Notes on the South-East Research Framework public seminar on the Environment theme (12/01/08)

Chair: Dominique de Moulins

Speakers: Dominique de Moulins, Martin Bates, Nick Branch, Wendy Smith, Rob Symmonds, Chris Stevens, Julie Hamilton and Justine Bayley

Notes: Jake Weekes

Introduction

Dominique de Moulins (DM)

DM welcomed those present to the seminar and said that it had a dual purpose: to provide material for the first chapter of the SERF Resource Assessment volume on the environmental setting for human activity in the region, but also to highlight importance of Environmental Science, which needs to integrated with all archaeological work, rather than being considered a speciality.

Landscapes from the Palaeolithic to the present

Martin Bates (MB)

MB pointed out that he would be discussing the formation of the physical geography of the region rather than subjective and culturally specific constructions of 'landscape'.

Landscape investigations allow:

- Sites to be placed in their correct position within a former geography
- The function of a given site within a former geography to be considered
- Reasons for site foundation to be explored
- A framework for other forms of palaeoenvironmental investigation to be created
- The taphonomic context for archaeological and palaeoenvironmental material to be ascertained
- A tool for predicting where sites may be present within the landscape to be developed.

A practical geoarchaeologist draws on geology and also all the environmental analyses, in order to develop understanding of key elements:

- Underlying structure
- The nature of the superficial sediments
- Zones of deposition, stability and erosion
- The presence of any buried land surfaces
- A model for the physical development of the area

- The nature and distribution of biological remains.

Ideally researchers are looking for buried land surfaces, but even if we don't have that it is important to look at sequence and deposit types: to define environment context over time. Primarily we need to think about matters of scale, which contextualise the sorts of questions that can and can't be asked of the data. At the macro-scale, we are reconstructing landscapes with the coarsest resolution, looking at regional large-scale topography, such as the fluctuations of the Pleistocene land bridge between the British Isles and the Continent, and how this impacts on archaeology. The evidence can be derived from various contexts investigated together, such as thick sequences of river gravels, raised beaches, palaeo-channels, and the morphology of English Channel. Patches of these ancient landscapes survive in the superficial deposits of Kent, for example. We can also investigate the meso-scale, for example looking at Sussex coastal plain superficial deposits, throughout which there is very good evidence for preserved landscapes. At Boxgrove and other sites research has traced remnants of an ancient coastline stretching about 25–35 km from east to west. To the south of the upper coastal plain is the Brighton/Norton beach (more recent); this is even bigger (about 50km wide), stretching from Havant to Brighton. To the south of these are gravel ridges that give an idea of ancient beach ridges and lagoons in between. At the micro-scale, we are dealing with particular landscape surfaces. Mud crack polygons, roots and buried soils are all evidence of such surfaces (for example at Folkestone in Kent).

East sequence in fact operates at a multitude of scales. For example, at Swanscombe in Kent we can think about scale by stratigraphic unit: the loams are localised to the site itself (for example formed in a particular channel), but with the Middle Gravels we are in a body of sediment that can be correlated across a wide area: moving from the meso-scale to (with floral and faunal evidence) to the macro (for example, these deposits have affiliates in the Rhine area). We should not be applying a single set of criteria, therefore, but adapting to a multidimensional perspective. The recent finds at Southfleet Road in Kent are another case in point. At the micro-scale there was a Palaeolithic butchery site at the edge of an ancient lake, with delta deposits in a small basin in the lake, as well as in-flow deposits. Higher deposits constituted the same gravels that provide wider context on the meso- and macro- scale.

With more recent sequences we can consider the fluctuations of the region's coastline even since the medieval period. At Dover, we are at the micro- and indeed eventually urban scale, but we can find evidence of older landscape. Evidence from the town centre shows that basal late Pleistocene deposits are overlain by tufa (on to which the Dover Bronze Age Boat was deposited), which in turn were sealed by silts during the Anglo-Saxon and medieval periods. It has been possible to produce cross-sections and fence diagrams and begin to model landscape in more detail through time, including the development of a lagoon in the Roman period.

MB then discussed a case study of recent developer funded work in Medway estuary, investigating Pleistocene deposits on the Hoo peninsula, and in particular the sequence of river gravels of the ancient Medway which had been confluent with Thames. Various methods were used, including, at Kingsnorth Power Station, electrical conductivity. While it is important to be careful how we interpret such complex multi-phased data, the survey clearly showed at least two probably three depositional episodes. Further information can be derived from biological evidence within deposits, and especially comparison of Ostracods (type fossils).

The region has multidimensional landscapes and some of the best evidence available for this type of study anywhere: however, in terms of developing strategies, MB argued that work needed to proceed from the local to the regional (e.g. detailed comparison of cores), rather than attempting to impose a regional agenda on locally diverse circumstances.

Vegetation history of South-East England

Nick Branch (NB)

Even with admittedly still limited evidence, NB has been able to generate a Geographical Information System (GIS) giving the flavour of the main trends in Holocene vegetational history in South-East England. Most data are confined to the Holocene anyway, and there is a reasonable distribution of key pollen sequences of sufficient duration. These longer sequences tend to be from alluvial deposits (some are from waterlogged conditions in Lower Greensand). Patterns through time have therefore been superimposed on the region's solid geology, generating a series of speculative time slice models of dry land vegetation cover (NB intends to look at wetland as well in the future). The poor record from the Chalk downlands remains a problem over all.

Significant episodes and associated questions include:

- The timing of first post-glacial pine expansion should be investigated further

- From around 9500–9000 *uncal.* BP hazel becomes dominant, particularly on sandy soils (Hastings Beds, Lower Greensand); is the expansion of hazel linked with human activity in Mesolithic: specifically the 'cultivation' of hazel woodland? From around 9000 *uncal.* BP oak and elm begin to dominate

- From around 7500–3500 *uncal.* BP (encompassing the transition from Mesolithic to Neolithic and beyond), there is generally lime and oak dominance but some variation, with yew on peat surfaces in river valleys (this is different from modern ecology where yew is mainly found on the Chalk)

- Yew expansion on the Chalk downland dates from about 3500 *uncal.* BP. There is also elm decline from about 4300 *cal.* BC, and from around 3500 *uncal.* BP there is much more variation, and much more grassland. Lime declines from approximately 1800BC at least. The evidence supports the view that forest on the Chalk persisted during the Bronze Age, and suggests that actually the Downs were still quite heavily wooded. We might wonder about the exact reasons for the decline in yew; was this a consequence of human impact or even exploitation?

NB proceeded to discuss Mesolithic Surrey as an environmental archaeological resource case study. A GIS of the county has been built in order to compare sites were environmental analyses have been carried out with archaeological sites and find spots of Mesolithic date, along with more general environmental data such as elevation, proximity to water (also important for potential preservation of ecofactual evidence), soil types and degree of slope. There are records of some 400 Mesolithic sites in the county but only seven sites where environmental analyses have been carried out: moreover, these are not always equivalent or even proximal to the Mesolithic archaeological sites. Nonetheless, GIS modelling, breaking down landscape into palaeo-environmental variables in comparison with archaeological data has produced some interesting correlations as well as suggesting where data collection should be targeted in future (see the paper by Lucy Farr on this at the SERF Upper Palaeolithic/Mesolithic seminar earlier in series). NB suggested that this type of analysis should be applied on a regional scale, and combined with Palaeo-vegetation modelling.

This sort of work will help researchers to confront important questions relating to the transitions to Mesolithic and Neolithic in the region, for example. NB pointed out that re-sampling of the important site at Elstead Bog in Surrey had produced some very interesting evidence: specifically, high levels of microscopic charcoal which might relate to the cultivation of hazel woodland. A high concentration of *tranchet* axes in the same general area provides supporting evidence that Mesolithic groups were active in landscape at this time. Elm decline from around 4000–2500 *cal.* BC seems to tie in with Neolithic sites, so was this a result of the impact of human clearance of the landscape for farming? Alternatively, the elm decline at this time could be another episode of Dutch elm disease, and recent work at Horton Kirby in Kent has produced only the second example from the UK of insect carriers of the disease dating to the period. And yet we also have evidence for cereal pollen from the same site. The primary factor in the elm decline was perhaps disease, but this created conditions for farming. More evidence and analysis is required in order to resolve such questions.

Discussion:

It was noted that it is best to look to the river valleys for the ecofactual evidence required in order to carry out more wide-ranging surveys of this sort. The Chalk downland is still a problem in this area, with often the wrong preservation conditions on sites and very few environmental analyses having been carried out. A strategy of localised off-site analyses, even within the developer funded system, would be a useful step forward.

Notes on the following paper are adapted from text supplied by the speaker.

Archaeological wood: a review of distribution, landscape reconstruction and uses

Wendy Smith (WS)

Introduction

It is essential that sampling for charcoal/waterlogged wood be carried out with specific research objectives in mind from the outset. Consultation with a wood specialist from the earliest stages of a project is always preferable. Assessment of charcoal is best carried out by an experienced wood specialist, rather than an archaeobotanist, who may only be able to make simple identifications (e.g. oak/hawthorn group [*Pomoideae/Maloideae*]/non-oak). In this way, exotics and/or unusual *taxa* are more likely to be recognised and, ultimately, studied. Industries (e.g. pottery, metallurgy) or other activities (e.g. cremations), which regularly use wood for fuel, are still not fully understood. What woods were selected and how they were used in isolation or with other fuels (plant and non-plant [e.g. coal]) needs to be investigated further. Relating fuel use to woodland management is also a research priority.

Cremation deposits
Sampling of cremation deposits, in terms of detecting ritual practice (i.e. specific selection of woods for the cremation of individuals on the basis of gender or age) should be more frequently practiced. Examples from The Raunds Project (Gill Campbell) and from Radley Barrow Hills (Jill Thompson) have established that the woods used for cremations were related to age and gender, and this type of intensive sampling/analysis is providing an insight into funerary practice.

Metal working/Pottery production
Wood fuel would have been essential to these industries. In order to characterise what woods were being used, whether they were managed and how they may have been used with other fuels, sampling of such contexts and the analysis of wood/non-wood fuels is necessary.

Waterlogged wood from Neolithic/Bronze Age trackways
Establishing evidence for coppicing outside Somerset should be a research priority for the South-East region. It is likely that coppicing was occurring from the Neolithic; detecting evidence for this is a research priority. Excavation of trackways, wattles, or other structures using rods/poles should include collection of material potentially preserving remnants of the coppicing stool (the older base of the tree from which rods/poles are cut) for analysis.

Medieval and early Modern wood
This period is relatively under-studied. In part, this is because wooden objects and building timbers survive and the material therefore does not get sent to archaeological wood specialists. Also, in the field, later period sites (post- 1700/1800) are frequently considered ‘too modern’ and therefore not sampled. As a result, our understanding of these later periods is limited, and we may be missing opportunities.

Finally, although it is expensive to conserve waterlogged wood, this does not mean that it therefore should not be studied. In particular, prehistoric waterlogged wood is actually fairly limited for this region of England and, therefore, regardless of whether the wood will or will not ultimately be conserved, its analysis could add important new data.

Animal bones archives

Rob Symmonds (RS)

RS, who is the Fishbourne Roman Palace curator, said that while he would be mainly deal with evidence centred on Chichester, the points he wanted to make had relevance for all local museum collections in South-East. RS would briefly outline the nature of the collection at Fishbourne and then assess the analytical potential of such collections; not much work has been done on this material, actually, so the amount of analysis carried out to date probably doesn't match the potential.

RS argued that animal bone is an important but underrated element of site assemblages, even though it is so common on sites and not likely to be missed. Unlike ceramics, bones provide continuous record of human existence. Yet the material has had poor attention in the past, was not really picked up until the 1960s, and even then tended to be thrown away, or subjected to not particularly good analysis (i.e. just lists of types). A lot of recent moves forward in scientific analysis provide huge potential for returning to museum collections with new techniques. Also, identification has improved; work that was done in the 1960s needs to be revisited and much of the bone identified again. Moreover, it is important to move away from a 'laundry list' [purely descriptive] approach, towards research questions such as status, economy, culture, development etc.

There is a lot of material waiting to be revisited in Museum collections. The extent of collections at Fishbourne provides but one example. With about 650 sites represented (approximately), from Midhurst in the North to the Arun in the East, Hampshire to the West and to the sea to the South, the archive contains around 10,000 boxes and approximately 400,000 objects (of which about 20% are bones and bone fragments). The Fishbourne excavations led by Barry Cunliffe in the 1960s alone deposited about 10000 bone fragments in all. These were looked at by Annie Grant in the late 1960s, and published in the 400 page volume two of the report (but only 17 pages were given over to the report on the bones). Another substantial local site represented (with about 17000 fragments) is the Cattle Market (which has produced only a 35 page document so far); a further significant site for bone, Fishbourne Road East, still awaits analysis.

RS pointed out that the majority of those using the archives were still engaged in projects looking at ceramics, and argued that there is still an over-emphasis on pot focussed archaeology. Bone projects are not terribly well represented, but two recent projects stand out as being important contributions. Naomi Sykes has revisited the Fishbourne Palace collections and found the earliest evidence of fallow deer (by 1000 years). Strontium Isotope Analysis has shown that these animals were brought from Italy to the Chichester area, and lots more of them are represented in boxes on the shelves. Also, Martin Allen has been conducting doctoral research at Sussex, looking at Roman/IA transition fauna in Chichester area. Remarkably, these sites are being systematically compared for the first time (including re-analysis of previously published material). Martin Allen has now increased an original total of 4802 identifiable specimens to a total of 6176. Moreover, the bustard bones in the archive have often been cited as the earliest in the country, but most now turn out to be the bones of cranes. This is evidence, therefore, of Roman period wild fowling for crane in the harbour area: but one example of the sort of evidence that exists in museum collections, overlooked and brimming with potential.

Discussion:

Bone actually doesn't survive in many areas, and this is a real problem for comparative analysis; there is also a big difference between fragments and identifiable material, and therefore a limit to what can be done with, say, an unidentifiable rib. No centralised database yet exists for how much animal bone there is for different periods in the South-East, and this is work that needs to be carried out, preferably in tandem with the Historic Environment Records (HERs). There is a need to clean up and restructure databases for bone and other finds alongside sites and monuments records. A number of projects have been initiated on certain object types, but even a simple indication of presence or absence of material as a check box in the data entry fields would be a good starting point.

There is a similar if even bigger problem with sediment cores in terms of museum collections. The region needs a centralised store for key sedimentary sequences. Kent County Council is designing a proposal for a central finds store at the moment; the need for a cold store for cores should be considered. Each county would ideally have a centralised store. Special conservation techniques required can actually dissuade certain field projects from taking environmental and core samples because they do not have resources to deal with the material. Guidelines for contractors, HERs and other ongoing projects would be useful. There is an English Heritage framework being formulated for adding all manner of archaeological scientific data to the HERs, and it is hoped that Exegesis might produce a model that could be exported to half the HERs wholesale.

Small sites are very important as well for building up the overall mosaic of environmental information over time. Streams, pingos, etc might hold important information: it is vital that environmental Geographical Information Systems (GIS) can achieve high resolution, therefore. All data, regardless of the length and locality of a given sequence should be going into the database because this increases the robustness of the overall model. Strict criteria for input also need to be enforced, so that we can then generate models that can inform future research frameworks. There needs to be enough scope within the research agenda to cater for the local as well as the regional. Very little modelling of vegetation sequences has been done on the low Weald, for example.

Identification and analysis of off-site deposits in proximal locations would be extremely useful, although this is quite difficult in the developer funded context. Research framework stipulation would be useful here, and it is also a good idea to bring in PhD studentships for larger projects, as long as the research questions are well defined: actually a lot of developers interested in co-funding PhD studentships.

The following paper is adapted from a text supplied by the speaker.

Agriculture, local environment and diet: the plant macro remains

Chris Stevens (CS)

CS presented an analysis of plant macro remains from the region in the following general periods, which in fact were at least partly based on the apparent chronology of the plant remains themselves:

- Early Neolithic 4000–c. 3000 *cal.* BC

- Later Neo/Early Bronze Age 3000–1500 *cal.* BC
- Middle/Later Bronze Age 1500–700 *cal.* BC
- Iron Age 700 BC–43 AD
- Romano-British 43–410 AD
- Anglo-Saxon to Medieval 410–1450 AD.

In each case, CS gave examples of specific sites, along with details of the types of remains recovered from each. Overall evidence for farming in each period was then summarised and compared with that of other regions, and suggestions for future work proposed. Before moving on to the Early Neolithic, CS briefly summarised Mesolithic evidence from sites at Sandway Road, Kent, Westhampnett, West Sussex and Kettlebury, Surrey as being mainly hazelnuts, which of coarse compares well with other regions, and is highly suggestive that these formed a staple in the hunter-gatherer diet, and may even have begun to be cultivated (as suggested by NB, above).

Early Neolithic (4000–3000 cal. BC)
The Early Neolithic evidence presented by CS was derived from recent sites in Kent at White Horse Stone (including the rare building), Kingsborough Farm, Sheppey (a site with two causewayed camps), Westwood Cross (Thanet), Saltwood Tunnel and Little Stock Farm. The evidence can be summarised thus:

- Crops: emmer wheat (*Triticum dicoccum*); hulled and naked barley (*Hordeum vulgare*)
- Wild foods: hazelnut (*Corylus avellana*); sloe (*Prunus spinosa*); crab apple (*Malus sylvestris*)
- Few cereal remains, even less chaff, or weed seeds (mainly large)
- Occasional grain rich deposits
- Chaff used occasionally as pot temper (evidence from pottery impressions).

The dates attributed to the evidence are earlier than those from Hambledon Hill, but compare with evidence from other parts of the British Isles, particularly with sporadic cereals and wild foods and occasional large deposits. Future work should focus on

- Radiocarbon dating of early cereal deposits
- Targeting of undated grain rich deposits
- Examination of pottery for cereal impressions
- Examination of location and nature of querns.

Later Neolithic/Early Bronze Age (3000–1500 cal. BC)
For this period CS presented evidence from the Eyehorne Street, White Horse Stone and Beechbrook Wood sites in Kent, Glyn House, Ewell in Surrey and from Claypit Lane, Westhampnett, West Sussex. In summary, the plant macro information from these sites indicates:

- Crops: very little conclusive evidence for cereal remains, in comparison to both earlier and later periods
- Wild foods: hazelnut (*Corylus avellana*); sloe (*Prunus spinosa*); crab apple (*Malus sylvestris*)
- Few cereal remains, even less chaff, or weed seeds (mainly large)

- Occasional grain rich deposits
- Chaff used occasionally as pot temper (evidence from pottery impressions).

This compares well to the Late Neolithic sites cited by Moffett, Straker and Robinson (1989), in which the predominance of wild food remains was noted. Sites are also known of a Late Neolithic to Early Bronze Age date where there have been whole pits full of sloes, apples and/or hazelnuts, including one on the Dorset coast and in Horton, Berkshire. Only one cereal grain dated to this period is known, from the Stumble, Essex. Increased awareness of problems of intrusive cereal remains, and targeting of well-sealed deposits containing cereal remains for radiocarbon dating are therefore recommended, in order to provide more secure evidence for this apparent change and investigate it further.

Middle/Later Bronze Age (1500–700 cal. BC)
Evidence for this period is more extensive, with information from sites at Princes Road, Dartford, White Horse Stone, Westwood Cross and Saltwood Tunnel in Kent and Itford Hill, Black Patch, Mile Oak Farm and Bognor in East and West Sussex, for example, as well as an ard point from Horsleydown and ard marks from Southwark and in Surrey. Taken altogether, the evidence seems to be one of a new emphasis on agriculture:

- Crops: emmer wheat (*Triticum dicoccum*); spelt wheat (*Triticum spelta*); Barley (*Hordeum vulgare*); Celtic bean (*Vicia faba* var. *minor*); Flax (*Linum usitatissimum*)
- Wild foods: some hazelnut (*Corylus avellana*) but generally very little evidence
- Other evidence of agriculture: storage pits, 4-poster granaries, quern stones, field-systems, ard marks, occasional remains of ards, frequent although sometimes sporadic finds of cereals. Higher proportion of chaff and weed seeds.

A Middle Bronze Age date for introduction of spelt wheat compares well to sites at Yarnton, Oxfordshire; Godmanchester and Barleycroft Farm, Cambridgeshire and Haynes Lane, Devon, in fact, the evidence compares well to England as whole, and there is perhaps even a somewhat richer array of find spots in the South-East than is seen elsewhere. The following strategies are recommended:

- Radiocarbon dating of potentially earlier Middle Bronze Age contexts, especially potentially early deposits for the introduction of spelt
- Better integration of archaeobotanical remains with other evidence pertaining to farming
- Improved sampling strategies
- We *must* identify material and publish these identifications alongside radiocarbon dates!

Iron Age (700 BC–43 AD)
Evidence for this period was taken from sites at Park Farm, East Ashford and Sheppey in Kent, and Westhampnett in West Sussex. The summary of relative agricultural practice to wild food collection derived from these sites is:

- Crops: emmer wheat (*Triticum dicoccum*); spelt wheat (*Triticum spelta*); Barley (*Hordeum vulgare*); Celtic bean (*Vicia faba* var. *minor*); Flax (*Linum usitatissimum*)
- Wild foods: very little evidence
- Other evidence of agriculture: storage pits, 4-poster granaries, quern stones, field-systems.

This is essentially very similar to the summary for the Middle/Late Bronze Age. This compares well with other areas of England, and continued cultivation of emmer particularly compares with other parts of eastern England (e.g. East Anglia, North-East England). Better integration of archaeobotanical remains with other evidence pertaining to farming is recommended. In particular variation across region in use of rotary and saddle querns should be investigated.

Romano-British (43–410 AD)
Evidence for the Romano-British period was derived from sites at Springhead in Kent and Westhampnett and Pallant House, Chichester in West Sussex. An increase in the diversity of food remains seems to characterise this period:

- Crops: spelt wheat (*Triticum spelta*); barley (*Hordeum vulgare*); emmer wheat (*Triticum dicoccum*); celtic bean (*Vicia faba* var. *minor*); flax (*Linum usitatissimum*)
- Brewing and malting of spelt wheat (dumps of glume chaff)
- Cultivation of clay soils (*Anthemis cotula*)
- Other foods: imports in towns and villas, pinenuts, fig, grape, possibly lentil
- Probable increased use, collection, cultivation (?) of wild foods including hazelnuts.

This compares well with other parts of England, and evidence for malting is frequently seen at other sites across the country, often close to roadside towns and villas (as in the Springhead example). Emmer is more present still than in other parts of England, but many other sites in the region are dominated by spelt. CS recommends:

- More comparison of rural and urban sites
- Comparison of archaeobotanical data sets with evidence of 'Romanisation'
- Comparison of archaeobotanical datasets with evidence of querns, rotary querns and milling.

Anglo-Saxon to Medieval (410–1450 AD)
CS' evidence for the early and later Medieval periods comes from sites at Northfleet, Mersham and Westenhanger in Kent and from Pallant House, Chichester. The summary shows some marked changes in agricultural practice:

- Crops: free-threshing wheat (*Triticum aestivum*); barley (*Hordeum vulgare*); rye (*Scale cereale*); oats (*Avena sativa*); celtic bean (*Vicia faba* var. *minor*); pea (*Pisum sativum*); flax (*Linum usitatissimum*)
- Emmer and spelt wheat continue on some sites into the Saxon period, but generally these appear to have been dropped from cultivation
- Increased cultivation on the clay, seen though increased numbers of seeds of stinking mayweed
- Increased diversity of other utilized plants: a potentially large number of both imports and/or local cultivation.

This again compares well with other parts of England, where free-threshing wheat, rye and barley are seen to replace spelt. CS finally made the following recommendations for future work relating to this period:

- Radiocarbon dating of secure remains of spelt and emmer from Saxon deposits
- Increased comparison of archaeobtoanical records with historical documentation
- Increased comparison to regional pollen diagrams.

The potential of isotopic analysis

Julie Hamilton (JH)

JH promoted the archaeological potential for various types of isotopic analysis, initially providing a detailed introductory explanation as to how stable isotopes can yield important information:

- Some isotopes are unstable, and undergo radioactive decay (e.g. ^{14}C; ^{3}H [tritium])
- They are present in small amounts, and depending on the half-life some can be used for dating
- Isotopes that do not decay radioactively are known as *stable* isotopes e.g. ^{12}C; ^{13}C
- The ratio(s) of stable isotopes of an element can be used to trace chemical processes.

Certain isotopes are particularly useful for reconstructing certain aspects of ancient life:

- Hydrogen and Carbon: diet
- Oxygen and Nitrogen: water, altitudinal difference
- Strontium: local geology.

Isotope ratios and diet

- Carbon and Nitrogen ratios have been used together to look at diet
- Until recently, the focus was on human diets
- Animals provide baseline values for this type of analysis.

JH briefly discussed case studies of the change in diet from the British Mesolithic to Neolithic (interestingly, showing a marked absence of fish in diets from the end of the Mesolithic until the Romano-British period), variation in diet, apparently related to social differences as reflected in the Romano-British cemetery at Poundbury Camp, Dorset, and weaning ages from the Medieval site at Wharram Percy, Yorkshire (breastfeeding babies have a carnivorous profile as opposed to those weaned).

Isotope ratios and movement

- Hydrogen and Oxygen isotope ratios mainly reflect values in water
- This reflects climate via the balance between condensation and evaporation (e.g. d^{18}O in ice cores)
- On a large (continental) scale they are characteristic of different regions
- Strontium isotope ratios reflect local geology and proximity to the sea
- Carbon and Nitrogen isotope ratios also vary with climate
- Various combinations may be used to trace geographic origins or movements during an individual's lifetime.

As a case study in this area, JH outlined a case of Bronze Age childhood migration that had been revealed by Strontium and Oxygen isotope analysis of tooth enamel from a multiple Boscombe Down burial near Stonehenge in Wiltshire. The three adult males from the burial had spent their early childhood (evidence from premolar teeth) in an area with a particular Strontium isotope signature, and had then moved during early adolescence (evidence from 3rd molars) to a less radiogenic area, acquiring a different Strontium isotope signature. Wales is closest area with rocks with suitable Strontium and Oxygen isotope ratios, although other areas of Palaeozoic rock, such as Scotland and parts of Europe, cannot be ruled out. On the basis of the same evidence the two juveniles from the Boscombe Down burial were not from the same homeland as the adults with whom they shared a grave. In further contrast, two adult males from single burials at Normanton Down & Stonehenge showed no evidence of migration to the area, their Oxygen and Strontium data being consistent with a childhood in Stonehenge area.

Seasonality in animal transhumance is another area where such isotopes might be useful, although this requires incredibly detailed sampling strategies.

In summary, then, Isotopic Analyses have much potential in the following areas of archaeology:

- Carbon and Nitrogen isotopes: food webs, use of environments, climate, diet, behaviour, weaning
- Strontium isotopes: geology, geographical variation
- Nitrogen and Oxygen isotopes: climate, hydrology, seasonality, geographical variation.

JH finally noted a number of future directions for perfecting and applying this science in an archaeological context:

- Better characterisation of baseline isotope ratio distributions (climate, hydrology, geology)
- Better characterisation of baseline faunal values
- Recovery of plant values
- Microsampling, especially teeth, to look at small scale changes (e.g. seasonal movement)
- Investigation of the potential of other isotopes
- Analysis of individual amino acids.

Crafts and industries: the scientific investigation of processes and products

Justine Bayley (JB)

JB first listed types of artefacts that can contribute to our understanding of crafts and industries in the past, including different types of slags (variable in size, texture and also in composition, as well as quantities), crucibles (varied depending on the material to be melted), moulds and tools (including, for example, coin pellet moulds for making blanks and touch stones, three of which are known from pagan Saxon graves in Kent). Scrap and waste metal, including recycled material are also important, of course.

JB then discussed case studies that demonstrate the degree of detail that can actually be reconstructed concerning such activities, first looking at evidence of Iron smelting from the Romano-British small town site at Westhawk Farm, near Ashford, Kent. The Iron industry was enormous important in the Weald, with 1000s of tons being produced (some re-used in road metalling and later re-smelted). Around 1.5 tons of slag were recovered at the Westhawk Farm site in area B, and two different workshops were identified. Workshop R, in particular, was formed of a line of posts, a line of re-cut furnaces and a working floor. Soil samples taken from the floor (on a grid) revealed concentrations of hammer-scale, possibly indicating the exact location of anvil, and even patterns of movement within the building. Under a scanning electron microscope (SEM), the hammer-scale is revealed as tiny flakes and balls of slag. Interestingly, the Iron ore found in association with these workshops was not from the Weald, but actually from tertiary deposits overlying the Downs more locally, and a large billet of Iron was also recovered, with slag inclusions and minor elements from the same ore. It would be interesting to look over a wider area and start to map where ore was sourced from more generally.

Next, JB focussed on some idiosyncratic crucibles of the Roman period, recovered from Chapel Street, Chichester by Alec Down in the 1970s. There were two different types of crucibles: one with red deposits, the other with glassy deposits. JB had gradually revised her interpretation as to the exact function of these objects since their first discovery, from glass making (red enamel: Bayley in Down 1978) to their being used for ‘parting’, a process for separating silver and gold (a new interpretation in 1990s), to a more recent reappraisal. In the latter reassessment JB re-examined the glass with an SEM and found copper/silver alloys in bubbles in the glass; the glass was therefore a by-product of refining of silver. JB was then able to compare these findings with material from Heybridge in Essex (much more silica) and Xanten (much more comparable). So Roman Chichester has lost an enamelling site, but gained a precious metals workshop!

Similar microscopic and chemical analyses can be applied to coloured beads from pagan Saxon graves, for example. Most of these coloured beads are made of glass, the different colours resulting from different chemical compositions. Although the technology represented is very similar at different sites, Titanium levels help to provenance the sand from which the beads were made. Actually, this shows that there is indeed variability between graves, with beads being assembled from different sources. Social contexts therefore come into play once such variability has been identified. Romano-British brooches from Richborough in Kent provide a similar example where improvements in scientific techniques can have a considerable bearing on archaeological interpretation. Romano-British copper alloys have zinc and/or lead and/or tin as components. Different types of brooch can be shown to use different alloys, and there is a combination of technological, economic and social reasons for doing this.

Sea level change

Martin Bates (MB)

MB stood in for Andrew Haggart on this subject, who was unfortunately unable to attend. Sea levels fell to their lowest point (low stand) about 20000 years ago, when they were about 125m (or more) lower than they are at the present time. Fluctuation in sea levels is bound up with climate change, with the expansion of ice sheets in cold phases, and therefore retention of water on land, followed by warmer climates and melting and releasing of water into the sea.

Sea level curves can be generated from evidence of this cycle, and a detailed pattern is can now be traced for Britain from 12000 years ago to the present, charting an overall rise in sea level. This curve was initially quite steep, but has been more gradual recently. There are also different curves for different parts of the world. The interpretation of these curves is ‘hellishly complicated’ and much debate continues as to whether the curve represents constant or more undulating trends.

All of this has implications for understanding human activity. The lower deposits of river valleys (e.g. the Medway), storm beaches (e.g. Boxgrove), reclaimed areas (Romney Marsh etc), silts in esturine sub-tidal conditions, and more marshy incipient peat development are all directly associated with changes in sea level. There are in fact many local situations in relation to more general curve.

For example, recent work, using direct methods to get cores and samples as well as indirect evidence (electrical conductivity) has produced a schematic profile of what we find under the Thames along line of CTRL. Basal deposits of gravel at -7–8m OD are followed by early and middle Mesolithic ground surfaces, for example. The whole sequence in fact forms a characteristic tripartite system (typical of many rivers in region), with initial flooding, followed by brackish conditions (clay silts), being replaced at about 5m OD by peat (also fossil forest), and finally at 5500–4500 BC back to clay silts: so, inundation, back to usable land, then flooding again.

Ancient beach sequences are also extant, such as those at different elevations in a sort of staircase down the Sussex coastal plain. In the latter case sea level change is in fact not responsible *per se*, but the whole area has been uplifted geologically from an initial level approximately equal to the modern sea level, thus preserving the raised beaches. Ostracods and other fauna can be used to characterise ancient marine environment as compared with modern conditions (i.e. warmer or colder, higher or lower). Other forms of evidence include buried palaeochannels, which can be very complicated and difficult to interpret. Preserved within are sands and gravels, and also terrestrial objects (e.g. trees). For more recent periods in particular there are also historical records of sea level change that had an impact on local populations (for example the great storms of the 13th century on the South-East coast).

Once sea levels have been established, we can begin to put boundaries on what was happening to the landscape as a whole.

General discussion:

Roman villa sites are producing early Anglo-Saxon dates for plant macros, but the data for agricultural change are generally later. Also, assumptions about agricultural changes in Neolithic and early Bronze Age might be more to do with preservation. This is a research question requiring more and better data. A review of pre-barrow land surfaces in this light would be a good approach. Cranbourne Chase surfaces did not produce grain, and micromorphological aspects are also the subject of much debate in terms of what the evidence means. It is not at all easy to tell the difference in Neolithic contexts in terms of domestication/wild/feral. A mosaic of different local situations seems more likely perhaps than sweeping generalised change. Researchers might not have been looking in the 'right' places; further aspects, such as reconstructing insect ecologies of meadows, and stabling of domesticated animals might also be worth pursuing (it has been suggested that the use of ivy as a fodder crop might be evidenced in the pollen record, perhaps as early as the Mesolithic, for example). It was also generally agreed that more recent mid 18th to 19th century farming could also be subjected to similar environmental (and indeed isotopic) analyses, if only as a control, in order to contextualise findings from earlier periods.