

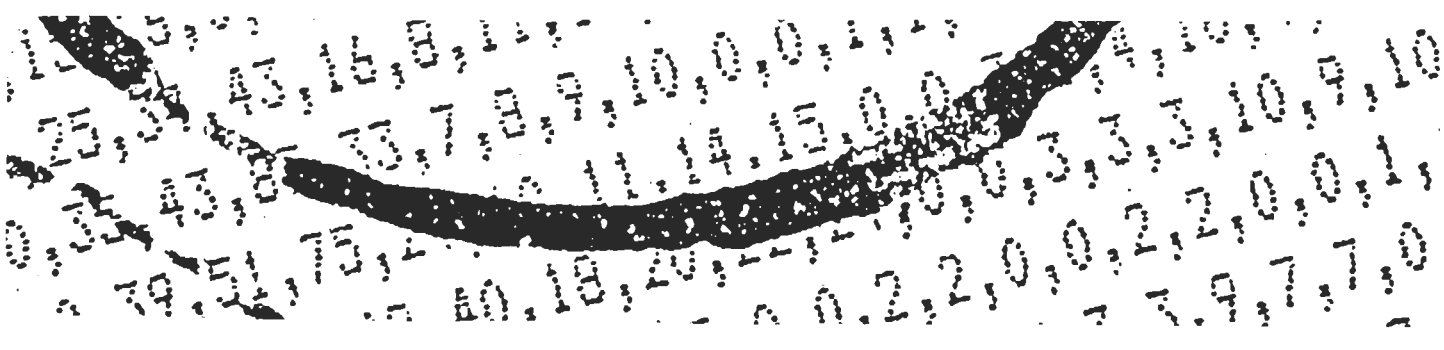
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CIRCAEA

CIRCAEA is the Bulletin of the Association for Environmental Archaeology, and - as from Volume 4 - it is published twice a year. It contains short articles and reviews as well as more substantial papers and notices of forthcoming publications.

The Newsletter of the Association, produced four times a year carries news about conferences and the business of the Association. It is edited by Vanessa Straker and Bruce Levitan, to whom copy should be sent c/o B. M. Levitan, University Museum, Parks Road, Oxford, OX1 3PW.

Editorial policy for Circaea is to include material of a controversial nature where important issues are involved. Although a high standard will be required in scientific contributions, the Editors will be happy to consider material the importance or relevance of which might not be apparent to the editors of scientific and archaeological journals, such as papers which consider in detail methodological problems like the identification of difficult bioarchaeological remains.

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Hard on the heels of Circaea 5(1) comes the second part for 1987, wisely delayed to avoid the Christmas postal chaos. We hope now to produce both issues of volume 6 within 1988 assuming, of course, that you, the readership and authors of this organ, supply the copy. We should like to remind you of the idea floated in a previous editorial for an 'iconoclasm' issue, presenting papers which candidly dissect and reconsider received wisdom on some matter relevant to environmental archaeology. Everyone seems very ready to do this kind of thing in conversation - perhaps it's time to have some thoughts in print?

Whilst on the subject of copy - may we respectfully request that intending authors read and digest the 'Notes for contributors' on the inside back cover of each issue of Circaea? It makes the editorial and refereeing process so much easier if typescripts are double-spaced and have adequate margins; furthermore, we do ask for TWO copies! We will confess to being somewhat inconsistent in how we render references, but there is a basic house-style to which we should like authors to adhere. One last gripe: almost no-one bothers to produce a summary of their paper and the editors are fed up with having to write them themselves!

This issue includes a paper by Keith Barber (offered on Tuesday, received and pasted up on Friday!) replying to John Schofield's article in Circaea 5(1). We should state that Schofield's paper was refereed in the usual way, and was revised in the light of referees' comments, but that the main points that Dr Barber makes deal with matters that editors and referees must needs take on trust - in this case data gleaned from the work of others. We are grateful to Dr Barber for setting an excellent example by replying so promptly, rather than grousing over tea-break and doing nothing (like the rest of us!).

The Editors would like to thank Tracy Painter for inputting virtually all of this issue to the word-processor; sadly (for us), she has recently moved to Devon and we are extremely sorry to have lost such a fast and efficient copy-typist.

MISCELLANY

George Wharton Ian Hodgson

Ian Hodgson, known earlier to his many friends in the north of England as George, was born in Whitley Bay in 1929, and died in September 1986 while on a fishing trip in Northumberland. Ian left school at 16 to work as a laboratory assistant in the chemical industry, and the following year entered King's College, Newcastle-upon-Tyne, then part of the University of Durham. He graduated with a General Degree with Honours in Science in 1949, and this training in biology provided a firm basis for his later work in archaeozoology. This work was, however, only one aspect of a very varied career, for Ian was successively a school master and college lecturer and his osteological work was always carried on alongside numerous other commitments. Outside these academic activities he was involved in musical affairs. He had been a Director of Northern Opera Ltd (Newcastle)

since 1979 and during his time in Dundee he was an enthusiastic member of the choir of the Episcopal Cathedral and it was there that a memorial service for him was held on 25th October 1986, with an address by The Primus.

After obtaining the Diploma in Education in 1950, Ian held a Regular Commission in the Royal Air Force in the Education and Administrative Branches, which marked the start of a varied and successful teaching career. He was a schoolmaster from 1953 to 1964 at Tynemouth Higher, Blyth Grammar, and at Rutherford Grammar, Newcastle, where he was Head of Biology. From 1970 to 1973 he was Head of Kenton Lower School where during three hectic years he had the opportunity to put into practice some of his own ideas on education. Earlier, he had been very involved in the introduction of Nuffield Biology Schemes in Tyneside.

Between 1964 and 1966 he was Lecturer in Science at Sunderland College of Education, and from 1966 to 1970 Senior Lecturer in Applied Science at Northern Counties College of Education at Newcastle. Appointed Senior Lecturer in Applied Science at Duncan of Jordanstone College of Art in Dundee in 1973 he was responsible for the development of a wide range of science courses in the College.

Ian had an unending enthusiasm for education in its broadest sense and was equally at home in school classrooms, college laboratories, research seminars, and extra-mural classes. He served on bodies as diverse as School Certificate Examinations Boards, and Area Training Organisation Boards. He persuaded, encouraged and cajoled his students to further efforts, and nothing gave him greater pleasure than when they, and younger colleagues from his earlier days, were successful in obtaining further qualifications and enjoyed their studies as much as he did. He was disappointed, and could never quite understand when colleagues failed to share his enthusiasm for education and his tireless attempts to provide better and fuller programmes for students of all sorts. His involvement with the Dundee Citizens Advice Bureau, of which he became Chairman in 1979, was a further example of his wide-ranging involvement in education in the broadest sense and in community affairs. Ian's interests also extended from teaching practice and education administration to education theory and these were reflected in his being awarded an M.Ed. by Newcastle University in 1973 for work in these areas and for a thesis on 'The History of Teacher Training in Northumberland'.

Education and the teaching of applied science, however, were only a part of Ian's career. In 1958 a Roman well was discovered during building works along the West Road, Newcastle, and pottery fragments were recovered. Ian, who worked opposite the site, was interested in the considerable number of animal bones which were left and he collected these for safe-keeping. His formal study of this material was begun in 1964 under Professor Eric Birley, and myself. His studies soon expanded and by 1967 he had completed an M.Sc. thesis for the University of Durham on the comparative analysis of faunal remains from a number of Roman and Native Sites in Northern England. Concurrently he had established a type collection of animal bones, through a wide variety of contacts ranging from landowners and gamekeepers to butchers and workers in a local glue factory.

Through the early 1970s a series of reports on animal remains from sites in northern England appeared in Archaeologia Aeliana. The Animals of Vindolanda was published in 1976 and a more detailed account, in 1977, in Vindolanda II. Reports were completed on material from Holy Island, from Oxfordshire, from Colchester and, beyond the Roman world, from Navan in Northern Ireland. His move to Scotland and subsequent financial support for a sequence of research assistants from the Scottish Development Department, were marked by

an expansion in output and reports were prepared on the large collections of medieval animal remains found on recent excavations in Scottish burghs, and it was on this material that Ian spoke at the AEA Symposium on Site, Environment and Economy held at St Andrews in 1980.

At the time of his death he had prepared some thirty papers on animal remains from sites, many of the later reports being authored jointly by Ian and his research assistants, Angela Jones and Catherine Smith. The detailed comparative study of the Scottish medieval material and of material from selected Roman sites in northern England formed the basis of his Ph.D. Thesis awarded by the University of Dundee in 1981. In the thesis and subsequent papers he provided a substantial amount of new data and in a unique and highly competent manner discussed the osteological data in relation to other evidence. Of special importance has been his discussion of the economy of medieval Scottish burghs in relation to the archaeological evidence and their legal status. In such analysis he demonstrated a combination of careful science and critical historical scholarship thereby adding a new dimension to archaeozoological studies.

Bruce Proudfoot, Department of Geography, University of St Andrews

AEA Conference and AGM: 'The Beginnings of Agriculture'

University College, Cardiff, 18th-21st September 1987

These conferences simply get better and better. Those AEA members who opted out of the 1987 Conference because it was 'another early domestication talking shop and not my subject anyway' missed eighteen diverse papers of a high academic standard overall, some lively discussion of new data and ideas, and field excursions which met the essential criteria of being informative and fun. On the other hand, they also missed the Aberdare Hall catering, which had served further to bond the conference in a spirit of shared adversity.

David Harris launched the meeting on Friday evening by describing his own initial misgivings about the conference theme, then surveyed the various theories and models for the emergence of agriculture on which the archaeological data have, often tenuously, been hung. Two topics were introduced which recurred throughout the meeting; the relative merits of gradualism as against the concept of a 'Neolithic revolution', and the project which Harris and various colleagues are basing on material from Tel Abu Hureyrah.

Alert wakefulness was at a premium on Saturday morning. Ken Thomas assured us that he didn't "... want to get sidetracked into discussing what reality is at nine o'clock on a Saturday morning", but clearly felt no compunction about discussing various complex theoretical ecological models as bases for explaining why and at what rate agriculture was adopted. In a stimulating half-hour, we were introduced to a hierarchical model of interacting sub-systems. Barbara Noddle subsequently summed up the feelings of many with her remark "I always thought a holon was a subatomic particle before I came here". From models to data, and accounts of current thoughts on the domestication of caprines and cereals were given by Tony Legge and Gordon Hillman, both of them using data from Abu Hureyrah. The next three papers gradually coaxed the conference nearer to home, by way of

Sebastian Payne's lucid account of his work at Franchthi Cave, Greece, Paul Halstead's creative use of ethnography to provide a model for the spread of farming onto the Central European loess, and John Evans' description of his recent work locating early Neolithic land surfaces and valley fills in North Wiltshire. Evans' paper was a late addition to the programme, having been compiled at a mere two days' notice, following the non-arrival of a promised contribution. The haste didn't show, and it was good to see snails intruding amongst the goats and grains.

A homicidally-spiced lasagne for lunch failed to dampen either the enthusiasm or the quality of the Saturday afternoon papers. Vertebrates were variously discussed by Caroline Grigson and Simon Davis (whose use of the educational cartoon is definitely to be encouraged), and two German colleagues then shed light on some recent palaeobotanical work in Central Europe. Hansjörg Küster has been investigating pollen sequences from the Northern fringe of the Alps, where the onset of agriculture is clearly marked in the pollen data, though virtually absent from the archaeological record. Angela Kreuz drew murmurs of sympathy when she admitted to having identified 10 000 pieces of charcoal from a Linearbandkeramic settlement. Analyses of the spatial distribution of the taxa, and comparison with associated pollen sequences have shown a remarkably sophisticated selection and use of different timbers. Keeping to the resource exploitation theme, David Robinson rounded off a very full day of lectures by describing his and Peter Rasmussen's work on botanical remains from the lake-village at Weier, in Switzerland.

Saturday evening's AGM will have been formally reported in the AEA Newsletter, and needs little comment here. The meeting was held in the oak-panelled common room of Aberdare Hall, with portraits of former Wardens of this, one of Britain's first Halls of Residence exclusively for ladies, gazing blue-stockingedly down. All of this was clearly lost on Nick Balaam, whose enthusiastic discussion of any and every point, on or off the Agenda, ensured a lively meeting.

The second day of lectures started gently, with Barbara Noddle casting a vet's eye over the material remains of early domestic and wild ruminants from Britain, and introducing her pet mouflon along the way. Royston Clark chose a more theoretical framework for arguing that the whole process from Palaeolithic hunting through to sedentary cultivation can be viewed as a series of risk-management exercises, stages within one continuous process rather than discrete cultural events. It was during Clark's lecture that the only projector jam of the conference occurred. Within seconds, a back-up machine was in position and normal service was resumed: well done Neville! Keeping a spare projector to hand is risk-management of the most sensible kind.

Risks were further to the fore when Annie Grant presented her own and Roy Entwistle's somewhat iconoclastic thoughts on the development of agriculture through the British Neolithic and Bronze Age. It was a challenging thesis, replacing the sedentary, cereal-based, plough-using Neolithic which we have grown to accept with a system of hoe-based horticulture and stock-rearing, in which cattle may have had a largely symbolic, even ritual role. It was a brave thesis to present to an audience which included John Evans and Tony Legge, and in the heated discussion which ensued, an onslaught of data left it looking rather battered and bruised. None the less, it was good to see a sceptical eye being turned on received wisdom.

As blood pressures around the hall restabilised, Kevin Edwards reviewed the potential and difficulties of studying the sparse pre-Ulmus decline records of cereal pollen. Frank Chambers was more positive ("Good morning ladies and gentlemen, and anyone else that's crawled in ...") in his examination of the evidence for the early exploitation of rye in North-West Europe. Chambers stressed a couple of important points: the versatility of rye as a crop on poor soils, and the problems it would present to a community accustomed to non-free-threshing cereals. The final lecture ought perhaps to have been the first, as Susan Limbrey explored possible connections between soil types and the options which they presented to early farming communities, drawing particular attention to the potential value of self-mulching vertisols. Finally, Willy Groenman gave a very positive summing-up, detailing areas where studies can go forward, and anticipating another such conference in ten years' time.

The Sunday afternoon outings were by way of gentle relief. A charabanc outing set off for the excellent Welsh Folk Museum, just outside Cardiff, where reconstructed buildings from all over Wales are set in a park landscape, and a variety of crafts and industries are carried on. There can't be many water-powered spinning frames still operating in Britain. Neither are there many Chinese dinosaurs, so a second party formed a neat crocodile and were taken to the National Museum of Wales to see this internationally-important exhibition. Sunday evening rounded off the conference in great style. Over thirty people engaged in a hugely enjoyable skittles match in a local pub, in which the Animals narrowly but convincingly defeated the Plants (naturally!). Given that conferences are at least in part social occasions, booking the skittles alley was a brilliant stroke of inspiration.

Monday's field trips were blessed with mild weather, which was just as well. One party travelled down the road to Newport to inspect the land surfaces and trackways which are being exposed and eroded along the Welsh side of the Severn Estuary. What effect might the proposed barrier have, one wonders? Meanwhile, a somewhat larger group toured Mid-Glamorgan and neighbouring bits of Powys in search of glacial landforms and deposits. Traeth Mawr, near Brecon, provided a hands-on and feet-in mire experience which will not quickly be forgotten.

The 1987 AEA Conference thus managed to be stimulating, informative and enjoyable. The necessary planning had clearly been done well in advance, and in sufficient detail to ensure the smooth running of a packed schedule. When the proceedings are published, the papers will provide a valuable digest of current thoughts and progress in this fascinating area of research. The conference was organised by Annie Milles and Di Williams, with the aid of a seemingly endless supply of willing colleagues, and all those involved deserve to be congratulated for producing one of the best AEA Conferences to date.

T. P. O'Connor

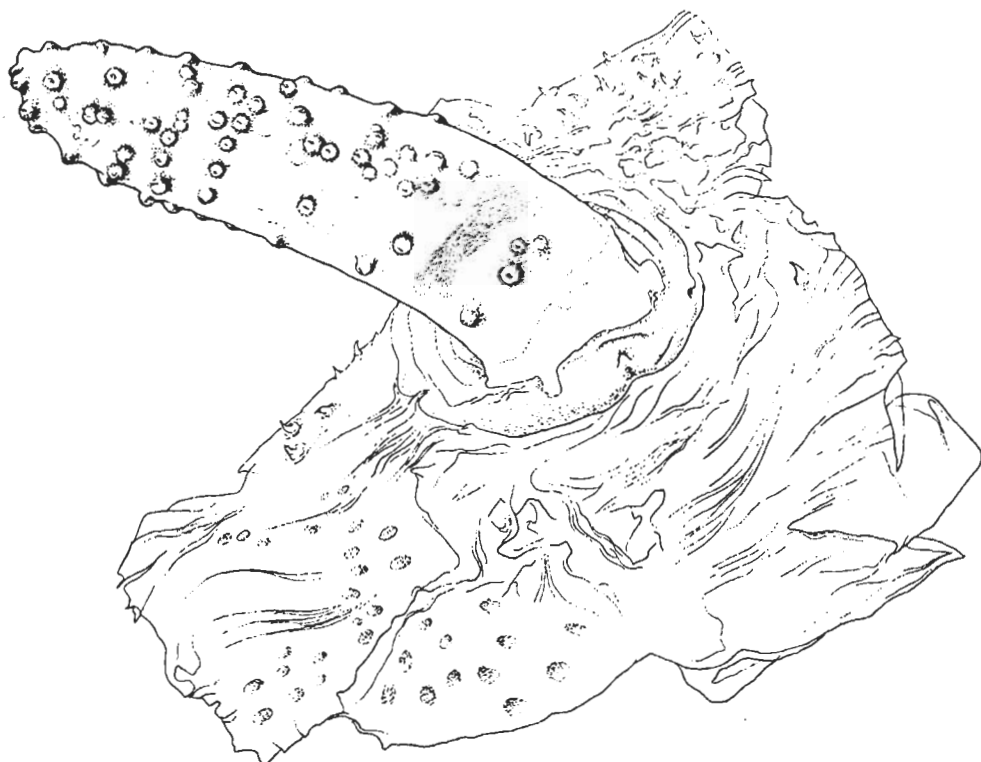
Mystery object identified

In Spring 1985, the cover of Circaea bore a drawing of 'a mystery object, presumed to be arthropod, often found in Viking Age deposits at York' (reproduced here). One of us (JP) had only just started work in entomoarchaeology and had no idea what it could be, nor did the entomologists at the Zoological Museum of Amsterdam. However, its status as a

well-defined unidentified object proved useful when a colleague, H. van Haaster, found similar, but not identical objects in material from cesspits in 14th century Lübeck. After a search of records extending from caterpillar appendages to tapeworm genitalia, the objects were put aside.

They were then found in material from a modern habitat - a pile of rotting seaweed - during investigations into the ecological requirements and structure of fly species found in archaeological deposits. The objects stood out like horns on top of a rat-tailed fly puparium.

These horns are the anterior respiratory organs of the pupae, often referred to as pupal spiracles, and are most conspicuous in some syrphid genera such as Eristalis. The anterior spiracles of the better-known larvae are much smaller, which explains the relative unfamiliarity of these objects. When the imago emerges the spiracles are shed together with the operculum of the puparium and, because the rest of the puparium does not survive as well as do, for instance, muscid puparia, they are likely to be the main source of information on these organisms. Use of the keys in Hartley (1961) and Dolezil (1971) will probably make possible the identification of many Eristalini and some other Syrphidae.



Eristaline pupal anterior respiratory process from Anglo-Scandinavian deposits at York.

The larvae of Eristalini all live in very wet places with decomposing organic material, where they feed by filtering bacteria. They differ in their preference for water type and degree of sewage contamination, from very wet manure to ponds with decaying vegetation.

This identification was mentioned by JP at the Birmingham meeting of the AEA in March 1987, where the work of TH was acknowledged.

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AEA one-day meeting at The University of Birmingham,

March 1987

Summaries of papers, supplied by authors

Medieval carbonised plant remains

from the deserted village of West Cotton, Northamptonshire

Introduction

The excavation at West Cotton is one of several being carried out as part of the Raunds Archaeological Project (R.A.P.). Work had been taking place on archaeological sites in the area since 1975 when this project was set up in 1985. Both the Northamptonshire Archaeological Unit and the Central Excavation Unit are involved in excavating a number of sites within the project area over five years. These sites include a Bronze Age barrow cemetery at Irthlingborough, a Roman villa and associated settlement at Stanwick, a deserted medieval village at West Cotton and a medieval manor house complex in Raunds. I have been overseeing the day to day running of the environmental programme for the Project on the various sites in summer and sorting flots and identifying the carbonised seeds throughout the year.

West Cotton dates from the late Saxon/early Norman period through to the 15th century, when it was rapidly deserted. There is little later disturbance of the site. It is one of a series of deserted medieval settlements in this area of the Nene Valley known from documents and field survey. Associated with these villages are two manor houses in the extant village of Raunds: (i) Furnells, dug from 1977 to 1981, and (ii) Burystead, the excavations of which are continuing in 1987.

West Cotton is being excavated in advance of the construction of the new A45/A605 road and only the road 'corridor' was dug in the first two years. This resulted in the part-excavation of three plots fronting a green but as yet we have no complete view of any one plot. All the samples I have analysed therefore are from the buildings in the frontages of the plots. Further excavations now in progress should ensure that samples from the backage of at least one of these plots will be available by 1988.

A sampling policy was adopted to ensure a good representation of all types of context and feature. The policy had been devised so that the results from each site within the Project should be as closely comparable as possible. The carbonised plant remains were recovered by flotation and this was carried out locally to the site.

The crop plants

A range of cereals has been identified including both free-threshing hexaploid and tetraploid wheats, six-row barley, rye and oats. As seems usual for medieval sites, grains were the most abundant cereal remains.

The identification of a free-threshing tetraploid wheat Triticum turgidum/durum (rivet/macaroni wheat) is of particular significance. As there is no evidence that Triticum durum was ever grown as a crop in this country (and would presumably be an uneconomic, unsuccessful crop) it is assumed that the tetraploid wheat represented on this site is T. turgidum. This was identified from spikelet forks, with the help of Lisa Moffett of the University of Birmingham. In the samples from West Cotton where spikelet forks are identifiable to either the tetraploid or hexaploid form, the tetraploid type seems to predominate, but they are always outnumbered by spikelet forks that cannot be identified more closely than to Triticum sp. The grains of wheat recovered are mostly quite dumpy, high-backed forms which resemble compact-grained versions of free-threshing hexaploid wheat (Triticum aestivum s.l.). However Lisa Moffett has recently commented that differentiating free-threshing hexaploid from tetraploid wheat by the grain is very difficult and may not be possible. Nevertheless there remains the possibility that rivet wheat was the more important wheat, and therefore the dominant crop on site since wheat remains are the commonest crop remain so far. As the possible occurrence of T. turgidum in archaeological assemblages has previously rarely been considered, it is important to be aware of the possibility of its presence on other medieval sites.

There were three structures excavated which have been interpreted as malting ovens. From one, a quantity of sprouted grain was recovered - both barley and oats. The other two ovens did not have this high predominance of sprouted grain. All the ovens did show a range of other remains, however, including various cereal grains, legumes and Brassica sp.. The ovens also contained many chaff fragments and weed seeds. This has implications as to whether these structures had one use or a variety, one of which was malting. Each oven was rigorously sampled from front to back, including the rake-out, so that more detailed work on them can be undertaken if necessary.

The legumes mentioned above are present all over the site. A few of them have been identified as Vicia faba (field bean) and a few as Vicia sativa (common vetch). Unfortunately it is usually impossible to place most of the smaller ones in a more definite category than Pisum/Vicia/Lathyrus due to the lack of surviving hila. Nevertheless, the majority of them seem a bit small for peas and there remains the possibility that Vicia sativa was cultivated as a crop. No legume processing waste was found on the site.

There is evidence of foods other than cereals and legumes. Brassica sp. seeds were abundant in one oven. They were also found mineralised in a cess pit at Furnells (Mark Robinson, pers. comm.). These occurrences suggest a specific use of these seeds rather than a presence simply as a weed. Brassica sp. does not seem to fit into the habitat types otherwise represented by the assemblage of weed seeds, which also raises the possibility that the Brassica was a cultivated crop. Even if the seeds are not Brassica nigra (black mustard) they could still have been used as a mustard flavouring.

Other indications of food are the presence of two apple (Malus sylvestris) pips from a floor level and occasional finds of fragments of hazelnut (Corylus avellana) shell.

A few carbonised seeds of flax (Linum usitatissimum) were recognised. The importance of this crop at West Cotton is emphasised by the discovery of waterlogged flax-retting debris from test bore holes into a silted former river channel adjacent to the site.

Preliminary ecological interpretation

Carbonised seeds have been identified from a fairly large proportion of the samples taken from the medieval levels on this site and preliminary work has started on interpreting the plant communities represented by the weed seeds present and how they reflect the soil types in use. This work is based on information about the British ecology of the plants from Clapham, Tutin and Warburg (1952), Silverside (1977) and Mark Robinson's extensive knowledge.

Taken as a whole, the plant assemblage appears to be one associated with arable cultivation, especially of autumn-sown cereals and on soils of relatively low fertility (Order: Centaurealia cyani Tx.).

Apparently at least two major soil types are represented:

- (i) heavier calcareous claylands, suggested especially by the presence of Anthemis cotula (stinking mayweed) and Odontites verna (red bartsia) which are of common occurrence in most of the samples; and
- (ii) sandy, or sandy-loam soils of a circum-neutral nature as indicated by the presence of Medicago lupulina (black medick), Spergula arvensis (corn spurrey) and Rumex acetosella (sheep's sorrel). The last two species represent an acidophilous component of the flora of these soils. The absence of a full range of acid-ground weeds, however, suggests that the cultivated area did not include acidic soil.

There is also the possibility that a light, well-drained calcareous soil type is represented, but disguised by the other two assemblages.

It appears that cultivation extended up to the edge of wetter, marshy land as evidenced by the persistent presence of low amounts of Eleocharis palustris (common spike-rush) nutlets - both silicified and carbonised. It is suggested that this indicates wetter land on the edge of fields as opposed to waterlogged furrows in ridge and furrow cultivation because, when the latter are cultivated nowadays Mark Robinson (pers. comm.) has noted that Polygonum persicaria (persicaria) is often the most abundant weed. In the remains at West Cotton, P. persicaria is almost completely absent.

Identification notes

Fruits (mericarps) of a large-fruited umbellifer from West Cotton which had proved very difficult to identify were eventually tracked down to Scandix pecten-veneris (shepherd's needle). These fruits had been noted but not identified from several Roman and medieval waterlogged sites (e.g. Robinson in Miles 1986, 34). They were thought possibly to be an alien species of Chaerophyllum until it was realised by Mark Robinson that the plant grown as S. pecten-veneris in several British botanic gardens which had supplied archaeobotanists with reference fruits was in fact S. australis, which has rather smaller fruits. The archaeological specimens were only correctly identified when compared with herbarium material of S. pecten-veneris, where the identity of the plants could be checked.

The carbonised fruits of S. pecten-veneris had usually fragmented, but they could still be recognised by their large size, their ribs and the fact that, unlike most umbellifer fruits when charred, the dorsal surface is convex along its length and the ventral surface is longitudinally convex on either side of the median furrow.

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Plant remains from a late-Roman site in Bulgaria

The site of Nicopolis ad Istrum lies in Northern Bulgaria, 30 km south of the River Danube. The early Roman town, founded by Trajan, is thought to have been abandoned in the late 3rd century A.D., and occupation transferred to the strongly fortified enclosure or castellum, to the south-east. Literary sources indicate the survival of the town till at least the 7th century. Since 1985, British archaeologists have been carrying out a programme of research and excavation in the area of the castellum (Poulter et al. forthcoming). The aim is to provide information on the character of late-Roman urbanism in the region.

The areas excavated have been selected on the basis of results from geophysical and topographical surveys carried out in the first two seasons. Preliminary archaeobotanical

results show the presence of a wide variety of economic taxa, both as carbonised and mineralised remains. Fourth-century deposits contained evidence of einkorn (Triticum monococcum L.), durum wheat (T. durum Desf.), bread/club wheat (T. 'aestivum-compactum'), six-row barley (Hordeum vulgare L. var hexastichum), rye (Secale cereale L.) and millets (Panicum spp.). The pulses identified so far are lentil (Lens culinaris Medic.), pea (Pisum sativum L.) and bitter vetch (Vicia ervilia (L.) Willd.). Also present are remains of grape (Vitis vinifera L.), walnut (Juglans regia L.) and olive (Olea europaea L.). The olives found are likely to have been imported since the winter temperatures in this area were unsuitable for local cultivation. A site reference collection is being compiled to aid the identification of the weed seeds.

One of the problems of working in this area is that there is little comparative evidence available from other sites. Indeed, a second aim of the project is to provide well-stratified sequences of all classes of evidence to act as a standard for other excavations in deposits of this period. The only other site in the territory of Nicopolis to have produced plant remains from the 4th century A.D. is Krivina, on the Danube (Hajnalová 1982). However, there is no indication of any representative sampling strategy having been adopted at that site and the conclusion that rye was the predominant cereal consumed there is open to question.

Initial results have provided information about the history of plant use at Nicopolis. Further work should provide a more detailed picture of the past agricultural economy of this site and its territory and it is hoped that this will prompt studies at other sites in the region.

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The archaeological remains of flies

For determining fly puparia, I use mainly the shape and disposition of the posterior spiracular slits and the shape of the anal sclerite, since these require minimal preparation so that a considerable number of puparia can be examined quickly. The use of cuticular characters would greatly reduce the number that could be processed and, though it might help with some specific determinations, there is no certainty that this would result in more information on habitats and conditions. Records of larval habitats are often scanty and when there are many records they often indicate a wide choice of habitats.

Musca domestica L., the house fly, is the most numerous species in Roman, Anglo-Scandinavian and medieval deposits from various levels from excavations at 16-22 Coppergate and 24-30 Tanner Row, York. It has been recorded from a great variety of habitats and Oldroyd (1964) describes it as 'characteristic of household garbage in a primitive community'. I have found it associated with Stomoxys calcitrans (L.), a 'stable

fly'. This association has been recorded in modern populations, and appears to result from oviposition by M. domestica females in a mass of decomposing material, and by S. calcitrans in cracks in the drying surface of the mass. In the Coppergate material a large number of puparia was found in a mass of stem fragments of dyer's greenweed (Genista tinctoria L.). About 60% of these puparia were whole, i.e. the adults had not emerged (which activity involves pushing off the end of the puparium). It seems probable that the addition of new plant material to the deposits resulted in the deaths, perhaps by 'drowning', of puparia. Any larvae present would not have left recognisable remains, while adult flies emerging but unable to escape would not have left whole puparia.

Teichomyza fusca Macquart is another species that has been found in some numbers. The larvae live in cess pits, latrines etc. They have been reared rather unsuccessfully on urine-soaked sawdust, but did much better when faeces were also supplied (Vogler 1900). I have found this species attached to faecal concretions and associated with the sepsids Nemopoda sp. or Themira sp. or both, and with some species of Leptocera. It seems probable that all these can be taken to indicate really foul conditions. There has been confusion in the past between I. fusca and Leptocera zosteræ; it appears, however, that both taxa occur in archaeological deposits.

Eristalis tenax (L.), the larvae of which are rat-tailed maggots, is another inhabitant of cess-pits and privies. I have found very few puparia, but considerable numbers of the mystery objects depicted on the cover of Circaea 3(1) (1985), which appear to be anterior spiracular processes from puparia of this or related genera, have been recorded during sorting for insect and plant remains. These puparia are not heavily tanned and are not usually preserved unless mineralised.

I have found a number of puparia of Melophagus ovinus (L.), the sheep ked. This is a wingless fly that passes its whole life history on the sheep, feeding on its blood. The female lays full-grown larvae which immediately pupate. Thus, the presence of puparia of this species must indicate some stage of wool processing, probably an early one, which results in combing them out.

There are a few puparia of Spilogona sp., whose larvae live in moss. These may indicate the use of moss as anal wipes and again be associated with privies, etc.

Finally, I have found no puparia of Calliphora sp. (blow flies) and only one of Sarcophaga sp. (flesh flies). The larvae of these flies live in flesh and their absence may indicate that no meat remains were allowed to lie about until larvae could pupate. Possibly such meat fragments were eaten by dogs or pigs.

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(Note added in proof: The identification of Eristalis anterior spiracles is discussed further by Hakbijl and Phipps in Miscellany in this issue of Circaea.)

Distinguishing cereal from wild grass pollen: some limitations

Camilla Dickson *

Summary

The criteria used to distinguish pollen grains of cereals from those of wild grasses are tabulated and discussed. The importance of accurate annulus measurements and the resolution of surface sculpturing using phase contrast microscopy are shown. The problem of distinguishing Hordeum (barley) pollen from that of certain wild grasses is emphasised. Caution is needed in separating pollen of Avena (oats) from that of Triticum (wheat). Secale (rye) grains may be more confidently identified.

Introduction

Problems in distinguishing pollen of cereals from those of wild grasses have led to the adoption of varying criteria by different workers. This paper is an attempt to summarize the non-British literature on cereal pollen identification and also to suggest a more standardised form in which results can be presented. The state of preservation varies according to local conditions and whether mires, ditches, soils, pits, 'cess', coprolites, potsherds or even bog bodies are pollen-analysed and therefore the degree of certainty which can be attached to the identification is not constant.

Size and surface sculpturing

Andersen (1979) divides Poaceae (Gramineae) pollen into four groups:

- (1) Wild grass group: mean annulus diameters smaller than 8 μm , mean pollen size less than 37 μm , surface sculpturing scabrate or verrucate. This group includes most Bromus spp. which usually have a slightly smaller mean annulus diameter, although the mean grain size is within the range of group 2 (Andersen 1979, table 1).
- (2) Hordeum group: mean annulus diameters 8-10 μm , mean pollen size 32-45 μm , scabrate. This group comprises wild grasses and cultivated species.
- (3) Avena-Triticum group: mean annulus diameters larger than 10 μm , mean pollen size larger than 40 μm , verrucate. This group comprises cultivated species and one wild grass, Avena fatua.

4) Secale cereale: the grains are scabrate and only separated from group 2 by Andersen on account of their larger pollen index (ibid, table 3). They are here included in group 2. The grains are usually prolate and therefore the only cereal pollen which can be identified solely on shape.

The species listed in Andersen's groups 2, 3 and 4 are here given in Table 7.

The scabrate patterning of the Hordeum group is shown as isolated dark dots (spinules, punctae) with phase contrast (Fig. 5(a)). Scanning electron micrographs of some of the species in this group (Andersen and Bertelsen 1972) show that the sculpturing differs slightly between some genera. Faegri and Iversen (1975) note differences in the pore and annulus structure. Vorren (1986) has suggested that distinctions in the sculpturing of certain species can be seen with the light microscope.

The verrucate patterning of the Avena-Triticum group is seen as irregular dark spots (maculae) in phase contrast (Fig. 5(b)). These spots are composed of spinules grouped on small islands together with single spinules and shown in scanning electron micrographs by Andersen and Bertelsen (1972). However Andersen (1979) points out that this may not always be distinguishable from scabrate sculpturing. On the other hand Beug (1961, figs. 12 and 13), using phase contrast, separates Avena-type from Triticum-type on differences in the grouping of the dark spots. Faegri and Iversen (1975) also note sculpturing differences within the group.

Chemical treatment and mounting medium

The preparation of reference grass pollen for measurements of size and annulus diameter have usually consisted of treatment with potassium hydroxide (KOH) and acetolysis followed by mounting in silicone oil. However various workers have noted that grains swell after acetolysis and so Corylus at c. 25 μm , has been used to standardise the results (Faegri and Iversen 1975; Andersen 1979). Corylus and grass pollen swell by a similar proportion if mounted in glycerol (Faegri and Iversen 1975, table 2). The type of deposit may further affect the size (op. cit., table 12) which tends to be more constant if mounted in silicone oil. KOH treatment without acetolysis appears not to affect the size of the grains. It may be advantageous in some circumstances also to prepare the sample without acetolysis so as to be able to measure the annulus diameter and size, especially if Corylus is not present in the sample as a standard. The swollen grains which frequently result from acetolysis may show the surface sculpturing more clearly than those treated with KOH alone.

Identifying fossil grains

Hordeum group

As is shown in Table 7, grains of Hordeum group can be separated from those of Avena-Triticum group by the smaller annulus diameter, used in combination with the scabrate sculpturing. Pollen size may be helpful but the larger fossil grass grains are frequently crumpled. Andersen (1979, fig. 6) has used the annulus diameters to separate crumpled grains of Glyceria from those of Hordeum vulgare and Elymus (Agropyron) repens. Obviously this is only possible when a number of grains can be very carefully measured. Vorren (1986) has distinguished Hordeum from Elymus repens using the thicker Hordeum annulus with steep peripheral margin (which E. repens lacks), together with the tendency for the punctae of E. repens to be dispersed in groups. Andersen and Bertelsen (1972) note that in phase contrast irregular dots may be seen in some grains of E. repens.

Ditch deposits are particularly likely to contain pollen of Glyceria, and Glyceria spp. may also be found in shallow damp hollows in pasture (J. H. Dickson pers. comm.). Elymus repens is very common in waste places such as field margins. Inland locations will probably exclude the three maritime grasses in this group and known geographical ranges may exclude Triticum monococcum and Hordeum murinum from consideration; the latter has a rather southern and eastern distribution in the British Isles (Perring and Walters 1976).

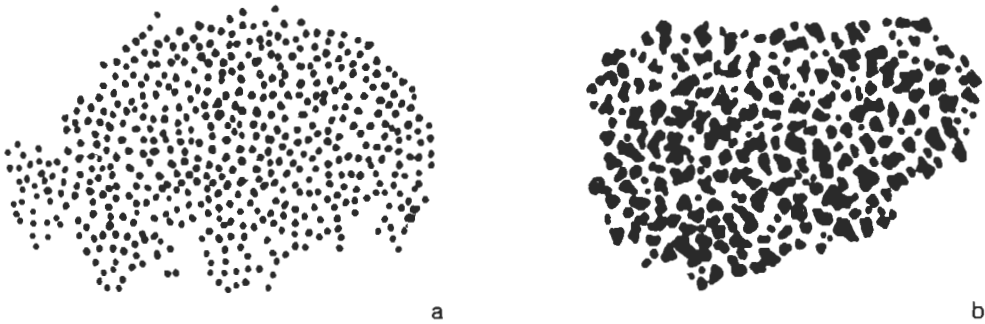


Figure 5. Surface sculpturing of (a) Hordeum-type (H. distichon); (b) Avena-type (A. sativa) pollen grains. Redrawn from Beug (1961), and based on phase contrast photographs (x 2200).

Avena-Triticum group

The only wild grass in this group is Avena fatua but its ubiquitous presence in barley and other cereal crops, from the Iron Age onwards in Britain, is a serious problem in the interpretation of post-Bronze Age Avena-Triticum pollen. The smaller mean annulus size of A. sativa has enabled Andersen (1979, fig. 9) to identify crumpled grains, using the annulus and surface sculpturing as criteria. It must be noted that the size range of annulus diameters of A. sativa overlaps in particular with that for Triticum aestivum and so small numbers of grains are not necessarily distinguishable. Pollen analysts have distinguished Triticum pollen, and those grains with a particularly large annulus seem separable from those of Avena spp.

Conclusion

If large grass pollen is present only as occasional grains, Secale may be the only cereal identifiable to the generic level with certainty. Grains frequently become swollen by acetolysis and by mounting in glycerol, and both annulus diameter and grain size must be corrected against Corylus as a standard. Pollen of Hordeum group (including wild grasses) may be distinguished by its smaller annulus size and scabrate sculpturing from that of Avena (including A. fatua) and Triticum with verrucate grains. It may be possible to distinguish Hordeum pollen from that of wild grasses by very accurate

measurement of the annulus diameter combined with observation of well-preserved surface sculpturing using phase contrast. Pollen of Avena sativa has been distinguished when similarly very accurate measurements of annulus diameters have been made on a number of grains. Some species of Triticum appear separable on their larger annulus diameters.

It is highly desirable that the criteria used for identification are stated in both published and unpublished reports together with a list of wild grasses which may be contributing.

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Table 7 (opposite). Measurements of Poaceae (Gramineae) pollen grains from the available literature (all given in μm). Measurements from Andersen (1979) and Fægri and Iversen (1975) are for grains mounted in silicone oil and standardized against Corylus = 24.5 and 25 μm respectively. The measurements from Beug (1961) are from grains mounted in glycerol and therefore larger; use of a correction factor of 0.78 to both annulus diameter and size range will give results comparable with those from the other authors.

Anl D mean diameter of annulus

$\frac{M+ + M-}{2}$ mean of greatest diameter (M+) and diameter at a right angle to M+ (M-)

G D greatest diameter of grain

* average of more than one collection

+ tentative identification of the genus by Beug

	Andersen, 1979	Faegri & Iversen, 1975	Beug, 1961
	Anl D M+ + M- 2	Anl D G D	Anl D G D
HORDEUM GROUP			
<u>Amnophila arenaria</u> (L.) Link	8.44		10.9
<u>Bromus inermis</u> Leysser			11.3
<u>Elymus farctus</u> (<u>Agropyron junceiforme</u>) (Viv.) Run. ex Meld.	8.89	8-10.5	12.2
<u>Elymus</u> (<u>Agropyron</u>) <u>repens</u> (L.) Gould	8.80*	7-10.5	8.7+
<u>Glyceria fluitans</u> (L.) R. Br.	9.55*	< 40	11.3
<u>G. plicata</u> Fr.	9.66	< 40	11.3
<u>Hordeum murinum</u> L.	8.77		11.2
<u>H. vulgare</u> L.	8.23*	8-10.5	10.7
<u>Leymus</u> (<u>Elymus</u>) <u>arenarius</u> (L.) Hochst.	8.88*	< 12	10.6
<u>Secale cereale</u> L.	8.93*	< 12	10.7
<u>Triticum monococcum</u> L.	9.19*	9-11.5	11.3
			31.9-43.8
			39.8-55.7
			38.5-55.1
			37.2-49.1+
			30.5-43.8
			29.9-42.5
			37.2-53.7
			35.2-53.7
			37.8-57.7
			31.9-65.0
			32.5-59.1
AVENA-TRITICUM GROUP			
<u>Avena fatua</u> L.	11.93	11-13	13.0
<u>A. nuda</u> Højer	11.60	47-54	10.8
<u>A. sativa</u> L.	10.72*	38-55	12.0
<u>A. strigosa</u> Schreb.			10.0
<u>Triticum aestivum</u> L.	11.81*	11.5-16	16.6
<u>T. compactum</u> Host.	14.18	11.5-16	16.3
<u>T. dicoccum</u> Schrank	13.51	11.5-16	14.6
<u>T. polonicum</u> L.	10.98		
<u>T. spelta</u> L.	12.59	11.5-16	15.9
			43.8
			34.5-47.8
			49.1-55.0
			37.8-66.4
			39.8-69.0
			44.5-66.4
			38.5-71.0
			41.8-72.3

Gardening in Roman Alcester

Lisa Moffett *

Summary

Finds of charred macrofossil remains of three species of probable garden plants - Asparagus officinalis (asparagus), Aquilegia cf. vulgaris (columbine) and Beta vulgaris (beet) - provide rare evidence of gardening in the Roman period.

Introduction

Archaeobotanical evidence for field crops is often plentiful on archaeological sites and has contributed greatly to our knowledge of ancient agriculture. By contrast, most of what we know about gardening and garden plants is based on evidence from documentary and iconographic sources. For some periods, notably the medieval period and later, these sources may be relatively abundant and highly informative (e.g. Green 1984; Willerding 1984), while for other periods they are non-existent or limited in scope. Several of the Classical authors, for example, discuss the cultivation and uses of vegetables and herbs in detail but they are primarily referring to plants known and used in the Mediterranean region and it cannot even be assumed that the plants they discuss which are native to Britain were necessarily cultivated in Britain. Archaeobotanical evidence is necessary if we are to understand anything about garden plants in pre-medieval Britain, but such evidence is rarely found.

Problems in identifying the evidence

The reasons for the scarcity of archaeobotanical evidence seem to be threefold. First, there is the problem of survival of the evidence. The vegetative parts of vegetables and herbs are unlikely to survive except in waterlogged deposits. Charring is likely either to destroy the material or render it unrecognisable, at least by current techniques. Seeds survive charring better but, where the vegetative parts of the plant are the parts used, the plants may not be allowed to run to seed except for a few to provide the seed for the next year's planting.

The second problem is one of recognition. In the past vegetative fragments of 'useful' plants have seldom been identified even from richly organic deposits well preserved by waterlogging. Recent work by Tomlinson (1985) has begun to rectify this omission and has resulted in the identification of vegetable remains such as leek (Allium porrum; Tomlinson forthcoming). Other such identifications have begun to follow as archaeobotanists learn to recognise the material (Greig, unpub.).

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The third problem is one of interpretation. Seed remains of possible garden plants have been more frequently identified, usually waterlogged although occasionally charred, but the seeds of most garden plants are indistinguishable from those of their wild relatives; this is also true of their pollen. In this case, cultivated plants with wild relatives native to Britain can only be recognised - albeit tentatively - from the context in which their seeds or pollen are found.

The evidence from Alcester

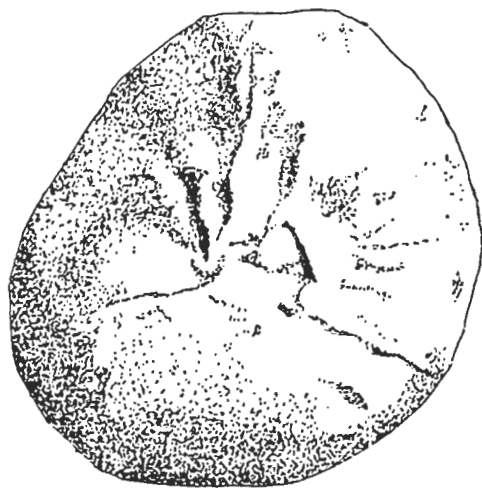
The charred seeds of three species of plants native to Britain, but which are interpreted as garden plants, were found in archaeological deposits from the Roman town of Alcester, Warwickshire, and dated approximately to the third century A.D. Asparagus (Asparagus officinalis L.) and columbine (Aquilegia cf. vulgaris L.) were found during a small excavation of various features inside the Roman defences on the north-east edge of the town at Tibbet's Close (Moffett 1986a), and beet (Beta vulgaris L.) was found in a dump of charred material under the late Roman defences on the south-west side of the town (Moffett 1986b).

Asparagus officinalis L.

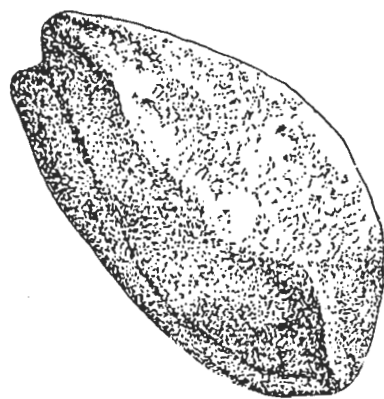
Two subspecies of Asparagus officinalis occur in Britain: the wild, prostrate ssp. prostratus, and the upright, cultivated asparagus, ssp. officinalis. Wild asparagus occurs on dunes and coastal areas, although today ssp. officinalis can also be found inland as a garden escape on waste ground. Although the seeds of the two subspecies are indistinguishable, the presence of asparagus so far from its native coastal habitats is strongly indicative of cultivation.

I have not been able to find any previous archaeobotanical records of asparagus. Oddly, asparagus seeds may have had a higher risk of exposure to fire, and thus a higher probability of being preserved by charring, than many other vegetable seeds. Cato gives careful attention to the cultivation of asparagus and states that the asparagus bed should be burned over in the autumn after the asparagus has gone to seed (Hooper 1936). He does also say that the seed should be collected first, but asparagus is a perennial which is grown in permanent beds, so this need should not arise. Columella, writing roughly three centuries after Cato, gives very similar instructions (Ash 1977). Mediterranean horticultural methods, however well established, were not necessarily practised in Britain, of course, but it happens that the burning over of asparagus beds is also a traditional method of asparagus management in Britain (Mark Robinson pers. comm.). How far back this tradition extends is a matter of speculation.

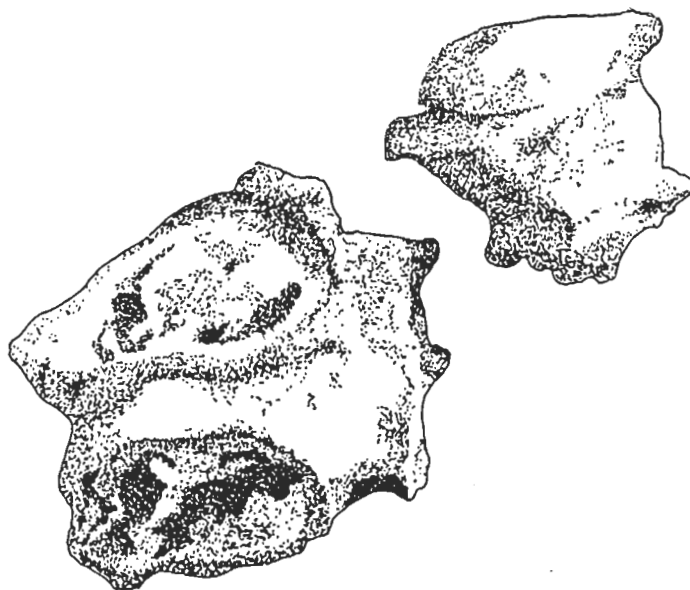
The charred asparagus seeds from Alcester were not apparently found in a cultivated soil, which is where seeds from burning over an asparagus bed might be expected to occur. Three came from a hearth, one from the backfill of the hearth, nine from a ditch pre-dating the hearth, and one from a pit roughly contemporaneous with this ditch (Cracknell forthcoming a). This possibly suggests the burning of garden refuse in the hearth, although there were only a few other charred items found. The ditch, however, was definitely earlier than the hearth and therefore there must have been at least two occasions during the occupation of the site when asparagus seeds were burned.



1 mm



1 mm



1 mm

Figure 6. Plant remains from Alcester: top left, seed of *Asparagus officinalis*; top right, seed of *Aquilegia cf. vulgaris* (both from Tippet's Close site); bottom: fruit fragment of *Beta vulgaris* (Gateway [formerly known as International] Supermarket site).

Aquilegia cf. vulgaris L.

Columbine is a plant of open woodland with a preference for calcareous soils (Fitter 1978). When found away from cultivation today in Warwickshire it is regarded as a garden escape (Cadbury et al. 1971). There are patches of calcareous soil near Alcester, and it is possible that the plant did once grow wild in the county. The presence of columbine seeds in the town suggests either that its seeds were collected or that it was cultivated.

Columbine has been recorded from a late Saxon context at Winchester Cathedral Green where it was interpreted as a garden plant (Monk, as cited in Green 1979, 122). There have been later medieval finds of columbine from three sites in West Germany - Neuss (Knörzer and Müller 1968), Braunschweig, and Göttingen (both Willerding 1984) - where it was also considered to be a garden plant. The single columbine seed recovered from Alcester came from the same site and same hearth as the asparagus, supporting the suggestion that garden waste had been burned in the hearth.

Beta vulgaris L.

Wild beet (Beta vulgaris ssp. maritima) is native to Britain, its natural habitat being sea coasts. The fruits and seeds of the cultivated beet (ssp. vulgaris) are indistinguishable from those of wild beet, but the presence of beet so far from the coast might be taken to indicate its cultivation.

The Roman beet was not the red beetroot with which we are familiar today, but probably something more like spinach beet, cultivated mainly for its leaves. Beet figures as a potherb in the writings of Columella (Forster and Heffner 1955) and Pliny the Elder (Bostock and Riley 1856). We are indebted to Theophrastus for a description of the root, which he says is long and straight, not bulbous, but fleshy, sweet and pleasant to eat, being eaten raw by some people (Hort 1916).

Roman beet fruits are known from urban sites in continental Europe, notably at Neuss (Novaesium; Knörzer 1970) and Butzbach (Knörzer 1973) in West Germany. Beet was also found in the well at the Roman villa at Denton, Lincolnshire (Conolly 1971).

The beet fruit remains from Alcester (about 50 fruit clusters) came from a dump of charred material which was sealed under the late Roman defences (Cracknell forthcoming b) on the opposite side of the town from Tibbet's Close. Although there are a few cereal remains associated with the beet fruits, the two other main components of the sample (by numbers) were flower heads and achenes of stinking mayweed (Anthemis cotula L.), and fruits of hemlock (Conium maculatum L.) (Moffett 1986b). These two ruderals would have grown quite readily in gardens. Hemlock prefers damp ground, and indeed this edge of the town was bordered by marsh (Woodwards, Greig and Girling 1980).

Conclusion

The probable garden plant species most frequently found on Roman sites are the herb and spice plants where the seed is the part of the plant used. Dill and celery are known from Roman sites in Britain, and coriander in particular seems to have been common (Greig 1983). It is easy to recognise cultivated (or imported) plants, such as dill and coriander, when the species are not native to Britain, but interpretation is more difficult when native plants are involved. Difficulties are even greater when the seeds or fruits are not the part used, as the seeds are usually either rarely found or their

presence is ambiguous. Daucus carota L. fruits and Brassica spp. seeds, for example, are frequently found but seldom claimed to represent cultivated plants. The significance of the material from Alcester is that by rare chance the seeds were preserved even though they were not the usable part of the plant, and the species concerned were well outside their natural habitats and were therefore clearly not wild.

Acknowledgements

I would like to thank Steve Cracknell for helpful information about the Alcester sites, James Greig for identifying the Aquilegia and permission to refer to his unpublished material, Mark Robinson for his help and advice, and Philippa Tomlinson for allowing me to refer to her unpublished work.

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A method for recording archaeological animal bones: the use of diagnostic zones

Keith Dobney and Kevin Rielly *

Summary

A system of recording bone fragments is reported here which has been developed over a number of years and successfully applied to numerous and diverse assemblages. It relies on the premise that whole bones can be divided into a number of readily identifiable morphological zones.

Its strength lies in its flexibility, enabling more accurate recording of bone fragmentation as well as, for example, the position of butchery marks and pathological conditions. It also facilitates the application of a wide variety of quantitative methods which can be employed in subsequent interpretation.

Introduction

The study of animal bones from archaeological sites has generated large quantities of data which have greatly improved and often radically changed our understanding of past economies. Enormous bone assemblages have been recovered and studied from sites of all types from throughout the world and, needless to say, there are still more awaiting analysis. Although zooarchaeology is still in its infancy, the discipline has made much progress in relatively few years. It is to the credit of those working in the field that the potential of such studies has been established and also that so much has been accomplished to date.

There are three basic premises that must be accepted when reading published bone reports. The first is that the initial identification of bone fragments is correct; the second is that the method of recording information is systematic and reproducible; and the third is that the quantitative methods used statistically to represent those fragments give an accurate impression of the material recovered from the ground.

The ways in which quantitative methods are used in subsequent economic interpretation are many and varied and depend entirely on the systems used to record the initial information. It is therefore imperative that the systems used take account of the numerous ante- and post-mortem processes which have shaped and moulded the archaeological bone record.

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Actual recording methods vary tremendously between individual zooarchaeologists and depend on a number of factors, in particular the nature of the assemblage, its archaeological importance, the experience of the zooarchaeologist and the time which is available for study. One common factor needed is systematic and rigorous recording, since no satisfactory collation of data may be achieved unless this has occurred in the first instance.

The problem that confronts us all is precisely how to record a single bone fragment accurately and to relate it to its counterparts and the rest of the assemblage. Fragments that are grouped as similar with respect to species and skeletal element, often show differences in fragmentation and preservation, typically as a direct result of factors such as animal selection, butchery practices and taphonomic processes. To proceed with interpretation on the basis of a naïve grouping of fragments by species and element will largely ignore these factors and may as a result bias information derived from statistical analyses.

It was with these fundamental problems in mind that we attempted to produce a systematic method for recording fragmented bones which would be detailed and rigorous as well as flexible, yet at the same time would be cost-effective and simple in its application.

Why diagnostic zones?

The idea of using diagnostic zones in recording animal bone assemblages was initially proposed by Watson (1979) who developed a system for recording comminuted animal bone fragments from Khirokitia, Cyprus. Rackham (1986) developed and used a similar system while recording animal bones from Piercebridge Roman Fort.

Using diagnostic zones relies on the premise that a skeletal element can be divided into a number of morphologically distinct zones that can be recorded merely as present or absent. These zones, when complete, are by definition non-repeatable elements; i.e. they can occur no more than once on a particular bone. Thus each archaeological bone fragment will consist of one or more of these zones in a variety of possible combinations. An extremely accurate record of each fragment can therefore be achieved which does not rely on subjective estimation of the proportion of whole bone which is represented in that fragment.

Obviously certain parts of bones (e.g. the shaft region of various long bones) are less susceptible to morphological subdivision than others, and in Rackham's method these areas remained largely ignored for that very reason. The system described here attempts to define these areas in order to incorporate the whole bone. This is made possible by the fact that these less diagnostic zones can often be recognised since they are frequently juxtaposed with highly diagnostic ones. Of course there will still be the ubiquitous pile of unidentifiable fragments, and thus a bias in the sample towards those which can be identified through anatomically direct association.

Method

The system reported here developed over a number of years and has been applied to several diverse archaeological bone assemblages from Europe and the Near East. The system was also updated constantly until virtually any bone fragment could be recorded with the described ease and precision.

The system was devised to include all the economically important domestic animals which commonly occur on archaeological sites, i.e. cattle, horse, pig and caprines. Obviously the general principles could and should be readily adapted to include carnivores, birds, and even fish, at locations where these may be of particular economic interest.

A series of drawings was prepared giving standard anatomical views of all major skeletal elements excluding the carpals and minor tarsals, patella, fibula, and sacrum. These drawings are reproduced here as Figs. 7-23. Additional illustrations are included where morphological coincidence of analogous zones of different species does not occur, e.g. in the metapodials.

Each zone is represented by a numerical code and is defined by a precise anatomical description (see captions to figures). All illustrated elements are shown from the left side (unless otherwise indicated) and with the zones usually numbered from the medial to the lateral surface. The lowest numbers usually represent the articular surfaces of the proximal and the distal ends of the bone.

The skull is not dealt with here. It may be divided into as many or few zones as desired, each zone representing a complete bone, for example: 1 - frontal; 2 - parietal; 3- occipital; 4 - petrous temporal, etc.

It was felt that an illustration or template of the zones was necessary to facilitate the speed and uniformity of application. These serve primarily as visual prompts to the recorder and allow only a limited number of recording options. These drawings are, of course, two-dimensional representations of three-dimensional objects; in other words, the zones being recorded are not completely flat surfaces. Therefore it should be remembered, for example, that where a particular zone is shown on the anterior aspect, it will also continue around to the corresponding part of the posterior aspect unless otherwise indicated. The zones on these various aspects could be further divided in order to accommodate detailed analysis of axially-based fracturing, but such subdivision would probably only add unnecessary complications for a small return of information.

The system explained

When initial sorting had been carried out, i.e. when the bone fragments had been assigned to species and element, each was then recorded using the new system. It was found to be simpler to deal with groups of homologous elements at the same time since in this way familiarity with zones was gained much more rapidly.

Each individual fragment was compared with the appropriate template to establish which particular zones were present. Each zone was then assessed individually in order to establish whether more than 50% of that zone was present on the specimen. The numerical code, i.e. the number by which that zone is labelled for each was then recorded in one of the two available columns of the pro-forma (i.e. less than 50% or greater than 50% - see Fig. 23).

Application

Quantitative analysis

The crux of zooarchaeological interpretation relies on the accurate quantification of the original assemblage. It is of little value to calculate minimum numbers of individuals (MNI), or to establish epiphyseal fragment counts, or to apply whatever sophisticated statistics to the sample, if the original recording system does not accurately and consistently represent each bone fragment. Ideally a recording system is needed which can be applied to the majority of more commonly used quantitative methods.

By definition, a morphologically distinct zone occurs only once on each bone. If more than 50% of that zone is present then it may be regarded as a non-repeatable element. Thus by totalling the frequencies of each zone for each element per species, a MNI estimation can be made from the zone most frequently recorded as greater than 50% complete.

General fragmentation and bone survival patterns can be assessed by rank ordering the zone frequencies per bone (see Figs. 24 and 25), while more detailed information can be gained by computing the frequencies of combinations of zones which often occur together.

Obviously the more quantitative methods that are used, the more reliable and informative the interpretation of the relevant data. Since many zones are defined by fusion lines, epiphyseal fragments can readily be isolated from individual records for using the 'epiphyses only' method of quantification. Total numbers of fragments can also easily be calculated directly from the same recording pro-forma.

Recording butchery and pathology

When butchery marks, animal gnawing, pathology or other noticeable insults to the bone were located on fragments, a series of codes were used accurately to define each category of modification and its location. The zone or zones on which the modification to the bone occurred were recorded along with its aspect, orientation, type and frequency. The following coding: But/1,2/med/-k/x4, for example, indicates that butchery marks were present in zones 1 and 2 on the medial surface, and consisted of horizontal knife marks, there being four in each zone. GnC/1,4 or GnR/1,4 signifies that carnivore or rodent gnawing is present in zones 1 and 4. Pathological information was recorded in much the same way, e.g. Ar/1,2,3,4/med+lat/gd2 indicates the presence of an arthropathy in zones 1,2,3 and 4, on the medial + lateral surface, of grade 2 severity (on a scale of 0 to 4).

Positional information is particularly important when recording processes which directly affect the integrity of bone, for example damage due to butchery, preservation, trauma or disease. A system which subdivides individual skeletal elements into small identifiable portions defined on consistent anatomical criteria can also be used accurately to record the position and extent of butchery marks, pathological conditions, and so forth. Thus the understanding of general butchery patterns and the like can be undertaken by comparing total frequencies for each bone zone with more detailed information on the type, orientation and direction of the damage.

Conclusion

The system presented here was largely developed as a response to the need for detailed recording of fragmented bones. It is flexible enough to allow a variety of quantitative methods to be used without the need for a further category of recording and can also be used to record detailed information regarding preservation, butchery and pathology. It is simple to use and, once familiarity with the zonation scheme is achieved, information can be recorded rapidly.

It can be applied to any bone assemblage and is most useful where bone is heavily comminuted and preservation is poor, or where detailed recording of preservation, butchery practices or pathology is required. It is highly reproducible within and between individuals, and thus allows reliable data comparison.

The system is very flexible and can be adapted to suit changing priorities. More zones could, for example, be added, while existing ones could be subdivided or combined, depending entirely upon the material and research emphasis. It would, however, be imperative to illustrate fully and to describe precisely how this was done for the sake of others wishing to use the system or data derived from it.

This recording system can be seen as yet another method to add to the vast array of well-established and often highly personalised techniques with which zooarchaeologists attempt to bring some order and sense to bone assemblages. These are developed to suit particular needs and as such are constantly being updated as material and perspectives change. It would be absurd to assume that one rigid method alone could ever meet the inevitable diversity of requirements. However, problems arise when it is unclear just how bones have been dealt with, because all too often an inadequate description is given of the recording system used.

Further problems can arise when a particular recording system varies in its application between individuals as this inevitably reduces the validity of data comparisons. It is therefore imperative that a detailed description is given of whatever recording system is applied so that the relevant information can be confidently used by others.

Recording diagnostic zones has proved to be an extremely useful tool for general zooarchaeological needs and it is hoped that others may also find its application equally useful.

Acknowledgements

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Watson. J. P. N. (1979). The estimation of the relative frequencies of mammalian species: Khirokitia 1972. Journal of Archaeological Science 6, 127-37.

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Figures 7-22. Diagnostic zones.

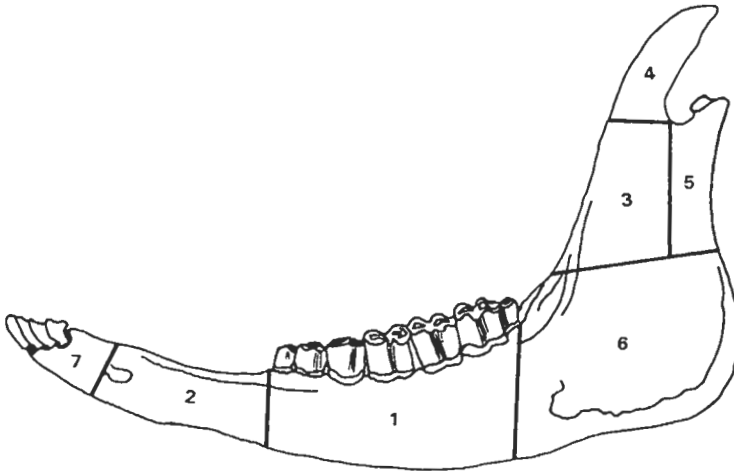


Figure 7. Mandible. 1 - tooth row; 2 - diastema including mental foramen; 3 - coronoid process (Processus coronoideus); 4 - anterior portion of ascending ramus; 5 - condyle and neck (Condylus mandibulae); 6 - ascending ramus (Collum manibulae); 7 - Corpus manibulae.

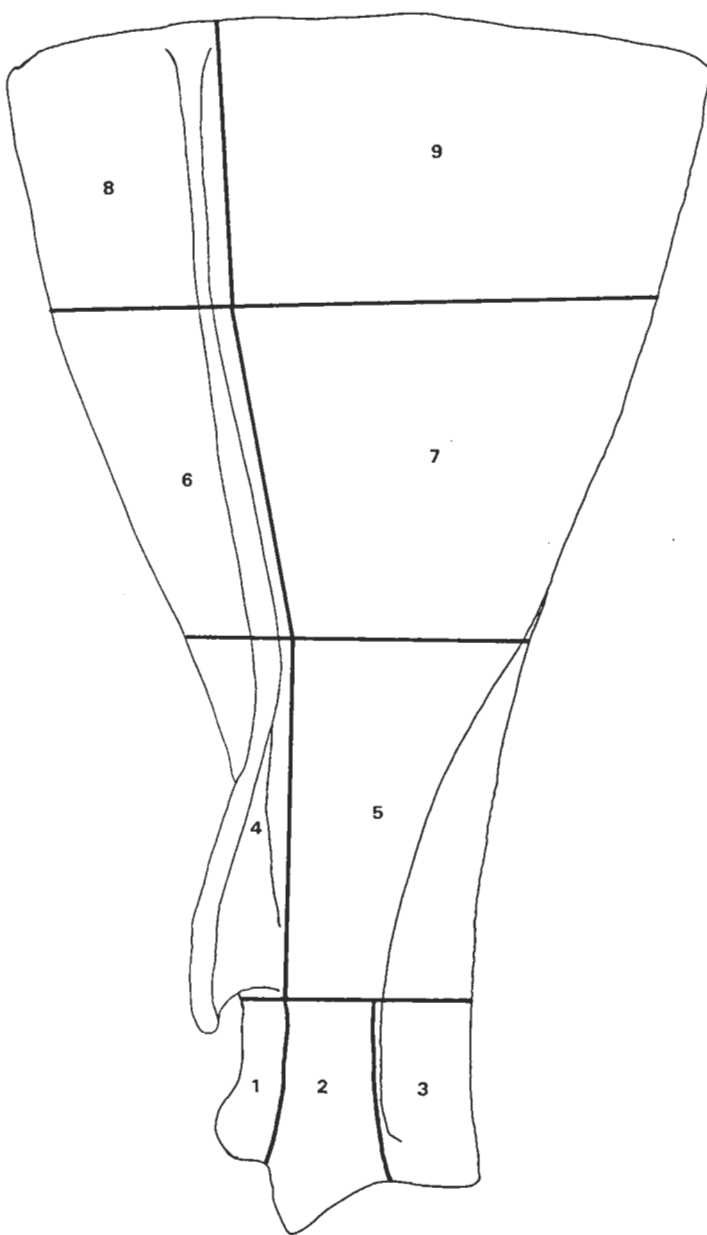


Figure 8. Scapula. 1 - Tuber scapulae; 2 - anterior half of glenoid cavity; 3 - posterior half of glenoid cavity; 4 - portion of blade including acromion and tuber spine; 5 - portion of blade including nutrient foramen; 6 - mid portion of blade including spine and supraspinous fossa; 7 - mid portion of blade including infraspinous fossa; 8 - portion of blade including spine and anterior angle; 9 - portion of blade including posterior angle.

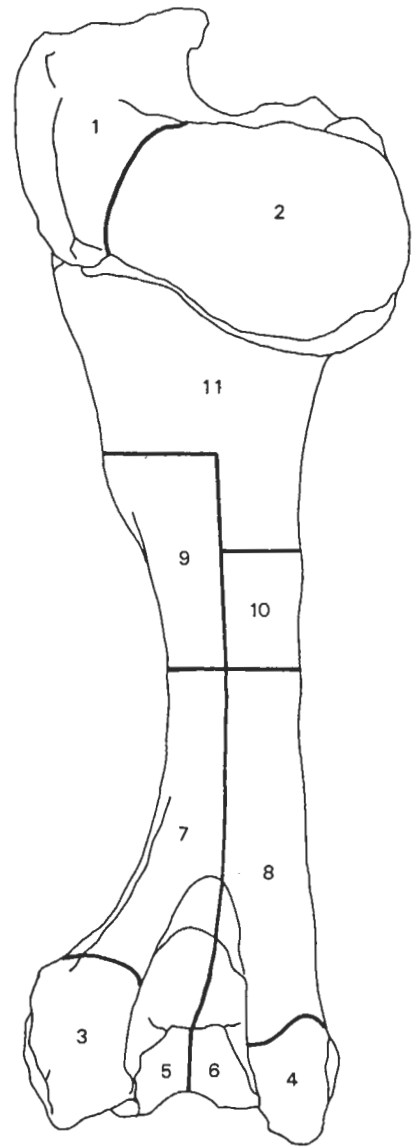
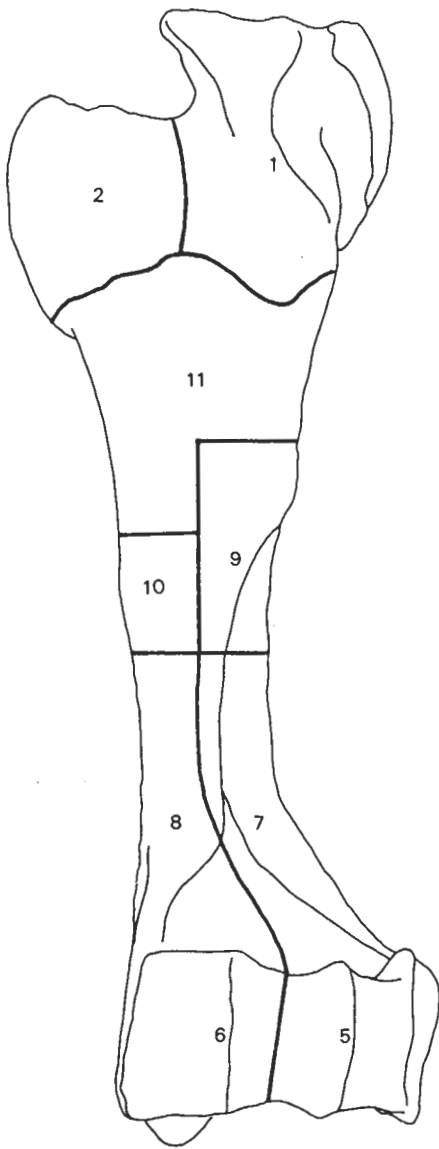


Figure 9. Humerus. 1 - lateral tuberosity; 2 - head including medial tuberosity and intertuberal groove; 3 - lateral epicondyle; 4 - medial epicondyle; 5 - lateral condyle; 6 - medial condyle; 7 - lateral distal half of shaft including musculospiral groove and coronoid and olecranon fossae; 8 - medial distal half of shaft including nutrient foramen and coronoid fossa; 9 - deltoid tuberosity; 10 - Tuberculum teres; 11 - proximal portion of shaft.

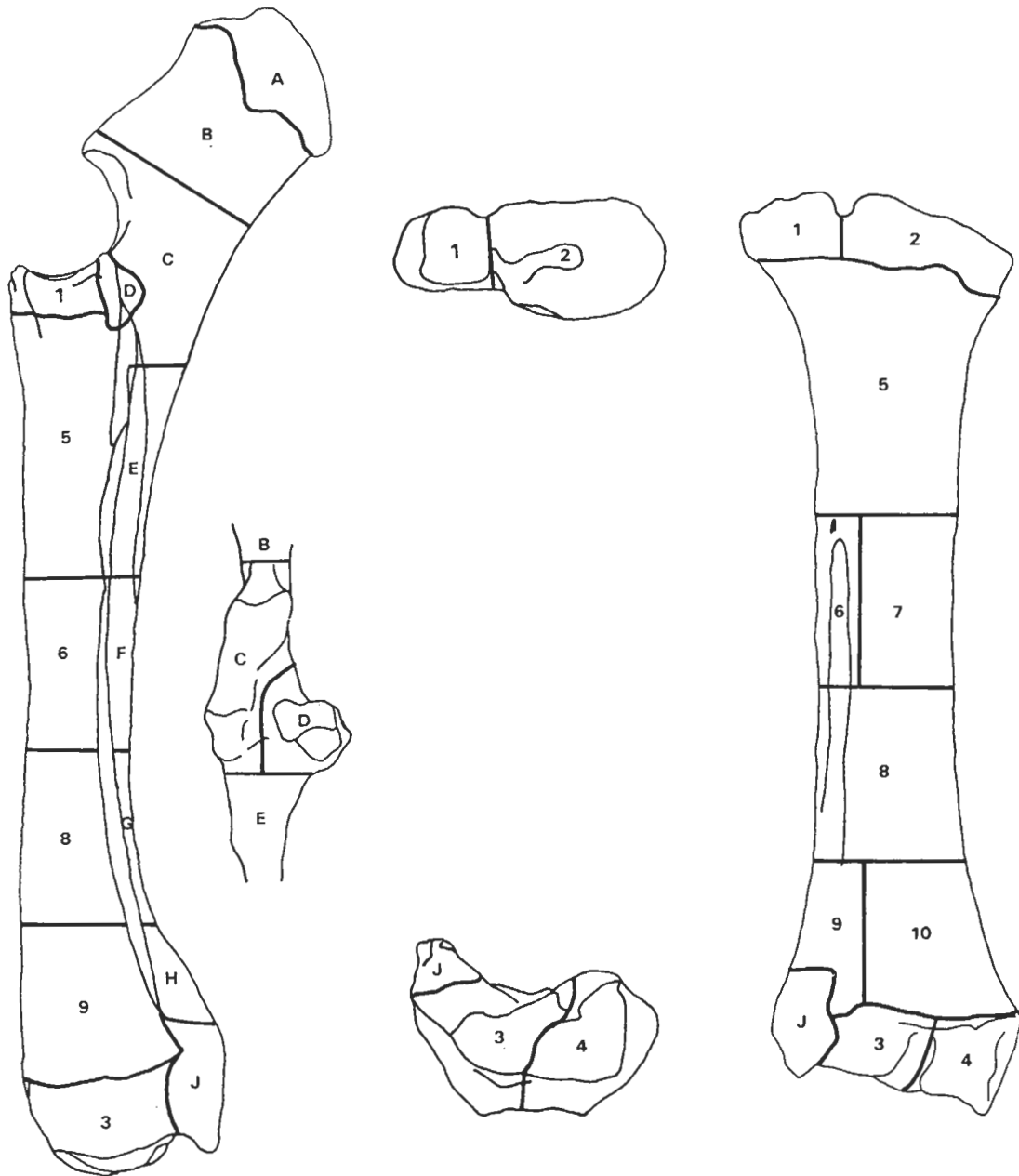


Figure 10. Radius/Ulna. 1 - lateral portion of humeral articular surface including coronoid process and radial tuberosity; 2 - medial portion of humeral articular surface including glenoid cavity and radial tuberosity; 3 - lateral portion of distal articulation; 4 - medial portion of distal articulation; 5 - proximal portion of shaft incorporating proximal inter-osseous space; 6 - lateral portion of shaft including proximal portion of ulna scar below nutrient foramen; 7 - medial portion of shaft; 8 - shaft including remaining ulna scar; 9 - distal shaft incorporating distal inter-osseous space; 10 - medial portion of distal shaft; A - olecranon; B - portion of ulna between the olecranon and Processus anconaeus; C - Processus anconaeus, semilunar notch and posterior portion; D - lateral articular surface; E - Portion of shaft inferior to articular surfaces including inter-osseous space; F - mid portion of shaft; G, H - distal portions of shaft; J - styloid process.

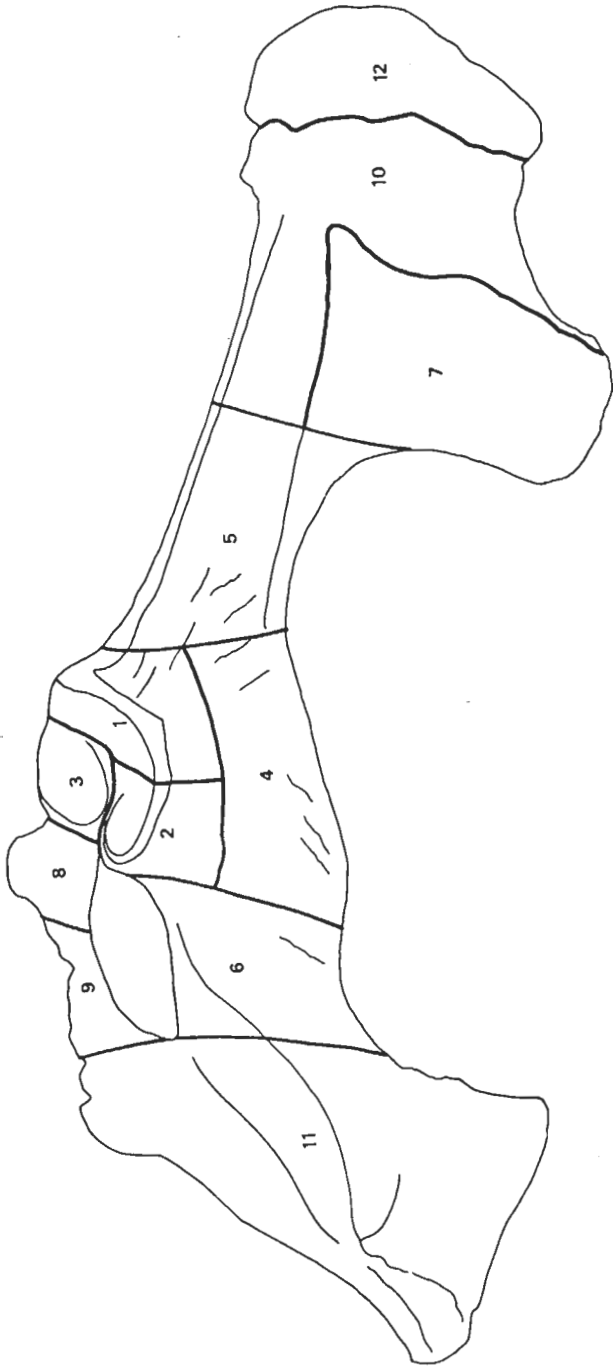


Figure 11. Innominate. 1 - Cranial portion of acetabular articulation; 2, 3 - acetabular articulation divided by acetabular fossa; 4 - ischial spine; 5 - shaft of ilium including greater sciatic notch; 6 - portion of ischium opposite obturator foramen; 7 - portion of ilium which articulates with sacral wing; 8 - portion of pubis including ilio-pectineal eminence and pubic tubercle; 9 - remaining portion of pubis including acetabular and symphyseal branch; 10 - remaining portion of ilium; 11 - remaining portion of ischium; 12 - Tuber coxae.

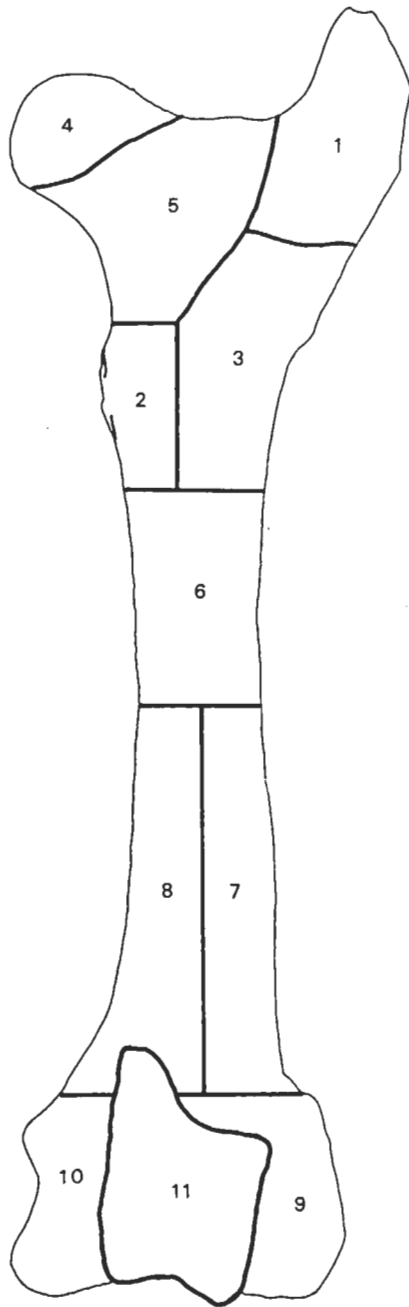
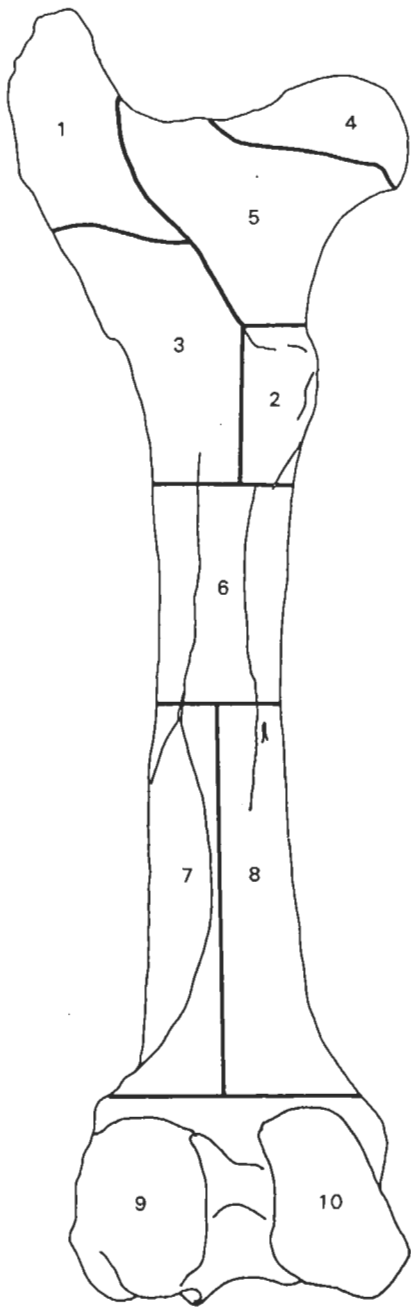


Figure 12. Femur. 1 - Trochanter major; 2 - Trochanter minor; 3 - Trochanter tertius (present in perissodactyles); 4 - head; 5 - trochanteric fossa and neck; 6 - mid portion of shaft; 7 - lateral portion of shaft including nutrient foramen and vascular groove; 8 - medial portion of shaft including supracondylar crest and supracondylar fossa; 9 - medial condyle and epicondyle; 10 - lateral condyle and epicondyle; 11 - trochlea.

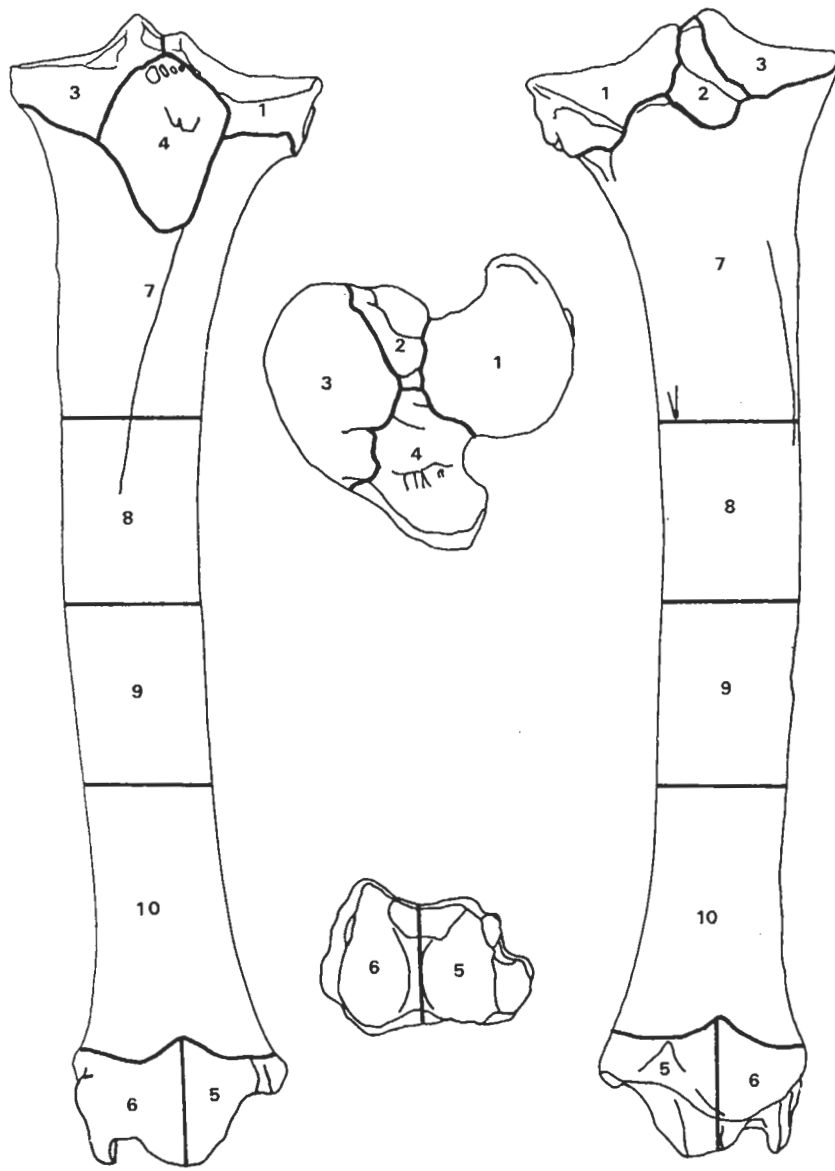


Figure 13. Tibia. 1 - medial condyle; 2 - intercondylar fossa; 3 - lateral condyle; 4 - proximal tuberosity and area between tubercles of spine; 5 - medial malleolus; 6 - lateral malleolus; 7 - proximal portion of shaft including nutrient foramen, most of crest and muscle attachment lines; 8, 9 - mid portions of shaft (8 includes distal end of anterior crest); 10 - distal portion of shaft.

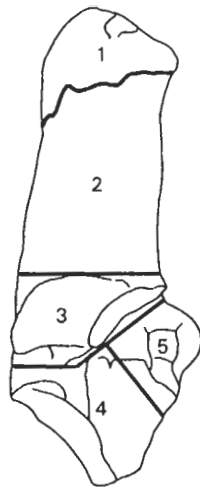


Figure 14. Calcaneum. 1 - Tuber calcis; 2 - body; 3 - Sustentaculum; 4 - distal tuberosity and articulation; 5 - Processus cochlearis.

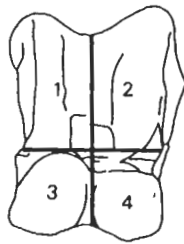


Figure 15. Astragalus. 1 - medial half of trochlea; 2 - lateral half of trochlea; 3 - medial half of distal articulation; 4 - lateral half of distal articulation.

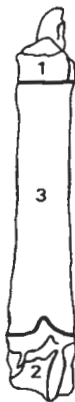


Figure 16. Metapodial (pig). 1 - proximal articulation; 2 - distal condyle; 3 - shaft region. N.B. for horse metapodials follow the same scheme as for pig but further dividing the shaft into two halves.

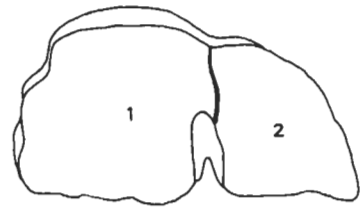
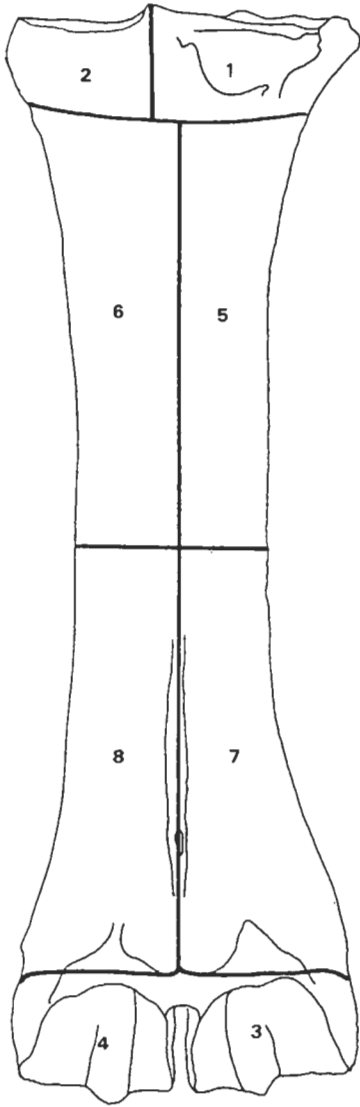


Figure 17. Metapodial (artiodactyles excluding pig). 1 - lateral portion of proximal articulation; 2 - medial portion of proximal articulation; 3 - lateral condyle; 4 - medial condyle; 5, 6 - proximal half of shaft divided by vascular groove; 7, 8 - distal half of shaft divided by vascular groove.

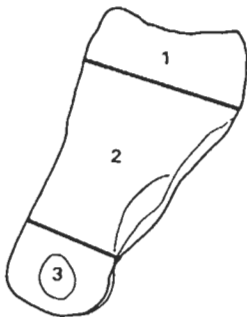


Figure 18. Phalanges. 1 - proximal articulation; 2 - distal articulation (for 3rd phalanx this is remaining portion of bone); 3 - shaft region.

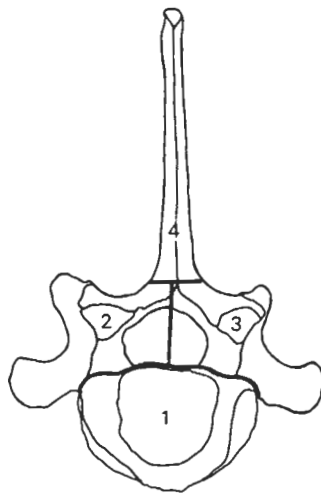


Figure 19. Vertebrae (excluding atlas and axis) (cranial aspect). 1 - head and body; 2 - right articular and transverse process; 3 - left articular and transverse process; 4 - spinous process.



Figure 20. Axis (lateral view).
Zones as Figure 19.

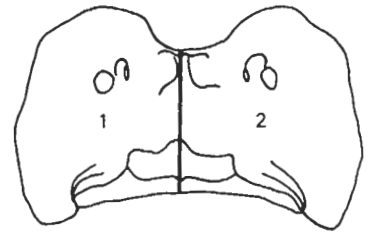


Figure 21. Atlas.
1 - left half; 2 - right half.

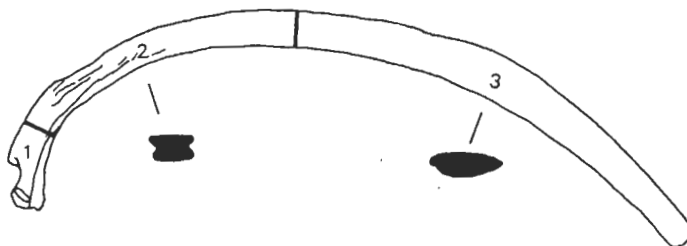


Figure 22. Rib. 1 - head, neck and tubercle; 2 - portion of blade with square section; 3 - portion of blade with flattened section.

Record Identifier	Bone No	Trench	Unit Context	Period	Context Descrip	Species	Element	Left Right	Measure
663	455		09		Hellenistic pit	Ovi	aph	L	Glpe: 37.09 / Bp: 12.88
664	455		09		"	Ovi	aph	L	Glpe: 39.38 / Bp: 13.52
665	455		09		"	Ovi	aph	R	Glpe: 40.85 / Bp: 14.68
666	455		09		"	Ovc	aph	L	Glpe: 42.66 / Bp: 15.30
667	455		09		"	Ovc	aph	L	Bp: 17.77
668	455		09		"	Cap	aph	L	Glpe: 35.59 / Bp: 12
669	455		09		"	Cap	aph	R	Glpe: 41.13 / Bp: 14
670	455		09		"	Cap	aph	R	Glpe: 39.37 / Bp:
671	455		09		"	Cap	aph	R	Glpe: 43.82 / Bp:
672	455		09		"	Cap	aph	R	Glpe: 38.24 / Bp
673	455		09		"	Cap	baph	L	Glpe: 24.14 / Bp
674	455		09		"	Cap	bph	L	Glpe: 25.65 / Bp:
675	455		09		"	Cap	bph	L	Glpe: 25.30 / Bp
676	455		09		"	Cap	bph	L	Bd: 13.11
677	455		09		"	Cap	Cph	L	Ld: 30.39 / 2L2
678	455		09		"	Ovi	Mc	L	Gl: 15.49 / Bp: 26.50
679	455		09		"	Cap	Mc	?	Sp: 24.65 / a: 9.83 / b: 6
679	455		09		"	Cap	Mc	?	a: 9.51 / b: 16.65
680	455		09		"	Ovc	horn	L	68b: 32.26 / 6T: 30.88
681	455		09		"	Ovc	horn	R	68: 33.67 / 6T: 31.68
	455		09		"	Ovc/g	Mc	?	---
682	455		09		"	Ovi	Rad	L	---
	455		09		"	Ovc	Rad	R	---
683	455		09		"	Cap	Tib	L	Bd: 28.81
684	455		09		"	Ovc/g	Tib	L	---
	455		09		"	Ovc/g	Tib	R	---
685	455		09		"	Ovc/g	Tib	R	---
	455		09		"	Ovc/g	Tib	R	---
	455		09		"	Ovc	Tib	R	---
686	455		09		"	Ovc/g	Tib	R	---
687	455		09		"	Cap	Cal	L	66: 22.31 / LF: 0.41 / 12: 2
688	455		09		"	Ovi	Pist	L	64: 33.60 / 6LM: 31.22
689	455		09		"	Ovc/g	Fem	L	---
	455		09		"	Cap	horn	B	---
	455		09		"	Cap	horn	B	---
	455		09		"	Ovc/g	pel	L	---
	455		09		"	Ovc/g	pel	L	---
	455		09		"	Ovc/g	pel	L	---
690	455		09		"	Ovc	pel	L	---
	455		09		"	Ovc	Uln	L	---
	455		09		"	Ovc	Uln	L	---
	455		09		"	Ovc	Uln	R	---
691	455		09		"	Ovi	Scap	L	---
692	455		09		"	Ovc	Scap	L	---
	455		09		"	Ovc	Scap	L	---
	455		09		"	Ovc/g	Scap	L	---
	455		09		"	Ovc	Rad	R	---
	455		09		"	Ovc	horn	R	---

Figure 23. Example of a recording pro-forma used in the field. Columns 11 and 12 are used to record the morphological zones, while columns 15 and 16 record butchery and pathology.

Comments	Zones 75%+	Zones < 50%	Fusion Ageing	Teeth Present	Bone Alteration	Pathology	Preservation	Fresh, Br spiral line Root etch etc	Photo x-ray removed Drawn
8d: 11-47	1/2/3	—	Pf Df	—	—	—	Fair	—	—
8d: 11-92	1/2/3	—	Pf Df	—	—	—	Fair	—	—
8d: 13-89	1/2/3	—	Pf Df	—	—	—	Fair	—	—
8d: 13-12	1/2/3	—	Pf Df	—	—	—	Fair	—	—
12/8d: 11-87	1/2/3	—	Pf Df	—	—	Am/3/Normal/	Good	—	R/P
10/8d: 13-48	1/2/3	—	Pf Df	—	—	—	Good	—	—
14-53/8d: 12-76	1/2/3	—	Pf Df	—	—	—	Fair	—	—
13-43/8d: 12-18	1/2/3	—	Pf Df	—	—	—	Fair	—	—
38-24/8d: 13-01	1/2/3	—	Pf Df	—	—	—	Good	—	—
18-84/8d: 10-88	1/2/3	—	Pf Df	—	—	—	Good	—	—
12-04/8d: 10-54	1/2/3	—	Pf Df	—	—	—	Fair	—	—
13-82/8d: 11-36	1/2/3	—	Pf Df	—	—	—	Fair	—	—
6	2/3	—	Df	—	—	—	Fair	—	—
37-17	1/2/3	—	Pf	—	—	—	Good	—	—
(8d: 31-44/a: 12-53/b: 11-17)	1/2/3/4/6/7/8	—	Pf Df	—	—	—	Fair	FB (small)	—
3-86	3/4	—	Dn	—	—	—	Fair	—	—
	3or4	—	Dn	—	—	—	Fair	—	—
16D: 16-20	5/6/7/8	9 mm	Dg	—	—	—	Fair	FB	—
6S: 16-10	5/6/7/8	—	Dg	—	Band/ All	—	Fair	FB	—
	7/8	—	Dn/Ju	—	—	—	Poor	FB	—
	5/6/7/8/9	—	Dn/Ju	—	—	—	Poor	—	—
	8/9/10	7	Dn	—	—	—	Fair	—	—
	7/8/9	6	Dg	—	—	—	Fair	FB/SF	—
	5/6/7/8	—	Dn	—	(But 5/Ked - c/f)	—	Fair	—	—
	6/7	—	Dn	—	But 1/all	—	Fair	—	—
	4/5/	6	Pn	—	But 1/1/all - 1/5	—	Fair	—	—
	5	6	—	—	—	—	Fair	FB	—
	1/2/3	—	Pn	—	—	—	Poor	—	—
	1/2	3	Pn	—	But 3/1/all - c/f	—	Poor	FB	—
110/6: 14-74	2/3	—	Pn	—	—	—	Fair	—	—
16d: 20-4/8d: 17-54	1/2/3/4	—	Ma	—	—	—	Fair	Wenth	—
	8/9/10	6/7	Dn	—	—	—	Poor	—	—
	1/2	3	—	—	—	—	Fair	FB	—
	1	2	—	—	—	—	Fair	FB	—
	1/4/5/6	2	Ma	—	—	—	Fair	FB	—
	1/6/11	4/3	In	—	—	—	Poor	—	—
	1/6	4/11	In	—	—	—	Poor	—	—
	5/7/10	—	Ma	—	But 5/1/all - 1/5	—	Fair	—	—
	2/3	4	Pn	—	—	—	Poor	—	—
	2/3	—	Pn	—	—	—	Poor	—	—
	2/3	4	Pn	—	—	—	Poor	FB	—
	1/2/3/4/5	—	Pf	—	—	epiphyseal form	Fair	FB	—
	4/5/6/7	8/9	—	—	But 4/5/1/all - 1/5	—	Fair	FB/Wenth	—
	4/5/6/9	—	—	—	—	—	Poor	—	—
	9/6	10	Bn	—	—	—	Fair	Wenth	—
	1	5/6	Pf	—	—	—	Fair	—	—
	2/3	10	Pn	—	—	—	Fair	—	—

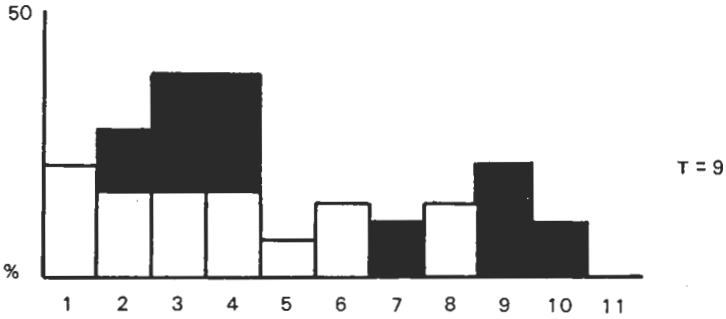
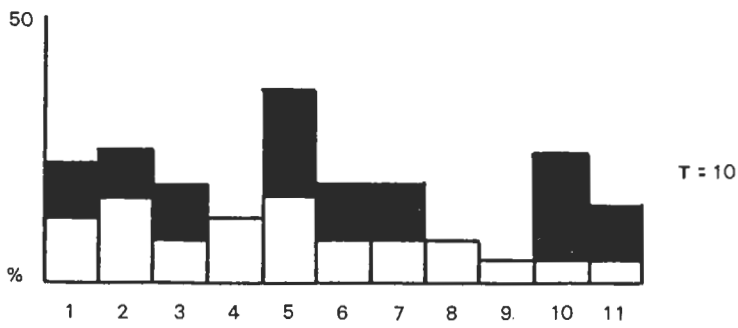


Figure 24. Histograms showing frequencies of morphological zones in caprovid pelvis fragments from Uruk-period deposits at two sites in north and south Iraq - above: Mohammed Arab; below: Abu Salabikh. Zone 12 was not recorded in these two instances. T - total number of bone specimens; percentages are calculated from the total number of zones recorded as > 50% present (25 for site Mohammed Arab and 14 for Abu Salabikh) or < 50% present (10 and 9 respectively).

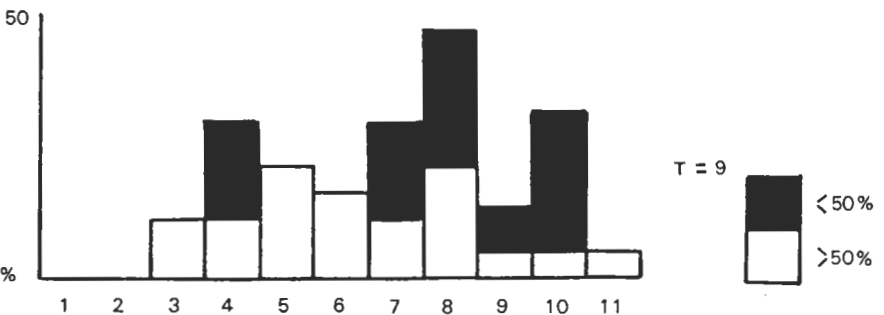
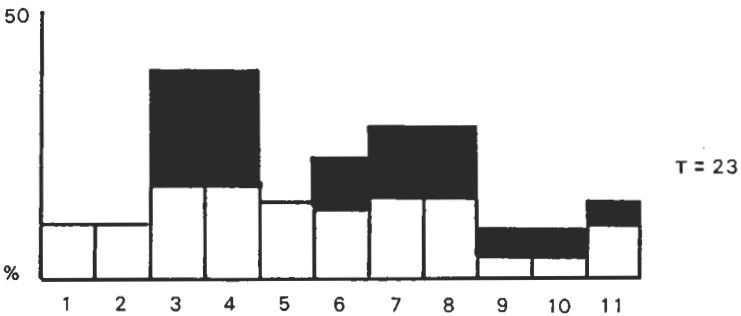


Figure 25. As Figure 24, for caprovid humerus fragments; total numbers of zones recorded as > 50% present are 101 for Mohammed Arab (above) and 19 for Abu Salabikh (below); total numbers recorded as < 50% present are 21 and 11 respectively.

A simple device for obtaining contiguous peat samples of small volume for pollen analysis

Patricia E. J. Wiltshire *

Summary

A device for taking very closely-spaced samples from cores for pollen analysis is described and illustrated.

Introduction

In pollen analysis, close sampling of peat cores is often necessary where peat accretion is slow, where rapid changes in pollen influx have occurred, or where vegetation changes need to be analysed with high temporal resolution.

Where the sediment is very fibrous, this kind of sampling may prove to be quite tricky, and a simple device which facilitates such sampling, and which is cheap and easily made, is described here. This device has been used very successfully by several workers in the author's Department.

Description of the sampler

A number of sheets of perspex (5.0 x 2.5 x 0.2 cm), corresponding to the number of contiguous samples required, are sandwiched together with a larger block of perspex (5.0 x 2.5 x 1.0 cm) placed at each end. Thus, in the example illustrated here, samples of 0.2 cm thickness are obtained.

Two holes are drilled through the whole sandwich and a threaded bolt inserted into each 'tunnel' thus created. A double-edged razor blade is placed between each piece of perspex, each one resting on the threaded bolt. The whole structure is then secured by four nuts, one on each end of each bolt, as shown in Fig. 26.

Method of use

The sampler is held perpendicular to the peat face and then pushed into the sediment. The peat becomes wedged into the spaces between the razor blades and is easily removed with a small spatula or scalpel, without any need for the device being dismantled.

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Advantages of the sampler

- (1) The thickness of perspex can be varied so that the individual peat samples can be of any volume required.
- (2) Sample volume can be doubled, trebled, etc., simply by omitting some of the razor blades.
- (3) The sharpness of the blades enables the analyst to sample fibrous material relatively accurately.
- (4) A reasonably accurate calculation of the volume of the peat sample can be made very simply since the length of the blade, the amount of blade protruding, and the distance between the blades are easily measured.
- (5) The sampler is effective in both organic and mineral sediments and may be used in the field or the laboratory.

Discussion

The device has proved to be remarkably effective in obtaining contiguous samples of almost identical volume for any given core of sediment. This consistency has been demonstrated by estimation of both the wet and dry weights of samples after their removal from between the razor blades and, even in fibrous peat, the replication of sample mass was good. Indeed, it was in deposits rich in monocotyledonous leaves and roots that the sampler proved its worth; it was able to slice through the fibres and so avoid the disruption of the peat that so commonly occurs during conventional sampling.

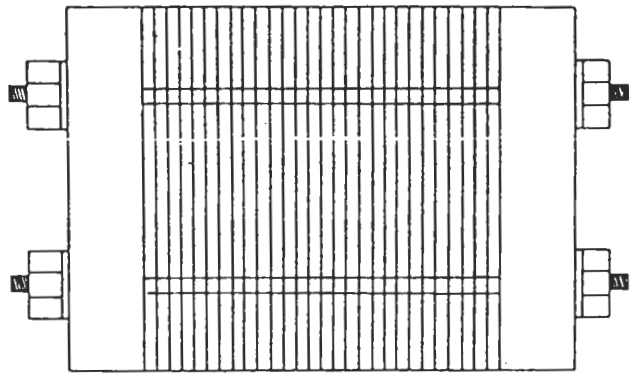
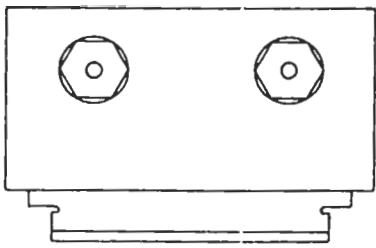
In spite of there having been no mishap so far amongst the numerous undergraduates who have used the sampler, the device is potentially dangerous and should be kept in some sort of protective container (such as a small box) when not in use.

Acknowledgements

I would like to thank King's College workshop and Mr Clive Daws for making the sampler, and Mr Michael Rootes for drawing the diagrams.

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Figure 26 (opposite). Diagrams showing the structure and construction of the peat sampler. Above, left: end view; above, right: top view; centre: side view; below: partly assembled.



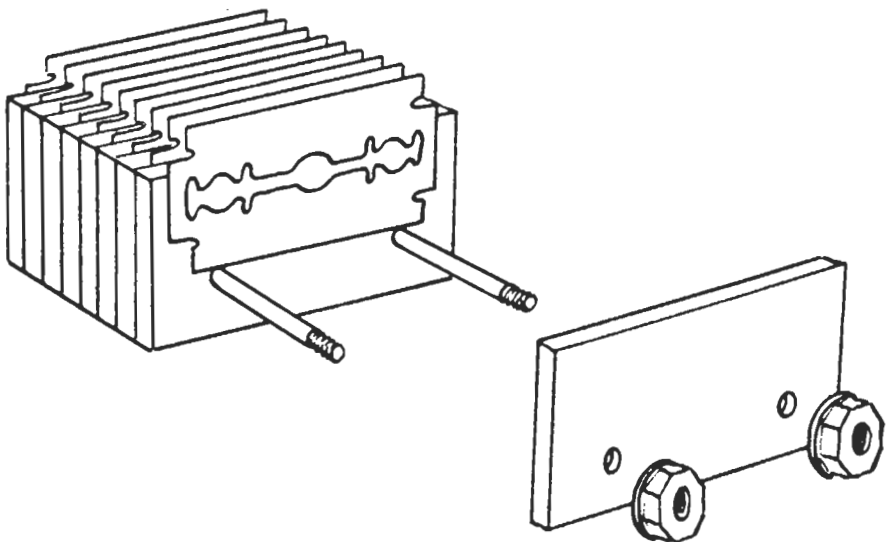
Threaded bolt

Intermediate perspex block

Nut

Perspex end block

Razor blade



Cereals in Scottish antiquity

W. E. Boyd *

Summary

A catalogue of records of charred and waterlogged cereal remains from archaeological sites in Scotland is presented, together with some comments on the distribution of the evidence in space and time.

Introduction

The author has, until recently, been compiling a catalogue of references to the presence of cereal fossils (excluding pollen, for which see, for example, Edwards and Hiron 1984) occurring in Scottish archaeological contexts. However since I have now moved to Australia, it is unlikely that the compilation of this catalogue will continue for the foreseeable future. It seems unhelpful to file this information away, and publication of the basic information contained in the catalogue will be of use to those beginning or continuing research in the field of Scottish environmental archaeology. The catalogue, while being moderately complete up to 1986, is undoubtedly not exhaustive; in particular the files of the Scottish Development Department (Historic Buildings and Monuments) are likely to contain unpublished data of relevance to this catalogue.

Sites and references

The following is a list of Scottish sites for which there are fossil records of cereals. The number(s) in brackets following each site indicate the publication details listed below. The county names are those used prior to 1974.

Neolithic: Easterton, Roseisle, Burghhead (1); Eday, Orkney (1); Isbister, Shetland (2); Knap of Howar, Papa Westray, Orkney (3); Townhead, Rothesay, Bute (1, 4, 5); Unstan, Orkney (1).

Bronze Age: Archerfield, Haddington (1); Ardnave, Islay (6); Arniston, Edinburgh (1); Balbirnie, Fife (1); Barvas Machair, Lewis (7); Baskerfield, Glenluce, Wigtownshire (1); Brackmont Mill, Leuchars, Fife (1, 8); Buckie, Banffshire (1); Cadder, Lanarkshire (1); Carmylie, Forfar (1); Chapel of Gariock, Aberdeenshire (1); Chrichie, Aberdeenshire (1); Craigentiny, Edinburgh (1); Culbin Sands, Wigtownshire (1, 4); Dalmore, Lewis (9); Daviot, Aberdeenshire (10); Dean Bridge, Edinburgh (1); Donne Castle, Forfar (1); Drymmiewood, Balbirnie, Fife (1); Gambrie, Gardenstown, Banffshire (1); Glenballoch, New Rattray, Perthshire (1); Glenluce, Wigtownshire (1); Glenluce Sands, Wigtownshire (1);

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Greenoakhill, Mount Vernon, Glasgow (1, 10); Jarlshof, Shetland (1, 10); Largs, Ayrshire (1); Leuchars, Fife (1, 10, 11); Lintlaw, Bunkle, Berwick (1); Magdalen Bridge, Edinburgh (1); Musselburgh (1); Myrehead, Falkirk (12, 13); Newlands, Longside, Glasgow (1); Ness of Gruting, Shetland (14, 15); North Berwick (1); Outerston Hill, Edinburgh (1); Point of Buckquoy, Mainland, Orkney (16); Rosinish, Benbecula (17); Spottiswood, Berwick (1); Strathblane, Stirlingshire (1); Torrs, Luce, Wigtownshire (1); Turriff, Aberdeenshire (1); Tusculum, North Berwick (5, 18); Upper Boyndlie, Tyrie, Aberdeenshire (1); Unknown locality, Aberdeenshire (1); West Kilbride, Ayrshire (1); Westwood, Newport, Fife (1); Wetherhill, Muirkirk, Ayrshire (1); Windyhall, Rothesay, Bute (1).

Iron Age: Balloch Hill, Kintyre (19); Baleshare, Uist (59); Borness Cave, Kirkcudbrightshire (1, 10, 20, 21); Broch of Burrian, North Ronaldsay, Orkney (22); Broch of Gurness, Orkney (7); Bu Broch, Orkney (7); Camelon, Falkirk (23); Crosskirk, Caithness (24); Dun Beag, Struan, Skye (22, 25); Dun Cul Bhuirg, Iona (26); Dun Mor Vault, Tiree (27, 28); Erskine Ferry, Old Kilpatrick, Dumbartonshire (10); Fairy Knowe, Buchlyvie, Stirlingshire (29); Hornish Point, Uist (59); Howe of Howe, Orkney (7); Leckie Dun, Stirlingshire (7); Lingraw Broch, Orkney (30); Machrins, Colonsay (7); Road Broch, Keiss, Caithness (10, 31); Sheils, Govan, Renfrewshire (32); Stenness, Orkney (33).

Roman: Bearsden, Dumbartonshire (7, 34, 35, 36); Birrens, Dumfriesshire (1, 37); Castlecary, Stirlingshire (1, 7, 11, 36); Forth and Clyde Canal, Stirlingshire (1); Kintore, Aberdeenshire (38); Newstead, Melrose, Roxburghshire (39); Westerwood, Stirlingshire (40); Yorkhill, Glasgow (1).

Dark Age, Viking, Pictish: Barhapple Loch, Wigtownshire (1); Barvas Machair, Lewis (7); Bay of Birsay, Orkney (16); Dalladies, Perthshire (41); Dunadd, Argyllshire (42); Dundurn, St Fillans, Perthshire (43); Freswick Castle, Caithness (44); Freswick Links, Caithness (45); Machrins, Colonsay (46); Saevar Howe, Orkney (47); Sandwick, Unst, Shetland (48).

Medieval and post-medieval: Aberdeen (49); Camphill, Glasgow (1, 10, 50); Castlehill of Strachan, Kincardine and Deeside (51, 52); Elgin (49); High St., Glasgow (53); Machrins, Colonsay (54); Nethermills Farm, Banchory, Deeside (52, 55); Perth (49, 56, 57); St Andrews (57).

Unknown age: Old Kilpatrick, Erskine, Dumbartonshire (1, 4); Wemyss, Fife (10, 58).

Publications referred to in the catalogue

(1) Jessen and Helbaek (1944); (2) A. Lynch, in Hedges (1983a); (3) C. A. Dickson, in Ritchie (1984); (4) Callander (1929); (5) Curwen (1938); (6) C. A. Dickson, in Ritchie and Welfare (1984); (7) C. A. Dickson, unpublished reports; (8) Mears (1937); (9) Ponting and Ponting (1984); (10) Kilbride-Jones and Mitchell (1933); (11) Percival (1934); (12) Barclay (1983); (13) Barclay and Fairweather (1984); (14) H. Helbaek, in Calder (1950); (15) A. Milles, unpublished; (16) Donaldson et al. (1981); (17) Shepherd and Tuckwell (1979); (18) Cree (1908); (19) C. A. Dickson, in Peltenburg (1982); (20) Corrie et al. (1875); (21) Callander (1911); (22) MacGregor (1975); (23) G. W. Dimbleby and J. Sheldon, in Proudfoot (1980); (24) Dickson (1979); (25) Callander (1921); (26) C. A. Dickson, in Ritchie and Lane (1981); (27) J. M. Renfrew, in MacKie (1974); (28) MacKie (1969); (29) Boyd (1982-83); (30) Petrie (1873); (31) Anderson (1901); (32) Robinson (1983); (33) C. MacLean, in Ritchie (1978); (34) Dickson et al. (1979); (35) Knights et al. (1983); (36) Dickson and Dickson (forthcoming); (37) Wilson (1975); (38) W. E. Boyd, unpublished

report; (39) Tagg, in Curle (1911); (40) MacDonald (1933); (41) Watkins (1981); (42) A. Milles, in A. Lane, unpublished reports; (43) C. A. Dickson, in L. Alcock, unpublished report; (44) A. Donaldson, in Batey et al. (1984); (45) Rackham et al. (1984); (46) C. A. Dickson, in Ritchie (1981); (47) C. A. Dickson, in Hedges (1983b); (48) G. E. M. Jones, unpublished report; (49) Fraser (1981); (50) Fairhurst and Scott (1953); (51) W. E. Boyd, in Yeoman (1984); (52) Boyd (1986a); (53) W. E. Boyd (1986b) and (in press); (54) C. A. Dickson, in Ritchie (1981); (55) Boyd (1986c); (56) D. E. Robinson, in Blanchard (forthcoming); (57) W. E. Boyd, unpublished reports; (58) Simpson (1875), quoted in (10); (59) Jones, unpublished report.

Discussion

Even given the increase in the amount of available data on cereals in antiquity, it is doubtful that there is yet sufficient resolution in terms of spatial and temporal distribution of sites in Scotland to update Jessen and Helbaek's (1944) early distribution maps in order to recognise a complete expression of the spread and use of cereals in ancient Scotland. This problem stems from several basic facts. Firstly, the distribution of excavated sites providing botanical evidence is uneven and, to a degree, geographically constrained. There are, for example, concentrations of sites of different ages in certain areas, such as the Northern Isles (neolithic) and, naturally, some urban settings (medieval). Furthermore, a relatively small proportion of the known archaeological sites provide palaeobotanical evidence; thus, for example, the several hundreds of neolithic artefact and monument sites in Scotland (e.g. Smith 1974, figs 12, 14-16; Henshall 1977, figs 19, 20) contrast with the six catalogued neolithic sites at which fossil cereal remains are recorded. A related factor is that not all sites necessarily provide the botanical material required for the comprehensive and rigorous study of past cereal distribution and use. Most of the Bronze Age sites recorded by Jessen and Helbaek (1944), for example, represent records of single or few grains, and many sites throughout Scottish antiquity provide similarly small fossil assemblages. Not only is it unclear, therefore, whether the full range of cereals associated with former human activity at these sites is represented, but also there is minimal potential for further detailed analysis based upon various approaches such as those of Hillman (1981; 1984 a, b) and G. E. M. Jones (1984) or of M. Jones (1984; 1985). These factors, of course, do not merely constrain research advances in archaeology-based palaeobotany, but in many other archaeological fields.

The situation described above contrasts with that generally pertaining in Quaternary palaeobotany, in which it is now possible to represent the early Flandrian spread of many major plants at a continental level (e.g. Huntley and Birks 1983; Delcourt and Delcourt 1985) and, in some cases, at a macro-regional level (e.g. Godwin 1975; Birks 1980; Bennett 1984). This success reflects the intrinsic differences between Quaternary palaeoenvironmental studies and much of environmental archaeology; in the former long temporal sequences can be studied, whereas in the latter, sites tend to represent small numbers (often only one) of discrete temporal units. Likewise, the effort required to extract equivalent palynological and plant macrofossil assemblages differs considerably, and equivalent interpretation is frustrated by the considerable differences in the influence and effects of differing taphonomic processes in the two types of study. In general, the degree of data resolution available to plant macrofossil analysis is lower than in palynological studies, and consequently, efforts to summarise trends in spatial and temporal distributions of, for example, cereals must be conducted, in most cases and for the time being, at a moderately high level of generalisation (see, for example, Godwin 1975, figs 139-41; Hubbard 1976; 1980).

Although it is not the primary purpose of this paper to discuss cereal distributions in Scottish antiquity in detail, it is possible, on the basis of this catalogue to make some general points which may illustrate the difficulties outlined above. These comments must be regarded, in some cases, as tentative, since future or continuing research will undoubtedly clarify or alter some of the ideas.

Of the six neolithic sites, four are from the Northern Isles, and only one (Townhead, Rothesay) from southern Scotland. At all sites, the few cereal remains are of six-row barley (Hordeum vulgare), where identifiable to species level; the grain at Townhead was originally recorded as probable wheat (Triticum sp.) but has been subsequently re-identified as Hordeum (C. A. Dickson pers. comm.).

The Bronze Age provides the greatest number of cereal sites in Scotland although, since these are largely finds of grain impressions in pottery, it is debatable whether local cereal use and cultivation is reflected. In general, Hordeum is most common, although at many of the coastal dune sites - Culbin Sands, Glenluce, Rosinish and Leuchars - Triticum (mainly emmer, T. dicoccum) is present, perhaps reflecting the arrival of pottery from further south into these coastal areas, or the greater suitability of the drier sandy soils for wheat cultivation. One notable site is the inland site of Myrehead, Falkirk, where finds of rye (Secale cereale) are recorded. These, however, are regarded as intrusive weeds rather than a reflection of deliberate cultivation (Barclay and Fairweather 1984). In terms of site distribution, Bronze Age cereal sites tend to be in outlying northern and southern areas and along the eastern seaboard; there is a notable paucity of sites throughout the west and northwest of Scotland.

The Iron Age likewise is poorly represented; sites where cereals have been recorded typically occur in the northern and western islands and highlands. Hordeum vulgare again is predominant, although at Baleshare and Hornish Point (Uist), Balloch Hill (Kintyre), Fairy Knowe (Forth Valley) and Bu Broch (Orkney) Triticum (probably all T. dicoccum) is recorded as a secondary cereal. Oats, Avena, appears for the first time in Scotland and, where grains are identifiable to species level, A. strigosa appears to be the commonly cultivated oat. In general, the Iron Age sites provide small and inadequate assemblages although at Fairy Knowe analysis following Hillman (1981) was possible, and provided, for the first time in Scotland, evidence for the cultivation (rather than merely the presence) of cereals at an Iron Age site (Boyd 1982-83). The arrival of the Romans saw a major change, with Triticum (both T. dicoccum and bread/club wheat, T. compactum/aestivum) being more commonly represented than Hordeum at archaeological sites. It is probable, however, that Triticum and Secale (as at the Castlecary and Forth and Clyde Canal sites) were imported rather than grown locally for Roman military consumption (Helbaek 1971; Godwin 1975, 414). Avena (not only A. strigosa but also A. sativa) is present at some sites. Again, the total number of Roman sites where cereals have been recorded is low in comparison with all the known sites of this date (see, for example, Breeze 1979), and the extent to which interaction between Roman trade and supply and local cultivation existed has not yet been examined fully.

During the Dark Ages (*sensu lato*) Hordeum (where identifiable, H. vulgare) returns to prominence at Viking, Pictish and other sites. Triticum dicoccum occurs at the south-west Scottish Dark Age sites of Barhapple Loch and Dunadd, and Avena (either A. strigosa or the weed A. fatua) occurs at most sites. Again, however, the paucity and uneven distribution of sites precludes any detailed spatial analysis.

Sites of medieval and post-medieval age are also sparse and unevenly distributed in Scotland with, in this case, the predominant emphasis upon large and well-excavated urban sites (notably in Perth, but also in Glasgow, St Andrews, Elgin and Aberdeen), where Hordeum (often H. vulgare), Avena strigosa and/or sativa and Triticum (mainly T. compactum/aestivum) are recorded. At St Andrews, Secale cereale and Triticum dicoccum have also been recorded, probably reflecting the optimal agricultural conditions which exist along a narrow coastal strip in central eastern Scotland. Only three rural sites are recorded and the data from these are minimal (Boyd, in press).

In conclusion, the overall picture is one of sparse and unevenly-distributed sites. Cultivation and use of six-row barley (Hordeum vulgare) predominates throughout Scottish antiquity, with a middle period in which emmer (Triticum dicoccum) appears. The balance of species recorded alters substantially during the Roman period, largely reflecting the intrusive nature of the Roman occupation of southern Scotland, and the most convincing period of wheat cultivation in Scotland appears to be the medieval and post-medieval period, in which bread wheat (T. compactum/aestivum) was widely grown and used. Likewise, the cultivated oat (Avena sativa) appears to be a moderately recent addition, with the bristle or black oat (A. strigosa) having a slightly longer history in Scotland but, by comparison with barley or emmer, A. strigosa can hardly be regarded as an ancient Scottish cereal. The last main northern European cereal, rye (Secale cereale), occurs only as a 'fringe' cereal, possibly only having been cultivated on the eastern seaboard during the medieval period. Despite this relatively recent increase in diversity, Hordeum vulgare has, until modern times, remained the principal cereal crop to be cultivated in Scotland (Bland 1977).

Post-script

In late stages of preparing this text, Annie Milles informed me of her work in the early agricultural settlement at Scord of Brouster, Shetland, which is contained in her 1984 M.Sc. thesis (Milles 1984) and is being prepared for full publication in the excavation report (Whittle forthcoming).

Acknowledgements

The information presented here was mainly compiled while the author was working in the Department of Botany at the University of Glasgow. I wish to extend my thanks to those members of the staff at Glasgow who contributed to my knowledge of the subject, and in particular to Camilla Dickson, who was always willing to share her considerable understanding of the subject, and has kindly allowed me to quote some of her unpublished work. Thanks also go to the various researchers beyond Glasgow with whom I have corresponded and who have likewise allowed me access to unpublished material. During my time at Glasgow, much of my work was funded by the Scottish Development Department (Historic Buildings and Monuments) and the Scottish Urban Archaeological Trust, funding which was always gratefully received and without which the work reported here would not have been undertaken.

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(Editors' Note: Many of the references to papers in Proceedings of the Society of Antiquaries of Scotland are given with both the year of printing and the 'year(s) for which' they were published; bound copies usually bear the latter date(s) on the spine but they are not strictly speaking the date of publication.)

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A critical review of the role of pollen-analytical research in the environmental archaeology of central southern England

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Summary

The misuse of pollen-analytical data in a recent paper on the role of palaeoecology in understanding variations in man's impact on the landscape is reviewed. It is clear that empirical data from the various specialisms within environmental archaeology should be reviewed by, or in co-operation with, the relevant specialist.

I am compelled to reply to Schofield's (1987) paper in the last issue of Circaea, on the role of palaeoecology in understanding variations in regional survey data, since he misinterprets my own research and that of two former research students of mine, Lesley Haskins and Paul Waton. I have no comment to pass on Schofield's interpretation of snail or lithic assemblages - the following points all refer to pollen-analytical investigations.

First, there is the general point of the representativity of pollen diagrams. The size and type of site are vitally important factors in the interpretation of any pollen sequence, the most frequently cited papers in this regard being those by Jacobson and Bradshaw (1981) and Edwards (1979), the latter having an avowedly archaeological bias. Schofield ignores the elementary fact that large pollen-collecting basins, such as those at Wareham, Cranes Moor and The Moors, will have a pollen catchment of several square kilometres, whereas small bogs such as Rinsmoor and Church Moor receive most of their pollen from a few tens or hundreds of metres away. A few moments spent studying the diagram relating basin size to pollen catchment in Jacobsen and Bradshaw - a diagram repeated in a number of other reviews - would have avoided this elementary error. The fact that different-sized basins are 'sensing' the palaeoenvironment at different scales (Barber and Twigger 1987) makes a nonsense of Schofield's figure 1, where clearance of trees is shown extending from the floodplain to terraces and hillsides: this could only be shown by careful analysis of a number of small sites situated in the same area and by consideration of the habitat preferences of the tree taxa being cleared. For example, Brown and Barber (1985) have demonstrated that in the Lower Severn valley there was massive Iron Age clearance which first affected limewoods on the drier terrace soils, with floodplain clearance of alderwoods occurring later.

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This leads on to a second general point - the importance of some ecological knowledge when interpreting pollen diagrams. Different tree species have different ecological niches and, fortunately for pollen-analysts, we are able to identify the major tree species of northern Europe down at least to generic, if not specific, rank. However, the same good fortune does not extend to grass and herb species, and all environmental archaeologists would do well to read Behre's (1981) review of the interpretation of anthropogenic indicators in pollen diagrams. Schofield perpetrates the gross error of equating grass pollen percentages of 30-40% at Winnal Moors (Winchester) with 'open' conditions in the mesolithic, going on to mention the Avebury region where there was a '...tendency for mesolithic finds associated with early woodland disturbance to be concentrated in the valley bottoms'. Now, apart from cereal-type pollen grains, it is virtually impossible to tell apart the dozens of grass species from their pollen. In fact there is macrofossil evidence in the peat from Winnal Moors which led Waton (1982, 216) to conclude that the high Gramineae pollen levels originated in Phragmites, the common reed, and other wetland grasses, growing naturally in a mixed fen. Winnal Moors during mesolithic times was probably very like it is today - a tangle of brambles, tall reeds and scrub, unsuitable for colonisation by the major forest trees because of a high water-table.

Schofield's table 2, dividing some pollen and snail sites into 'valley' and 'non-valley' sites and plotting thereon a number of 'dates for the earliest major clearance phase', is highly misleading. Setting aside the misuse of a symbol suggestive of a radiocarbon date plus error bars, I can list the following errors with regard to the pollen sites:

- (1) The early neolithic clearance at Winnal Moors does not extend back into mesolithic times, nor does it finish at the end of the early neolithic, but instead extends through to the historic period;
- (2) Rinsmoor is not a valley site but a doline or solution hollow filled with peat (Waton and Barber 1987). Amongst Schofield's 'non-valley' sites, Church Moor and Cranes Moor (Clarke and Barber 1987; Barber and Clarke 1987) and Rempstone, Luscombe, The Moors and Godlingstone (Haskins 1978) are all valley bogs. If one substitutes 'floodplain' for 'valley' the list is still misleading.
- (3) The dates ascribed to the 'earliest major clearances' are at best imprecise and in some cases quite wrong. There is no major early neolithic clearance at Wareham (Haskins 1978, 155-8), nor is there any clearance evidence from Church Moor (Barber 1975; Clarke and Barber 1987) in the Bronze Age. At Cranes Moor (Barber and Clarke 1987, but also Seagrief 1960, not cited by Schofield) there is something like two metres of peat missing from the top of the mire because of historic peat-digging, and the record is truncated shortly after the elm decline (radiocarbon dated to 2600 bc) - so where does the Bronze Age clearance evidence come from? The 'Early-Middle Bronze Age' clearance dates in table 2 from the Dorset basin sites of Rempstone, Luscombe, The Moors and Godlingstone are not supported by the pollen-analytical evidence - both Haskins (1978, 160-73) and Waton (1982, 310-26) see the late Bronze Age as the time of major clearance.

One of the major themes coming through from our palaeoecological research at Southampton, and that of Scaife (1987), is that the differential impact of man across central southern England is closely connected to soil type and geology. This is clearly shown by the early and permanent clearance of the chalkland around Winchester, contrasting

with the persistence of woodland cover on clay-rich soils at Snelmsore, near Newbury, through most of prehistory (Waton 1982, 303-7) and throughout the whole of the Holocene in parts of the New Forest (Barber 1981). Such differential impact may be linked to factors such as seasonal soil waterlogging and soil workability, as well as inherent fertility and the ease with which such fertility may be maintained. The prehistoric use of major river valleys as routeways, and of gravel spurs and valley constrictions as favoured settlement sites, may well be indicated by lithic assemblages, but sensible speculation on man's overall use of the landscape demands a close understanding of the palaeoecological data. Schofield's statement (p. 37) 'the concentration of early prehistoric communities in river valleys indicated by the palaeoecological evidence...' is simply not borne out by pollen diagrams from central southern England.

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