

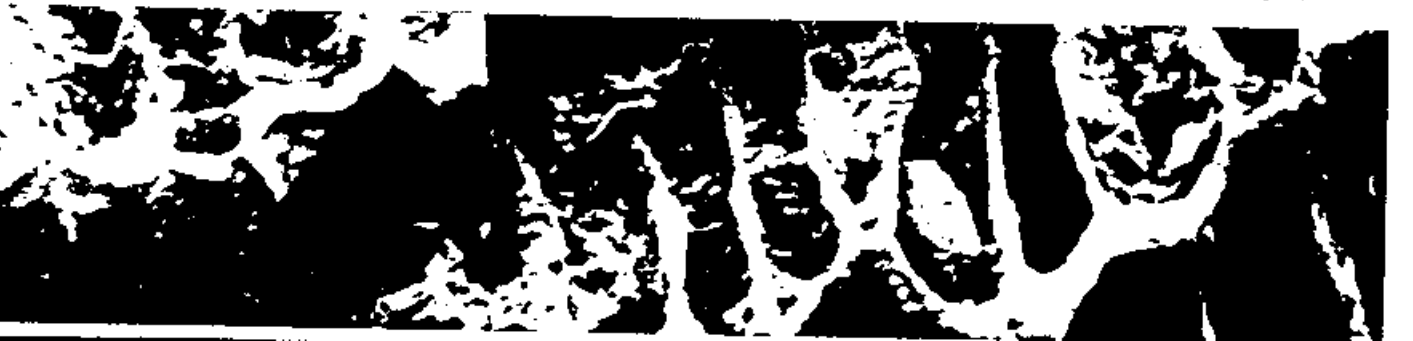


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# CIRCAEA



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Association for  
Environmental Archaeology



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## Editorial

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Over the past few months we have received several approaches for subscriptions to Circaea from a variety of institutions, libraries and journal subscription agencies. The subscription for these is £9.00 per annum. May we suggest that members encourage libraries in their parent institutions to follow this trend? It will help to keep members' subscriptions stable as well as disseminating our august organ further and wider.

In case anyone hasn't heard, the EAU has moved to new accommodation - and that's our excuse this time for the late appearance of the 'Spring' issue! (Mind you, Spring was rather late this year, at least in North Yorkshire...) We still intend to co-ordinate with the Editors of the Newsletter by the Spring 1987 issue. Please note that our address remains the same (see inside front cover) and our telephone extensions (N.B. now to OS04 430000) are 5531 and 5849.

Circaea is attracting a modest flow of material of quality suitable for publication, but we are, of course, always glad to receive contributions from members and others. May we remind you of the editorial policy outlined on the opposite page, and also of the Notes for Contributors on the inside back page. Perhaps we could emphasise that, by following these notes, authors will greatly speed up the publishing process, especially with regard to return of proofs - bear in mind that we ask for them to be returned within three days, whilst many long-established journals insist on receiving marked proofs by return post. Almost none of our aspiring authors bothers to include a summary, despite our request; it is hardly the editors' job to supply one! And (last gripe), although we may not be entirely consistent ourselves with regard to the format of references, something approaching Circaea house style would be appreciated...

### Change of address

Dr Philip Armitage (currently of Booth Museum of Natural History, Dyke Road, Brighton) informs us that from the end of August his address will be:

8891 Mockingbird Drive  
Sanibel  
Florida 33957  
U.S.A.

We are sure that our readers will join us in wishing Philip well in the land of oranges and alligators.

## Book Notices

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Notice has been received of the forthcoming production of a 'field-guide to the bird bones of Britain and Europe' by Dr G. S. Cowles, with the collaboration of an artist. This book is expected in a year or so's time and promises to provide, at long last, a series of detailed drawings comparing skeletal elements from the full range of European birds. Hooray!

Another eminently useful tome that has just appeared off the presses is Simon Hillson's Teeth, in the Cambridge Manuals in Archaeology series. First impressions (no pun intended) are highly favourable: we hope to publish a full review in due course.

## Miscellany

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### Conference Report - 7th International Work Group for Palaeoethnobotany

Cambridge, 6-11th April 1986

In the second week of April 1986, the icy winds that once drove the freshwater tortoise from these isles tore relentlessly across the East Anglian plain, and around the collective ears of members of the International Work Group for Palaeoethnobotany. Specialists from 26 different nations had gathered in Cambridge where they huddled and shivered in as many winter clothes as they could amass - and that was just in New Hall College dining room.

Yet all was not in vain. As the week progressed, the unflappable Jane Renfrew steered us expertly through climatic extremes to provide us with a most valuable, memorable and enjoyable conference, for which I would immediately record our gratitude. It is no mean feat to coordinate the largest, and most geographically diverse, I.W.G.P. meeting to date, and this was achieved to everyone's satisfaction.

We were soon ensconced in the comfortably Interglacial conditions of our lecture room, where we heard of the plant economies of India, Africa and the Mediterranean, and listened while Rolf Mathewes and Mordechai Kislev debated the relative virtues of the Red Cedar and the Date Palm as all-purpose economic plants. The week's papers were to span a valuable range, in terms not just of geography, but also of the many aspects of the plant-based economy.

Food studies are becoming less and less confined to relatively intact seeds and fruits. We learnt of the detection of soup and gruel (C. & J. Dickson), tubers (Hillman) and other vegetative tissues (Tomlinson). We were also able to contrast the refined diet of baked bread enjoyed by the Lindow Moss bog-man with the rather vulgar assortment of herbs and shrubs that constituted the lunch-time diet of Allan Hall and Philippa Tomlinson during the conference. Valuable papers were also heard on economic plants other than foodstuffs; on wood (Mathewes), textiles, cordage and wickerwork (Körber-Grohne), dyeplants (Hall), mosses (Foldó) and on a range of coastal-zone resources (Murphy).

We benefitted from numerous regional syntheses, covering India (Kajale), Cyprus (Hansen), Switzerland (Jacomet), Scandinavia (Engelmark, Jensen), Ireland (Monk), various parts of Britain (the Dicksons, Murphy, Green) and France (Marinval and Russ). These last contributors gave details of a number of exciting new records, including the very early cultivar legumes recovered from Baume de l'Abeurador and Baume de Fontbregoua.

Methodology was very much to the fore with papers mentioning electron spin resonance (Robins), scanning electron microscopy (Hansen) and electron microprobe analysis (Robinson and Straker), as well as the more low-tech topics such as crop-processing (Bakels, van der Veen) and 'macro' morphology (Butler, Kosina). A special mention must be made of Glynis Jones for her fluent and professional delivery (in his absence) of Romuald Kosina's paper on the vital statistics of the hazelnut. I found her sincere conviction on the question of continuous polymorphism in the nut's cicatrix carpica quite moving.

The conference introduced at least one new piece of jargon, 'Kopro-analyse' (KnoBrzer), but I feel that at this conference, turds slipped into second place in the list of 'themes-that-every-speaker-mentions'. As soon as Mark Robinson and Vanessa Straker drew our attention to silica ash, it seemed that every other speaker admitted to having encountered vast quantities of the stuff. It is clearly a category of data that needs some attention.

The evident expansion of our subject was also tempered with some cautionary notes. Philip Tallantire emphasised the need for botanical expertise and full documentation in 'macro' work, and Gay Wilson took a swipe at flotation machines and their users.

Midway through this week of wide-ranging papers, our field trip took us to a corner of East Anglia that made even the New Hall dining room seem tropical. On the flat open landscape around Etton nothing offers protection from whatever blows in from the coldest parts of the Northern Hemisphere; everywhere shares the same bitter exposure. Except of course the dykes, which are even more exposed, and along which an ebullient Francis Pryor directed us all towards his unique and important site.

As we all froze around the vestiges of the causewayed enclosure, a searing wind from the Urals whipped off Francis' erudite words to somewhere in Northern France [somebody teach him some Geography! Eds.]. He proceeded, inaudible but undaunted, to paw from a wind-blasted remnant of a section, a fragment of the millions of pieces of preserved wood that give this site its considerable significance on British archaeology.

More of the wood at Wicken Fen and West Stow was thankfully in the form of growing trees, and the remainder of our excellent field trip was enjoyed in luxurious shelter from the winds. We thank Charles Turner, Richard Darrah, as well as Francis, Maisie Taylor, Charlie French and their colleagues for giving up so much of their time - we benefitted enormously.

One of the topics of conversation on the field trip had been the previous day's news that Professor KBrber-Grohne will be retiring from her post at the University of Stuttgart (Hohenheim) in 1988. Many of us have received considerable stimulation from her innovative work over the years, and were delighted to hear that there will be a special meeting of the I.W.G.P. that year at Stuttgart, to mark the event. (The next ordinary meeting will be at Nitra (Czechoslovakia) in 1989, and no doubt Circaea will keep us posted about both meetings.)

Not only was there a certain sadness that such an active and influential career should reach its conclusion, but there was also a feeling of concern about the effect of Professor KBrber-Grohne's retirement on the future of palaeoethnobotany in Central Europe. Despite a lively young generation of researchers, there will remain precious few tenured posts in the region, something essential to sustain the momentum that was so clearly evident at this conference. On the next day Stefanie Jacomet drew attention to the economic fragility of so many research programmes, even those that concern sites of such global importance as the Swiss Lake Dwellings.

This indeed was a message that arose forcefully from the 7th I.W.G.P. conference. Our most problematic climate was not that of the dining room but instead the economic climate,

and it is clear that we will need to push hard to ensure that environmental archaeology is not damaged in the next few years. I would dissent from the various whispers that I.W.G.P. is getting 'too large', and should revert to being a cosy and select group. The progressive expansion in numbers from meeting to meeting reflects the importance and vitality of our subject and should be encouraged. It is this vitality that will bring our subject through the current economic glaciation and ensure its continuing place within an archaeological discipline that emerges in better times.

Martin Jones, Department of Archaeology, University of Durham, 46 Saddler Street, Durham DH1 3NU, U.K.

John Phipps, connoisseur of fly puparia and sometime Professor of Zoology in most of the known Commonwealth, contributes the following observations:

Mimicry of sphaerocerid (Diptera) puparia by elytra of Coleoptera

in archaeological deposits: a note

In the course of examining material from archaeological samples, especially flots prepared by paraffining and then preserved in alcohol, my attention has often been drawn by what appeared to be a puparium of a sphaerocerid lurking amongst the assorted plant debris, only to find that the object was a detached beetle elytron. Such puparia have been described in some detail by various authors, most accessibly in Phipps (1983). The elytra of Coleoptera are described in various books on beetles, a recent account being that by Harde (1984). The observant reader who looks up the illustrations in these works will no doubt wonder how such apparently dissimilar objects can be confused, but it must be remembered that sphaerocerid puparia in archaeological samples are flattened and leaf-like, often dark brown or even black and, most importantly, often deformed. This deformation sometimes leads to the loss of bilateral symmetry, producing shapes like those illustrated in the figure reproduced here, where such a puparium is shown beside a beetle elytron of similar size. The possibility of confusion is obvious.

The value of such mimicry is by no means clear, but it is possible to speculate, so demonstrating the fertility of the mind of the author. In this note it has been assumed that the puparium is the model and the elytron the mimic, for no other reason than that puparia were the objects being sought. But if we regard the environmental archaeologist seeking Diptera as the chief or only predator of this prey, it would be more reasonable to regard the puparium as the mimic, since it may thus escape notice. This does not take into account the activities of another important predator, the environmental archaeologist seeking the remains of beetles, who may occasionally be deflected by a mimicking puparium, or who may even overlook an elytron, taking it for a puparium. It must be admitted that there is no evidence in this laboratory that this has ever happened, but this should not deter us from discussing the possibility, especially if such a discussion can be extended for several pages in a later paper. A further point is that such resemblance would lose all significance in the face of a more generalised predator such as an environmental archaeologist concerned with the whole field of entomology. The fact that such similarities exist may be regarded as evidence of the scarcity of such predators.

If we go on to consider how such resemblances come about, we are faced with a further set of problems. There appears to be little opportunity for evolution in a deposit and selection only operates after excavation and processing. As this occurs much later than the burial of the material, a considerable measure of pre-adaptation appears to be involved.

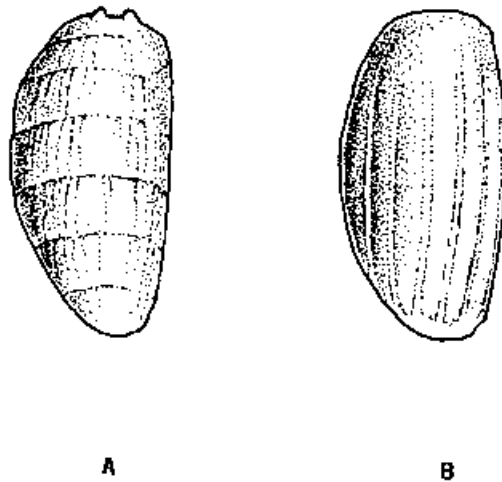


Figure: A - deformed puparium of Leptocera sp. (Sphaeroceridae); B - beetle elytron of similar size. Both about 3 mm in length. The similarity is enhanced by almost closing the eyes, to obtain resolution similar to that of a standard binocular 'sorting microscope'.

Apparently the attempt to explain this mimicry by the standard scientific approach fails and we must consider it on another philosophical level. An explanation that springs to the mind is that it is another example of Sod's Law, which states that if anything can go wrong, it will. A more philosophical statement of the same principle with reference to experimental evidence has been enunciated by Jennings (date unknown, but I should be grateful if anyone else knows) as Resistentialism, which encompasses the opposition of things to the endeavours and aspirations of people. Readers will be able to quote further examples from all fields of endeavour, unless they have been very much luckier than the rest of us.

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Prof. John Phipps, Environmental Archaeology Unit, University of York, Heslington, York YO1 5DD, U.K.

Bernard Maloney contributes the following account of recent work with which he has been involved in Thailand.

#### Environmental Archaeology at Khok Phanom Di, Central Thailand

Khok Phanom Di is located c. 50 km from Bangkok and 18 km north of Phanat Nikhom in the lower Ban Pakong Valley of east central Thailand. The archaeological site comprises a midden of potsherds and marine mollusc shells (largely Anadira sp.) on top of a natural prominence which is probably the remnant of a spit or river-mouth bar. It was discovered in 1977 and Thai workers opened up two small test squares. The results suggested that a larger excavation would be worthwhile and a team from the University of Otago, New Zealand, led by Prof. C. F. W. Higham, and the Royal Thai Fine Arts Department (co-director Rachanie Bannanurag) opened up a 100 m square in late 1984-mid 1985. Radiocarbon dates are not yet available from the most recent excavation, but human bone from one of the test pits covers the period 5000-2000 BC, a time of known rising sea-level. A major aim of the excavation has been to uncover evidence for prehistoric subsistence, in particular for changes associated with the adoption of rice agriculture. Pottery from various levels commencing 0.5 m above natural is tempered with what appears to be rice straw and grain impressions are sometimes present. Gillian Thompson, now a post-graduate of the Australian National University, operated a flotation machine and will work on all plant macrofossils recovered, except those of grasses which D. E. Yen, also of ANU, has kindly agreed to study to establish if we have remains of cultivated rice.

My own research is largely concerned with providing information on the environmental background of the near environs of Khok Phanom Di. However, coprolites of possible human origin have been recovered from the upper levels of the site (we found little dog bone), while two of the lower of 153 burials had their stomach contents in situ, and I intend investigating these for pollen and phytoliths. Others will work on plant macrofossil, bone and any parasite remains to be found in these materials. My research student, Judith Brown, removed small samples from graves, etc., during the excavation of the upper to middle levels of the site but this material is almost certainly too dry and powdery to contain recognisable pollen, although phytoliths may be present. I felt that there were too many inexperienced helpers in the square and that there was too much dust flying (especially when the occasional snake or scorpion appeared!) to make this worthwhile, but I asked that a monolith should be removed from one wall at the end of the excavation (I had to leave before completion) and from the natural. I recognise that this will impose limitations on the phytolith analysis but this is a new technique for south-east Asia. I have to build a reference collection and some limit has to be placed on the amount of work from a single site to which one can commit oneself.

A few of the lower skeletons were laid out on what seems to be bark cloth and I asked Prof. Higham to take a sample from immediately beneath this. The sample (Burial 149) contained an abundance of phytoliths, including some from grasses. He also sent me some samples from small lenses in the lower stratigraphy and these appear to be composed of loess and marine overwash, but examination by a geomorphologist is necessary. There are numerous ash layers in the site stratigraphy and a lump of sediment from the top of natural (the monolith is still in transit to me) contained macrofossil and microfossil charcoal but was otherwise barren. So the vegetation of the mound, probably the undergrowth, was disturbed before occupation although the other ash layers may consist of material brought to the site as fuel for cooking and in pottery making.



Dr Hylleberg and Anuwat Nateewathna (Phuket Marine Biological Center) have examined some gastropod samples from the site (recovered by sieving) and their conclusions suggest that fresh water was available nearby at least seasonally. Dr Ken McKenzie (Riverina - Murray Institute of Higher Education, Wagga Wagga, Australia) has agreed to look at the ostracods for us: apparently rice fields have a distinctive ostracod fauna.

I undertook a plant ecological survey of the herb/shrub vegetation on the mound while Judith Brown studied the trees (probably largely planted) using line transects. I also examined the flora of the surrounds, considering 464 one metre square quadrats in all, using the Braun-Blanquet method. Naming of the plants collected is well advanced and the number of exotics is less than one might expect for a largely man-modified vegetation. Interestingly, Azima sarmentosa, a likely mangrove relic, was quite abundant on the mound. Numerous surface sediment samples were collected for pollen, phytolith, diatom and ostracod analysis.

Logistical difficulties meant that we only had a corer for about three weeks. By the time it arrived, I had taken a monolith from a side-wall of a deep, newly-constructed fishpond (much to the concern of the locals!). This reached a depth of c. 2.5 m, but cores of almost 7 m were extracted later. Through shortage of time and the hardness of the soils, most cores had to be extracted from irrigation/drainage canals. So the upper part of a number is missing and there is recent fill. However, two cores (BMR2 from north of the site and KPD DG from the south-east of the mound) start from ground surface level and contain the lowest stratigraphic unit obtained: a white, organic banded clay of likely fluvial origin and probable pre-Holocene date. This was overlain, perhaps unconformably, by a grey sandy-silty clay which has an abundance of mangrove (mainly Rhizophora spp.) pollen and salt-water diatoms and which may have been deposited in a shallow transgressive sea. Unfortunately the lack of detailed topographic data, information on Holocene tectonics and on recent coastal processes may make it impossible to reconstruct a relative sea-level curve.

Some cores had a second, thinner, unit of green-grey sediment above the main unit and the fishpond section had c. 90 cm of similar material over grey, apparently brackish-water clays. This may represent a second transgressive phase but could relate to erosion and re-deposition following barrier breaching. In general, dark grey clays of likely salt-water estuarine or lagoonal origin covered the main green-grey unit and light grey clays - silty clays representing incipient to actual acid sulphate soil formation or brown clays of freshwater origin overlaid these. Samples of light grey clay examined so far are dominated by grass pollen.

Sediments from this kind of lowland environment, where mean tidal range is 2-4 m and annual flooding by the river is likely, are very difficult materials for pollen analytical interpretation but no closed basin sites were available locally and it was a case of either working on these or on nothing.

The main faunal remains from the excavation were of marine origin (crabs, turtles, etc.) and confirm the finding that mangrove was nearby. Rhizophora (mangle) is a prized source of charcoal even today and it is not surprising with the wild harvest that the area was occupied in prehistory. What we want to establish is if rice was initially part of the wild harvest and later taken into cultivation. We hope that examination of the human skeletons at the University of Otago Medical School and establishment of  $\delta^{13}\text{C}$  figures for any bone collagen present may give valuable dietary information.

A more detailed account of the fieldwork and some preliminary palaeoecological results have been submitted jointly by Charles Higham, Rachanie Bannanurag and myself for publication in the Indo-Pacific Prehistory Bulletin.

Bernard Maloney, Department of Geography and the Palaeoecology Centre, Queen's University, Belfast.

## Summaries of papers delivered at AEA Spring Meeting

Oxford, 21st March 1986

Some of these contributions are rather more than mere summaries, but the Editors felt that they were worth publishing as they stood.

Julie Hamilton's paper on bones from Mallorca was based on recently published work. She asks us to give a full reference to that work, viz.:

Hamilton, J. (1984). 'The population structure of Myotragus balearicus from the cave of Muleta, Mallorca'. Pp. 71-88 + figs. in W. H. Waldren, R. Chapman, J. Leuthwaite and R.-C. Kennard (eds.) The Deya Conference of Prehistory. Early settlement in the western mediterranean islands and the peripheral areas. British Archaeological Reports, International Series 229. Oxford.

### Archaeobotany underwater

With archaeological excavations of Mediterranean underwater shipwreck sites in the 1960s, new direct sources of evidence of ancient trade, shipping practices, and technology became accessible. Although plant remains (apart from wood used in ship construction and as packing material) were recorded from the earliest excavations, few seeds smaller, and less characteristically identifiable, than grape seeds were recovered until recently.

During the past 15 years, recovery of plant remains from archaeological sites on land through the use of flotation techniques has become standard practice. Beginning in the 1970s, nautical archaeologists in the Mediterranean and elsewhere began actively looking for botanical remains on shipwreck sites. Contents of shipping amphorae were screened for visually identifiable seeds by some excavators; others collected organic residues from shipwreck components.

In 1979, the Institute of Nautical Archaeology, based at Texas A & M University, began a program of systematic recovery of plant remains off the Turkish coast. A Hellenistic shipwreck provided the first large sample of plant remains. Contents of over 150 ceramic vessels were floated, and archaeobotanical analysis of these plant remains proved rewarding. A major program of retrieval and analysis of plant remains from other shipwrecks was embarked upon.

Currently, over 500 archaeobotanical samples have been taken by Institute of Nautical Archaeology excavators. Four shipwrecks, from the Late Bronze Age to the medieval period, provide the bulk of the samples. Diverse organic cargo constituents demonstrate a major contribution of archaeobotany to the interpretation of shipwrecks: archaeologists are no longer forced to rely upon an amphora's shape to determine its previous contents.

These shipwrecks contain a wide variety of organic material, usually preserved by waterlogging. Mineralized and charred plant remains also occur. In addition to seeds of economic plants, such as grape and olive, a multitude of weed species are frequently represented. Pollen is well-preserved in contexts from at least one shipwreck, and wood fragments and wooden artefacts are common to all four sites. Leaves, twigs, and herbaceous plant tissues, as well as plant resins and pitches, are indicators both of human activity and the environment. Insects and bone complete the catalogue of organic finds to date. Artifactual material has also been retrieved during recovery of plant remains.

In examining plant remains from shipwreck sites, identifying well-preserved, but sometimes fragmentary, bits of Near Eastern flora is the least pressing problem. Creating a framework for interpreting such plant remains is of primary concern because merely providing species lists to excavators is unproductive. Methodological questions which consider factors such as intra-wreck dispersal systems, and determine the degree of probability that recovered plant tissues represent original cargo components, are central to the creation of such a framework. Spatial distribution of plant remains and context-related variation must also be included in interpretive efforts.

Archaeobotanical analysis of plant remains from shipwrecks contributes not only to our knowledge of ancient technology, trade, and environment, but also to awareness of human activity, shipboard life, and seaborne commerce.

Cheryl Haldane, 2517 Limestone Lane, Garland, Texas 75040, U.S.A.

#### Optimising the detection of cereal-type

#### pollen grains in pre-elm decline deposits

The possible existence of pollen grains in pre-elm decline deposits from Britain and Ireland has important implications for both palynology and early agriculture (Groenman-van Waateringe 1983; Edwards and Hiron 1984). The detection of cereal pollen, however, is not without its difficulties, viz.:

- (i) cereal pollen is produced in small amounts;
- (ii) the grains are large and so travel short distances;
- (iii) although most large Gramineae grains may derive from cultivated grasses, other graminaceous grains, especially those at the upper end of their size-ranges, may be attributed wrongly to the Cerealia.

This report concentrates on the first two items, and item (iii), which involves a consideration of pollen morphology and phase-contrast and scanning electron microscopy, will not be discussed at any length here.

- (i) Given the low amounts of cereal pollen produced, there is statistically a good chance

of missing grains and it would seem desirable to find a method of increasing the likelihood of detecting the relatively rare cereal-type grains. Two methods have received consideration by us - (a) rapid scanning and (b) filtering:

(a) Cereal-type pollen grains are large (typically 37  $\mu\text{m}$  or more in diameter) and relatively easily spotted on microscope slides at low magnifications such as x100 when the analyst is practised in the search. The rapid scanning of a slide with a cover slip of 22 x 22 mm may take 15 minutes. A subsequent (or prior) count of the other fossil and/or exotic grains over, say, five transects at normal counting magnifications, permits an estimate to be made of the total pollen count per slide. Using this search strategy on any number of replicate slides effectively allows the analyst to scan many thousands of pollen grains in the search for the elusive but important cereals. The method also makes it feasible to count contiguous samples through the relevant sections of the core, thus reducing the risk of missing cereal grains because of the existence of a sampling interval.

(b) Cereal-type grains are likely to be present in very low concentrations per unit volume of peat or lake sediment. It should be possible to increase the effective concentration in samples by passing large amounts of material through sieves with a mesh size sufficient to retain cereal-sized grains, while allowing smaller palynomorphs to pass through. It may be worthwhile to exclude larger palynomorphs also by using a sieve of larger mesh size. The mesh size would have to be small enough to trap cereal grains whose smallest cross-grain diameter may be quite narrow (e.g. 30  $\mu\text{m}$ ). Quantitative estimates of cereal grain counts can then be made with reference to similar-sized but more abundant palynomorphs, such as Pinus pollen and Filicales spores, whose ratio to total pollen counts has been determined by methods as in (a) above. As an alternative, it may be possible to separate the Cerealia (and palynomorphs of similar size) by differential settling or specific gravity. We have not tested these methods yet.

(ii) If cereals were being cultivated close to the edge of an accumulating peat bog, then a core obtained from close to the edge will possibly have a better chance of containing short-travelled cereal pollen grains than one from the distant deep centre. We have worked at two sites in Scotland from which cores from close to the bog edge have been examined.

#### Summary of results

A profile from Machrie Moor, Isle of Arran, Scotland (Robinson 1981) had revealed cereal-type pollen grains both in pre-elm decline deposits and also after the start of the elm decline; and at Aros Moss, Kintyre, Scotland (Nichols 1967) no cereal-type pollen was detected until well after the elm decline. Cereal-type grains were found at both elm decline and earlier levels at the two new edge profiles after rapid scanning searches on contiguous levels.

At the new Machrie Moor profile, five grains were found prior to the elm decline (111 levels were searched). At the new Aros Moss profile, three grains were found in pre-elm decline levels (89 were searched). At both sites, cereal-type grains were also found at and immediately above the elm decline.

Although it is clear that cereal-type pollen in pre- (and post-!) elm decline deposits may not have originated in cultivated grasses, confidence in their assignment to

the Cerealia would be increased if the spectra containing the grains also produced herbaceous pollen types typically found in arable situations (cf. the sites discussed by Edwards and Hiron 1984). The early levels in the new Machrie Moor core produced Artemisia, Umbelliferae and declines in Betula, while at Aros Moss, Cruciferae, Labiatae and Umbelliferae were accompanied by falls in Betula and coryloid pollen. Such NAP types are less frequently found in levels containing no cereal-type pollen and the question of floristic reconstruction would be the subject of a report in its own right.

The strategy outlined above has produced some interesting results. A combination of rapid scanning of bog-edge profiles (with or without supplementary filtering) would build up a database of possible sites for the investigation of early agriculture. Additional scanning electron microscopy might then become feasible for a sufficiently large number of sites to confirm or urge caution on cereal determinations made with the light microscope, though even SEM identifications may not be conclusive (Köhler and Lange 1979).

#### Acknowledgment

The Science and Engineering Research Council is thanked for financial support.

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## Palaeoenvironmental investigations into Mesolithic impacts

### on the landscape of western Scotland

Evidence, in the form of lithic scatters and the few occupation sites known, shows that pre-agricultural communities of hunter-gatherers have ranged widely over the landscape of Scotland. The work of archaeologists and palaeoecologists currently places the activities of these peoples in the period c. 6650-3000 BC (Morrison 1980; Wickham-Jones and Sharples 1984). Over recent years the possible environmental impact of such Mesolithic communities in Britain has been demonstrated with varying degrees of certainty (reviewed by Edwards and Ralston 1985). This project attempts an evaluation of the wider context of such environmental impacts at selected sites in the west of Scotland - an area which has received relatively little attention in palaeo-environmental terms for this period.

The investigation aims to supplement pollen and charcoal analyses by considering other sedimentary evidence for man's possible role in modifying vegetation, and the consequences of these activities in terms of possible soil erosion. A prerequisite for such a study is evidence for a local Mesolithic presence in areas which provide the potential for producing data about human impact. This assessment will involve the application of a range of palaeoenvironmental techniques and a comparison of supplementary deposits - small bogs or soils with local pollen records and large lakes with a more regional pollen catchment.

Two study sites in south-west Scotland, Lochs Doon and Dee, provide lake-shore find-spots of Mesolithic character, with local blanket and basin peats and acidic soils. At Kinloch, Isle of Rhum, archaeological deposits and local peat, slopewash and soil profiles provide interesting comparisons intimately related to evidence for Mesolithic settlement activities. Other possible sites are under investigation.

(i) Loch Doon is a deep glacial lake surrounded by find-spots of Mesolithic type (Edwards *et al.* 1983). Excavations on the south-western shore have revealed fire-sites and possible post-holes. Pollen and charcoal analyses from basin and blanket peats and soils (Edwards, Carter and Newell unpublished) will provide a local record of any small-scale changes in close proximity to the excavated sites. A 6 m core has been recovered from the southern end of the loch. Pollen analyses and palaeomagnetic measurements indicate that base of the core is of early postglacial age. Further analyses of sediment chemistry, particle size and magnetic minerals are planned for this and a duplicate core.

(ii) A number of find-spots of Mesolithic flints has been recorded around Loch Dee as well as in peat profiles away from the loch side. Again the intention is to look for linkages between the lake sediments and their drainage basins using lacustrine and terrestrial deposits. Blanket peat sections examined above the loch contained inwash 'stripes' of sandy material at various locations. There is some evidence to suggest that these may result from soil erosion following early vegetational disturbances (cf. Simmons *et al.* 1975). It is intended to look more closely at the extent of the stripes, their particle size characteristics and pollen and charcoal analyses of the peat. Events at the time of sand movement in the catchment will then be put into wider context by examining the broader lake sediment record.

(iii) Excavations at the Kinloch Farm site, Isle of Rhum, the earliest known occupation site in Scotland (6650 BC, Wickham-Jones and Sharples 1984), revealed evidence

for possible early soil erosion. Nearby peats have been shown to contain slopewash deposits and preliminary pollen analyses suggest that an early postglacial record may be preserved there. A combination of evidence from the bog and at the site of excavation will be used to investigate the possible nature and extent of Mesolithic impacts at Kinloch.

#### Acknowledgment

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#### Close sampling for terrestrial Mollusca

The problem of temporal resolution is at the centre of any progress in land snail analysis. Unless we have some understanding of the time-span represented by a sample or sequence of samples it is difficult to give a reasonable interpretation of it.

Temporal resolution will ultimately be limited by assemblage mixing (primarily mixing by biota in non-accumulating calcareous soils) but it is also affected by sample thickness. Using modern soils with a known simple vegetation history and careful close sampling it has been possible to compare the relative importance of assemblage mixing and sample thickness on temporal resolution.

A sample thickness of 1 cm was chosen as the minimum possible in stone-free horizons. Typical shell densities in the A horizon of rendzinas indicated that a minimum sample volume of 1600 cm<sup>3</sup> was required; this gave a sample with the dimensions 40 x 40 x 1 cm. Samples were collected by inserting a metal tray of the same dimensions into the soil section, working from the surface downwards.

Calculation of actual sample volume based on sample weights and density estimates for two columns from War Down, Hampshire showed that volume errors up to  $\pm 25\%$  existed. This was equivalent to a  $\pm 2.5$  mm vertical error with a maximum cumulative vertical error within the column of 4 mm.

Analysis of the snail assemblages from the War Down soil columns revealed that mixing processes had destroyed what had been an abrupt change in snail faunas and instead showed a gradual replacement of one snail community by another throughout the 14 cm deep A horizon. Maximum temporal resolution was therefore determined by mixing processes and close sampling revealed the details of this mixing.

Sampling at 1 cm intervals is laborious, one sample taking at least 30 minutes to collect. There are high risks of contamination with such a large surface area and up to 10% of the sample may be crushed during collection. Such close sampling is not recommended as a standard method.

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#### The Late Bronze Age Midden at Potterne

The medieval village of Potterne lies approximately one mile (1.6 km) south of Devizes in Wiltshire. The Late Bronze Age midden and underlying settlement are situated to the north-west of the village on a spur of the Upper Greensand escarpment. For nearly 70 years part of the site has been used as the village cemetery and grave-digging has produced large amounts of Late Bronze Age pottery and bone, and more recently a gold bracelet. A further area of the site is threatened by the extension of the graveyard and for this reason small-scale excavations were undertaken in 1982-84 by the Trust for Wessex Archaeology in order to evaluate the site (Gingell and Lawson 1984; 1985). An auger survey of the area demonstrated that the midden deposit covers at least 3.5 ha of the hillside and that the thickness of the deposit varies, reaching a maximum of 2 m.

The site of the settlement that created the midden is unknown. Evidence from test-pits, auger samples and pottery analysis suggest that the midden built up uniformly over the area, possibly within a few hundred years. A hearth has provided an archaeomagnetic date of 750 BC and the absence of iron artefacts at the top of the midden appears to limit the build-up to the Late Bronze Age. Radiocarbon dating of charcoal samples from 2 columns is currently in progress.

By the end of the 1984 season of excavation a 10 x 20 m area of midden deposit had been excavated. As visible stratigraphy could not be detected, the midden was excavated in metre squares and in spits of 10 cm. Six of these squares were selected to be floated and wet-sieved for environmental remains, effectively giving six sample columns through the midden. Pre-midden occupation features were revealed below the midden and these were also sampled for environmental remains.

The excavation of this small area of midden has produced large amounts of pottery and bone which is particularly well preserved. This is probably largely a result of mineralisation, which has been found to occur throughout the levels examined. Electron microprobe analysis of mineralised plant and insect remains from the midden has shown that calcium phosphate replacement is responsible for the preservation of the remains. A study



of the distribution and species composition of the mineralised plant remains suggests that the mineralisation has occurred in situ in the midden. The species represented are primarily ruderal and arable weeds, several of which are nitrophilous, and these are likely to have been growing on the midden during its formation, or seeds may have originated in waste material. Mineralised seeds have been recovered from all the samples examined to date in varying numbers (average of 50 per 10 litre soil sample) and over 70 taxa have already been recovered. Identification and analysis of this material is currently in progress.

Carbonised plant remains have been recovered in relatively small amounts throughout the midden deposit. Vanessa Straker is undertaking the analysis of these remains at present. Results from two columns analysed so far (Straker 1985) have shown there to be cereal grains, chaff and weed seeds throughout the midden in varying amounts. The occurrence of spikelet forks, glume-bases and arable weed seeds indicates the presence of crop-processing waste, and the recovery of spelt (Triticum spelta L.) as well as emmer T. dicoccum SchÜbl.) and barley (Hordeum sp.), makes the site comparable to the few other Late Bronze Age spelt sites that have been recorded to date, such as Black Patch and Runnymede.

Approximately 135,000 fragments of well-preserved bone have been recovered from the small area excavated and these are currently being examined by Alison Locker. Mineralised arthropods, molluscs, earthworm egg cocoons and coprolites are also being analysed.

Pre-midden features consist of a terrace with a row of stake-holes along the edge, a blank area that may represent a trackway, a number of hearths and an area of post-holes. The area examined was too small to enable a detailed interpretation of the features to be made. Most of the samples from pre-midden features have yet to be examined for environmental remains.

Trial excavations at Potterne have shown the site to be unique in the scale and nature of the midden deposit. Although the artefactual and environmental evidence is of some value in itself, it is unlikely that wider questions as to why and how the deposit accumulated in the Late Bronze Age can be answered by small-scale excavation.

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Note: Wendy would be very interested to hear from anyone else who has worked or is working on mineralised plant remains, particularly from early non-cess-pit deposits.

Magnetic susceptibility as a potential  
palaeoenvironmental determinant

Magnetic measurement is familiar to archaeologists as a method of prospecting, using a variety of instruments to read variations in the magnetic field of surface and buried features. Magnetic susceptibility has been used as a prospecting tool (e.g. Tite and Mullins 1971; Mullins 1974; Clark 1975; 1983); however I am concentrating here on this technique as a method for palaeoenvironmental interpretation. This study is partly derived from principles published by those mentioned above but also from the work of Oldfield et al. (1978; undated) and more recently Allen and Macphail (1985; forthcoming), Sell and Allen (forthcoming) and Allen (1983; forthcoming).

Magnetic susceptibility (MS) is a parameter which expresses the ratio between the magnetisation induced in a sample and the magnetising field. Magnetic susceptibility enhancement (MSE) results from the conversion of iron oxides in the soil from weakly ferromagnetic forms (e.g. haematite) to the strongly magnetic form maghaemite which has a strong positively aligned moment if placed in a magnetic field. Furthermore it is capable of retaining remanence when removed from that field.

One of the advantages of MS measurement is that it is quick and easy to record: 100 g of air dried soil of particle size less than 2 mm are placed in a sensor coil and the susceptibility read off the digital display of a Bartington MS1 meter. Although there are other more sophisticated MS measurements, these require complex and time-consuming laboratory preparations and remove the attractive simplicity of magnetic susceptibility in my research.

Magnetic susceptibility enhancement is caused by both burning and pedogenic activity. Topsoils are enhanced compared with subsoils and this immediately provides a way of determining possible topsoil components in buried soils or, more importantly, in colluvial deposits. Geographers studying lacustrine sediments have been able to differentiate not only between topsoil and subsoil components, but also between woodland, grassland and arable components. I therefore attempted, perhaps naively, to apply this technique to terrestrial sediments. Nearly 1,000 readings taken from modern chalkland contexts show considerable variability and seem to indicate that such soils may be differentially enhanced according to their vegetational and pedogenic regime. This produced a framework into which to fit archaeological results. My initial work with archaeological deposits on chalk were encouraging. Measurements of MS of 105 samples from colluvium in the Bourne Valley, Eastbourne, indicate topsoil rather than subsoil components, and furthermore equate more readily with arable levels. This hypothesis was substantiated by micromorphological, sedimentological and molluscan analysis (Allen 1983). A buried Bronze Age grassland soil at North Kite, Wiltshire, produced MS levels almost identical to the present day grassland regime on the site, thus verifying MS as a palaeoenvironmental indicator in some situations at least.

MS of a soil is enhanced through burning and the mechanisms are fairly well understood as this is replicable in the laboratory (Le Borgne 1955; 1960). Biological and chemical activity within soils produce 'pedogenic enhancement' with higher MS in A horizons compared with subsoils, but these effects are less well understood. Analysis of MS levels in conjunction with studies of soil micromorphology have allowed statements of MS enhancement as well as additional palaeoenvironmental statements to be made (Allen and

Macphail 1985; forthcoming). For instance, analysis of soils from Hazelton long cairn (Gloucestershire), Seaford Head (Sussex) and Uscio, Italy, all situated on different limestone geologies, produced complex and superficially anomalous MS readings. Here, taphonomic and post-burial processes were shown to have altered MS levels from the original archaeological levels. It was concluded that complex pedogenic histories may result in enhanced MS via: (i) incorporation of organic rich A horizon soil through tree-throw; (ii) clay illuviation from surface horizons; and (iii) hydromorphism. Long burial created anaerobic conditions and resulted in iron mobilisation via hydromorphism and redox changes and thus also created enhanced MS. The incorporation of fine charred organic matter also results in enhanced MS. Such processes and change in MS occurred in anaerobic conditions associated with long burial and resulted in the redistribution of iron within the soils. Where the soil remained aerobic, high levels of biotic activity were observed and the MS levels seemed to be preserved. MS was heightened by complex pedogenic histories and the inclusion of weathered parent material and pedorelicts (fragments of ancient relic soil) observed in the microfabrics. We were also able to detect a variation in MS of arable soils in different periods, which we attributed to the reduction of earthworms in the Neolithic period caused by tillage, thus reducing organic matter and mixing.

More recently detailed molluscan analysis from the deposits at the foot of Hambleton Hill, Dorset, have also been integrated with studies of MS (Bell and Allen forthcoming). In the lynchet profile examined, the maximum MS coincided with the highest mollusc concentration and indicates stable conditions. MS measurements generally confirmed and were complementary to mollusc analyses.

Since the work described above was carried out, a preliminary suite of samples from Ashcombe Bottom, Sussex, has been analysed and shows great MS variability which has aided greatly the interpretation of the colluvial sequence. The coombe rock naturally produced low MS levels, whereas the overlying, reddened, silty clay produced very high levels. In general the colluvium above produced levels similar to those from arable land, but decreased up-profile as a result of the reduction of included reddish fabrics. A subsoil hollow produced a 'woodland' MS level, confirmed by both mollusc and micromorphological analysis. A buried soil was confirmed within the colluvial sequence by significant MS enhancement. Finally, soil within a gravel fan indicated subsoil, thus providing some information on the nature of the gravel fan and its associated erosion regimes.

This brief summary of my preliminary researches does perhaps indicate the potential of MS as a palaeoenvironmental indicator. Obviously much further work is needed to establish this as a widely applicable environmental technique, and this is what I hope to do within the constraints of my future research funded by SERC.

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#### A preliminary study of charred plant

##### remains from the tell at Busra

The tell at Busra, excavated by a team from the American University at Beirut, has been sampled for plant remains. This tell is located in a fertile position on the Hawran plain, near the Jebel Druz uplands of south-eastern Syria. The history of occupation of the site extends from the early Islamic Umayyad period, back to the early third millennium BC.

The first objectives of the excavator were to obtain evidence for occupation prior to Nabatean/Roman times, and to relate an ethnographic study of the village at Busra to the archaeological evidence. After a season of digging, questions about the urban or rural status of the settlement over time, and patterns of settlement and land-use, were raised.

Answers to these latter problems are accessible through analysis of the plant remains. During the third season of digging, sampling for plant remains was undertaken, and analysis of these remains has begun.

Several goals have been formulated with respect to the plant assemblage from Busra. These include the original questions about the status of the settlement over time, and land-use. Further, modes of arrival of plants on site, evidence for trade of plant resources, functions of structures, and use of ecological habitats are aspects which will be addressed during interpretation.

The main problem with this particular assemblage is the extremely restricted nature of the sample. The potential of the remains to answer all the questions which have been posed is thus limited. Despite the qualifications which will be necessary, interpretation is still worthwhile because any discovery will add to the knowledge about the site.

Once sorting of the sample is completed, the bulk of identification will be started. Although methodology is best drafted before excavation, in this case a framework continues to be developed. It is certain that ethnographic comparison will be an important component in the interpretation of these plant remains.

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### Differential Human Impact in later Prehistory:

#### Vegetational Clearances in North Shropshire

##### Introduction

Six sites - four small lakes, referred to locally as meres, and two peat mosses - located north-west of Shrewsbury in north Shropshire, have been examined for their pollen record. The object of the research has been to examine in detail the similarities and differences between the pollen spectra recorded by each site. The four meres, collectively referred to as the Baschurch Group (Reynolds 1979), and the peat mosses are listed in Table 1 and their location shown in Fig. 1.

Fenemere, Marton Pool and Birchgrove Pool occupy separate hollows, probably glacial kettle-holes, within a larger basin surrounded by low sand and gravel ridges. This basin has no natural outflow, and peat deposits have built up between the pools. The peat between Marton Pool and Fenemere, which are c. 100 m apart, is only 1.5 m deep and overlies shelly mud, which in turn rests on sand; this peat contains abundant macrofossils of mesotrophic Sphagnum mosses. Deposits of this type would not build up if a sheet of open water continuously linked the meres. Whilst it cannot be stated categorically that water surface coalescence never occurred during the time period under study, it is

believed that the pollen profiles from Marton, Fenemere and Birchgrove are predominantly independent of one another. Berth Pool is surrounded by peat deposits in a similar basin, but at a slightly higher elevation.

The four Baschurch Pools are less than 2 km apart; theoretically, they could have some extra-local and regional pollen source areas in common. Intrinsic site factors such as size and sedimentary type could influence the contribution of different source areas (Janssen 1966; 1973; Tauber 1965; 1977; Jacobsen and Bradshaw 1981; Prentice 1985).

	Site	Grid ref	Area (ha)
Lakes:	Berth Pool	SJ 430234	2.9
	Birchgrove Pool	SJ 436232	1.7
	Marton Pool	SJ 448234	6.8
	Fenemere	SJ 446229	9.4
Peat mosses:	Boreatton Moss	SJ 417226	8.1
	New Pool	SJ 415182	1.9

Table 1. Location and size of the sites discussed in this summary.

### Results

Pollen diagrams from all six sites have been correlated to one another by their pollen stratigraphic similarities, and also by radiocarbon dating (Twigger in prep.). To facilitate detailed correlation and comparison, only part of the complete stratigraphy was selected, with reference to other published profiles from the area. Sites elsewhere in the Shropshire-Cheshire Plain have revealed a distinctive phase of pollen frequency change, commencing with a marked decline in Tilia (lime) pollen, showing a gradual increase in non-arboreal pollen frequencies, and finally indicating a woodland regeneration phase with increases in Quercus (oak), Betula (birch), and Fraxinus (ash) pollen. This phase has been identified at Crose Mere, 7 km north of Baschurch (Beales 1980), Whixall Moss, 13 km north of Baschurch (Turner 1964), and is incorporated in the proposed sub-regional vegetational history outlined by Beales and Birks (1973).

Radiocarbon dates obtained from levels above and below Tilia decline at Boreatton Moss, New Pool and Fenemere give the following chronology:

1. New Pool: 87 to 95 cm, high Tilia pollen frequencies, few or no herb taxa: 3950 $\pm$ 50 bp (SRR-2834).

2. Boreatton Moss: 195 to 205 cm, reduced Tilia pollen frequencies, some increases in herb taxa: 3790±50 bp (SRR-2832).

3. Boreatton Moss: 182 to 192 cm, continuous Tilia curve ends, herb taxa increase further: 3660±50 bp (SRR-2831).

4. New Pool: 70 to 75 cm, peat above a Tilia decline (levels correlate approximately, on pollen stratigraphy, to levels 182 to 192 cm at Boreatton Moss): 3550±50 bp (SRR-2833).

5. Fenemere 305 to 315 cm, limnic sediment at a later Tilia decline: 3190±50 bp (SRR-2923).

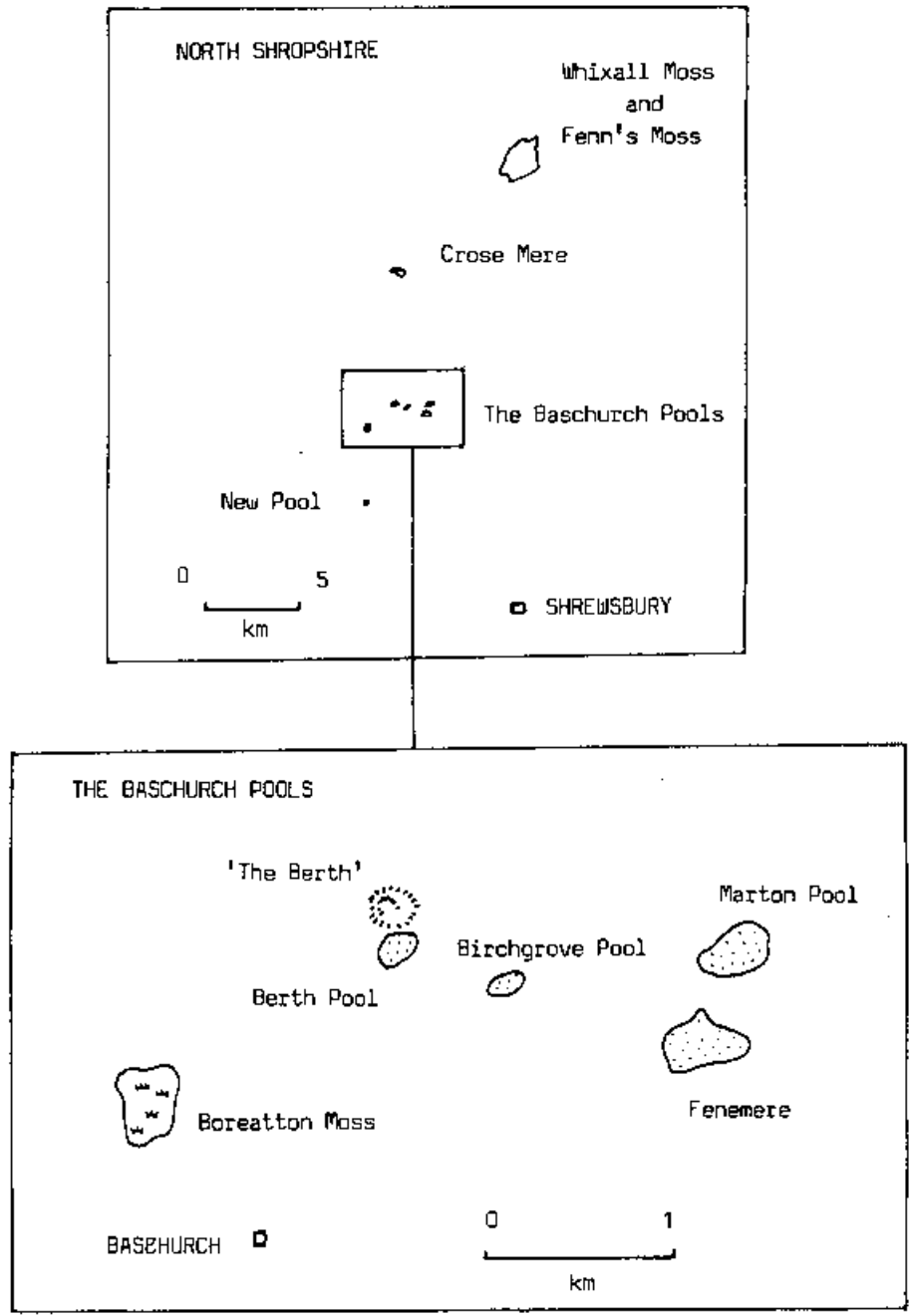


Figure 1. The Baschurch Pools.

The pollen profiles produced for the Baschurch Pools (Twigger in prep.) show that the later decline in Tilia pollen was followed by two short-lived peaks in Gramineae (grass) pollen; both peaks were immediately succeeded by peaks in Fraxinus pollen. This pattern is confirmed at each of the pools and indicates an initial phase of interference in, or exploitation of the woodland, without a widespread reduction in total tree cover. These two cycles of short-lived woodland interference and regeneration are followed by a clear reduction in Quercus, Ulmus (elm), Fraxinus, Alnus (alder) and Betula pollen. An expansion and diversification of herb pollen types occurs at this level which is identified as an important pollen zone boundary by numerical zonation procedures (Gordon and Birks 1972; Birks and Gordon 1985; Birks 1986).

The phase of grass and herb pollen increases which follows this significant arboreal reduction is succeeded by evidence for woodland regeneration adjacent to Fenemere, Birchgrove Pool, Marton Pool, and also at Boreatton Moss, which is less than 2 km from the Baschurch Pools. A radiocarbon date from Fenemere of 1890 $\pm$ 50 bp (SRR-2920) places this regeneration in the late Iron Age or in early Roman times.

The New Pool stratigraphy has been disturbed and truncated by drainage operations, and the pollen diagram does not reach the Quercus decline horizon. At Berth Pool however, the pollen diagram was counted up to the present mud-water interface. No clear regeneration phase could be identified at this site at levels following the Quercus decline. The pollen spectra (Twigger in prep.) show that total tree pollen percentages at Berth Pool have remained at about 20% or less since the main arboreal decline, which is dated by correlation with interpolated dates at Fenemere to c. 790 bc, a time when fortifications were being constructed at the Breiddin hillfort 24 km west of Baschurch (Musson 1976).

A small hillock of fluvioglacial sand and gravel adjacent to Berth Pool was fortified and occupied in the Iron Age (Gelling and Stanford 1965; Stanford 1972). Occupation of a number of hillforts in this area is believed to have been contemporaneous some time between c. 390 bc and AD 50 (Stanford 1972). It is believed that c. AD 60 a change in the pattern of land use occurred in the vicinity of the Baschurch Pools. Up to this time, a widespread expansion of species rich grassland is indicated, with the date of maximum clearance estimated to be c. 100 bc.

Although Berth Pool is less than 400 m from Birchgrove Pool, there is no clear point of correlation between Berth Pool and Birchgrove Pool at the woodland regeneration level.

#### Conclusions

It appears that for a period of c. 200 years, cleared land around Fenemere, Marton Pool, Birchgrove Pool and Boreatton Moss was abandoned and left to regenerate a woodland cover. The possibility exists, therefore, that occupation continued in the vicinity of Berth Pool whilst land closer to the other three pools was abandoned.

A temporary shift in land-use type, from extensive to intensive, is indicated. Despite the proximity of the four Baschurch Pools to one another, and to Boreatton Moss, it would therefore be inadvisable to characterise the local vegetation history on the basis of just one site.



A multiple-core strategy has been proved necessary for the accurate reconstruction of localised vegetation changes during an important phase of prehistory.

If detailed environmental inferences are to be related directly to known archaeological developments, multi-site data are indispensable (Simmons and Innes 1985; Edwards and Ralston 1984). The question of pollen profile replicability is of key importance (Edwards 1983). Ideally, the sampling strategy adopted in a palaeoenvironmental study should be designed to anticipate possible questions about single sample representativity and profile replicability.

#### Acknowledgements

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#### Faunal remains from Bewsey Old Hall, Warrington

Bewsey Old Hall is situated 1.5 km (approx. 1 mile) from Warrington, Cheshire, and was occupied from the second half of the 13th century until 1983. It was originally the seat of the Butlers, barons of Warrington, and on their extinction in the 16th century they were succeeded by the Irelands. It is a moated site and was excavated from 1983 to 1985 by Becky Smart, funded by the Warrington and Runcorn Development Corporation.

Just over 10,000 pieces of bone were recovered from 313 contexts of all ages. They were mostly in good condition and 75% were identifiable, representing 10 mammal species, 10 species of bird, one amphibian and four fish species. There was no policy of sieving on

site because of the nature of the ground (according to the excavator), so many small bones may have been missed. The bones that were discovered came from all kinds of features with a few major deposits.

From the medieval period there are two pits of interest. One at the front of the house may originally have been a saw-pit, but was later used to store acorns, which survived well in the waterlogged soil. To the rear of the house was a very large, deep pit, probably originally a fishpond, which silted up slowly and was then deliberately filled in. It does not appear to have been used for kitchen refuse, but contained three complete skulls, one each of horse, cattle and pig. A sample taken for botanical analysis by Philippa Tomlinson from this pit incidentally provided evidence of three taxa of fish - eel (Anguilla anguilla L.), pike (Esox lucius L.), and a cyprinid, identified by Andrew Jones, and two frog (Rana temporaria L.) bones identified by Dr Terry O'Connor.

On the 22nd of October 1579, an inventory was taken of all that the late Sir Thomas Butler owned at Bewsey, complete with a list and prices of all the livestock. There were 35 sheep, 97 cattle, 23 horses and 54 pigs, two pairs of swans, and a blackbird and her cage bought by Sir Thomas in London. Contemporaneous with this list is a kitchen midden which contained the bones of cattle, sheep, pig, horse, red deer (Cervus elaphus L.), dog, rabbit, goose, chicken, woodcock (Scolopax rusticola L.) and cod (Gadus morhua L.). Whether the ratios of the species in the midden correspond to those in the list is yet to be discovered.

Sealing the 16th century midden was a bone-rich 17th century layer, contemporaneous with another inventory. In this list, livestock is much reduced; there are no sheep, half the number of horses, pigs of half the value of a century before, and only ten cattle. In the 17th century layer, cattle bones vastly outnumber those of any other species, and the goose-to-chicken ratio of the 16th century is reversed, chicken being twice as frequent. In addition to the bones of mallard/domestic duck, there are those of teal (Anas crecca L.).

Sir Gilbert Ireland, for whom the inventory was made, built an ornamental garden decorated with elaborate terracotta urns, and this may have been the habitat of the peafowl (Pavo cristatus L.), represented by a single humerus dated to the early 18th century. Other 18th century remains include turkey (Meleagris gallopavo L.) bones and a dog burial.

This is a brief summary based on a superficial examination; a lot of analyses remain to be done. It is hoped to fit work at Bewsey into a programme of research on other moated sites on Merseyside and in the surrounding area, all of which will, I hope, provide plenty of bones.

#### Acknowledgment

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## Experimental archaeology and burnt animal bone from archaeological sites

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### Introduction

Many archaeological sites are in regions which have subsoils that inhibit the preservation of bone; only burnt bone survives in these contexts, and even that is often in small quantities. Yet it is in these areas, such as northern and western Britain, that the traditional interpretation has been of a pastoral subsistence economy. This has been the view held by most of those studying Iron Age and Romano-British south-west Wales (Fox 1961; Williams 1979), although recently some carbonised grains, four-post granaries and quernstones have been recovered (Mytum 1982; Williams 1981; 1985). The animal bone that does survive is surely an important archaeological resource in even an outline understanding of the economic strategy (or strategies) employed in the region. In south-west Wales, Coygan Camp is so far unique in producing quantities of unburnt animal bone (Wainwright 1967), and it is only recently that systematic sampling programmes have recovered useful assemblages of burnt bone from other sites. However, these assemblages can only be interpreted if the processes that led to the creation and deposition of the burnt bone are understood. These processes can be considered under two main headings:

(i) The physical processes which created the burnt bone sample, and which prevented its subsequent destruction;

(ii) the cultural factors that controlled which material was exposed to the physical processes, and that affected the subsequent disposal of the bone.

This paper is concerned with some of the elements of (i), and the processes under study are not necessarily limited to one area, period, or culture. But research is also progressing with regard to (ii) for south-west Wales in the Iron Age and Romano-British period, and that is culturally specific. It involves examination of attitudes of these past societies to rubbish and its disposal (Mytum, forthcoming). Application of middle range theory, and the testing of models by simulation and experiment are important for the clarification of processes involved in the creation of the archaeological record.

Experiments have previously been conducted in order to cook meat, either by boiling in an animal hide suspended over fire (Ryder 1966) or by adding hot stones to water-filled troughs (O'Kelly 1954). Experiments have been also been carried out to understand bone

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taphonomy by simulation in laboratory conditions (Shipman *et al.* 1984). However the heating of samples in those experiments was more uniform than that done over an open fire, and so experimental archaeology was used by the present authors to examine the phenomena of bone-burning in the field. A series of bone-burning experiments was undertaken as part of the larger programme of experimental archaeology at Castell Henllys, an inland Iron Age promontory fort in Dyfed (Pembrokeshire) (Mytum 1985; 1986). Part I of the experiment was conducted to determine the maximum temperatures reached by animal bones in man-made open-air wood fires, to calculate the percentage shrinkage achieved at the maximum temperatures and to chart the changes in colour undergone by the bone. In Part II of the experiment, the burnt bone was compared to archaeological burnt bone excavated from Castell Henllys.

Conditions for bone preservation at Castell Henllys are generally poor because a glacial deposit of gravel and clay provides an acidic soil, allowing the survival only of burnt bone. The only exception is beneath the large inner clay bank of the fort, where unburnt bone and antler survived on the old ground surface and in the lower layers of the bank (Mytum 1983). The major components of bone are the protein collagen, and a mineral - hydroxyapatite in microcrystalline form. Strength and durability are provided by the organic matter and rigidity by the mineral. Although the organic content of bone can be completely destroyed by prolonged heating, incomplete calcination can fortify the bone against other agents of destruction. Before complete calcination occurs, the organic matter chars, but it remains, filling the pores of the bone, and thus cementing the mineral components together. Once carbonized, the organic matter remains stable and resistant to chemical change encountered in the soil (Cornwall 1956).

The samples of fresh bone to be burnt were chosen according to the taxa identified in archaeological deposits of bone from Castell Henllys. The site has yielded a predominance of burnt sheep/goat remains with some cattle. There was a large number of ribs and vertebrae, especially of sheep, and fragments of the shafts of long bones. For the purpose of the experiments, cattle tibiae and femora and lamb ribs and vertebrae (conjoined) were used. A further sample of bones was burnt in order to accrue a database for later analysis. These included cattle radii and ulnae, sheep radii and ulnae, sheep femora and pig femora.

### Experiment Part 1

#### Method

A rectangular hearth was constructed by digging a shallow pit, and lining it with flat shale stones. The stones were cemented with clay, and standing shale stones were packed into place around the outer edge of the hearth.

Fresh animal bone was obtained from a local butcher and cleaned manually. Measurements were taken according to a standard guide for archaeological bones (von den Driesch 1976) using sliding vernier calipers to an accuracy of 0.1 mm. The following measurements were taken for femora and tibiae:

- Bp - Greatest breadth of the proximal end
- SD - Smallest breadth of diaphysis
- CD - Smallest circumference of diaphysis
- Bd - Greatest breadth of the distal end
- GL - Greatest length

For vertebrae and ribs, these measurements were taken:

- LcDe - Greatest length in the region of the corpus including the dens (axis)
- BFor - Greatest breadth of the facies articularis cranialis
- BFcd - Greatest breadth of the facies articularis caudalis
- H - Height (atlas)
- GL - Greatest length of the rib
- GB - Greatest breadth of the rib
- SB - Smallest breadth of the rib

The measurements were taken before burning, and a Munsell Soil Colour Chart was used to record hue, value and chroma of the fresh bone.

A fire was constructed in the hearth using hazel (Corylus) and ash (Fraxinus) wood, mainly collected from the Castell Henllys area. The temperature of the fire was monitored by a thermometer with digital display, its probe extended to the part of the fire where the bones were placed. When the temperature of the fire reached 180° C, the bones were placed on a wire mesh suspended over the fire.

The temperature of the fire was monitored continuously, and the bones were removed at regular intervals of temperature in order to record changes in colour. The air temperature over a period of ten days of burning averaged at 15° C around the fire; the maximum temperature reached by the fire was 800° C. Each sample of bones was burnt for approximately four hours with the temperature mainly at 400-600° C.

When the bones were completely calcined, they were removed from the fire, and the series of measurements was repeated. A final record of colour was made from the Munsell Soil Colour Chart and observations of changes in bone surface texture were recorded.

### Results

The size of the sample was greatly reduced by exposure to the open fire. For the initial samples of cattle femora and tibiae, 14.3% and 12.5% respectively were either completely lost in the fire or considered not measurable. The lamb ribs+vertebrae sample decreased even more sharply, with 50% being destroyed in the fire.

Physical changes in the bones could be ordered by increasing temperature (Table 2). The bone begins to discolour at 220° C, passing through pale yellow/brown to pink/brown.

After exposure to temperatures of 350-400° C the bone was dark brown to black, and only partly incinerated. At this stage the lamb ribs separated from the vertebrae and either split longitudinally or cracked into pieces. The lamb vertebrae unfused and began to separate in the fire.

Between 400-500° C the bone began to warp and developed a cracked texture as dehydration occurred. Circular cracks separated the long bones at mid-shaft and the epiphyses separated at the fusion points. The colour of the bone ranged from dark blue-grey through to light grey and, as the destruction of the organic component of the bone progressed, the epiphyses became spongy and honeycombed in appearance.

	Hue	Colour	Value/Chroma
<b>Fresh Bone</b>	5Y	White	8/2
<b>Experimental Bone</b>			
Fire temperature (°C)			
200	10YR	Very Pale Brown	8/4
	2.5YR	Pale Yellow	8/4
280	7.5YR	Pink	7/4
300	7.5YR	Brown	5/4
	5YR	Dark Reddish Brown	3/2
350	7.5Y	Dark Brown	3/2
	5YR	Black	2.5/1
	7.5YR	Black	N2.5
420		Dark Blue Grey	5B4/1
		Bluish Grey	5B6/1
		Light Blue Grey	5B7/1
500	2.5Y	Light Grey	N7/
	7.5YR	Light Grey	N7/
600	7.5YR	Pinkish Grey	6/2
	2.5Y	White	N8/
700	7.5YR	White	N8/
<b>Archaeological Bone</b>			
	5YR	White	8/1
	10YR	White	8/2
	10YR	Very Pale Brown	8/3
	10YR	Very Pale Brown	8/4

Table 2. Colour changes in experimentally burnt bone.

At 500-600° C the bone passed from light grey to pinkish grey and longitudinal cracks developed in the long bones. By 700-750° C the predominant colour of the bone was white, with some grey, and where the marrow survived it was black. Bubbling occurred on the surface tissue of some bones, and the overall condition was friable, porous and of very low density.

Recording of the surface changes in the bone was limited by the method of observation, using a magnifying glass. Morphology and crystal structure have been studied elsewhere (Shipman *et al.* 1984) to chart the physical reaction of the substance hydroxyapatite during heating. The temperatures measured during our experiment were of the heating device, not the specimen.

The percentage shrinkage after treatment is shown in Table 3. From the sample of nine cattle tibiae, one was incompletely incinerated and deleted from the calculation of mean and standard deviation. The mean of the percentage shrinkage for cattle tibiae was 11.4%±1.5. If shrinkage of the epiphyses was considered independent of shaft measurements, the mean was 9.1%±1.3. Sample size for cattle femora was reduced from eight to seven by destruction in the open fire; the mean percentage shrinkage for cattle femora was 6.8%±1.3. Omitting shrinkage percentages for the shaft, the mean was 5.3%±1.4.

Percentage shrinkage for lamb ribs+vertebrae differed considerably from that for the cattle long-bones. Another test was carried out to determine whether these differences were defined by the divisions in anatomical elements or limited to differences in species. Four cattle lumbar vertebrae and ribs were burned and similar results were achieved to the lamb bones. Shrinkage of lamb vertebrae was 19.4%±1.6, and mean for the shrinkage of cattle vertebrae was 23.0%±1.1. When considering the lamb and cattle ribs, the shrinkage percentage increased still further. The mean of percentage shrinkage of lamb ribs was 32.9%±1.8, and the mean for cattle ribs was 29.3%±2.0.

#### Experiment Part 2

As the second part of the-bone burning experiment, a study was made of the ash material remaining in the hearth after the removal of the measurable specimens, in order to make a comparison with the archaeological material.

The remaining ash was sieved at mesh sizes of 5, 4 and 3 mm. The sample contained a large amount of charcoal, burnt clay and fire-cracked rock in addition to the burnt bone. The 4 mm sieved sample closely resembled the archaeological burnt bone excavated from Castell Henllys. A comparison was made between the experimental and archaeological bones, in which colour, breakage patterns and the characteristic surface appearance of the bones were examined.

Three predominant colours were recognised for the archaeological bone and compared with the predominant colours of the experimental burnt bone. Hue of the archaeological bone was either mid yellow/red or maximum yellow/red, containing more yellow than red as hue increased. The experimental bone was more definitely yellow, with either a yellow hue or high yellow/red hue. Both the archaeological and experimental burnt bone had low value numbers, a measure of lightness. The chroma designations for the experimental bone were neutral values for achromatic colours (pure greys and white). The completely calcined experimental bone was consistently light grey to white, while the archaeological material was yellow to very pale brown. The difference in colour between the two samples was



	original dimension	final dimension	shrinkage	femora (BP)
	mm	mm	%	
tibiae (BP)	119.8	105.9	11.6	152.0
	111.7	103.6	7.3	154.0
	109.3	102.2	6.5	137.0
	114.7	110.9	3.3	126.0
	121.9	113.9	6.6	130.0
	110.7	104.6	5.5	147.0
	100.2	93.2	7.0	149.0
	118.1	109.5	6.9	127.0
				113.0
				107.0
				106.0
				96.0
				102.0
			109.0	
			118.0	
(BD)	84.3	59.9	28.9	
	82.6	75.1	9.1	Mean (epiphyses) 5.3%±1.4
	77.4	74.1	4.3	(SD) 48.9
	80.6	72.9	9.6	42.1
	68.8	63.3	8.0	
	83.2	67.7	18.6	Mean for all femora 5.8%±1.3
	80.9	77.2	4.6	
	79.6	73.3	7.9	
				Mean (epiphyses) 9.8%±1.3
(SD)	46.4	42.3	9.8	175.0
	50.9	43.5	14.5	195.0
	50.4	34.9	30.8	29.5
	50.4	36.3	28.0	29.5
				17.3
				16.3
				41.3
				44.7
				20.8
				40.5
				Mean for ribs 29.3%±2.0

vertebrae						
(GL)	50.3	37.4	25.6			
	49.1	36.3	22.0			
	49.2	38.7	21.3			

Mean for vertebrae 23.0%±1.1

**lamb**

rib+vertebra						
rib(GL)	147.0	86.1	41.4			
	173.0	126.5	26.9			
	140.0	68.9	50.8			
	153.0	108.0	29.0			
	123.0	84.8	31.1			
	139.0	120.0	13.7			
	145.0	115.0	19.8			
	124.0	61.1	50.7			

Mean for ribs 32.9%±1.8

Axis(LCDe)	32.3	27.1	16.1
	16.6	15.4	7.2
	33.2	27.1	18.4
	28.9	26.3	9.0

(BFcr)	18.3	17.9	2.2
	29.4	28.1	4.4
	17.4	14.7	15.5
	34.2	27.2	20.5

Atlas(BFcd)	16.9	11.9	29.6
	32.4	28.4	12.3
	19.3	11.9	38.3
	19.6	16.1	17.8
(H)	58.6	48.2	17.7
	39.6	31.9	19.4
	68.1	42.6	37.4
	29.5	18.6	36.9
	28.8	24.7	14.2
	31.5	26.7	15.2
	29.5	18.6	36.9

Mean for axis and atlas 19.4%±1.6

Table 3. Original dimensions and percentage shrinkage of experimentally burnt bone.

probably attributable to the factor of burial of the archaeological bones, which were probably altered in colour by trace elements in the soil. This possibility will be examined in future experiments.

Breakage patterns and surface tissue changes could be split into two categories defined by anatomical elements. Remains of the cattle long-bones in the sieved sample were represented as roughly rectangular pieces of shaft, which closely resembled their archaeological counterparts. In section, both the archaeological and experimental bone fragments were shown to have been incompletely calcined, with a characteristic layer of black remaining in the centre of the walls of the shaft. Substantial cracks could be observed across the bone, with smaller cracks running longitudinally.

Regular patterns of breakage could be seen in the lamb ribs both in the experimental sample and the archaeological material. The densest portion of the rib where it attached to the vertebra, the costa, survived frequently and was well-represented in both samples. The ribs themselves either fragmented into a number of components, ranging from 10.5 to 47.3 mm, or into pieces that had split longitudinally, exposing the honeycombed texture of the marrow. Incompletely calcined ribs developed longitudinal feather cracks, whereas the calcined bone became very porous and pitted in appearance.

The lamb vertebrae seldom remained intact, with the exception of the cranial and caudal articular surfaces of the atlas and axis. The compact vertebra base, or body, survived separately, as did the spines of thoracic vertebrae. Vertebral bodies exhibited a porous surface appearance, with circular cracks forming on the articular ends.

The similarity in the sieved experimental bone and the archaeological material suggested that the Castell Menllys burnt bone had been produced in an open fire. This burning may have been a by-product of cooking activities, with meat accidentally falling into the fire, or a deliberate mode of disposal, representing bones thrown back into the fire after the meat had been eaten.

Several contributing factors may have determined which of the bones were left to be calcined completely in the fire. Methods of butchering would dictate which bones actually reached the areas of burning, and certain larger bones may have been butchered and then boiled up rather than roasted. Some bone would have been utilised for other food purposes, such as feeding dogs or pigs, or made into bonemeal or glue. Incompletely burnt bone may have been removed by scavengers, or deliberately removed for marrow extraction. None of the archaeological burnt bone exhibited signs of gnawing.

#### Summary and conclusion

The maximum temperatures achieved by the hazel and ash fires ranged from 700-800° C. The average daily temperature of the fire remained around 500° C, with the air temperature at 15° C, and each bone required about four hours for complete incineration.

Loss of sample averaged 13.4% for cattle long-bones and 50% for lamb ribs+vertebrae. The implication for the archaeological record is that bones that disintegrate at low to medium temperatures may well be under-represented.

Typical shrinkages could be separated into two categories, divided by the type of anatomical element. Shrinkage for cattle tibiae and femora was 11.4% and 5.8%

respectively, or 9.1% and 5.3% omitting measurements for shaft. Shrinkage for lamb and cattle vertebrae was 19.4% and 23.0% respectively, and 32.9% and 29.3% for shrinkage of ribs.

Shrinkage of the cattle long-bones was uniform in the epiphyses, with a higher percentage shrinkage for the shaft. The lamb lumbar vertebrae, axis and atlas showed similar shrinkage to the cattle vertebrae, with a uniform increase in shrinkage for both the lamb and cattle ribs.

The two patterns of shrinkage, that of the long-bones and of the ribs+vertebrae, correspond to the actual make-up of bone tissues. Bone can be divided into two discrete elements, the compact substance and the cancellous spongy tissue of the articular ends of long-bones. It would seem that bone containing a higher ratio of compact to spongy bone will have a greater shrinkage, so that the ribs in the experiment would have a much higher percentage shrinkage than the proximal and distal ends of the femora and tibiae. It has previously been noted that the amount of shrinkage possible is dictated by the relative proportion and distribution of spongy and compact bone relative to the plane of measurement (Herrmann 1977).

It is in the measurement of animal bones from archaeological sites for the purpose of reconstruction of animal size, that the significance of the shrinkage findings lie. These estimates generally employ the long-bones of the animal, so that if burnt archaeological specimens were used in the reconstruction, according to the results of these experiments, the size of the bone would have been 5.8-11.4% larger before burning occurred. Until a standard shrinkage figure can be arrived at, only unburnt specimens can give a fully accurate database for reconstruction of individual animal size.

Colours observed on the experimental bone sample clearly varied from the dark brown or black of incompletely incinerated bone, to the characteristic bluish grey and white of calcined bone. The achromatic greys, black and white of the experimental bone were absent in the archaeological sample. The gravel and clay soil stained the archaeological burnt bone to a high yellow/red hue, making it very pale brown (10YR 8/3 or 10YR 8/4) in appearance.

Regular breakage patterns corresponded in the experimental sample and the archaeological material, with characteristic breakages for long-bones and ribs+vertebrae. The ash remaining in the hearth after the series of experiments contained rectangular fragments of cattle long-bone shaft, costa and rib fragments of lamb rib, the articular ends of axis and atlas, the spines of thoracic vertebrae and the bodies of vertebrae. These patterns corresponded to the archaeological material, as did the pattern of large cracks on cattle long-bones and the porous, pitted appearance of lamb ribs+vertebrae.

Further experiments will be conducted to compare the shrinkage of spongy and compact bone tissue for different anatomical elements, and to survey the changes in burnt bone when buried.

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## Minor finds of cereals at two medieval rural archaeological sites in north-east Scotland

W. E. Boyd \*

### Introduction

Although the main aim of most research in environmental archaeology is to provide some understanding of facets of the economy and environment associated with the former occupation of a site (Jones 1985), an elementary first step is the compilation of species lists, these being the catalogues of basic data. This is perhaps the most straightforward stage in the environmental analysis, which often ends there. In such cases the original sampling may have been haphazard, the species list is short, and the environmental data are confined to publication appendices, contributing little to the understanding of the site. Such data may, however, have a use, whether or not they contribute directly to site interpretation. They provide evidence for the presence of, say, a domesticated plant at one site or during one period, thus contributing to the knowledge of the former geographical distribution of that plant. In the light of reconstruction of environment and economy, the mapping and cataloguing of such data from a series of sites may seem to be old-fashioned, unexciting and of little intellectual interest. However, sites do not occur in isolation, and the mapping of former distributions may allow sites to be placed in fuller regional contexts. As with all artifactual distributions, the mapped data may not necessarily reflect the true former distribution, but the distribution of excavated sites. However some indication of former presence can be gained. For such distributions to be refined, the basic data must be assembled. The purpose of this paper is to present some of these data in the context of Scottish antiquity.

Data from two sites will be summarized in this paper. The data sets are relatively meagre and, it is admitted, would not warrant full publication on their own. However, two factors play an influencing role in their publication here. Firstly, the data sets contain information which is of relevance to any research concerned with the presence of cereals in the past in Scotland; although the data are few, some of the fossils recorded are significant. Secondly, and perhaps more contentiously, this publication may represent the main printed publication of many of these data. Some of the data have already been consigned entirely to microfiche (Boyd in Yeoman 1984), thus greatly reducing their accessibility. The remaining data may meet a similar fate when the relevant excavation report is published in full. Comments on this justification for publication will be welcomed!

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Two medieval rural sites

At Castlehill of Strachan (Grampian Region; N.G.R. NO 662921) the recent excavation of a motte provides evidence for a timber hall and palisade dating from the 13th century (Yeoman 1984). Three samples containing carbonised plant fossils (Table 4) indicate the former presence and probable local cultivation of Hordeum sp. (probably all hulled barley H. vulgare), Avena strigosa and Triticum sp. These occurred with a small quantity of arable crop weeds, although Brassica sp. and Sinapis sp. seeds may represent the cultivation of these plants.

		Sample No.		
		E2	E3	E6
<u>Hordeum</u> sp.	caryopses	-	1f	1f
<u>H. vulgare</u>	caryopses	1f	-	5
<u>Avena</u> sp.	caryopses	-	-	2f
<u>A. strigosa</u>	florets	-	-	2
<u>A. cf. strigosa</u>	florets	-	-	1f
	caryopses	-	-	1f
<u>Triticum</u> sp.	caryopses	-	-	1 + 1f
cereal	caryopses	1f	-	-
<u>Corylus avellana</u>	nuts	5f	-	-
<u>Brassica</u> sp	seeds	-	-	2
<u>Chenopodium</u> sp.	seeds	-	-	11 + 36f
<u>C. album</u>	seeds	-	2f	11 + 17f
<u>Polygonum aviculare</u> aggr.	fruits	-	1	-
<u>P. lapathifolium</u>	fruits	-	-	1
<u>Rumex</u> sp.	fruits	-	-	2
<u>Sinapis</u> sp.	seeds	-	-	2
<u>Spergula arvensis</u>	seeds	-	-	1

Table 4. Botanical fossils recovered from three samples at the medieval rural site of Castlehill of Strachan, Grampian Region. The fossils are complete unless marked 'f' (fragment) and are all carbonised. Full identification notes are in Yeoman (1984).

At Nethermills Farm (Grampian Region; N.G.R. NJ 583615) a Mesolithic occupation site is overlain by a medieval (or possibly early post-medieval) rig-and-furrow field system. At this site the bulk of the carbonised plants fossils comprise charcoal and Corylus nut fragments, most of which, if not all, are probably Mesolithic in age. However, there are a few fossils of other plants which occur in the upper soil samples. These remains tend to be in a poor state of preservation and are post-Mesolithic; they are probably associated with the overlying rig-and-furrow system. Limited as the total range of fossils is (Table 5), it resembles a typical carbonised cereal-processing waste assemblage (Hillman 1981) and therefore represents some aspect of the agricultural economy of the farm of which the rig-and-furrow system is part.

Most of the evidence for medieval cereal cultivation in Scotland comes from urban sites, and there is only one other rural medieval site known to the author at which cereal fossils are recorded: at Camphill, Glasgow, *A. strigosa* and *H. vulgare* were recorded by Jessen and Helbaek (1944; see Fairhurst and Scott (1951) for dating of this site). Despite its former widespread historical presence in Scotland (Bland 1971), *A. strigosa* is poorly represented in the archaeological record. Elsewhere in Scotland, *A. strigosa* is present in medieval Perth, Glasgow and St Andrews (Robinson forthcoming; Boyd unpublished). Likewise, *Hordeum* is recorded at relatively few medieval sites, despite being the most-commonly recorded cereal in other Scottish archaeological contexts, and being formerly extensively grown throughout Scotland (Bland 1971). *H. vulgare* is recorded at the medieval urban sites of Aberdeen, Elgin, Perth, St Andrews and Glasgow (Fraser 1981; Robinson unpublished; Boyd unpublished). *Triticum* is also recorded at these urban sites, though less commonly, and probably was not as widely cultivated as oats and barley.

		No. of finds
<i>Hordeum</i> sp. and <i>H. vulgare</i>	caryopses	18
Cereal and cf. cereal	caryopses	15
<i>Claviceps</i> sp.	sclerotia	5
<i>Raphanus</i> sp.	pod segments	3
<i>Brassica</i> spp. and cf. <i>Brassica</i> spp.	seeds	6
<i>Vicia</i> spp. and cf. <i>Vicia</i> spp.	seeds	5
<i>Galium</i> sp. and cf. <i>Galium</i> sp.	fruits	5
cf. <i>Rosa</i> sp.	achene	1

Table 5. Summary of post-Mesolithic (probable medieval) carbonised plant remains from upper soil samples at Nethermills Farm.

The seeds and fruits of weeds and probable cultivars are typical of arable fossil assemblages, and the latter point to a possible wide agricultural economy. A find of ergot (*Claviceps*) at Nethermills provides the first medieval evidence for this infamous scourge in Scotland, and is discussed elsewhere (Boyd 1986).

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## The archaeobotany of the Cowick medieval moat and some thoughts on moat studies

James Greig \*

### Introduction

This is intended as a concise article which discusses the significance of the main results of some analyses of deposits from a medieval moat and how they might apply to other sites, without undue formality or pollen diagrams.

### The excavation

The moat at Cowick was originally dug in AD 1323 around the site of the royal hunting-lodge there, near Snaith, Humberside. There was not time to discover from documentary records whether it was ever re-cut. In 1976 the moat was dug out by machine to make a fish pool and some salvage archaeology was undertaken while this was going on. This report is based on the results from pollen analysis of samples from a profile covering most of the deposits, and from analyses of the pollen and macrofossils from some 'grab' samples taken from the bottom of the moat. The profile was 110 cm deep and 11 samples were analysed for pollen. The moat bottom sediment was also analysed for pollen and macrofossils counted from a one litre subsample. A further four litres were scanned for additional taxa, together with two litres of another sample.

The list of taxa recorded appears in Table 6. There are a few comments on the associated beetles made by the late Dr Maureen Girling.

### 'Woodland' trees, shrubs and herbs

There is abundant evidence of the general 'woodland' plant community from the pollen, seeds and vegetative remains identified. The main interest here is to see the various ways 'woodland' is represented by the different lines of evidence, each with its own bias. The 'seed' counts show Alnus (alder) frequent, with Crataegus (hawthorn) and the occasional Fraxinus (ash) and Betula (birch) fruits and one Quercus acorn. Seeds of the ubiquitous Sambucus nigra (elder) are abundant - other shrubs, such as Corylus (hazel) and Rosa sp. (wild rose), less so. Few specific woodland herbs were found fossil, and some of the commonest seen growing around the site at time of excavation (Circaea (enchanter's nightshade) and Endymion (bluebell)), were not found at all.

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The pollen sample from this deposit shows a very different order of importance when the results are corrected for production and dispersal factors (following Andersen 1970): ash is the main tree, followed by oak, alder and a little Prunus-type (sloe etc.), Crataegus-type (hawthorn etc.), Betula (birch), Lilium (lime), Acer (maple) and Ilex (holly). The last three are only recorded as pollen. There is also pollen of a range of shrubs and climbers such as Buxus (box), Salix (willow), Ligustrum (privet), Hedera (ivy), Viburnum-type (including guelder rose) and Lonicera (honeysuckle), all but willow leaving no macrofossil record.

The vegetative macrofossils, mainly buds and thorns, show yet another bias, with oak (buds) abundant, followed by willow (buds and seed capsules), plenty of thorns of hawthorn/sloe and of rose/bramble, and a possible Populus tremula (aspen) bud. Most of the mosses could have grown in woodland or on walls.

The evidence for woodland vegetation contemporaneous with the time the moat was in use that I find most convincing is that from the pollen. Applying Andersen's (1970) representation factors, ash appears really to have been the dominant tree, although perhaps just at that point of the moat circuit (see Fig. 2). There was an ash tree growing about the point of excavation, a descendant, perhaps, of the original.

The importance of oak is to be seen from the pollen and buds (the latter show that it was probably growing very near), but the preservability of acorns seems to be very poor. Hawthorn, wild rose (and other Rosaceae shrubs in Prunus-type) are poorly shown up by pollen, somewhat better by seeds and thorns. The trees and shrubs all seem to have been growing very locally, within tens or at most hundreds of metres of the site, because it seems unlikely that the water in the moat would have transported and concentrated the seeds from further afield. The Juglans (walnut) pollen record is interesting because it shows the presence of a tree that would probably have been planted; it may, indeed, have been introduced at this time, since there are so far no earlier pollen records from Britain. The Ligustrum (privet) and Buxus (box) records are also suggestive of some measure of gardening.

The archaeological customer usually wants to know 'the environment' but in this case it is difficult to say whether more than the immediate surroundings of the site were well-wooded. When excavated, the site was very overgrown, but set in rather open farmland, and under these conditions a sample of the uppermost moat sediment, which may have been laid down under similar conditions, contained around 50% tree pollen. However, the proportion of tree pollen in the lower samples is likely to be affected by the amount of pollen from plant materials dumped into the moat, which further obscures the estimation of the state of the past woodland there. The presence of 'old forest' beetles is perhaps an indication that there was forest not just local woodland.

#### Wetland vegetation: aquatic, marsh and bankside plants

It is obvious that waterlogged environments of the kind represented by a moat will preserve evidence of wetland vegetation. However, it is usually of limited archaeological interest because such vegetation usually provides little information about human activity.

The records of taxa of wetland vegetation show that the moat was originally filled with water, supporting aquatics such as Potamogetonaceae (pondweeds) and Myriophyllum (milfoil), as shown by pollen and macrofossil analyses of the lower part of the profile.

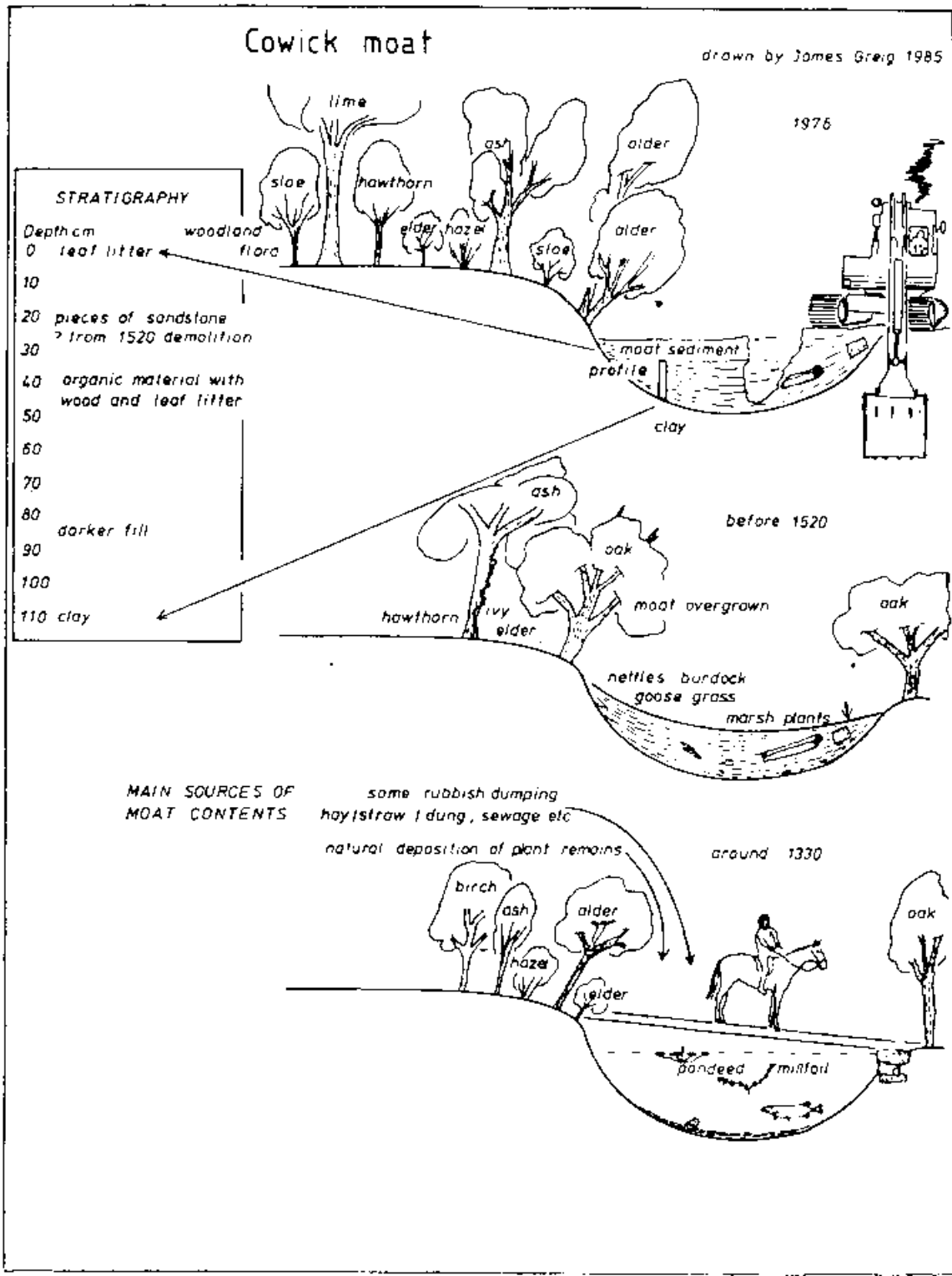


Fig. 2. The botanical history of the Cowick Moat.

Maureen Girling reported the presence of water beetles that live in moving water - members of the Elmidae. Higher up the profile the pollen of aquatic plants is less abundant, and beetles of less aquatic and more foul conditions were reported. Thus the moat was filled with water that may have been flowing, or it may have received flood water when it was originally cut (Fig. 2, lowermost drawing). Later on, it seems to have become overgrown and marshy (Fig. 2, middle drawing).

#### Field and garden crops, imports, weeds

These are central to the botanical interest of a site, because crops and weeds are, by definition, connected with human habitation and activities. A moat (also a ditch, pond or well) may act simply as a preserving medium conveniently close to a settlement, and into which remains - often of organic waste - may find their way.

It was therefore no surprise to find evidence of cereals in these moat deposits: a small amount of pollen, some waterlogged chaff and grain fragments, two charred grains, and some cereal culm-nodes (the 'knees' of straw). This does not help much to answer the other great archaeological question, concerning the 'economy' of the site. The remains could equally well have come from grain or straw (together with the cornfield weeds), though the charred grain might represent some domestic waste.

The other field crops found, Linum usitatissimum (flax), Vicia faba (field bean, pollen only), something like cabbage (Brassica sp.), and possibly hemp (pollen again: Cannabiaceae) are within the range normally found on medieval sites. The cultivated fruit sour cherry (Prunus cerasus), damson/bullace (P. domestica ssp. insititia) and apple (Malus sylvestris) seem to represent more food waste, as do fig (Ficus carica) and grape (Vitis vinifera) (which would have been imported) and fennel (Foeniculum vulgare). A single egg of the intestinal nematode whip-worm (Irichuris) provides a little evidence that sewage was present, and Maureen Girling reported that there were beetles in some of her samples indicative of foul conditions.

It is always a temptation to search for the largest possible flora of cultivated plants in suitable material such as this, and I did scan a very large amount ('train spotting') which provided most of the records of fruits. The justification for doing this is to help build up a picture of as many as possible of the preservable cultivated plants present at different times and in different places. Exotics such as fig and grape are fairly well-known from urban deposits, and perhaps this site, although deep in the countryside, benefitted from a touch of urban sophistication, for it did have royal connections.

#### Grasslands

Evidence of 'grassy' material is difficult to obtain because the plants generally produce fewer seeds than those of weedy vegetation. Grassland communities are also difficult to recognise because they often overlap with marsh and bankside communities, which here might have occurred at the edge of the moat. Filipendula (meadowsweet) is perhaps a plant from such a community; others, such as Anthriscus sylvestris (cow parsley), might grow on woodland margins - another floristic overlap with grassland. Even so, there are about 20 possible grassland taxa which were found here, including plants such as Sanguisorba officinalis (greater burnet; pollen only) which may well represent the use of the hay crop from damp grassland in the medieval period; this is discussed further

by Greig (in press).

### Some thoughts on the usefulness of studying moat deposits

Moats (and ditches and ponds) are a fairly widespread source of waterlogged evidence, from prehistoric, Roman and medieval sites and, since this is often the only source of biological information, one should not ignore them. They may preserve anything interesting that has been thrown into them, in a far less disturbed state than may be the case with richly organic urban deposits.

#### Sampling

The problem here is that of knowing how to obtain the best chance of finding anything interesting or significant in the tons of potential sample material. At Cowick a simple sample column taken near the remains of the bridge across the moat at least provided a coherent series for various different studies to be done. A bulk-sieving programme might have shown if there were any other deposits worthy of further study, and columns of samples from other parts of the moat might have been useful, although the salvage conditions during excavation did not allow that. Against that would have to be balanced the question whether further results would fully justify the extra time spent. The material was very organic and rich in plant remains without any super-abundant seeds, so it was not necessary to use very small sub-samples for the seed counts.

#### Dating

The digging of the moat is dated historically, and dendrochronology of the timber from the bridge across it also supports the evidence that it took place early in the 14th century. If the fills are the result of uninterrupted deposition, they should be later than this. Radiocarbon dating might have been useful to show the approximate rate of deposition and thus the age of various horizons.

It is a problem with many finds of plant remains, especially medieval ones, that the dating is only roughly known. Yet the Middle Ages was a time when a range of crops was introduced and least one weed, Centaurea cyanus (cornflower), appears to have spread. Data of the kind discussed in this paper may be of limited significance within the context of an individual site, but is very important for building up an overall picture of the changing landscape through the ages.

#### Conclusions

The fact that plant remains are readily preserved in moats, ditches etc., does not necessarily mean that their study will provide the results desired by the archaeologist in terms of 'environment' or 'economy'. They can, however, yield useful assemblages of plants associated with human life which justifies their study. Deposits from these kinds of feature can vary from the almost completely organic ones like Cowick, to the essentially inorganic ones which I have studied. The fossil floras can be largely interpreted as having originated in wetland and aquatic vegetation in a water-filled moat, such as that at Birmingham (Greig 1981), or from rubbish in a wet ditch, such as the one at Nantwich (Colledge 1978); in each case, these were the only part of the site where plant remains

mosses:

Bryum sp.

Plagiomnium rostratum (Schrad.) Kop.  
Aulocomnium palustre (Hedw.) Schwaegr.  
Climacium dendroides (Hedw.) Web. & Mohr  
Leucodon sciuroides (Hedw.) Schwaegr.  
Calliergon cuspidatum (Hedw.) Kindb.  
Isoetecium myosuroides Brid.  
Homalothecium sericeum (Hedw.) Br. Eur.  
Hypnum cupressiforme Hedw.

ferns:

Pteridium aquilinum (L.) Kuhn  
POLYPODIUM

seed plants:

PINUS  
MUPHAR  
Caltha palustris L.  
cf. ANEMONE  
Ranunculus cf. acris L.  
R. Subg. Ranunculus (DC) A. Gray  
R. sardous L.  
R. cf. lingua L.  
R. flammula L.  
R. sceleratus L.  
Ceratophyllum demersum L.  
Papaver dubium L.  
P. argemone L.  
Brassica sp.  
Raphanus raphanistrum L.  
Coronopus squamatus (Forsk.) Aschers.  
Rorippa cf. microphylla (Boenn.) Hyland.  
Viola cf. tricolor L.  
Agrostemma githago L.  
Cerastium holosteoides Fr.

Stellaria media (L.) Vill.  
S. cf. palustris Retz.  
Spergula arvensis L.  
Montia fontana ssp.  
chondrosperma (Fenzl.) S. M. Walters

TILIA

Chenopodium cf. album L.  
Atriplex sp.  
Malva sylvestris L.  
Linum usitatissimum L.

GERANIUM-type

ACER

ILEX AQUIFOLIUM

BUXUS

Vitis vinifera L.

Medicago lupulina L.

Trifolium sp. (flower parts)

TRIFOLIUM REPENS-type

T. PRATENSE-type

LOTUS-type

VICIA FABAE

Filipendula ulmaria (L.) Maxim.

Rubus fruticosus agg.

Rubus/Rosa sp. (thorns)

Potentilla anserina L.

P. erecta (L.) R. R. Sch.

?Agrimonia eupatoria L.

SANGUISORBA OFFICINALIS

Rosa sp.

Prunus domestica ssp.

insititia (L.) C. K. Schneid.

P. cerasus L.

Prunus/Crataegus (thorns)

Crataegus cf. monogyna Jacq.

Malus domestica Mill.

Epilobium sp.

Myriophyllum verticillatum L.

HEDERA

Hydrocotyle vulgaris L.

Anthriscus sylvestris (L.) Hoffm.

Conium maculatum L.

Table 6. The fossil flora of the Cowick Moat. The taxa found only as pollen or spores are given in capitals; mosses were all identified by Dr S. Nye; \* = identified by P. Tomlinson; remainder identified by J. Greig. Order and nomenclature of vascular plants follows Clapham et al. (1962), Jermy et al. (1982) and Lousley and Kent (1981), and for mosses, Smith (1980).

cf. Apium inundatum (L.) Rehb. f.

Oenanthe aquatica (L.) Poir.

Aethusa cynapium L.

Foeniculum vulgare Mill.

Heracleum sphondylium L.

Daucus carota L.

Polygonum Sect.

avicularia Meissner

P. lapathifolium L.

P. hydropiper L.

P. convolvulus L.

Rumex acetosella agg.

R. cf. obtusifolius L.

R. conglomeratus Murr.

Rumex sp.

Urtica urens L.

U. dioica L.

CANNABIACEAE

ULMUS

Ficus carica L.

JUGLANS

Betula sp.

Alnus glutinosa (L.) Gaertn.

Corylus avellana L.

Quercus sp. (acorn, buds\*)

Populus cf. tremula L. (buds\*)

Salix sp. (buds\*, seed capsules)

ERICALES

PRIMULACEAE

Fraxinus excelsior (fruit\*, twig\*)

LIGUSTRUM

Menyanthes trifoliata L.

CALYSTEZIA

Solanum dulcamara L.

RHINANTHUS-type

Scrophularia sp.

Lycopus europaeus L.

Prunella vulgaris L.

Stachys cf. sylvatica L.

Lamium sp.

Galeopsis tetrahit L.

/G. speciosa Mill.

Glechoma hederacea L.

Plantago major L.

PLANTAGO LANCEOLATA

CAMPANULACEAE

Galium palustre L.

G. aparine L.

Sambucus nigra L.

VIBURNUM-type

LONICERA

DIPSACACEAE

Anthemis cotula L.

Achillea ptarmica L.

Chrysanthemum segetum L.

ARTEMISIA

Arctium sp.

Cirsium sp.

Centaurea cyanus L.

CENTAUREA NIGRA-type

Leontodon taraxacoides (Vill.) Mèrat

Picris echioides L.

Sonchus palustris L.

S. oleraceus L.

S. asper (L.) Hill

Alisma sp.

Potamogeton cf. natans L.

Juncus sp.

Lemna sp.

Sparganium cf. erectum Rehm.

S. cf. minimum Wallr.

Eleocharis palustris (L.) Roem. & Schult.

/E. uniglumis (Link) Schult.

Scirpus tabernaemontani (C. C. Gmel.) Palla

Isolepis setacea (L.) R. Br.

Carex pseudocyperus L.

C. cf. pallescens L.

C. cf. hirta L.

C. cf. nigra

C. ovalis Good.

?Poa sp.

Glyceria cf. maxima (Hartm.) Holmberg

Triticum sp. (charred)

Avena sp. (charred)



were found preserved. Buds and twigs (Tomlinson 1985) can be well-preserved and useful in organic deposits such as this. The evidence from beetles also provides vital clues about conditions that may not be evident from the plant remains, or useful confirmation of botanical evidence. Some work should be done on modern ditch deposits to get a better idea of the representation of various kinds of plant remains compared with the actual vegetation.

#### Acknowledgements

The vegetative plant remains, mainly buds, were studied by Philippa Tomlinson, and the mosses by Dr Sandra Nye, to whom many thanks. The indications of the beetle faunas come from telephone conversations with Dr Maureen Girling shortly before she died; it seems appropriate to include them.

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## A cleaning technique for land molluscs from archaeological contexts

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### Summary

Examination and identification of terrestrial molluscs are occasionally made difficult or impossible by secondary calcareous encrustations which obscure the shell surface. A technique for the removal of such encrustations has been devised and is described below.

### Introduction

Analysis of terrestrial molluscs to produce evidence of the local, often site-specific, environmental conditions, such as vegetation cover and human disturbance, is a technique well known to archaeology (Evans 1972; Kerney 1966). Studies of this type are often necessarily restricted to limestone or chalk areas where molluscs are more abundant, because here the base-rich soils and sediments provide the calcium carbonate needed in shell formation. Although some molluscs are present on acid soils, they are usually sparse and their shells very thin and fragile and there is less likelihood of their being preserved.

The calcareous nature of both the deposits in which the molluscan remains are preserved, and those which overlie them, means that it is not unusual to find specimens, or even entire assemblages, coated with a calcareous encrustation caused by the secondary movement of calcium carbonate ( $\text{CaCO}_3$ ). The movement of calcium carbonate is more likely to occur on chalk as its rate of weathering is much greater than for other limestones. Calcareous coatings obscure gross morphology and microsculpture of the shell, making comparison and identification difficult, especially the differentiation between similar species. At Coneybury Henge, Wiltshire, for example, differentiation of the species of *Aegopinella* was made impossible by calcareous encrustations (Bell and Shackleton 1982) and a Bronze Age assemblage from the ditch of Wen Barrow, Surrey, contained molluscs so highly encrusted with calcareous coatings that a few species were not even readily identifiable to family level (Allen 1984). Similar deposits were noted on molluscs from a medieval corn-drying kiln at Norton, East Sussex.

Base-rich deposits in which secondary movement of calcium carbonate has occurred tend to produce well preserved assemblages of molluscs, even though the shell may be obscured by calcareous encrustations. It therefore seems irresponsible to damage and destroy such assemblages by careless manual cleaning.

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### Cleaning Technique No. 1

Experiments with mollusc specimens from the Wen Barrow site showed manual cleaning to be a slow, clumsy process, which damaged many shells. Further experiments allowed a cleaning method to be devised using dilute sulphuric acid which acted upon the junction of the encrustation and the shell. Stronger solutions of acid did, however, tend to act on the shells, removing the microsculpture rather than the calcareous coating, and even destroying some shells entirely while making others very brittle.

#### Procedure

The molluscs were cleaned by placing them in a 0.1-0.5% solution of sulphuric acid ( $H_2SO_4$ ) for five to ten minutes and then decanting. This removed or loosened much of the concretion but did occasionally leave translucent crystals over some specimens. These crystals (probably of calcium sulphate) and any remaining encrustation, were removed by soaking the shells in a solution of 5M hydrogen peroxide ( $H_2O_2$ ) for 24 hours. Experiments substituting hydrochloric acid (HCl) for sulphuric acid cleaned the shells but did not leave transparent crystals over the specimens, although soaking the shells in a solution of water and hydrogen peroxide was still required to remove any remaining calcareous deposits. The molluscs were rinsed on a sieve and dried, the encrustations having been totally removed.

#### Discussion

Molluscs in various states of encrustation (from nil to totally obscured) were subjected to this cleaning method. Unfortunately, some loss of identifiable specimens was noticed. The main sample from Wen Barrow suffered the loss of one apex in 263. Previous experimentation with groups of 150 and 97 specimens showed a loss of two and nil apices respectively, i.e. a maximum loss of 1.3%. Samples from a medieval corn-drying oven at Norton were cleaned with no damage.

From these initial experiments, it was not certain at which stage in the cleaning procedure the loss of small apical fragments occurred. The losses were most probably of small apices of Vitrea spp. and may have occurred when the specimens were transferred to, and dried on, a sieve of 500  $\mu m$  mesh aperture. This hypothesis was proved with further experimentation using a 300  $\mu m$  mesh aperture sieve. This resulted in no losses from three experiments each using 100 molluscs.

### Cleaning Technique No. 2

An alternative method to the chemical cleaning technique described above involves placing the molluscs in a ultra-sonic bath for a few seconds. This was found to separate most encrustations from the shell. The ultra-sonic bath used was a Semat UC101 running at 50 kHz pulsed at twice the supply input (80 W).

This technique was very satisfactory for cleaning large numbers of Mollusca from Neolithic contexts at Greyhounds Yard, Dorchester, Dorset, from which three assemblages of 378, 782 and 421 specimens respectively were treated in this way. However some damage was noted to Carychium spp. (where the body whorl separated from the apex), and similarly with

the Clausiliidae. This occurred in up to 4.1% of the specimens and was considered an unacceptable loss. A single apex loss was recorded when decanting onto a 500 um sieve but no further losses were recorded when the sieve mesh aperture was reduced to 300 um.

#### Conclusion

The chemical method (No. 1) allowed satisfactory identification of specimens from the Bronze Age Bell barrow of Wen Barrow, Surrey, and a medieval corn-drying oven at Norton, Sussex. Moreover, this technique should be available to most archaeologists requiring to clean land molluscs as it does not involve expensive equipment. The loss of apices involved in the earlier experiments has been avoided by the use of a smaller mesh aperture.

The use of the ultra-sonic bath (method No. 2) cleaned most of the specimens effectively and very quickly, but did involve some damage to some of the species with elongated shells.

Without the removal of the calcium carbonate crust the identification of highly encrusted molluscs is extremely difficult or impossible. Manual removal of these coatings with a fine, moist paint brush proved to damage more shells than either of the cleaning techniques described above.

#### Acknowledgements

I would like to thank many friends who made comments at various stages of my investigations and particularly Beverley Maddens for helping to design the chemical cleaning methodology described and the late Dr Maureen Girling for her constructive comments and suggestions.

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**Bird bones from the excavation at  
Crown car park, Nantwich, Cheshire**

C. T. Fisher \*

Introduction

During the summer of 1978, excavations were carried out in Nantwich on the line of the proposed ring road, which is intended to take heavy traffic away from the historic town centre. Nantwich is a small market town 3 miles (4.8 km) south-west of Crewe and twenty miles south-east of Chester. It was the second most important town in Cheshire during the Middle Ages and its brine springs have been used throughout recorded history, the earliest written record being in the Domesday survey of 1089. The location of the castle is unknown, but its memory is perpetuated in the name Castle Street, one of the roads leading off the High Street down to the River Weaver. It was hoped that excavations along the line of this street would uncover foundations associated with the castle. The main excavation was in an area on the banks of the River Weaver immediately behind the Crown Hotel (N.G.R. SJ 650524), because of its proximity to the present and medieval town centre.

The excavation was divided into eight phases by the archaeologists (McNeil Sale et al. 1978):

- I ..... Early ditch and its infilling, 10th - early 12th century?
- II ..... Industrial activity, pre-12th century?
- III ..... Terracing, mid-late 12th century
- IV ..... Second phase of terracing, 12th-14th century
- V ..... Cutting and silting of medieval ditch, 13th-14th century
- VI ..... ? Ploughing, 13th-15th century
- VII ..... Mill race clay and circular pit, 15th-18th century?
- VIII ..... All later activity

In total, 120 bird bone fragments were recovered from this excavation. Of these, 115 have been identified, the remaining five being immature bones of which identification must remain uncertain. Most of the bones are in a good state of preservation, although some - especially those of immature birds - are worn. Others have been broken and several goose and chicken bones show evidence of butchery, although the majority are whole and unmarked as is consistent with a carcass disarticulated after cooking.

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The bird species recovered from the excavation are (order after Peters 1931-79):

<u>Anser anser</u> (Linnaeus)	(?domestic) greylag goose
<u>Anas platyrhynchos</u> Linnaeus	(?domestic) mallard
<u>Haliaeetus albicilla</u> (Linnaeus)	white-tailed sea eagle
<u>Buteo buteo</u> (Linnaeus)	common buzzard
<u>Accipiter gentilis</u> (Linnaeus)	goshawk
<u>A. nisus</u> (Linnaeus)	sparrow-hawk
<u>Gallus gallus</u> (Linnaeus)	domestic chicken
<u>Pavo cristatus</u> Linnaeus	peacock
<u>Scolopax rusticola</u> Linnaeus	woodcock
<u>Corvus corax</u> Linnaeus	raven
<u>C. corone/frugilegus</u> Linnaeus	crow/rook
<u>C. monedula</u> Linnaeus	jackdaw
<u>Pica pica</u> (Linnaeus)	magpie

These have been grouped together (Tables 7, 9 and 10) in the same phases I-VIII as above, in order to give some impression of the period in which they originated.

#### Phase I : Early ditch and its infilling, 10th-12th century

The chicken, woodcock and peafowl bones from this phase (all tarso-metatarsae or skuli fragments) are probably all remains of table birds. Woodcock, a forest and heathland species, appears in many medieval excavations and was obviously a popular game-bird throughout the period. A single tarso-metatarsus from peafowl was recovered - obviously from a male bird, as it has a spur 17 mm long. This bird is a native of India and is said to have exceedingly tough flesh (Zeuner 1963) but this may only apply to old birds. Whistler (1949) wrote that 'the immature birds are good eating. The old birds, however, should be recommended to those who by choice pick out the oldest and toughest of their fowls for eating'. Hyams (1972) reported that 'I myself have eaten peacock and very nasty it is, excessively tough and with no distinguishable flavour' and Dr Y. P. O'Connor (pers. comm.) found the flesh rather dry and bland but not tough. By custom peacocks formed the centre-piece of banquets (presumably because of the decorative effect of the feathers) from the Roman period to the late Middle Ages (Zeuner 1963; Fitter 1969). After medieval times the importance of the peacock declined, most probably due to the introduction of the North American turkey, Meleagris gallopavo, in the mid-16th century (Zeuner 1963).

#### Phase II : Industrial activity, pre-12th century

The only bone retrieved from this period is a scapula (broken after death) of a raven. These birds must have been common in Cheshire throughout the Middle Ages as bones were also found in the later phases IV and V, and in considerable numbers in the latter. They have also been identified from other excavations in the area, notably from the town of Chester (details held by the Grosvenor Museum's Field Archaeology Unit).

Ravens are scavengers like most other members of the crow family and would have been frequent sights at medieval rubbish pits. Past literature reveals that they were often kept as pets in this country, from at least the Roman period onwards (Maltby 1979; Eastham 1971; 1977) and could be taught to talk.

### Phase III : Terracing, mid-late 12th century

Three bones - probably from the same bird - are from either crow or rook, two species that are osteologically very similar. They may have been common birds, like the ravens, and these remains could have been from cage birds or more probably wild scavengers.

Two chicken bones, both from the leg, were present in different contexts. The bones of most interest in this phase, however, are six from goose found in three contexts. All the bones compare well with those of domestic goose - they are slightly larger and more robust than the wild greylag which is thought to be the ancestral form (Zeuner 1963). Domestic geese are mentioned in the Odyssey of Homer and were later a staple food of the Romans, who discovered the art of force-feeding to enlarge the liver (Toynbee 1973; Zeuner 1963). Caesar remarked that the Britons tended to keep the birds primarily as pets or watchdogs (De Bello Gallico V, 12.6) but in the medieval period they were in fairly common use as table birds. Defoe (1724) describes geese being driven on foot from East Anglia to the markets of London, with up to two thousand in one drove. In Lancashire, geese were specially fattened for Michaelmas on the lake at Martin Mere, having being brought there from different parts of the country (Holt 1795).

### Phase IV : Second phase of terracing, 12th-14th century

Only two contexts contained bird bones, these being single bones of chicken, raven and goose. The latter, a femur, is an immature bone which may indicate some level of husbandry (see Table 10).

### Phase V : Cutting and silting of medieval ditch, 13th-14th century

By far the greatest number of bird bones (78) were found in this phase, in 15 separate contexts. Of the corvids, raven, crow/rook and magpie were identified, raven bones being fairly frequent throughout the phase. Two goose bones were identified, and an increase in chicken husbandry may be indicated by the 9 immature bones present out of the total of 40 identified of this species (see Table 10).

Two very immature bones, possibly from a duck, were found in two contexts. Ducks of domestic origin seem to be uncommon in medieval contexts (Eastham 1977; Maltby 1979), although the Romans kept aviaries (nessotrophia) of ducks partly to fatten them for the table (Toynbee 1973) and domestic ducks are often identified in archaeological deposits from the 16th century onwards. Woodcock bones were also present in three contexts from this phase.

The most interesting aspect of this phase (and indeed the whole excavation) is the presence of bones from four bird of prey species. In context 270 (from the lower deposits of the medieval ditch), a carpo-metacarpus and radius, probably from the same bird, were identified as white-tailed sea eagle. This bird, known as the 'erne' to Anglo-Saxons, bred in Britain until the early part of the 20th century - the last pair resided at Unst, Shetland until the male was shot in 1908. It is a bird of coasts, or lakes and rivers in forested country and would have been seen regularly in 13th-century Cheshire. The two bones may have belonged to an injured bird subsequently kept captive - the pathological report (see appendix to this article) mentions a well-healed break on the radius. However,

the ulna may have acted as a splint sufficiently well for the bird to have survived in the wild until it was killed for sport or because of its predatory habits. Another interesting possibility is that this, in fact, was a continental bird. Reichstein (1974) has argued that the predominance of distal forelimb bones in finds of white-tailed sea eagles from European excavations indicates trade in feathers for fletching.

Sparrowhawk bones were found in four separate contexts, goshawk in two; it therefore seems likely that a falconry operated in this area in the 13th century. Both birds were popular hawks of the fist, being flown at quarry straight from the hand unlike the longer-winged falcons, such as the peregrine, which more usually stoop at their prey (Brown and Amadon 1968). As their short wings and long tails are perfectly adapted for the rapid variations in speed, height and direction required in a headlong chase through the undergrowth, hawks are useful birds in dense, wooded country (Mavrogordato 1973), as the area around Nantwich is likely to have been during this period.

The goshawk was employed to hunt food rather than for sport, being particularly adept at catching rabbits or pheasants and for despatching marauding rooks and crows. In the medieval period it was known as the 'Cook's bird' because of the amount of food it provided for the table (Glasier 1978).

The smaller sparrowhawk is more difficult to train, being very shy. Usually the female is flown, the quarry being smaller birds such as pigeons, blackbirds and thrushes (Mavrogordato 1973). Two-thirds of the sparrowhawk bones from the excavation are from females, four of these are probably from the same immature bird. Two further immature bones were present in context 180, indicating the possibility of captive breeding - it is more likely, however, that these were from young birds taken from the wild for training (see Table 10).

In the 15th century Boke of St Albans (Berners 1881) appears the famous list of the species of birds of prey allotted to various ranks of medieval society: in this case goshawk to yeoman and sparrowhawk to priest. In all probability goshawks were used for dense-cover work irrespective of society position; sparrowhawks are only of use to very experienced falconers (Glasier 1978).

The fourth bird of prey species, common buzzard, is represented by a single tarso-metatarsus from context 281. Young buzzards can be trained to take quarry such as moorhens and rabbits but are slower and less persistent than hawks or falcons (Glasier 1978). This bird is more likely to have been kept as a pet or perhaps shot or snared in the wild state.

#### Phase VI : ?Ploughing, 13th-15th century

Context 225 yielded the only positively identified duck bone in the excavation. This is a wing bone agreeing well with mallard and could be of either domestic or wild origin. As discussed before, duck does not seem to have been a common food item in most medieval communities. Two contexts from this period contained chicken bones; one fragment of chicken pelvis shows signs of butchery.

#### Phase VII : Mill-race clay and circular pit, 15th-16th century

The only bird remains in the circular pit were two chicken bones in separate contexts. As might be expected, no bones were retrieved from the mill-race clay.



### Phase VIII : Later activity, occupation horizons.

15th-16th century: of the 16 bones from five contexts in these occupation horizons, seven are woodcock and six chicken. Half of the latter are immature bones, all from the leg. Part of a breast-bone and a wing-bone of goose have also been identified; one immature wing-bone must remain of uncertain origin.

18th-19th century: one jackdaw femur has been identified from context 85. This was probably killed as a pest, although like other corvids they were often kept as children's pets as they are readily tamed and can mimic a few words (Martin 1980).

### Discussion

An investigation of minimum numbers (Table 9) gives some indication of the relative importance of table birds during the medieval period in Nantwich. As would be expected chicken bones are predominant, with a count of 46% by estimated minimum numbers (47% of the total bone fragments). The numbers of woodcock and goose are the same (either by estimated minimum numbers or by total fragment count) in the excavation as a whole, but most of the goose remains appear in the middle phases; woodcock bones are most frequent in the late medieval period. From the 13th century onwards there are indications of the development of chicken husbandry.

The overall majority (65%) of the bird bones were excavated from phase V, covering the 13th and 14th centuries. Although this may result in part from better conditions for preservation in the soil, it seems likely that it is linked to an increase in human activity during this period. The number of bird of prey bones from this phase suggest the presence of a well established falconry/aviary on the site and it is worth noting that in the Domesday book of 1086 mention is made of a falconry at Acton, two miles to the west of Nantwich:

'..... the same William holds Actone..... a wood VI leagues long and I broad, and a hawk's aery' (Beaumont 1882).

Thus in the 11th century the sport was already established in the area, with hawks rather than falcons being kept - a statement supported by the identity of the bones found in later phases of the Nantwich excavation.

### Measurements

All the bones have been measured, where possible, using the von den Driesch (1976) system. Although no statistical analysis is possible due to the small sample size, the data may be useful for comparison with bones from other excavations. Copies of the measurements are available from the Department of Vertebrate Zoology, Liverpool Museum, National Museums and Galleries on Merseyside, William Brown Street, Liverpool L3 8EN.

### Acknowledgements

I am very grateful to Graham Cowles and Jenny Blandamer of the Sub-department of Ornithology, British Museum (Natural History), for their help with identification and advice on the history of birds in Britain. I would also like to thank John Baker of the Veterinary Field Station, University of Liverpool, for his pathological report.

Species	Phase								Total
	I	II	III	IV	V	VI	VII	VIII	
<u>Anser anser</u>	-	-	6	1	2	-	-	2	11
<u>Anas platyrhynchos</u>	-	-	-	-	2	1	-	-	3
<u>Haliaeetus albicilla</u>	-	-	-	-	2	-	-	-	2
<u>Buteo buteo</u>	-	-	-	-	1	-	-	-	1
<u>Accipiter gentilis</u>	-	-	-	-	3	-	-	-	3
<u>A. nisus</u>	-	-	-	-	12	-	-	-	12
<u>Gallus gallus</u>	2	-	2	1	40	3	2	5&?1	56
<u>Pavo cristatus</u>	1	-	-	-	-	-	-	-	1
<u>Scolopax rusticola</u>	1	-	-	-	3	-	-	7	11
<u>Corvus corax</u>	-	1	-	1	10	-	-	-	12
<u>C. corone/frugilegus</u>	-	-	3	-	1	-	-	-	4
<u>C. monedula</u>	-	-	-	-	-	-	-	1	1
<u>Pica pica</u>	-	-	-	-	1	-	-	-	1
Unidentified	-	-	-	-	1	-	-	1	2
Total per phases:	4	1	11	3	78	4	2	17	120

Table 7. Numbers of bone fragments identified for each species.

Bone type	Species														Tot
	Aa	Ap	Ha	Bb	Ag	An	Gg	Pc	Sr	Cc	Cc/f	Cm	Pp	un	
Tarso-met.	1	2	-	1	-	1	16	1	2	-	-	-	-	-	24
Humerus	3	-	-	-	1	2	7	-	1	2	-	-	-	-	16
Ulna	-	1	-	-	-	1	7	-	2	2	1	-	-	1	15
Tibiotarsus	2	-	-	-	-	3	5	-	-	-	3	-	-	-	13
Radius	-	-	1	-	-	2	3	-	3	2	-	-	-	1	12
Carpo-met.	3	-	1	-	-	1	2	-	1	3	-	-	-	-	11
Femur	1	-	-	-	-	1	2	-	1	-	-	1	1	-	7
Skull	-	-	-	-	-	-	2	-	1	1	-	-	-	-	4
Clavicle	-	-	-	-	-	-	3	-	-	1	-	-	-	-	4
Coracoid	-	-	-	-	1	1	2	-	-	-	-	-	-	-	4
Sternum etc.	1	-	-	-	-	-	2	-	-	-	-	-	-	-	3
Lumbo-sac.	-	-	-	-	-	-	3	-	-	-	-	-	-	-	3
Scapula	-	-	-	-	1	-	-	-	-	1	-	-	-	-	2
Pelvis	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Rib	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Total	11	3	2	1	3	12	56	1	11	12	4	1	1	2	120

Table 8. Type of bone identified for each species. The abbreviated names across the top of the table follow left to right the order given top to bottom in Table 7.

Species	Phase								Total
	I	II	III	IV	V	VI	VII	VIII	
<u>Anser anser</u>	-	-	4	1	2	-	-	1	8
<u>Anas platyrhynchos</u>	-	-	-	-	72	1	-	-	73
<u>Haliaeetus albicilla</u>	-	-	-	-	1	-	-	-	1
<u>Buteo buteo</u>	-	-	-	-	1	-	-	-	1
<u>Accipiter gentilis</u>	-	-	-	-	2	-	-	-	2
<u>A. nisus</u>	-	-	-	-	8	-	-	-	8
<u>Gallus gallus</u>	2	-	2	1	22	2	2	5	36
<u>Pavo cristatus</u>	1	-	-	-	-	-	-	-	1
<u>Scolopax rusticola</u>	1	-	-	-	3	-	-	4	8
<u>Corvus corax</u>	-	1	-	1	4	-	-	-	6
<u>C. corone/frugilegus</u>	-	-	1	-	1	-	-	-	2
<u>C. monedula</u>	-	-	-	-	-	-	-	1	1
<u>Pica pica</u>	-	-	-	-	1	-	-	-	1
Unidentified	-	-	-	-	1	-	-	1	2
Total per phase:	4	1	7	3	48	3	2	12	80

Table 9. Minimum numbers of individuals calculated for each species.

Species	Phase							
	I	II	III	IV	V	VI	VII	VIII
<u>Anser anser</u>	-	-	0(6)	100(1)	0(2)	-	-	0(2)
<u>Anas platyrhynchos</u>	-	-	-	-	7100(72)	0(1)	-	-
<u>Accipiter nisus</u>	-	-	-	-	50(12)	-	-	-
<u>Gallus gallus</u>	0(2)	-	0(2)	0(1)	23(40)	50(2)	0(2)	40(571)

Table 10. Percentage frequencies of immature bones for four species (with actual numbers of bones concerned in parentheses).

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## Appendix

Report on the pathological features present in bird bones  
from Nantwich Crown car park excavations

J. R. Baker \*

### Phase V:

Context 270: Radius of white-tailed sea eagle

A healed fracture is present, approximately in the centre of this bone. It seems highly probable that the ulna was not broken and acted as a splint for this extremely well-healed break.

Context 168: Sparrowhawk ulna

This bone shows evidence of fairly severe bacterial osteoperiostitis.

Context 157: Tarso-metatarsus of chicken

There is evidence of very considerable new bone formation in the region of the spur, which could either have resulted from a healed fracture, or to a chronic low-grade periostitis which would have been caused by bacterial infection.

Context 240: Sternum of chicken

The keel of this bone is considerably bent. In modern chickens this is usually associated with a deficiency of mineral in the diet, particularly in rapidly growing birds.

Context 169: Part of a skull of a chicken

This shows considerable asymmetry of the foramina in the dorsal part of the orbit. This is presumably a congenital abnormality of no pathological significance.

### Phase VIII:

Context 85: Right femur of jackdaw

A very small area of eburnation is present on the proximal articular surface, indicating a minor degree of degenerative arthritis.

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Context 147: Sternum of goose

The keel of this bone is deviated away from the mid-line. The author has seen a similar specimen, though not from a goose, which was associated with pinioning of the bird. In that instance it was assumed that the keel was mis-shapen as a result of the bird's attempts to fly, causing eccentric muscle pull on the bone; the amount of muscular traction exerted on the wing not subject to surgery was thus greater than that on the other side. Whether or not this goose sternum is, in fact, a reflection of pinioning, is quite impossible to say.

**The efficiency of paraffin flotation for the separation  
of dipterous and coleopterous material**

J. Phipps \*

In the course of work on material from the excavations at 16-22, Coppergate, York, I have examined a considerable number of 'paraffin floats' for puparia of Diptera. These had been prepared by a number of technicians of widely differing experience using the method used to extract insect remains in the Environmental Archaeology Unit, University of York (Kenward et al. 1980). The same floats had already been examined for beetle remains by other members of the Unit. Following this I have examined the dried residues, taken at random, from 50 paraffin flotations. From each of these about 25 ml were taken for examination, after removal of all material larger than 10 mm. The amount examined was usually at least 25% of the residue and often 50% or more. Examinations of both floats and residues were carried out under a binocular microscope. At the same time as the puparia were recorded, any beetle parts were noted.

The species of Diptera recognised in the course of this work were Leptocera spp., Nemopoda sp., other Sepsidae, Iaphrochlamys sp., Musca domestica L., Stomoxys calcitrans (L.), Muscina spp. and Spilogona contractifrons (Zett.). The results are summarised in Table 11 and presented in more detail for four of the taxa involved in Fig. 3.

all species in residue were also found in float	no puparia were found in either	one species in residue was not found in float
32	14	4

Table 11. Distribution of species of fly puparia in residues and floats from samples from 16-22 Coppergate.

Table 11 shows that in only four of the 50 samples were any species represented in the residue which were not found in the float, and Fig. 13 illustrates the general relationship between numbers of puparia in floats and residues. It becomes of interest to consider the loss of information if only floats had been examined for the four exceptional samples. These involved the discovery in the residue of a single specimen in each case, once of Musca domestica, once of Stomoxys calcitrans, once of Muscina sp. and once of

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Leptocera sp., the last being found in a residue from which no puparia had been found in the float. In 25 samples, more species were found in the float than in the residue.

As regards Coleoptera, only a single elytron was found in one sample.

It seems safe to conclude that paraffin flotation as carried out in the E.A.U., York, is an efficient method of separating insect material, and that practically no beetle material and very little significant dipterous material will be overlooked by its use. This conclusion agrees with that of Kenward et al. (1980) that recovery of puparia is less complete than that of Coleoptera, but shows that it is adequate unless exact numbers are deemed to be important. The possibility of losing a small amount of information is a small price to pay for the vastly greater amount of material that can be thus examined.

I am grateful to Harry Kenward for advice especially on the preparation of Fig. 13.

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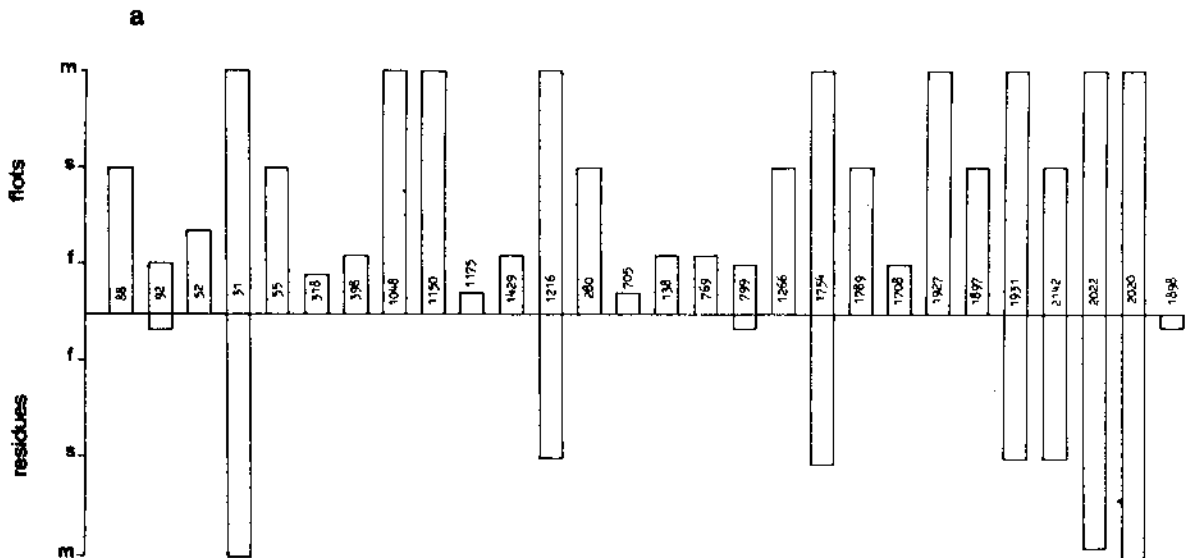
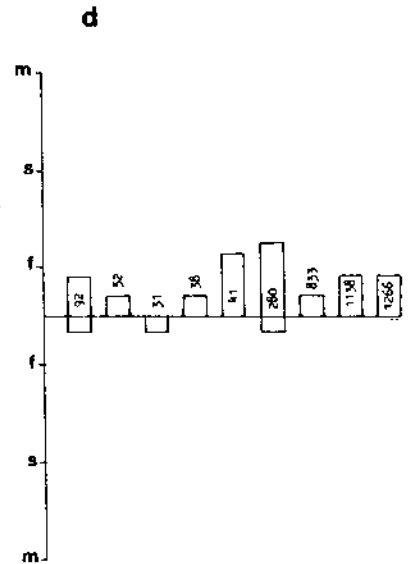
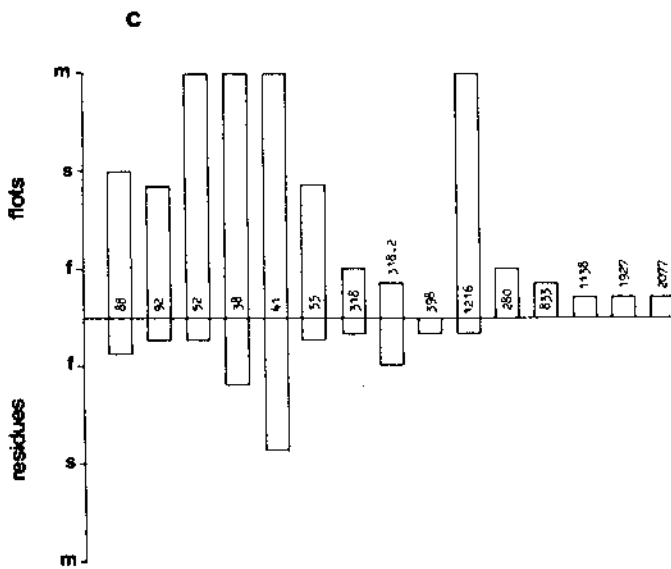
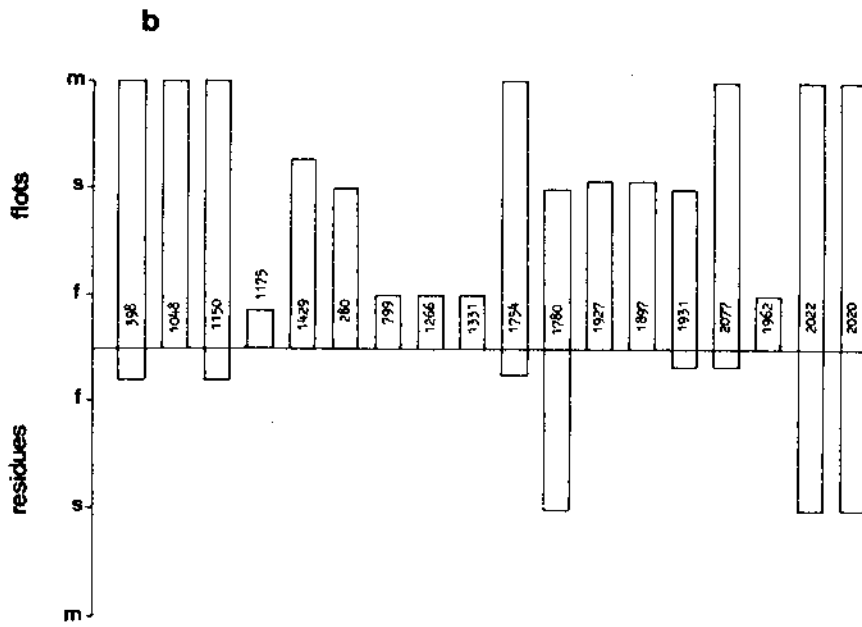


Fig. 13. Numbers of puparia, in flots and residues of: A. - Leptocera spp., B. - Sepsidae, C. - Musca domestica and D. - Stomoxys calcitrans. f. - few (up to 5), s. - some (5 - 20), m. - many (over 20). Sample numbers are inserted in flot bars.





## Results of a second marker trial

Andrew Jones\*, Julie Jones\*\* and James Spriggs\*\*

Since the report on our first series of marker pen trials (Jones, Jones and Spriggs 1980), we have received a number of enquiries about the suitability of certain makes of marker not included in the original tests for archaeological purposes. We therefore decided to test a second series of markers to gauge their usefulness. A number of other markers which have appeared on the market since the first trial have also been tested. Pens which we know are in current use by archaeologists and conservators have been included, as well as the 'Artline 70' pen, which performed best in the first series of tests. We decided to use the Artline 70 as a control against which to compare the performance of the other pens. All but four of the 14 pens tested were black, and they were all either felt- or fibre-tipped and produced various line widths. We decided not to include ballpoint pens, since a range had been tested before and none had performed particularly well.

### Methods

The trials were run using the three materials most commonly written upon in the context of our work: (i) 'Tyvek' (spun-bonded polyethylene) white labels; (ii) the white writing panels of self-sealing polyethylene bags; (iii) clear polyethylene bags.

A sample of each of these materials was marked with each of the pens to be tested and left for twelve months in each of the following typical storage environments:

(i) dry and dark (in a laboratory drawer); (ii) dry and on the wall of a normally-lit laboratory; (iii) immersed in cold water in normal room light; (iv) in bright sunlight (stuck to the glass of a south-facing window); (v) exposed in the open air on the roof of a four-storey building; (vi) in 0.05% Panacide (biocide) solution in warm, light conditions; (vii) in 0.05% Panacide solution, in warm (average temperature 50° C) and dark conditions.

### Results

The first comment that must be made is that the nature of the labelling material is as important as the quality of the pen or marker. It was found that the white writing

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panels on the self-sealing bags tended to wear off, both in wet storage conditions and when exposed out-of-doors. Polyethylene itself will become brittle and disintegrate after prolonged exposure to sunlight and weathering, but this was not evident over the period of our tests. The white 'Tyvek' labels are very resistant to weathering; moreover, since the marker ink will sink slightly into the label surface, legibility is enhanced over prolonged periods. The labels do, however, tend to yellow in Panacide solution, but this is no great hindrance to legibility. None of the coloured markers other than the black survived the wet tests, nor the extremes of light and weather. Even one of the better black markers tended to fade to purple in bright light. Only two of the fine-tipped brands that we tested fared at all well.

Overall - once again - the Shachihata 'Artline 70' (black; available from C. Williams (Liverpool) & Co. Ltd., 154 Bridport St., Liverpool, L3 5QS, U.K., price at time of test: 58p) performed best, remaining clearly legible throughout all the tests.

However, the following can be recommended as satisfactory for archaeological use:

Berol 'Toughpoint' (black), Berol 'Permanent Marker' (black), Berol 'Permanent Pen' (fine-tip, black) (all from Berol Ltd., Oldmeadow Rd., King's Lynn, Norfolk, PE30 4JR, U.K., price: 70p, 49p, 39p respectively). All these three markers remained clearly legible through all tests, apart from Test (v).

'Edding 400' (fine tip, black) (from C. W. Edding (UK) Ltd., North Orbital Trading Estate, Napsbury Lane, St. Albans, Herts., AL1 1XB, U.K., price: 83p). Despite its thin line, this pen remained clearly legible through all the tests.

Pentel 'Permanent Marker' MM50 (black) (from Pentel, 86-88 Upper Richmond Rd., London SW15 2ST, price: 72p). This remained clearly legible throughout all the tests, apart from Test (v).

Full experimental results of these tests are available upon request from the authors.

Because of the staining and surface damage caused by Panacide solution to clear polyethylene and the instability of white writing panels on self-sealing bags, we recommend that only 'Tyvek' labelling material be used in these and other wet storage conditions. Where one can be sure that labels will be stored away from light, water and abrasion, the choice of marker is less critical. In our experience such storage conditions can never be guaranteed!

#### Reference

Jones, A. K. G., Jones, J. J. M. and Spriggs, J. A. (1980). Results of a marker trial. Conservation News 11, 6-7. (Also published in Association for Environmental Archaeology Newsletter 2, 5-6 and Rescue News)

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