites.

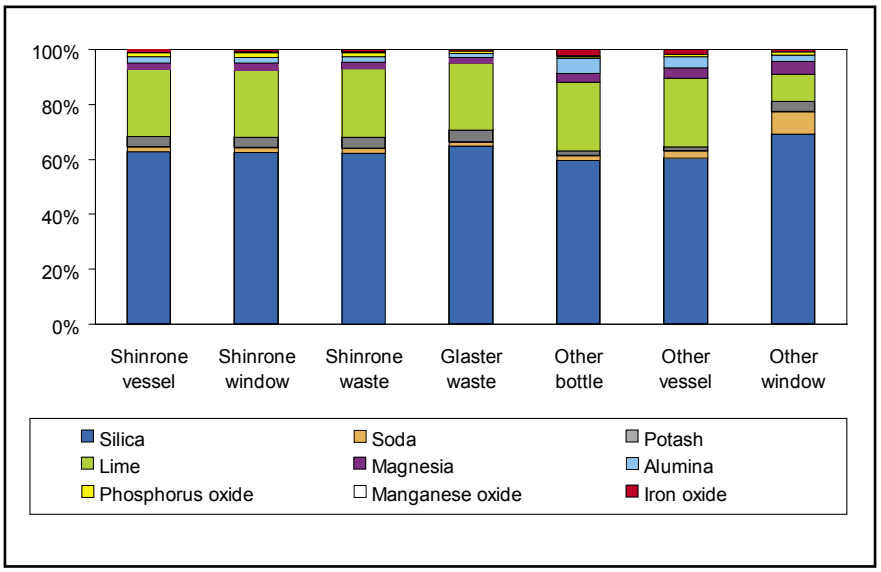


Fig 2. Showing the identical compositions of the glass waste and products made at Shinrone (Shinrone vessel, Shinrone window and Shinrone waste) and the different compositions of the glass found at Shinrone but produced elsewhere (other bottle, other vessel and other window). The composition of the glass made at Glaster (Glaster waste) is also distinct

Sarah Paynter, Caimin O'Brien[1] and Jean Farrelly[2] *(1&2 Co. Tipperary)*

ANALYSIS OF ROMAN COLOURLESS GLASS FROM BINCHESTER, CO DURHAM

Pioneering studies by a number of researchers have recently demonstrated how compositional data for glass produced at various times during the first millennium AD can be linked to the raw materials used in their production, ultimately providing information on how the glass was produced and traded. In this project Roman colourless glass tableware dating from the 1st to the mid-3rd centuries AD was investigated. Forty glass samples from Binchester were analysed using ICP spectrometry (at Royal Holloway and Bedford New College, University of London). At Fort Cumberland, the results were compared with studies of similar glass from Lincoln and Colchester. It was necessary to compensate for differences in reproducibility between the ICP datasets, and the method chosen for this was reanalysis of a selection of samples from each group using energy dispersive spectrometry (EDS).

The results were consistent with the production of colourless glass from natron (a soda-rich evaporitic mineral) and sand, on a large scale at a small number of furnace sites in the 1st to 3rd centuries, and the distribution of the glass as a bulk material to workshops, where glass workers shaped it into vessels. The concentration of lead in the glass, although consistently low, was found to vary and may be related to the date of glass production. It is likely that furnaces in the same general area produced much of the colourless glass because chemically similar sand was used. However samples of the same type of ware were found to have the most similar compositions, regardless of where they were recovered, and some distinct compositional groups, unique to certain types of ware, were identified (indicating that some glass was produced using a different source of sand). This suggests that glass workshops specialised in a particular style of product, or that they sourced different glass depending on the product, and that the wares were distributed widely.

Sarah Paynter

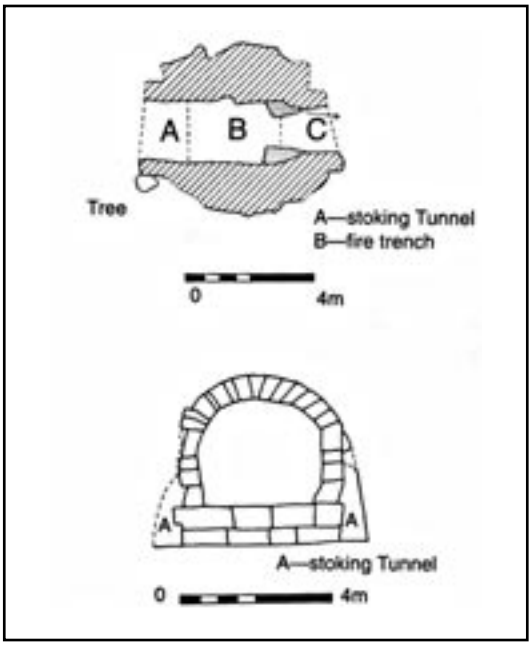


Fig 3. Plan and elevation of the glasshouse at Shinrone with flue running from north-east (on the left) to south-west (on the right)

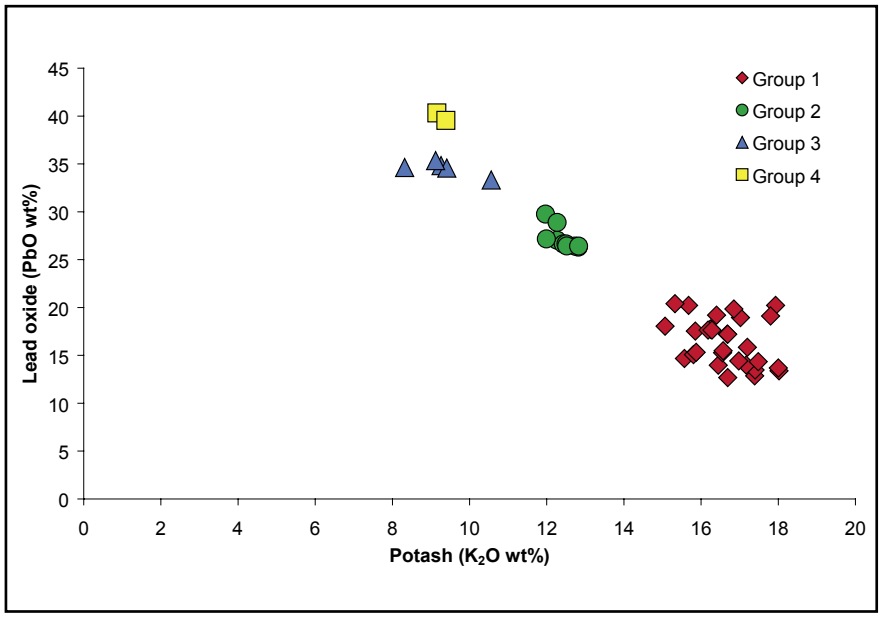


Fig 4. Potash and lead oxide content of lead glass

RAVENSCROFT AND THE INVENTION OF LEAD CRYSTAL

In the 18th century England was one of the leading producers of fine glassware, and this was based in large part on the manufacture of 'lead crystal' glass. The invention of this type of glass is traditionally attributed to George Ravenscroft who obtained a patent for 'a perticuler sort of christalline glasse resembling rock christall'. Unfortunately, the patent does not specify how the glass was made (and does not even mention lead). We have analysed 47 lead glasses dated to the period 1674-1690. These glasses are composed almost entirely of silica, lead oxide and potash. The glasses can be divided into four types based on the amounts of lead oxide and potash. The date range for each group is shown in the second figure. The earliest group has the lowest lead content and each subsequent group contains more lead oxide. All of the group 1 glasses have suffered from a form of corrosion ('crizzling'). The later groups have not suffered from corrosion: the higher levels of lead made these glasses more stable.

The results show that clear lead oxide glass was first developed in the 1670s and there was a period of intense experimentation which continued for the next decade or two (i.e. after Ravenscroft's patent expired and he left the glass industry).

David Dungworth and Colin Brain

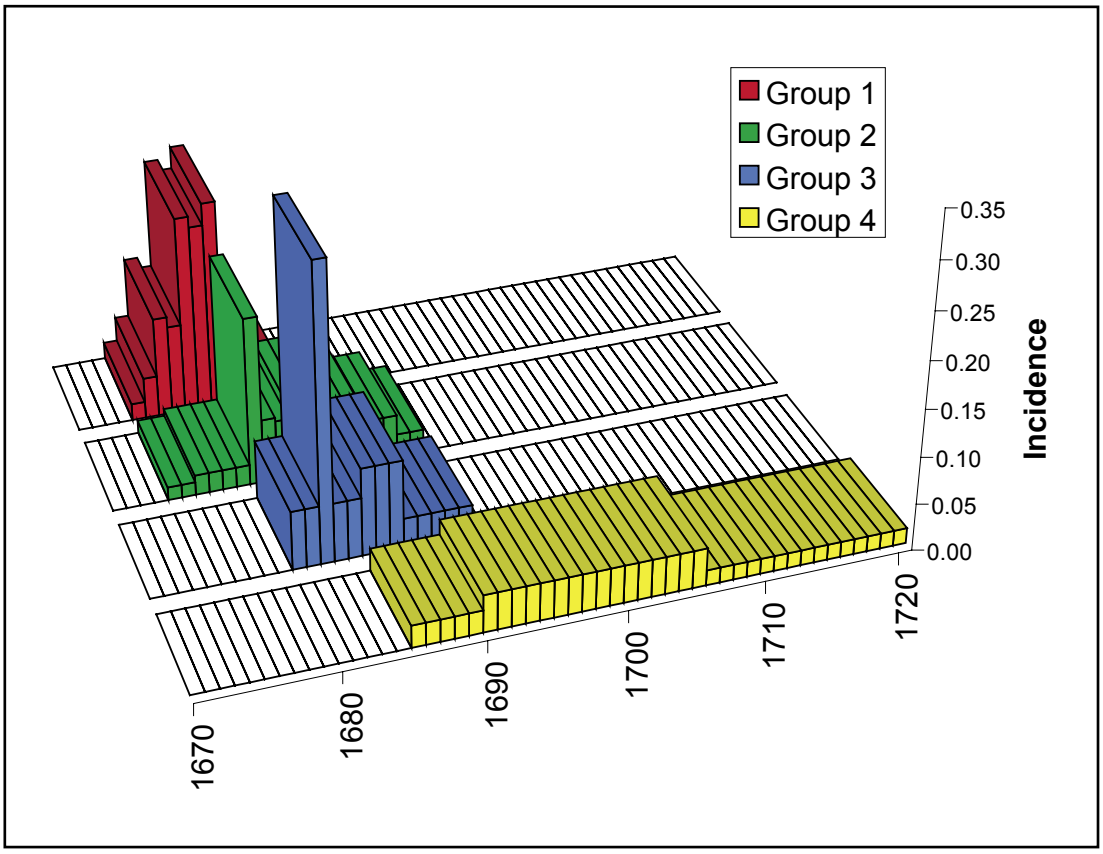


Fig 5. Date ranges for the four groups of lead glass

Fig 6. Watercolour showing three of Bristol's glasshouses (c.1821)

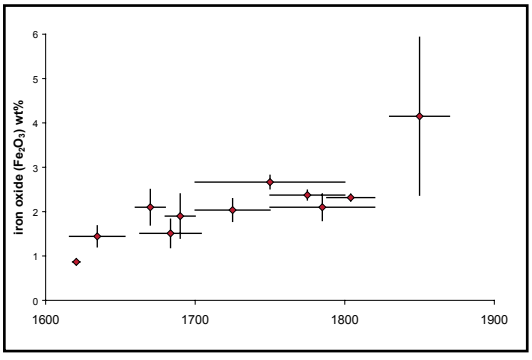
BRISTOL

In the post-medieval period Bristol had an important glass industry: in 1696 nine of the eighty-eight glasshouses in England and Wales were in Bristol. By 1761 there were fifteen glasshouses, but by 1833 there were only 4 and the last glasshouse closed in 1921.

Recently we have been able to examine material from four Bristol glasshouses (Cheese Lane, Bedminster, Limekiln Lane and Porwall Lane) that produced bottle glass. The bottles were always made from HLLA glass (*see* Shinrone *above*). Some of the components of the bottle glass show changes over time: the alumina and iron oxide contents increase while the phosphorus oxide and manganese oxide contents decrease.

The decline in phosphorus and manganese probably relates to a gradual shift away from plant ashes as a flux. The increase in the alumina and iron oxide reflects an increasing use of cheaper raw materials. A Swedish industrial spy visited Bristol in 1754 and reported that the ingredients used in bottle glass manufacture included sea sand, kelp, soaper's waste, and blast furnace slag.

David Dungworth and Sarah Paynter



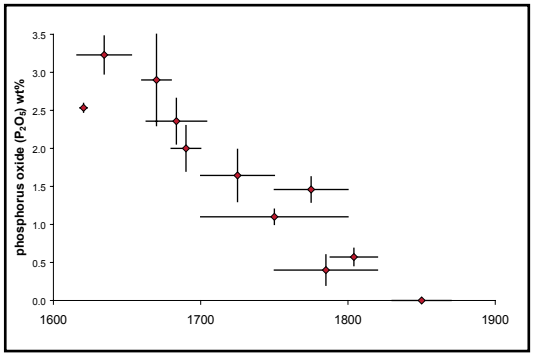


Fig 7 *(left)*. Changes in iron oxide content of bottle glass 1600–1900. The vertical error bars represent a single standard deviation. The horizontal bars indicate the period of manufacture. Some of the data points are from previously published sites (e.g. Silkstone)

Fig 8 *(right)*. Changes in phosphorus oxide content of bottle glass 1600–1900

Re-analysis of the Aveline's Hole excavation archive leads to surprising findings

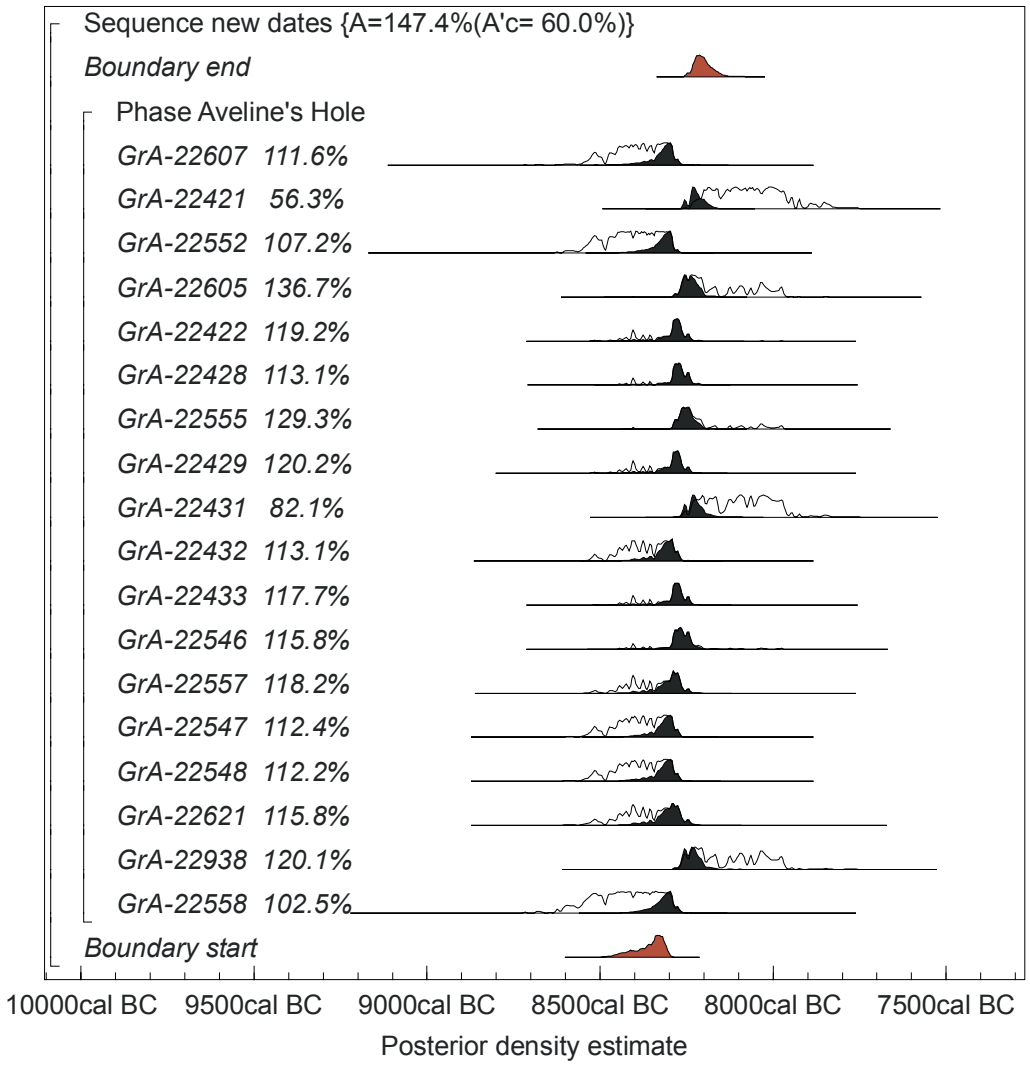
How re-analysis of the Aveline's Hole excavation archive is changing our understanding of Mesolithic society.

The re-analysis of archaeological material held in our museums is supplying exciting challenges for archaeological science and providing results that are radically changing our views about the past. Recent research on material from Aveline's Hole, Somerset (Fig 1), excavated in the eighteenth and nineteenth centuries, and between 1919-1933 by the University of Bristol Spelaeological Society, highlights the importance of this cinderella of archaeological resources.

Before its discovery in 1797 the cave known as Aveline's Hole appears to have been sealed from the outside world since its use a burial site in the early Mesolithic. The early explorers of the eighteenth and nineteenth centuries removed most of the skeletons (described by *Sporting Magazine* as 'lying promiscuously' on the cave floor). Unfortunately most of these 100 or so skeletons have been lost. However, the twentieth century excavations found flint tools, animal bones, and the fragmentary remains of 21 individuals. The remains were taken to Bristol where they were put on display, until November 1940 when the building was bombed and most of the collection, plus all the excavation records, were destroyed.

The surviving human skeletal material represents the largest Mesolithic assemblage of human remains in Britain. Despite this it has until recently been poorly researched. As part of a major re-analysis of the material (team headed by Dr Rick Schulting, Queen's University, Belfast and Dr Mick Wysocki,

Fig 1. Rick Schulting and Mick Wysoscki (with skull) at the entrance to Aveline's Hole



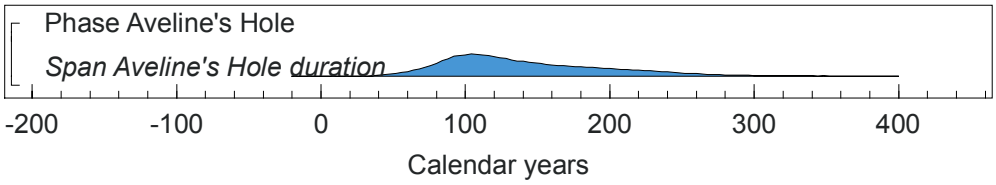


Fig 2. Radiocarbon results from Aveline's Hole

University of Central Lancashire) English Heritage commissioned eighteen radiocarbon measurements from the Centre for Isotope research at the University of Groningen. It was hoped these would provide precise dates for the start and end of burial activity within the cave, and either support or disprove the expectations that the site was used intermittently over a long period of time, with relatively few burials in any given century.

The results in the Bayesian model (Fig 2) show that, rather than be used intermittently, the dated skeletons all come from a single continuous phase of activity. Burial activity is thus estimated to have taken place over the course of a century or so between *c* 8400 cal BC to *c* 8200 cal BC. We can thus start to think of Aveline's Hole as a 'cemetery', not dissimilar to those that dot the landscape today. Generally we think that cemeteries only appear when people have an interest in marking a claim to a territory or an important resource. This raises the question of why did people keep coming back to the cave to bury their dead? It is certainly not something that persists; in Britain the next such concentration of burials is not seen for another 4000 years, with the appearance of farming in the Neolithic. The results of other investigations (eg skeletal morphology, stable isotope analysis, dental microwear) may help us answer these important questions raised by the dating programme. Even if they don't, the research has given an important glimpse into the way of life of people over 10,000 years ago.

Peter Marshall, Rick Schulting and Johannes van der Plicht

Conservation Management at Fiskerton, Lincolnshire

Analysis and experimental work at Fiskerton will provide models for dealing with land management change and flood alleviation schemes in the future.

The Iron Age wooden causeway at Fiskerton has been under an intensive arable farming and drainage regime for a number of years. Recent changes to land management – reversion to grassland and reduced drainage of the site will allow water-tables to rise, and will favour the creation of a natural wildlife habitat under a local Countryside Stewardship Scheme. However, the effects on the already desiccated soil and on archaeological materials are not known and it is possible that this may be detrimental due to the introduction of different water chemistry and oxygen regimes on site.

The causeway was excavated in part in 1981 by Naomi Field (funded by DoE), although its precise function is yet to be established. Associated with the causeway are metal weapons, tools and other artefacts, as well as finds of pottery, stone, bone, jet and amber. Since 2001, a number of surveys, including geophysical, auger and field walking have been completed by EH and other agencies in the immediate vicinity of the causeway and in the wider area of the Witham Valley, to characterise the archaeological and palaeoenvironmental aspects of the site. A conservation management project was also set up to assess, through monitoring, the current state of preservation of the site and artefacts and to determine the impact of re-watering (Fig 1).

Fig 1. Looking north from the River Witham towards the modern village of Fiskerton showing fenced monitoring points

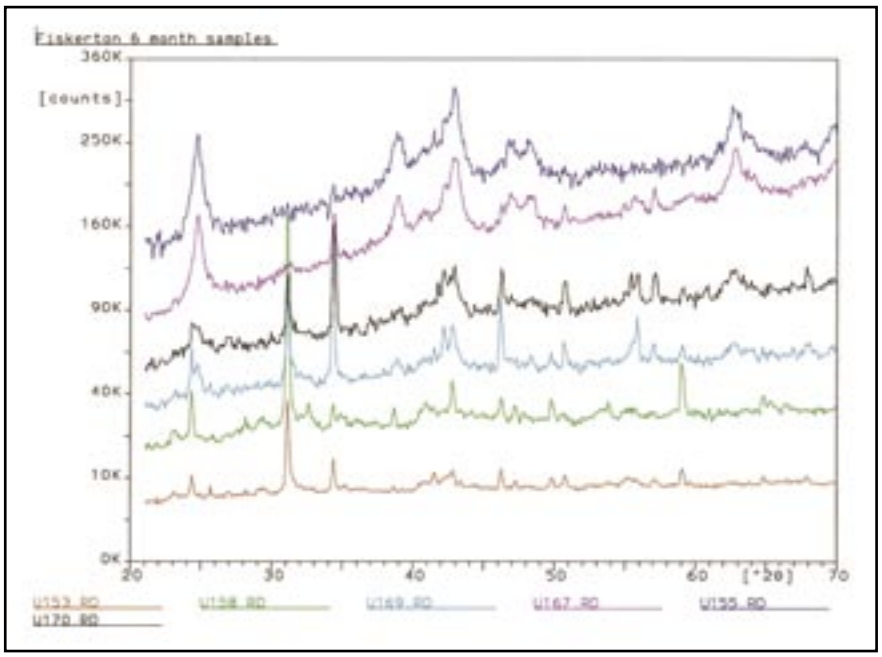
In December 2003, before re-watering, modern experimental materials were buried in the vicinity of the causeway. Samples of iron, copper, bone, antler and horn were mounted separately on a series of plastic rods or within perforated plastic tubes. These were installed at two locations with the aid of an auger to specific depths, up to a maximum of 1.7m (Fig 2), which approximately correlate with the depths at which the groundwater monitoring is taking place in the vicinity. The materials are recovered and analysed at regular intervals to determine how the process of re-watering affects their survival. Samples have been removed at 6, 12 and 18 months and further samples will be extracted at yearly intervals.

The metal samples are analysed by Vanessa Fell and Karla Graham (EH Fort Cumberland) to determine the type of corrosion products present. The antler and horn samples are analysed by Paul Simpson (University of Portsmouth) and the bone samples by Matthew Collins (University of York). The composition of the groundwater is determined through a monthly monitoring programme arranged by Jim Williams (RSA, East Midlands) and funded by Lincolnshire County Council and the Environment Agency. Characteristics such as pH, redox potential, temperature and chemical composition are measured. Results to date from the metal samples show that there is considerable

Fig 2 (*left*). Installing samples of experimental materials at Fiskerton, adjacent to the north delph of the River Witham. A rod of copper samples is being placed in an augered hole

Fig 3. Copper samples: before burial (*top*); from an oxidising horizon (*centre*); and from an anoxic and reducing horizon (*lower*)

Fig 4 (*below*). X-ray diffraction results from the analysis of iron samples show a variety of iron oxides and iron sulphides



oxidation in the upper 1.2 metres of soil and peat – the horizon where we expect the archaeology to be. Lower down, the soils are anoxic and reducing, except close to the river where there are distinct variables in the water-table (Figs 3, 4).

At the end of 2004, the field was re-watered by the blocking of land drains. As part of the Countryside Stewardship Scheme and for the benefit of wild life, 'scrapes' were created in the ground surface by the farmer. The field is now pasture for cattle. The conservation management project will continue to monitor the effects of changes in water-tables and chemistry of the groundwater which occur as a consequence of these changes.

The conservation management project will advise on the future management of the archaeological site at Fiskerton. The research will inform EH and the Environment Agency on local effects due to re-watering, and will contribute towards our understanding of the impact of changes in land-use elsewhere in the Witham Valley, where flood alleviation schemes are planned for the future. In addition, the project will advise on methodologies for monitoring and assessing the conditions of archaeological materials and the potential for preservation of archaeological remains *in situ*.

Vanessa Fell and Karla Graham

Badgers, beakers and brooches: excavations at Barrow Clump, Wiltshire

A project design to investigate badger damage to Bronze Age round barrows produced evidence for site use across four millennia, including Neolithic settlement, Bronze Age burial ritual and Anglo-Saxon graves.

In *CfA News 8* we reported on the start of a project to investigate badger damage to Bronze Age round barrows. Excavations at the first site, Barrow Clump, which were undertaken with the co-operation and assistance of Defence Estates, are now complete, allowing us to present some initial results. The serious management issues that underpin the project were discussed in the earlier article, and work in 2004 further demonstrated the extent of the problem (and the impact of rabbits, as well as badgers). Here, however, we concentrate on what we have learnt about the archaeology of the site.

Barrow Clump lies within the army's Salisbury Plain Training Area near Figheldean, Wiltshire. It overlooks to the west the valley of the river Avon, which flows southwards from here towards Durrington Walls and Stonehenge. This was a significant position in the landscape, next to an important routeway, and the location may account for the long history of activity our work has revealed.

Like many barrows across England, Barrow Clump was built on top of an earlier occupation site. Whether this was deliberate is unclear, but the presence of the mound has served to protect (though not from the animals!) the fragile remnants of Neolithic activity, indicated by large numbers of struck and burnt flints and a few sherds of pottery. The pottery belongs to a style called Peterborough ware, which dates to the centuries around 3000 BC.

About 1000 years later, at the start of the Bronze Age, the first burials took place at the site. On the edge of the mound we uncovered an oval pit containing the crouched remains of a child, surrounded by carefully placed nodules of flint and with a fine Beaker pot laid at its feet. Thankfully, the feature was deep enough to have escaped the attention of the badgers.

Fig 1. View of Barrow Clump from the south-east

Fig 2. Excavating a trench through the barrow mound; note the number of animal burrows

Towards the centre of the site we revealed a feature that may be contemporary with the Beaker burial: a small ring-ditch which probably surrounded another grave, although that lay outside our excavation (it may have enclosed the burial of an old man excavated in the 1890s). Significantly, the ring-ditch had been filled and recut twice before the main barrow mound was constructed over it, showing that the site did not achieve its final monumental form for a considerable time after its initial use for burial.

The mound, which can be dated to the first half of the second millennium BC, then offered a further surprise. It had been thought that Barrow Clump was a 'bowl barrow', a mound with a ditch immediately around it. But its true form has been obscured by earlier damage to the site – it is actually a 'bell barrow', a less common type with a gap or 'berm' of several metres between the mound and the ditch. The mound was shown to have two elements: a turf and soil core beneath a capping of white chalk, which would have made the barrow a prominent feature on the green hillside.

Before excavation, the ring-ditch that surrounded the barrow was not visible on the ground, although the large number of sett entrances above the soft ditch fills provided a clue to its position. Excavation proved that the monument in its final form was surrounded by a ring-ditch some 50m in diameter, the ditch cut being 3-4m wide and 1m deep below the natural chalk.

Although the site was abandoned during the Bronze Age, and the ditch began to silt up, it remained a significant place in the landscape. Some 2000 years later, around AD 500, the first Anglo-Saxon communities appeared in Wiltshire and began once again to bury the dead at Barrow Clump, this

Fig 3. The Beaker burial and pot being recorded

Fig 4. A section through the ring-ditch; in the foreground, a grave being excavated

time not beneath the mound but in graves cut into the ditch fills and the berm area. In three small trenches we uncovered twelve burials, some with grave goods such as brooches and beads, others without; some oriented roughly east-west, others aligned with the ring-ditch. Perhaps they span the transition from pagan to Christian. Also intriguing is the presence of a few Roman brooches, which may have been heirlooms. Unfortunately, however, the soft grave fills have proved attractive to badgers and several burials have been severely damaged, as the photograph shows.

The work at Barrow Clump has taught us a great deal about the site: we now have a far better understanding of its structure and sequence, and significant Neolithic and Anglo-Saxon phases can be added to its history. Once analysis of the finds is complete we will know considerably more. Above all, the excavation has shown us how much information may be left at an apparently severely damaged site, while at the same time demonstrating how vulnerable the surviving deposits are.

Jonathan Last

Fig 5. An Anglo-Saxon grave within the ring-ditch; the lower legs and part of the skull have been removed by badgers

Gloucestershire NMP and ridge and furrow ploughing

Aerial photography demonstrates both the full extent and rates of destruction of medieval field systems in the Vale of Evesham.

National Mapping Programme air photo interpretation and mapping of the Vale of Evesham has revealed the extent and character of the impressive medieval ridge and furrow field systems that covered this landscape. Often dramatically visible on RAF aerial photographs of the 1940s when the landscape was largely a pastoral one, much of the ridge and furrow has now been destroyed as the land has reverted to arable use. The colours in Fig 1 give an idea of the level of impact with the purple colour showing areas which have been largely levelled by modern ploughing and the blue indicating ridge and furrow still upstanding on the most recent available photographs. One side effect of this is that as the ridge and furrow becomes levelled cropmarks can sometimes reveal the pattern of pre-medieval settlement (Fig 2).

Sharon Bishop, Fiona Small, Cathy Stoertz, Ed Carpenter

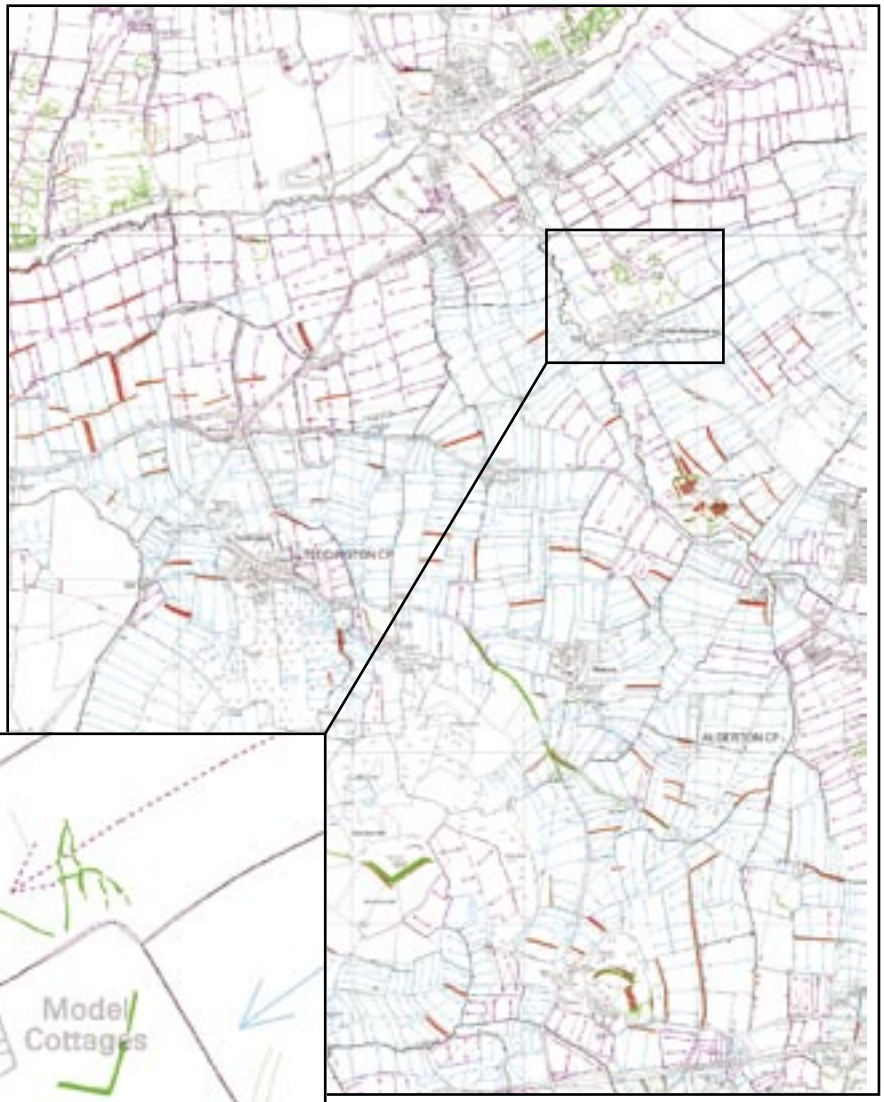


Fig 1. An extract of the NMP transcription depicting the sites recorded on map sheet SO 93 SE and part of SO 93 NE. The well preserved medieval cultivation (blue) is centred on an area of high ground on the northern edge of the Cotswold escarpment. *Background map OS crown copyright. Licence Number: GD03085G*

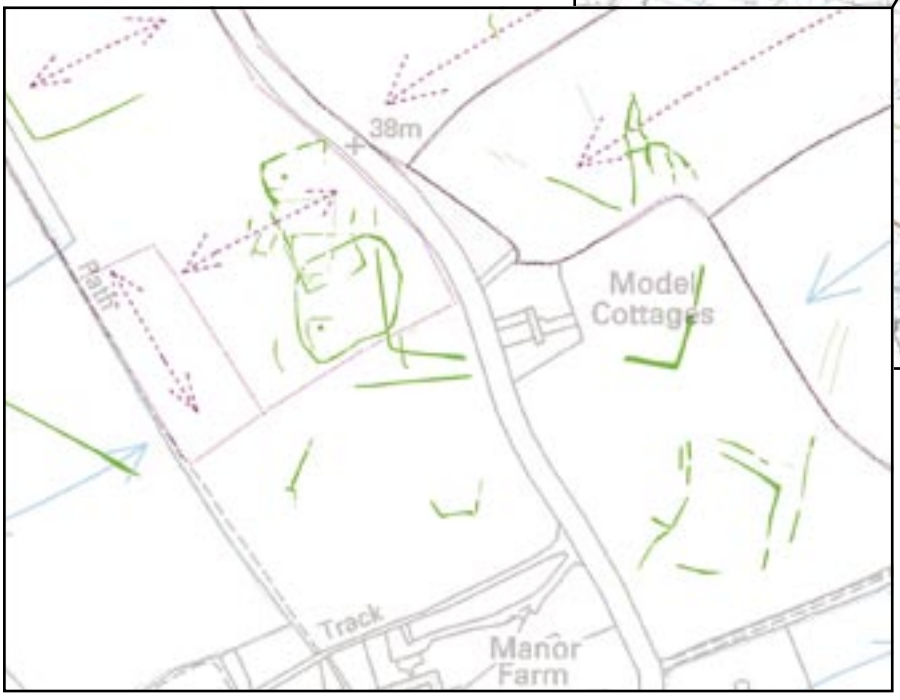


Fig 2. The faint cropmark traces of a multi-phase group of Iron Age/Romano-British enclosures have been recorded where the medieval ridge and furrow, extant in the 1940's, has been plough-levelled. *Background map OS crown copyright. Licence Number: GD03085G*

Out of the ashes: responding to the great Fylingdales fire

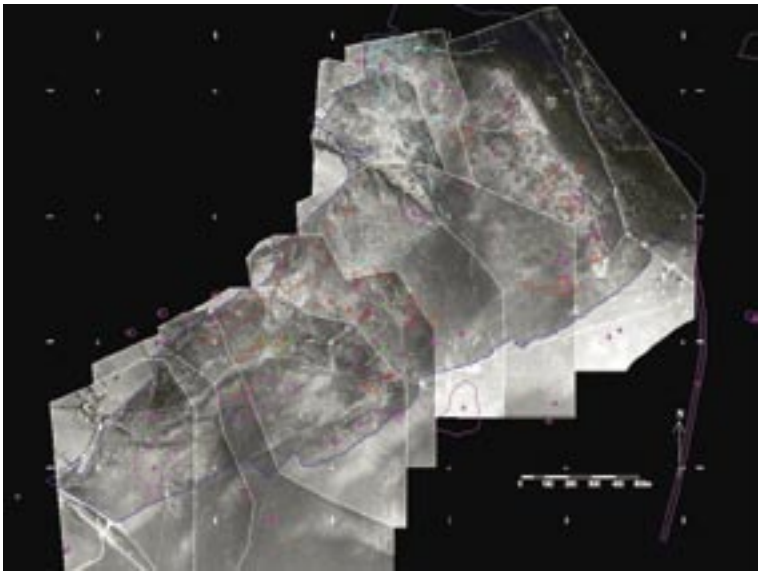
A natural disaster has revealed much new archaeology but also presented major challenges to its conservation.

The wild fire that raged across Fylingdales Moor between the 17th and 21st of September 2003 devastated the vegetation and fragile peat soils of 2.4km^2 of heather moorland. At the time it received national press coverage, but less immediately obvious to the general public was the effect on the archaeological sites on the moor. Within the burnt area were 30 Scheduled Monuments, including the impressive Robin Hood's Butts barrows, parts of a prehistoric field system and a scattering of rock art (mainly cup and ring marked rocks). The destruction of the vegetation revealed fascinating new archaeological detail, but also put it severely at threat. It was feared that a wet winter would cause rapid erosion of the exposed friable soils.

Fig1. Fylingdales moor shortly after the fire in September 2003

As a first response to the fire English Heritage Aerial Survey staff undertook oblique aerial photography of the burnt area, still in its heavily blackened ash-covered state 3rd October 2003 (Fig 1). These photographs were rapidly rectified to inform the field visit undertaken by various EH staff in conjunction with the National Park archaeologist (Fig 2). This early evaluation confirmed the fragility of the moor and it was felt that with the approaching winter it was vital to create a high quality objective record as a baseline for all future work. Metric Survey worked with Archaeological Commissions (now the Historic Environment Enabling Programme) to rapidly fund a vertical photographic survey of the highest quality, undertaken by Aerofilms on 23rd November 2003.

A preliminary air photo interpretation was undertaken which revealed further elements of the prehistoric landscape and features of a later date relating to the alum industry and military training activity (Coloured overlay on Fig 2). Once the new vertical photographs became available for the digital photogrammetric workstation, Metric Survey and Aerial Survey staff used them to produce an orthophoto for the whole moor



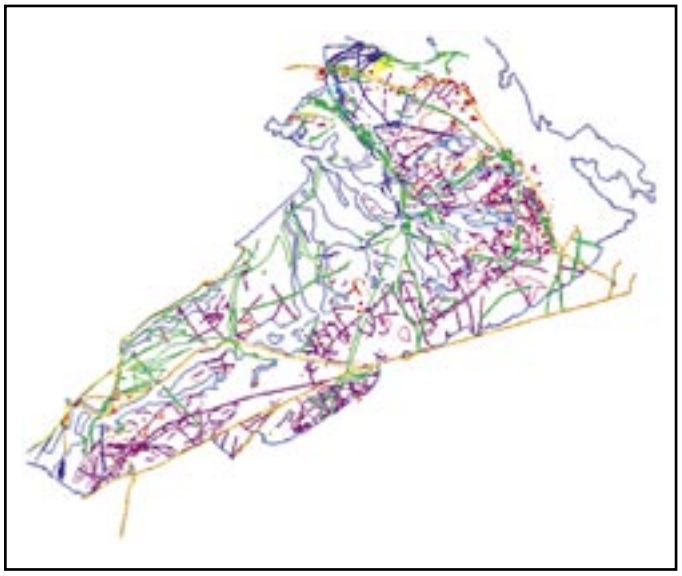


Fig 2 *(above left)*. Rectified oblique photos and preliminary interpretation

Fig 3 *(above right)*. Air photo interpretation from vertical photographs

accompanied by an annotated interpretative overlay of the visible features (Fig 3).

The English Heritage response, co-ordinated by the IAM Neil Redfern, has throughout been an integrated one, including staff from a wide variety of disciplines each bringing their skills to bear on the task of understanding and caring for the historic structures revealed on Fylingdales Moor. The priority was to establish a base record (through rapid field survey to supplement AP information) of what had been revealed and quickly to target the most threatened areas with environmental protection measures. In essence it was vital to regenerate a protective plant cover to stop the soils being further eroded away through exposure to wind and rain. Essential in developing a conservation strategy for the Moor was close collaboration with The North York Moors National Park Authority, English Nature, Defra, The Strickland Estate and the Court Leet.

To complement the overview provided by the rapid walkover survey and the air photo interpretation, the Archaeological Survey and Investigation team of English Heritage have undertaken a more detailed analytical field survey for a quarter of the burnt area, providing a greater understanding of the development and use of the moorland landscape.

Although the aerial photographs allowed the recognition of individual stones less than

Fig 4. Extract from vertical photograph

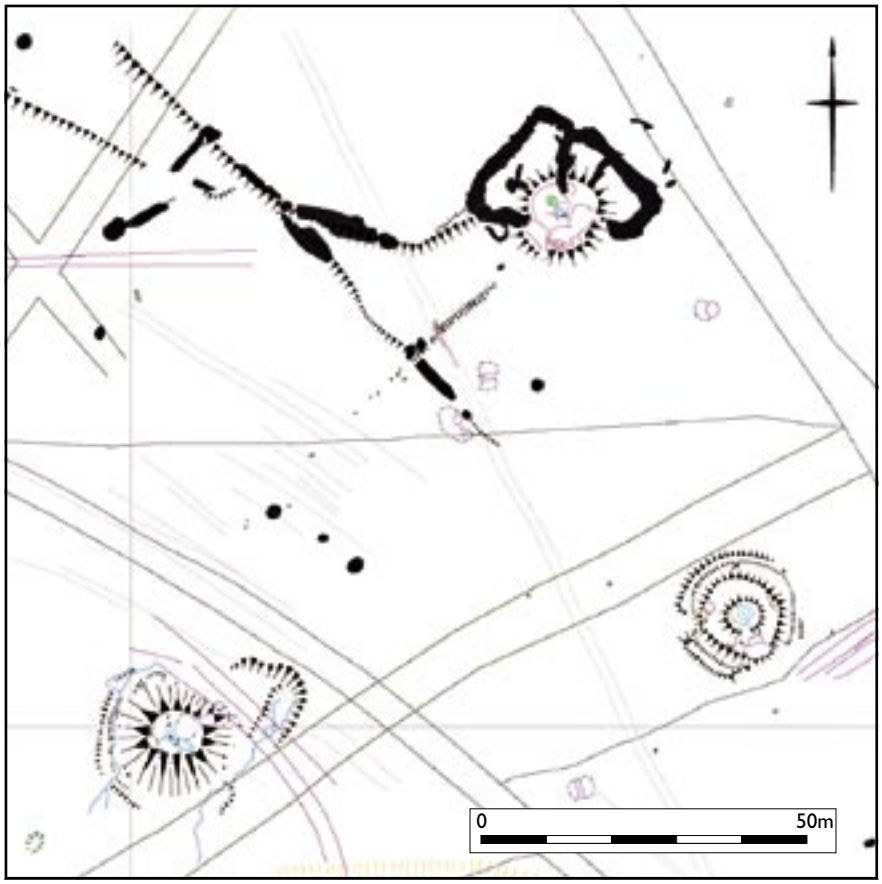


Fig 5 *(above)*. Extract from final drawing resulting from analytical field survey

15cm across, the rock art was way beyond its capabilities!

The walkover survey revealed over 150 new examples of decorated rock art panels with a final total nearing 190 examples. Further erosion to an existing feature and human investigation led to the discovery of a remarkable decorated stone seen illustrated here (Fig 6) using a computer generated image from the laser scan of the surface undertaken *in situ*. Due to the importance of this stone the laser scanning was done in conjunction with the Metric Survey team to provide the most accurate and suitable level of recording.

Regeneration is now well underway in the areas that were seeded with grass, as can be seen in this oblique photograph taken in November 2004 – the inset shows the state of the moor shortly after the fire.

Pete Horne, Dave MacLeod and Jane Stone

Fig 6. Laser scan of rock-art

Fig 7. Burnt moor after one year's regeneration

Integrating research and outreach at Tilbury Fort, Essex

Tilbury is best known for de Gomme's engineering masterpiece of the seventeenth century. But there is much more of significance to the site than this. The challenge here is how to sell the full story to visitors and local people alike.

Thorough investigation and research underpin the process of understanding the often complex monuments in the care of English Heritage. The process is essential for communicating effectively with the general public through considered interpretation and outreach.

At Tilbury Fort on the Thames in Essex, a massive programme of conservation in the 1960s and 1970s resulted in the opening of the site to the public in 1983. This work is a major achievement that took its inspiration from and focused particularly on Sir Bernard de Gomme's bastioned artillery fort of 1670-85, the finest example of its type and date in England. Subsequently, much of the interpretive material on site reflected that significance.

Tilbury today; the wide, open Parade Ground looking towards the Water Gate, Chapel and Guard House

Tilbury in the late 1940's, showing the Soldier's Quarters being demolished, with the Parade Ground occupied with 19th-century waggon sheds

In the last three years, a new programme of essential conservation works at Tilbury, and a budget for promoting small projects at our properties, provided the opportunity for a fresh look at the fort as a whole, in the form of an ad-hoc collaboration between staff from many EH departments, involving survey and investigation, documentary research, conservation, outreach, interpretation and marketing. A major outcome of this process is a new realisation of the complexity of the fort's development, from which springs the ability to distil and convey a story to the general public through new and concise interpretation. Put simply, Tilbury's significance does not begin and end with the work of de Gomme, it starts in the 16th century and extends well into the 20th, a continuum that reflects, on a single site, key elements of the changing policies and technologies of national coast defence. Why, for example, were two enormous gunpowder magazines – far too big for the supply of the fort itself – constructed on the north side of the parade ground around 1716? For what purposes did the parade ground gradually fill up with buildings in the 19th century? Although many of these buildings have now gone, they can be restored to the story through survey and investigation, the process which locates and puts into context all of the physical clues and sources that remain.

The fort has not been systematically and entirely surveyed since the 1880s. Our new investigative survey has been completed via a combination of GPS, EDM and traditional graphical methods, taking in all of the fort's structures, including the important outworks which are no longer accessible to the general public. The positions of vanished structures are being recorded by careful map regression and, for the first time, a comprehensive and holistic assessment made, charting the micro-development of the fort throughout its entire 465 year history. Our aim has been to make this new research available quickly through effective and timely internal collaboration and it is manifest in a new guidebook, a new audio guide, new site signage and a new display on the history and development of the fort in a national and international context.

The oral history project is looking for testimony of soldiers who served at Tilbury in the Second World War and after

New national priorities enable us to take the process at Tilbury further. Since coming into public hands, in some respects the fort has become remote from a local community of which it was always an integral part. Current work is aimed at re-engaging the community through several initiatives. One such is a play that has been partly written and will be performed by 65 young people, aged 16-25, recruited from the local community in Thurrock through public readings and dance and drama workshops. The play, called 'Diving through Time', has been entirely written by the local community under the guidance of a professional scriptwriter, Brian Abbot, and is funded by English Heritage, the Arts Council and Arts Generate. It will be performed at Tilbury Fort on the evenings of 16-19th August, telling through performance the story of the fort in the context of the Thames and the riverside communities of Thurrock. The results of research formed an important feature in the initial development of the play, both as part of the foundation on which the play could be built and one source for its inspiration.

A second community initiative stems from £50K of matched funding achieved via the EC Interreg IIIb programme. This initiative, part of the Crossing the Lines Project, aims to deliver various benefits to former fortifications and defence lines. These include improved interpretation, technical innovations in conservation techniques and developing a range of new and sustainable uses (see http://www.crossingthelines.com) At Tilbury, some of the funding is being devoted to an oral history project. Currently, a professional historian is training members of the local community to undertake interviews with individuals who lived and worked in and around Tilbury Fort during and after the Second World War. These memories and recollections – part of the social history of the area – will be made available to the visiting public via an inter-active touch-screen computer in the fort guardroom.

Paul Pattison, Louisa Sherman and Sarah James

South Acton: an 'ordinary' urban landscape

Ordinary places, ordinary people, ordinary perceptions all add up in South Acton to something rather special.

It has become common to acknowledge everyday urban landscapes as important parts of heritage or public history, as sources of identity and local pride, and as bases for sustainable communities. But *de haut en bas* acknowledgement is not enough. If the ordinary built environment has such value then historical questions need to be addressed: how did a place become what it is? what constitutes its character? what is locally distinctive? and what of this is understood locally? In the face of regeneration, researching these questions becomes ever more urgent, particularly if public participation in the process is to be meaningful. Effective participation presupposes knowledge – of places as well as processes – and this works both ways. All participants need to have better knowledge, each of the other, and take into account what

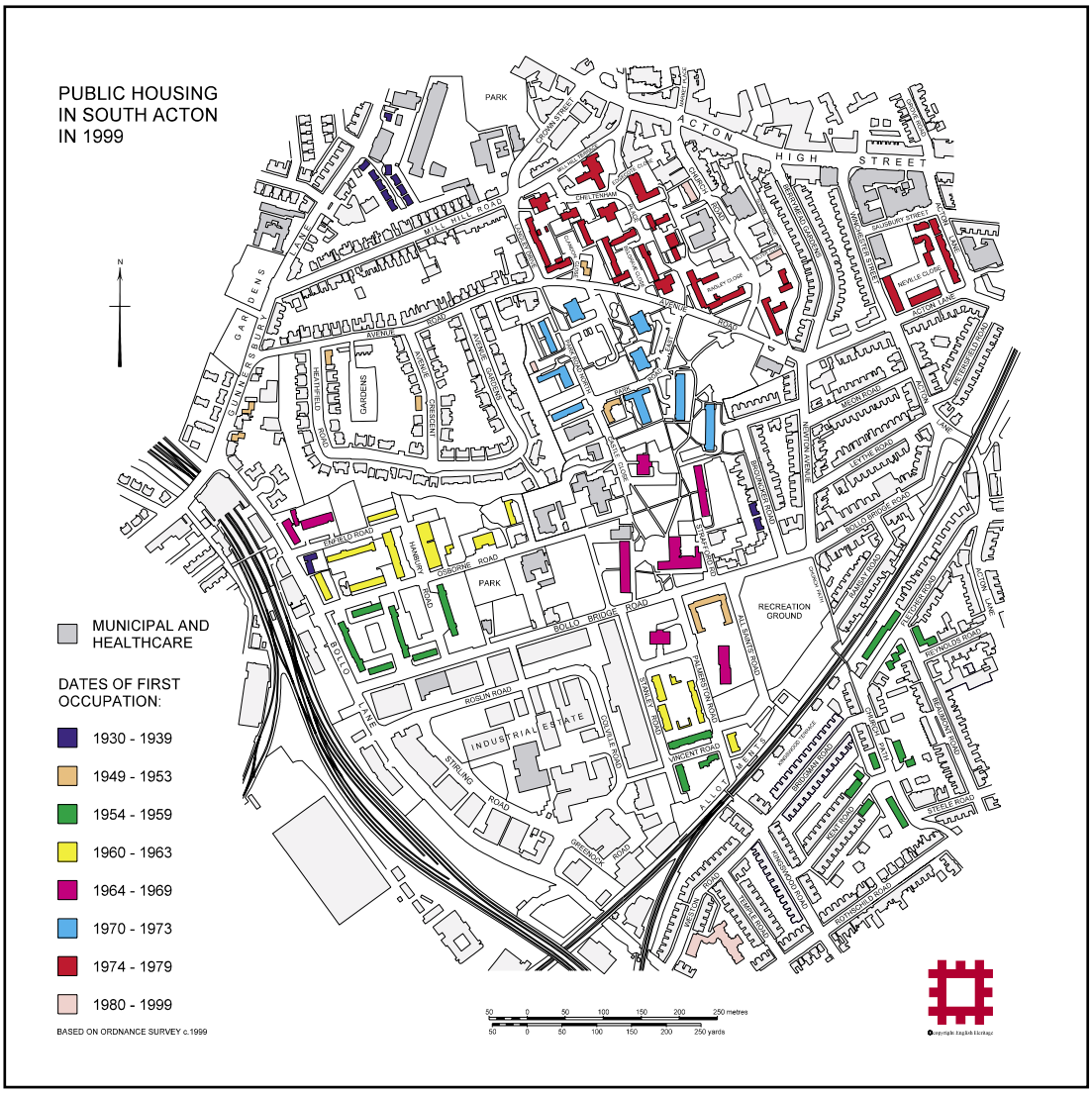


Fig 1. Public Housing in South Acton in 1999

Fig 2. Bollo Court, 32 maisonettes in three ranges enclosing a courtyard incorporating an early central heating system, 1949. Behind, Kipling Tower, 1963-5, 90 flats in a 12-storey double tower. Both built for Acton Borough Council

the historian Raphael Samuel characterised as 'unofficial knowledge' as well as professional understandings.

The suburban London district of South Acton has one of the largest post-war housing estates in west London, about 2,000 homes for around 5,000 people, in a rich and typical mixture of buildings from the 1950s, '60s and '70s, arising from a programme of 'comprehensive redevelopment' that involved the clearance of late-19th-century terraces that had been labelled 'slums'. The result is a mixture of high- and low-rise flats in a mature landscape, with a great variety of appearance and quality in both the architecture and the spaces between. Typically, social problems, real and perceived, and the costs of maintenance and repair mounted, and in 1996 the London Borough of Ealing began to plan 'comprehensive regeneration'. A start was made in 2001, but no more than that. In early 2005 the long-term master-plan envisages much demolition, new mixed-tenure housing and higher overall densities, proposals that, while broadly welcomed, have also generated opposition among local residents who fear the loss of good buildings and open spaces, and the destabilisation of established communities. South Acton has no buildings of outstanding historic or architectural interest, nor sufficient quality to warrant conservation-area designation. Yet there is a strong view that parts of the neighbourhood are worth keeping, and that the history and character of South Acton's built environment should be taken into account before the next attempt at a fresh start is too advanced. In the words of the South Acton Residents' Action Group (SARAG) 'the history, continuity and community spirit of the area is important and should inform what happens and which buildings are retained.'

To this end, and against this background, SARAG approached English Heritage. Following discussions in which the Ealing Civic Society became a third partner, English Heritage agreed to undertake research to characterise the historical and

Fig 3. Corfe, Harlech and Beaumaris towers, three 13-storey blocks containing 228 flats, known locally as 'the Castles', 1968-71. Built for the London Borough of Ealing

architectural development of South Acton. The local groups had no experience of such studies themselves. Indeed, there are no good models for the characterisation of comparable 'ordinary' places, and new approaches to the historical investigation of post-war housing that extend beyond assessments of architectural significance are needed. South Acton presented English Heritage with a timely opportunity to make an exemplary contribution on multiple fronts.

Working closely with local interests, English Heritage set up a project aiming to act as quickly as possible to catch up with an already well-advanced regeneration programme. Fieldwork, research and consultation in late 2004 led to the launch of reports in February 2005. The research report, 'South Acton: Housing Histories', does not make specific recommendations. It is about what has happened, not about what should happen. Methodologically it follows well-established practice for historic area assessments, combining rapid-survey fieldwork with documentary research, photography and phase mapping as raw materials for the construction of a narrative history. This blends social and economic contexts w ith details of topographical change and building development, architectural motivation, contexts and comparability being assessed in passing. The aim, of course, is to inform and influence those involved with the regeneration of South

Acton, a project that presents a substantial challenge for which recent history provides important lessons. A wider purpose is simply to raise the historical profile of ordinary post-war housing. The work also has further value for posterity as a 'threatened buildings' record of a fascinating place on the eve of major change. How many post-war housing estates will still be standing in 2050?

What is special about South Acton is in considerable measure its typicality. The place has a subtly unique disposition of familiar and widespread forms, representing virtually all major approaches to public housing from 1945 to 1979. By characterising mix rather than highlights, variability in public housing can be understood in terms of local contexts as well as in relation to national programmes. The degree to which use, as opposed to design, has affected (or failed to affect) what was initially provided is also significant. Alterations can be as revealing as original form.

The research report was only one half of a dual approach. The other half of which was community engagement, conducted with Miriam Levin, English Heritage's Head of Outreach. A parallel study was commissioned from Fluid, architects with a strong track record in community consultation. They created an oral-history based synthesis of local residents' thoughts, memories and feelings about South Acton, disseminated as a digital documentary entitled 'South Acton Stories: Sharing Histories, Revealing Identity'. The two arms of the project developed in close collaboration, integrating material and interpretations, the different approaches combining to provide complementary explorations, of convergence and divergence between architectural intentions and lived experience, as well as between academic and popular histories. All the work is being unified in a website, www.southactonstories.org.uk, to be launched later in 2005.

Peter Guillery

Fig 4. The 'red-brick' area, 1974-79, a development of 178 maisonettes in 18 low-rise blocks with private gardens, and 193 flats in three 11-storey towers. Built for the London Borough of Ealing

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.

THE ALUM INDUSTRY PROJECT

For almost 300 years until 1871, the North York Moors was one of the UK's foremost centres of alum production. Manufactured using the local shales, alum played an important role in the textile industry before the advent of modern chemical dyes, and was an extremely valuable commodity. Many of the Yorkshire shale quarries and processing sites are located above sea cliffs, and are now under threat from coastal erosion. Although several are scheduled, the only way to preserve them in the long term is by the creation of a detailed record based on analytical field survey aided by aerial and photogrammetric transcription. This has now been undertaken for two of the threatened sites – Kettleness (Fig 1) and Loftus. The project has also established a general recording methodology which can be applied to any archaeological site threatened by cliff erosion or which lies in a dangerous and mobile location. In addition, two inland Yorkshire alum sites – Ayton Banks and Stoupe Brow – have recently been recorded in detail by the Archaeological Survey and Investigation Team at York.

Christopher Dunn, Abby Hunt, Marcus Jecock and Trevor Pearson

ASLEEP ON THE JOB?

Senior Ranger Tim Russell from the Quantock Hills AONB took things a bit too literally by demonstrating how pillow mounds were used (Fig 2). This site, at Vinny Combe, West Quantoxhead, Somerset, is one of

Fig 1. *(Below)* Part of Kettleness Alum Works (NMR AA040214)

Fig 2. *(Inset)* Tim Russell relaxes at the Vinny Combe pillow mound

several medieval pillow mounds newly discovered or identified during the course of a major English Heritage survey project on the Quantock Hills AONB, run by Archaeological Survey and Investigation staff in Exeter. The project included field survey, geophysical survey, architectural investigation and air photographic transcription to achieve a new level of understanding of the development of a complex historic landscape. Outreach and training formed a key part of the project. The pillow mound was one of the sites used as part of a training day for professionals in countryside management organised by the CMA (Countryside Managers Association) and run by Archaeological Survey and Investigation staff in Exeter.

Hazel Riley

THE 'FANGED BEAST OF WARCOP'

On a recent visit by English Heritage staff to the Warcop army training ranges, Cumbria, to advise Defence Estates and the County Archaeologist on survey options for a rapidly eroding lead mining landscape, a most unusual and very unexpected discovery was made. Mick Clowes of the Metric Survey Team, spotted a fragment of carved stone in the stream bed amongst the rubble of a collapsed stone building, probably the remains of a crushing mill. The stone, which had been broken in antiquity, carries the cleanly pecked lines of part of a fanged beast in an early medieval, possibly Viking, style. The stone (Fig 3) was removed from its vulnerable location by Phil Abramson, the Defence Estates Archaeologist, and is awaiting further analysis.

Dave MacLeod

WITHAM VALLEY NMP AND LIDAR

Adding to the work of the Lincolnshire National Mapping Programme (NMP) project completed in 1997, the recently completed Witham Valley NMP project has provided a comprehensive record of archaeological features visible on aerial photographs as a part of this Beacon partnership project. Additionally the team have done a pilot analysis of the value of lidar data to augment the results of NMP.

Fig 3. Viking(?) carved stone, found on Warcop army range

Immediately obvious is the value of the lidar in revealing the previous river channels and lakes which would have had a profound affect on early settlement and land-use (Fig 4). The lidar has also proved valuable as a prospecting tool; the subtle three-dimensional data has been manipulated to reveal previously unrecorded archaeological features. It is hoped that when the new higher resolution lidar survey, to be undertaken in 2005 by the NERC, is available the results will be even more dramatic.

Dilwyn Jones and Yvonne Boutwood (NMP), and Simon Crutchley (Lidar)

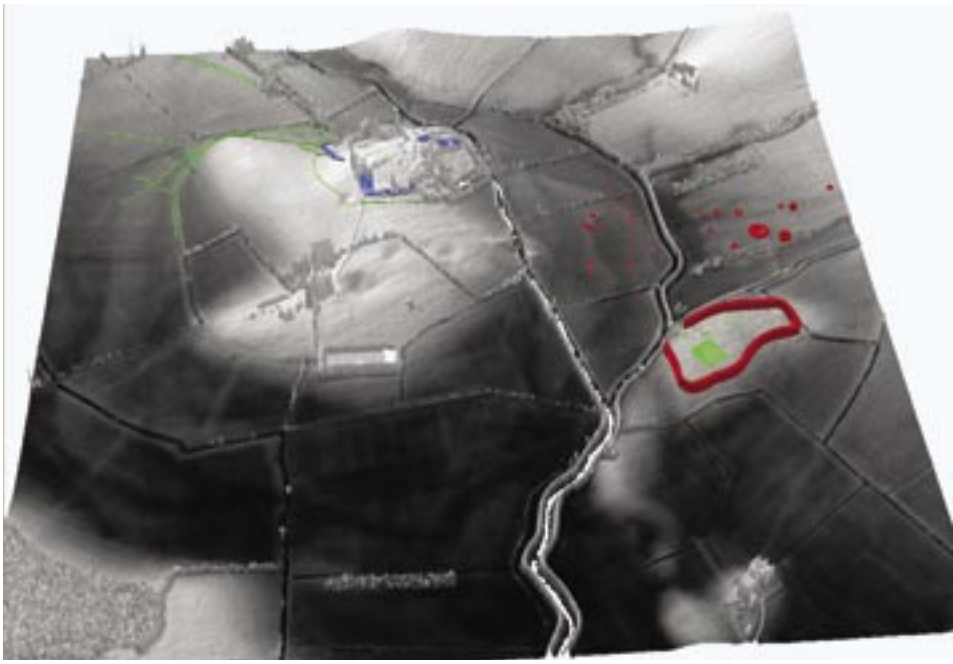


Fig 4. Barlings Abbey, Lincolnshire. A perspective view generated from lidar data and NMP mapping

THE SECRET POLICEMAN'S GRAFFITI IN CLERKENWELL

The police are helping the Survey of London with their enquiries. Staff registers kept in the Metropolitan Police archive store, a warehouse full of fascinating ephemera ranging from blue station lamps to anti-garotting collars, have provided the key to a small north London mystery, revealing the significance of quantities of seemingly coded graffiti carved into a boundary wall that was built in 1806-7 to improve the perimeter security of the waterworks at the New River Head. The wall's Listing description perpetuates a local myth that the numbers and letters, usually two or three digits followed by the letter G, were put there by prisoners of war building the wall. In fact, in the late nineteenth century and into the twentieth, police constables were circumspectly recording their 'collar' numbers in what was then a secluded alley, G being the suffix for the Met's local Division. A practice for which boredom might be sufficient explanation may have become ritual commemoration of a fallen colleague. The only name on the wall is 'ROBINSON', and a Detective Sergeant Robinson of G Division was stabbed in 1888. However, there are earlier inscriptions, such as 'Feby 1866 185G'. The boldest constable of the dozens to have recorded their numbers was Frederick Moore, who joined G Division in 1886 having served at Devonport Naval Dockyard. Sometime before his transfer in 1894, he took the time to carve '365 PLYMOUTH' and 'FM 365G Aug. 17 189?'.

Peter Guillery

Wall showing graffiti in Clerkenwell, London

ENGLISH HERITAGE ASSISTANCE TO IRAQI HERITAGE CO-PROFESSIONALS

Between 22nd and 26th November a team of three experts from English Heritage participated in a joint international training initiative (titled *GCI-WMF Iraq Cultural Heritage Conservation Initiative: Methodology for Rapid Assessment of Archeological and Historic Architecture*) to enable skills development in the compilation of heritage documentation in Iraq.

The partners in the project represent leading authorities in heritage conservation and include the Getty Conservation Institute (GCI) and the World Monument Fund (WMF). The project was funded by UNESCO, the US National Endowment for Humanities, and the J. M. Kaplan Fund, and with donations from Environmental Systems Research Institute Inc (ESRI). The State Board of Antiquities and Heritage (SBAH) is the principal partner for the project in Iraq. The project was convened with the assistance of the Department of Antiquities of the Hashemite Kingdom of Jordan and the American Centre for Oriental Research (ACOR) in Amman, Jordan.

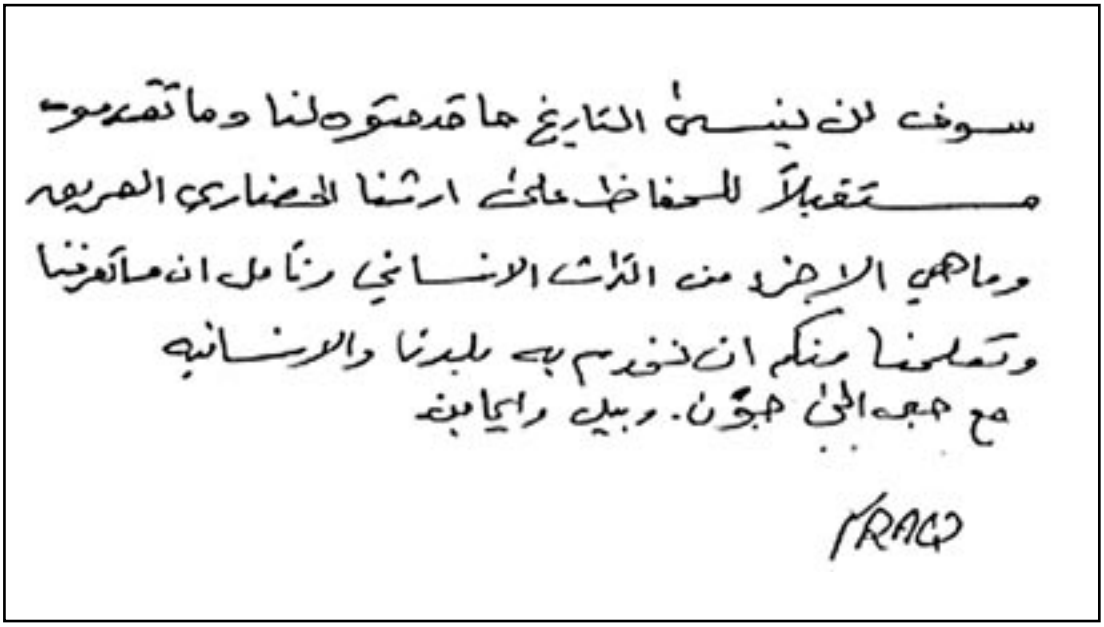
The partner institutions have donated technical assistance in the form of equipment (tablet computers, Global Positioning System units, survey total stations, digital cameras and laser distance meters) and training for Iraqi specialists faced with national inventory and local site-specific emergency recording issues.

The English Heritage component of the month-long project (coordinated in Amman by Mario Santana Quintero (WMF Consultant) and David Myers (GCI), focused on training in the use of metric survey techniques for a group of nine surveyors. The response to a request for help from Gaetano Palumbo at WMF was led by Bill Blake and Jon Bedford (Metric Survey), supported by Imogen Grundon (HBARD). The English Heritage team worked for four days to equip SBAH professionals with an entry-level skill set for metric survey, including real-time mapping in AutoCAD with EH's TheoLt (www.theolt.com) and photo-rectification with PhoToPlan by kubit. The goal of the English Heritage training element was to develop skills in metric survey techniques and to ensure the equipment donated was put to best use. By making use of the benefits of new surveying equipment and digital photography, Iraqi surveyors will be able to accelerate their recording programme and be able to react quickly to conservation engineering needs.

The training was carried out on two sites in Jordan, at ACOR and the Amman Citadel. Work at the latter site was coordinated with the Department of Antiquities of Jordan, owner of the site, and with Ignacio Arce, the conservation architect for the recent restoration of the Umayyad complex sponsored by the Spanish government.

Bill Blake

Jon Bedford gives some training to some members of SBAH



In thanks to English Heritage the SBAH trainees stated:

'The day will not be forgotten when you came and spoke to us, nor what you presented to us – those of us who are guardians over our deep cultural heritage – and what are the parts of the human heritage. And we hope that with what you taught us and enabled us to know that, with that, we will be able to serve our country and mankind.'

The sheep project: developing methodologies in zooarchaeology

Aiming to find out more about the effects of livestock management as an aid to interpreting past husbandry systems.

In *CfA News 2*, 2002, Sebastian Payne reviewed a project which is aimed at finding out more about medieval wool production. In this update, we discuss some of the results obtained through a pilot sample of skeletal material and the analysis of 'live' data. The main aims of these studies were to gain an initial idea of variation in the timing of tooth eruption and bone development, as well as in biometry (size and shape) between entire males (rams), castrates (wethers), unbred females (gimmers) and bred females (ewes), and between animals raised on different diets (high-improved pasture and low-unimproved pasture), and to see if the data from live animals echoes what we see in zooarchaeological assemblages. The development of criteria which will help to identify effects of different 'management' techniques will greatly assist us in our interpretation of past husbandry systems.

Fig 1. Mick Revill labelling the sheep skeleton collection. Careful curation of the collection includes the labelling of each specimen with its own unique accession number. Detailed records on the curation of each skeleton are held at Fort Cumberland

The use of data from modern animals provides the mainstay of zooarchaeological research. By comparing the zooarchaeological data to modern analogues, we can attempt to understand what animals were used for (for example, meat, dairy or wool), what they may have looked like (their shape and size) and how they were raised. The study of over 350 skeletons of known-age Shetland sheep, for which detailed records of diet and stock management (breeding ewes; castration of males) exist, is beginning to provide much new data, allowing re-evaluation of standard sources used in zooarchaeological analysis. However, there are many factors which we do not fully understand, and more extensive study is required. Now that the careful preparation and curation of the collection is drawing to a close, the detailed study will keep us busy for many months (Fig 1).

Castration of livestock is a traditional husbandry method and was probably practised throughout prehistory and the historical period. The aim of castration is to make animals more docile, so easier to handle, and also to 'fatten' lambs for slaughter. It is also said to enhance the quality of wool. Wethers are known to be hardier animals than breeding ewes.

The pilot study indicates that castration delays bone fusion, and a clear distinction between wethers and rams is evident. Fusion is delayed in wethers by approximately six months and possibly more. The skeletal study has highlighted some important differences from existing knowledge regarding the epiphyseal fusion sequence. In most cases fusion of the femur occurs earlier than previously thought. In addition, epiphyseal fusion within the same element

fluctuates considerably for a variety of reasons (such as nutrition). It will therefore be necessary to fully explore other variables that might 'confuse' the situation. Conversely, the skeletal study demonstrates that eruption of the third molar (wisdom tooth) is not substantially delayed in wethers. The 'live' data for incisor teeth also confirms that castration does not overtly effect tooth eruption. Our pilot analysis of rams and wethers has shown that while tooth eruption is little affected by castration, tooth wear does differ between rams and wethers. This may be due to the greater energy requirements of rams, more intensive feeding and increased attrition.

Because of the delay in bone fusion in wethers the developing bones continue growing for longer. As a result the bones of wethers are relatively longer and more slender than those of rams (Fig 2). The 'live' data also confirms that wethers weigh less than rams on average. However there is considerable overlap in both datasets. In addition, the presence of gimmer's and ewe's bones adds to the complexity. These should be small er and more slender than those of rams however a range of factors may contribute to overall variability, including nutrition and breeding.

The level of nutrition has a profound impact on the development of the mammalian skeleton. In severe cases, development ceases and only recommences once nutrition improves. Malnutrition often manifests itself physically through the modification of osseous material. Conditions often encountered by osteoarchaeologists include 'enamel hypoplasia' and 'Harris lines' effecting teeth and bones respectively (visible lines on the tooth or bone surface). However, malnutrition does not always lead to obvious bone modification, and is therefore absent from the archaeological record. Malnourished animals reputedly take longer to reach skeletal maturity (tooth eruption and bone fusion); so a malnourished animal might be mistaken for a younger individual, thus influencing mortality profiles and subsequent interpretation (hence the need to study the effects of nutrition).

A number of studies have been undertaken on the effect of different planes of nutrition on development of bones and teeth, but

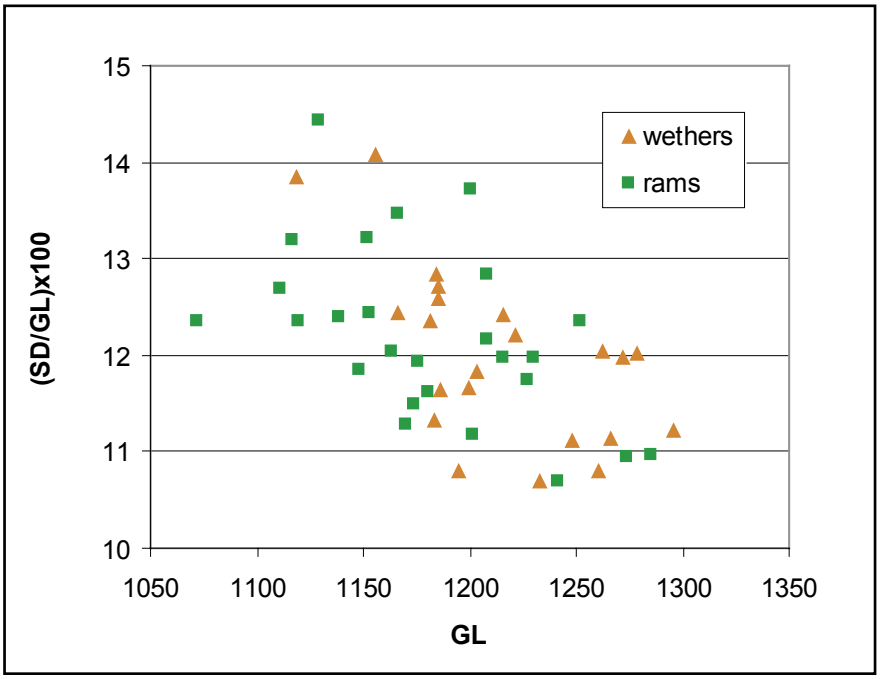


Fig. 2: Metacarpal shape in rams and wethers. The bones of wethers are generally more gracile than those of rams, due to delayed epiphyseal fusion and prolonged growth. Their length increases but breadth does not change as markedly. Measurements are in tenths of a mm; unfused bones are excluded

almost exclusively within the realm of agricultural science. The sheep project aims to redress this. It has concentrated upon skeletal development, by considering tooth eruption, ephiphyseal fusion and biometry by treatment (nutrition) group.

A delay in tooth eruption and bone development was noted in early studies on the effect of malnutrition, low planes of nutrition or specific nutritional deficiencies in sheep. The skeletal pilot study confirms the findings of earlier research; in general in rams and wethers of the same age group, bone fusion appears to be further advanced in the high nutrition than in low nutrition

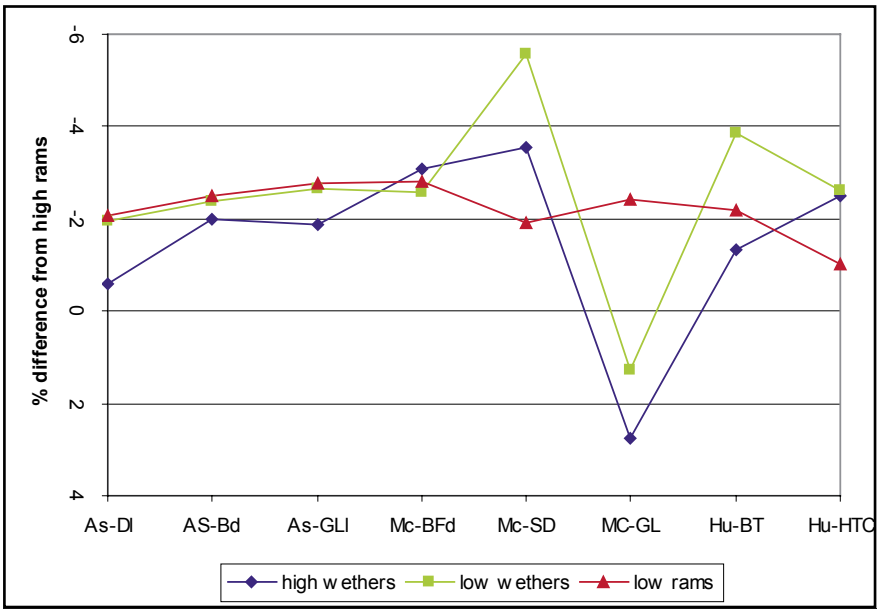


Fig 3. Comparison of bone measurement, based on percentage difference from the high rams. Note the increased length (MC-GL) and reduced shaft breadth (MC-SD) in wethers, indicating their more slender shape compared to rams

animals. Poorer nutrition delays the onset of fusion and probably slows the process also. Conversely, the 'live' data indicates that incisor eruption is not substantially delayed in low nutrition animals. Eruption of the third molar suggests a similar lack of variation; only in wethers do the low nutrition animals show a slight delay. Dental attrition has been shown to vary under different nutritional conditions also, although the exact factors involved are not easily distinguished. Again, only in wethers does attrition seem somewhat lighter in low nutrition animals, which may be related to the slightly later eruption observed above. The difference in attrition between nutritional groups is much less marked than that observed between wethers and rams.

The skeletal pilot study of selected measurements suggests that in general, sheep on high nutrition have larger bone measurements than those on low nutrition (Fig 3). However, when individual groups (for example age cohorts) within these populations are compared there is considerable variability in the way bone measurements behave, and the above generalisation does not always hold. The 'live' data also suggest this pattern of conformity and variation. On the whole high nutrition animals are slightly heavier than their low nutrition counterparts, but in some groups there is considerable variation in weight gain (Fig 4). Further analysis of the animal's life histories will help to better understand such ambiguities.

SUMMARY AND FUTURE WORK

As noted previously, tooth eruption and bone fusion based on modern comparative material form the basis of our zooarchaeological interpretations. However, variability due to sex or nutrition may result in deviations from these 'standards'. The study undertaken to date for the sheep project suggests that tooth eruption is little affected by sex (castration in rams), breeding age (in ewes) or nutrition. However, bone fusion is clearly delayed in wethers compared to rams. Further study will focus on determining if the differences between tooth eruption and bone fusion can be used to positively identify the presence of wethers, by

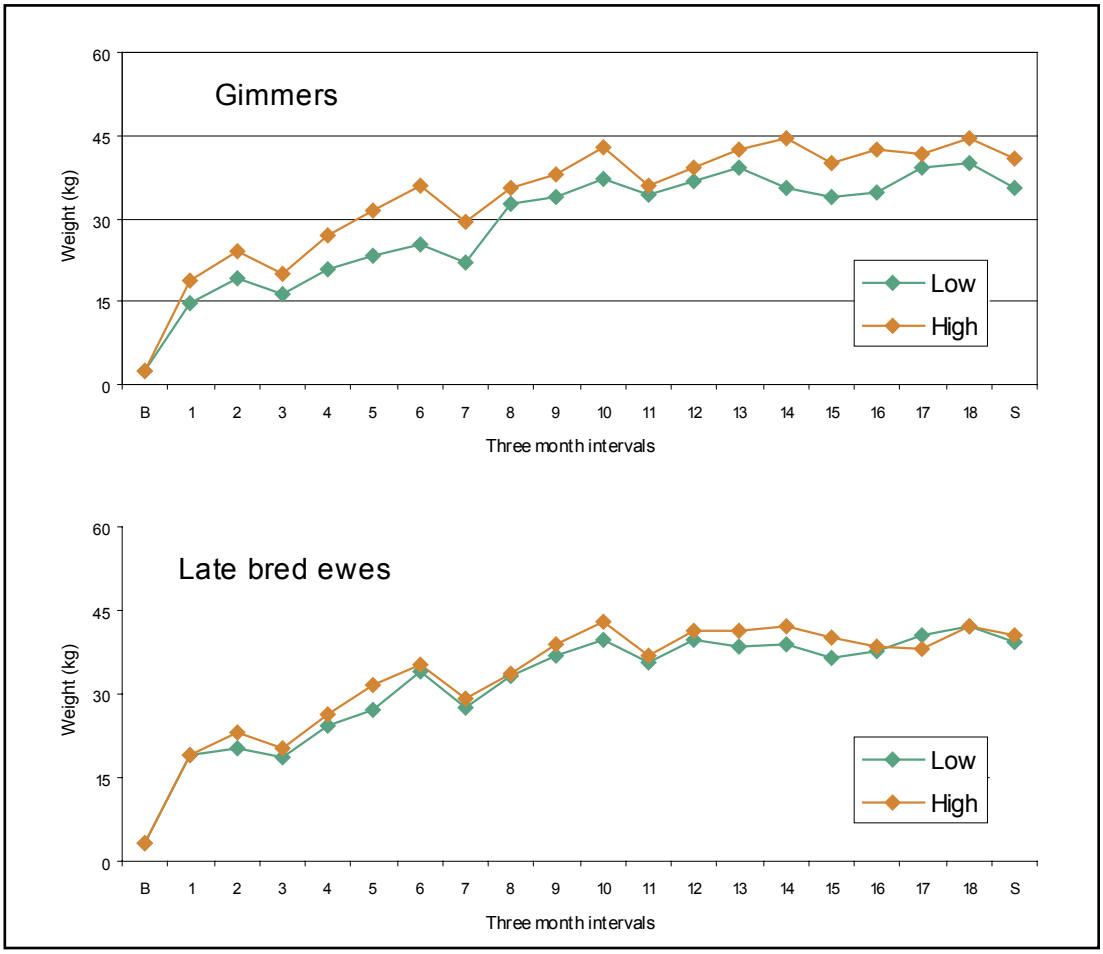


Fig 4. Live weight gain and seasonal weight loss in gimmers (unbred females) and late bred ewes on high and low nutrition. The animals were born in late April-early June. The dips at points 3, 7, 11, and 15 correspond to ages of approximately 9 months, 21 months, 33 months and 45 months respectively and represent weight loss in the winter

comparing teeth and elements that erupt and fuse at a similar point, as suggested originally by Sebastian Payne. Comparison of tooth wear between rams and wethers shows that there is possible confusion when dealing with the permanent teeth. In an archaeological assemblage, unfused bones and lightly worn second and third molars of wethers might be thought to represent a younger age group, thus biasing any interpretation. Failure to take into account differential wear that might be due to flock structure (ratio of ewes, rams and wethers) could lead to the misidentification of flock utilisation. Assessing the sexual composition of an archaeological sheep assemblage, therefore, must be a prerequisite prior to interpreting mortality data.

Further work on postcranial biometry will focus on identifying the effects of nutritional status on bone shape. Earlier work suggests that animals on poorer diet yield smaller bone measurements. Of particular interest and importance with regards to archaeological assemblages, is whether the effects of different planes of nutrition and castration result in different bone conformation.

To date most of our work has focused on the 'live' data and a selection of data on bone and tooth development in rams and wethers. The information for ewes will be invaluable for assessing variation due to breeding and to age of first breeding. We know that lambing and lactation place stress on breeding ewes. However, we do not know if different management of ewes results in varying bone size and shape, or whether the stress of lactation influences tooth eruption and bone fusion. Initial appraisal of the 'live' data shows that the early bred ewes, particularly those on low nutrition are amongst the 'light weights' of the flock. Other potential studies include x-ray scanning and measurement of cortical thickness to determine possible effects of breeding and nutrition on susceptibility to bone resorption.

Two aspects of the sheep data may contribute to seasonality studies. Analysis of the 'live' data demonstrated that season had a profound effect on the weight of individual animals in our Shetland flock, regardless of which nutritional group they were in. Every winter weights would consistently drop and would only start to increase again during spring time, reaching their maximum in the summer (Fig 4). These data may provide some indication of the animal's ability to 'catch-up' in weight in relation to severity of weight loss throughout life. This can then be compared to the bone data to determine if the cumulative effect of weight fluctuation ultimately influences bone size and shape.

Given that there seems to be little variation in tooth eruption between animals of different sex or nutrition, it may be possible to infer from archaeological teeth the approximate season or seasons of lambing, as proposed by Sebastian Payne. Tooth wear in high and low nutrition groups shows little difference also. However, the rate of tooth wear does seem to differ between rams and wethers, so differential wear between sexes may confuse the picture. As noted above, a prerequisite of using tooth eruption and wear, in this case to determine seasonality of lambing within an archaeological population, would be to first establish the sex ratios. Further work on the collection will help to clarify and define the parameters of such research.

Interpretation of any animal bone assemblage is reliant on the identification of possible taphonomic factors that may have influenced bone preservation. The study of traces on the bones allows us to better understand what has happened to the original material. In addition, a good understanding of bone development is necessary. One of the assumptions regarding preservation of mammal bones is that bones of young animals are more susceptible to destruction due to their immature (incompletely ossified) state; they include a higher proportion of organic to inorganic components compared to adult bones. A number of studies have been undertaken to assess the mineral or structural 'density' of bones of different species. In few cases has it been possible to study variation due to age within a single species. The collection available for the sheep project provides an ideal opportunity to study change in bone density due to age, as well as to castration and time of breeding in ewes.

Polydora Baker, Andy Hammon, Mick Revill

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