Circana

Circana is the Journal (formerly Bulletin) of the Association for Environmental Archaeology (AEA) 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, to whom copy should be sent (c/o Department of Geography, University of Bristol, Bristol BS8 1SS).

Editorial policy for Circana 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—for example, papers which consider in detail methodological problems such as the identification of difficult bioarchaeological remains.

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Front cover: Archaeological specimens of the snail Clausilia bidentata (Ström), favoured by shady conditions and of fairly frequent occurrence in archaeological assemblages. Photograph supplied by Terry O’Connar.
Editorial

This and the next issue of Circass are being published together, in an attempt to 'catch up'. As always, we apologise to authors who have had a long wait to see their articles in print; we trust that a steady flow of copy will mean that we can produce 9(2) before too long.

Book Reviews


This volume forms the proceedings of the annual conference of the Association for Environmental Archaeology held in Cardiff in September 1987. Out of the original papers a reduced number were submitted for publication; as a result the volume has a decidedly European flavour, no bad thing given the Near Eastern focus of most volumes on early agriculture. What is presented falls into three main groups: theoretical considerations concerning the adoption and spread of agriculture, reviews of the practical considerations of inferring agricultural strategies from assemblages of organic remains, and case studies synthesising the available environmental evidence (inevitably based on bones and plant remains) in terms of the economic strategies adopted on a site of regional basis.

The first three papers, grouped under the title 'theoretical approaches to the beginning, spread and organisation of agriculture' proved to be fairly tough going for someone not thoroughly versed on previous approaches to the beginnings of agriculture. Ken Thomas's paper on hierarchical approaches to the evolution of complex agricultural systems certainly didn't mix with the late night cocoa, introducing terms like 'holon', 'cybernetic theory' and 'agro-ecosystems' into a discussion on the applications of systems to the elucidation of economic strategies. Although thought-provoking, it would have been useful to see a little more reference to practical applications of these complex theories to excavated material, although Thomas himself admits p. 67 'in practice it will prove to be very difficult to demonstrate the existence of process-functional hierarchies using archaeological data'. Some of the diagrams (e.g. figure 4) did nothing to aid this reader's understanding of the concepts involved.

Roxton Clarke's paper on the integration of social and ecological approaches to early agriculture and Paul Halsey's application of a primarily ecological approach combined with a sociological model were more easily digested. Clarke concentrates on the development of risk-management strategies and consequent development of social organisation through the Mesolithic and Neolithic, using a number of bone assemblages from Italian sites. He argues that the diverse environment in northern Italy encouraged the continuation of hunting within the subsistence system during the Neolithic, as a risk-minimising strategy against the chances of agricultural failure. At the same time, populations in more uniform environments, where a subsistence strategy based on hunting and gathering was less reliable and so higher risk, adopted agriculture earlier and more exclusively. Consequently, more complex social structures evolved in these ecologically homogeneous areas, invoked by the need to develop strategies to buffer against the risk of crop or livestock failure.

Hastead examines the development of agriculture in south-east and central Europe, looking at settlement distributions and environmental evidence to suggest the strategies adopted for subsistence on a short-term (annual) and long-term (seasonal) basis. On the annual scale, his approach mainly derives from a study of the archaeologically recovered remains learned with environmental determinism. On the inter-annual scale risk-buffering mechanisms are stressed, and settlement patterns seen as a consequence of the need (or lack of need) for co-operation on a local or regional scale, depending on the scale of risks involved. In a diverse environment, it is argued, risks are usually local, so risk-buffering involves local co-operation and village settlement. In more uniform environments risks are more regional (e.g. drought) so longer distance contacts are required to reduce the risks of starvation. These contributions go some considerable way towards the integration of environmental archaeology with archaeological theory;
perhaps future sessions of the Theoretical Archaeology Group will take note.

Of more specialist interest, Caroline Grigson reviews the criteria for, and problems of, differentiating domestic from wild animals. She reviews previously published studies of early domestication of cattle from the Middle and Near East, and concludes that standards of recording and publication have been insufficient to enable a comprehensive study of the origins of domestication. Barbara Noddle concentrates on the domestication of cattle and sheep in northern Europe and Britain. The mind boggles at the concepts of frustrated male aurochs being driven into bogs, and at the population of aurochs being so large that they were 'forced to graze in dangerous situations'. Both of these papers provide extremely useful sources of information (in the latter case some of it previously unpublished) for the study of the development of cattle and both contain extensive bibliographies.

On the plant side, Kevin Edwards gives a thorough review of the methodological problems with reconstructing early agricultural practices from pollen records, and suggests some ways in which things might be improved. Standards of recording (to enable verification of identifications) are again stressed as requiring improvement, and other evidence of agricultural practices, for example by the study of weed floras, charcoal and soil micromorphology, should be sought. Hansvog Kister summarises the pollen evidence for the Neolithic in South Central Europe, largely recognising the problems outlined by Edwards; perhaps the most useful aspect of his article is the extensive bibliography, including many non-British references. Frank Chambers examines the evidence for the early exploitation of rye in North-West Europe, stressing the value of a crop on poor soils in marginal areas, its problems as a free-threshing cereal and a carrier of ergot, as well as its importance in the literary tradition which suggests it was largely considered a weed. Records of rye from archaeological sites indicate that it was present in pre-Roman times, but whether as a weed or a crop is unclear. The utilisation of wild foods in Neolithic Britain is discussed by Lisa Moffett, Mark Robinson and Vanessa Straker. In contrast to cereal Europe, wild foods such as nuts and berries seem to have played an important role in Britain during the Neolithic, and charred cereal remains are poorly represented. Whether this is a true reflection of the later adoption of cereal cultivation on a large scale in Britain, as the authors suggest, or a product of retrieval methods or site type, as Legge suggests in an earlier chapter, remains to be tested.

David Robinson and Peter Rasmussen's detailed report on the primarily botanical research undertaken on waterlogged deposits from a Neolithic lake village at Weier, north-west Switzerland, demonstrates what can be achieved by co-ordinated environmental and archaeological approach which incorporates a sensible sampling strategy. Apart from the obvious importance of a site which produced the earliest western European record of repeatedly cultivated and manured arable fields, the study is exceptional in the rigour with which the deposits were analysed. The material discussed in this paper includes bullrush from fields as well as samples taken from a building interpreted as a byre. Approaches discussed include experimental investigations into the extent to which cattle, sheep and goats digest different sorts of fodder, as well as the more traditional methods of analysing plant macrofossils. The results indicate that a wide range of plants were utilised to provide leaf fodder, which must have been used to overwinter animals.

The most contentious paper presented at the conference was apparently that by Roy Entwistle and Anne Geart, who dared to challenge the existing views on the importance of cereal cultivation and animal husbandry in the British Neolithic and Bronze Age. Their approach is one of caustic detachment based on the lack of an extensive database, they argue, we should not close our minds to alternative ways of viewing early economies. They conclude that there is no good evidence to support the interpretation of a cereal-based Neolithic economy, or a dairy-based cattle husbandry. This view is extensively debated and rejected by Legge, in his reply to their paper which is substantially more positive and pluralistic in nature. Clearly the former authors have achieved their aim if it was to stimulate debate.

Legge's paper, like many of the others provides an extremely comprehensive bibliography. Indeed, apart from some excellent papers, this volume is worth consulting for the references alone. Although many papers which appeared in the conference were unfortunately not published
Conference Report


This conference was the seventh in a series of joint meetings with the British Academy on archaeological science held at the Royal Society since 1989. A wide variety of techniques was surveyed, with the exclusion of dating which was covered by posters. Dating will also be discussed in the next joint symposium, The Origins of Modern Homo sapiens: the Impact of Science-based Dating in February 1992. Despite heavy snowfalls, over 200 people attended, and the combination of good time control and a professional projectionist ensured refreshingly smooth running. There was a surprising lack of younger speakers, and of representatives from centres such as London, Sheffield, and Southampton.

Some talks focused on the impact of new analytical methods (e.g. in biochemistry) and others on new interpretations that can now be made as substantial bodies of data become available (e.g. in dendrochronology). Most speakers resisted the temptation to become bogged down in methodological detail, and concentrated on illustrating results. New techniques of presentation are also starting to reach the archaeological world, with many dear, specially-prepared multi-colour graphics. The story of the fuzzy, grey graph (or worse, large tables of data in tiny print) may be numbered.

The symposium began with an excellent demonstration by Dr Mike Ballie (Belfast) of how to present ideas elegantly by likened the long (7000 years) tree-ring chronologies from Belfast and Germany that are now in routine use for dating to a ‘tree-ring kit without a set of instructions’, and then drew on a wide range of historical, archaeological and palynological data to try and discover just what ringing patterns and overall patterns of bog-oak growth and death might mean in terms of environmental change. The studies of the Neolithic ‘colonisation’ of Britain—distinct changes seem to be happening at about 4000 BC—and on the effects of volcanic eruptions are very exciting, as is the concept of looking at prehistoric change over periods of a few calendar years rather than in hundreds of radiocarbon years.

Continuing the theme of Prehistoric Human Environments, Professor B. Berghun (Lund, Sweden) described a ten-year project, with 25 staff in six university departments, studying all aspects of the landscape of southern Sweden over the last 6000 years. As we admired the resulting sequence of detailed land-use maps and reconstruction drawings, it became obvious that this is the kind of approach that we should all be taking. While the generous support of the Swedish National Bank certainly helped this project, the reason for its success (and the failure of so many other ‘interdisciplinary’ projects) must also relate to efficient organisation and the location of all the team members in one small city.

Dr M.-A. Court (CNRS, France) ended the morning with a convincing demonstration of how soil thin-sections can tell us about the formation of archaeological deposits, judging by a gorgeous colour section of a coprolite filled with grass-phytoliths; there is even more potential in this work if allied with analysis of bulk samples.

After lunch the theme was artefact studies, with three talks on characterising metal and stone, where the novelty lay less in the techniques used than in their careful application to archaeological questions. Dr N. H. Gale (Oxford) presented a close look at Bronze Age trade in the Aegean, where the sources of metal objects have been determined...
using mass spectrometry analysis of isotope ratios. A key element in his work has been detailed sampling of ores in the field. Dr Paul Codd (British Museum) described an interdisciplinary approach to early mining and smelting in Europe, stressing the importance of experimental and ethnographic work. This detailed and diverse approach allowed a strong argument for independent innovation of techniques throughout Europe. This is, of course, in stark contrast to the long-established concept of transfer of metallurgy technology from the Near East to Europe. A similarly wide-ranging approach to an old idea was taken by Dr O. Williams-Thorpe (Open University) to the origin of the Stonehenge bluestones. The heroic transport on rafts of these stones from Wales to the Salisbury plain has been a tenet of British archaeology for so long that, as the lengthy discussion afterwards made clear, the well-buttressed argument that these stones are just glacial erratics will take some time to sink in.

There were two technical talks in this session, with Professor M S. Kite (Oxford) on the role of the scanning electron microscopy in studying the microstructure of ceramics, and Clive Orton (Institute of Archaeology, London) on the statistics of counting potsherds. On Thursday morning we returned to bioarchaeology, with Dr R. P. Evereshed (Liverpool) on the use of gas chromatography to separate the components of organic residues on potsherds and mass spectrometry to identify the molecules involved. Although this kind of work has been going on for some years, previously results have been limited to a handful of potsherds per site. The Liverpool project, as well as looking in detail at important aspects of biochemistry such as post-deposition degradation, is looking at large numbers of early medieval potsherds. Professor Martin Jones (Cambridge) then surveyed the wide range of techniques now used in looking at human diet and exploitation of vegetation. Instead of looking at just a few components in great detail, it is becoming possible to integrate these sources of information, to look at food webs as whole systems.

Two lectures made up the session on site survey techniques. Dr J. Shennan (Durham) took the broader perspective of remote-sensing of landscapes. Multi-spectral waveband scanners on the French 'Spot' satellite and on aeroplane surveys are picking up very subtle changes in vegetation and, therefore, in underlying features. There are now imaging devices available cheaply, and the computers that allow them to be handled easily now cost £5000 or so, compared with sums of twenty times that amount five years ago. As Dr Shennan's work in the East Anglian fen shows, this technology is that now 'up and running'. Mr A. Aspinall (Bradford) looked at geographical techniques better suited to relatively small areas such as archaeological sites. Techniques such as radar are giving very pretty vertical sections, but a great deal more fieldwork is needed to decide what these actually mean stratigraphically.

The final session concerned the analysis of bits of human body. Professor N. J. van der Merwe (Harvard) described some very nice case studies using carbon isotopes to investigate early primae in diet. And the spread of maize in North America. In regions where C4 plants grow or are grown, this is clearly a useful technique, but the potential of isotope analysis of other elements, which might be of use in other areas, is still unclear. Dr P. E. Hase (Carnegie Institution) discussed the use of amino acids from ancient bone in dieting and diet studies. To end the conference papers, Dr. R. E. M. Hedges (Oxford) looked at the very new field of studying ancient DNA. Efforts at present concentrate on extracting sufficient material for sequencing; any assessment of this work as applied to archaeology will have to wait on these.

in his closing remarks Professor Colin Renfrew (Cambridge) made a couple of important points that attracted deservedly little discussion from the floor. He drew attention to the closer integration between scientists and archeologists, and contrasted the major developments in archaeological science over the last 30 years with the almost total lack of change in excavation techniques over the same time period. The talks at this conference certainly made clear that working in teams has led to genuine integration on specific projects. All the projects described featured a clear statement of archaeological aims deriving from close collaboration with excavators. While it is true that a lot of new work is driven by the availability of new technology, this is by no means a bad thing. If a new, more powerful technique is applied, there is a good chance it will turn up something previously unsuspected, with attendant important implications for
Heliinterpretation. A major theme of this conference was the astonishingly good preservation of organic materials from the past, for example of DNA in charred seeds or lipids in potsherd walls.

A point which was not raised is the risk that the current readiness to support the development of new techniques may divert funds from applying existing techniques to archaeological endeavours. To achieve the type of excellent synthesis presented by Prof. Berglund, dedicated and often tedious analysis of basic data is essential. One can also compare the paucity of large-seed seed and bone reports from British excavations to the excellent work coming from other European countries.

The contrast between the high quality of work going on in the laboratory and the usually casual nature of excavations is dismaying, and this seems to be a major weak point in overall strategy. It’s also dismaying that techniques developed twenty or more years ago, such as flotation and radiocarbon dating, are still not fully exploited. This has little to do with money, but involves questions of organisation and communications that fell outside the scope of this highly stimulating conference.

Reviewers: Mark Nesbitt and Delwen Samuel
14 Kirby Close, Cambridge CB4 1XP, U.K.

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Short contributions

Percival and Helbek's archive of plant remains
Fellow archaelobotanists may be interested to know of an archive of plant remains held in the herbarium at Reading University. Most of it originates from excavations of the 1920s and 1930s from sites all over the world, including many of the classic British sites published in Helbek's Early Crops in Southern England (1953). Proceedings of the Prehistoric Society 18, 196-237 also such as Meave, Filfield Barnard, Hembury, Infor Hill and Maiden Castle. The plant macrofossils were sent to Professor John Percival at Reading for identification, and amended identifications were added by Helbek in November 1957. There is also a collection of Helbek's own material which comes mainly from Scandinavia and southern England.

The full list of the carbonised and desiccated plant remains held at Reading (copied from Percival's notebook) is given below. Visits to the herbarium to examine the material should be arranged through Dr Stephen Jury, Plant Science Laboratories, University of Reading, Whiteknights, Reading, RG6 2AS (telephone 0734 8751235).

Wendy J. Curruthers
Room 532, Fortress House, 23 Saville Row, London W1X 1AB

Ancient Cereals
A list of desiccated and carbonised archaeological plant remains held at the Reading University herbarium, Plant Science Laboratories, Whiteknights, Reading, as recorded in Professor J. Percival's notebook. Amended identifications marked as * were added by H. Helbek in November 1957. The P numbers have been added more recently to assist in locating the material. * notes are added by WJC.

EGYPT
P18 Emmer 28/1900, Badarian, Monastiria, M. Egypt. From Guy Brunnock. 1928.
P19 Barley 28/100, disk.
P4 Emmer*? Predynastic Ab Adari, M. Egypt. From Guy Brunnock. 1924.
P17 Emmer chaff & spiklets Predynastic Monastiria, M. Egypt. From Guy Brunnock.
P15 Possibly emmer with dorsal hump and broad apex, Badarian, Monastiria, M. Egypt. From Guy Brunnock, 1927 (weatern).
P11 Wheat from Fayum in various gravels. From Miss Carr-Thomson 1925-6.
P113 Wheat grains from K pit 33 & 44, Fayum. From Miss Carr-Thomson, 1926. See Times April 6 & August 11 1926.
P171 Swart on barley grains chaffy pit 14, Fayum, Miss Carr-Thomson, 1925-6.
P111 Barley in various gravels, Fayum. Miss Carr-Thomson, 1925-6.

P118 Straw lining the storage pits, Faram. Miss. Catt-Thompson, 1926.

P8 Emmer grains from underground gallery Magazine, N side of Step Pyramid, Sakkara (Cairo Museum).

P10 Emmer spikelets from room of large tomb of the 3rd Dynasty, 3rd inside enclosure wall of the Step Pyramid at Sakkara (also a little barley) [remains missing from box].


P12 Emmer grains from Quedah in 1888. Probably 18th Dynasty.

P9 Emmer taken from box in Egyptian tomb of XVIII Dynasty. Sir E. Wallis Budge (British Museum).

P11 Emmer spikelets with grain from the tomb of Tutankhamen. Howard Carter sent to me for identification & sent me by Dr Boodle (Jodrell Lab, Kniv) [box missing].

INDIA


P46 II Wheat datta. SD area. 1927-8.


TURKEY


MESOPOTAMIA

P21 Wheat grains? A form of emmer found in a vase in an old Susian house 'Temdet Naser', Mesopotamia. 7th-NE of Kish. 3000 BC. Prof. S. Langdon. *T. dicoccum H.H.*

P22 Emmer. From grain room T.T.S. Tal Arpicayish, nr. Nineveh, M. E. E. L. Mallawies, 1933. (British Museum excavation). *T. dicoccum, one grain T. monococcum L. = 5,8; B = 2.38; T = 2.56mm. Some 13 grains of hulled barley transferred to P23. H.H.*


NE. A dozen unspecified hulled barley grains, one T. dicoccum, one T. (?) badly puffed. H.H.

N. SYRIA

P89 Barley. 2-rowed No. 1 T. S. Nin. H.H. c.1900 BC.


[All of the following] British Museum excavations at T. Brak, N. Syria by M. E. E. L. Mallawies, all 1939 except no. 14 [1985].

P81 No. 1 Barley J.N.P. 2400 BC?

P77 2 Barley. datta.

P77 *1 seed Prosper Stehli, hulled barley, a few T. dicoccum H.H.*

P77 3 Barley & a few wheat (? T. dicoccum) grains J.N.P. 2400 BC?

P78 2-rowed hulled barley, 6 grains of T. dicoccum.

P79 4 Barley & a few wheat grains J.N.P. 2400 BC?

P80 5. 4xu. 2500 BC accurately dated by a Sargontal Table.

P86 *1 frag. grain of Avene sp. 7 grains Aglans sp. var. a dozen hulled barley, a dozen T. dicoccum H.H.*

P86 4 Barley & a few wheat grains Ninam Sin's Palace. Room 13. Subjected to fire action. 2400 BC.

P86 *2-3/4 hulled barley. 1/3 T. dicoccum. 6 grains T. compactum?* 1 seed Lathyris sicilicus H.H.

P79 7 Barley & 5 or 6 white grains Curt. 2 J.N.P. 2400 BC.

P79 *Hulled barley. T. dicoccum. 1 seed Less exsectum.*

P78 5 Barley Ninam Sin's Palace. Room 10.

P80 10 Barley Grain from shaft no. 2 J.N.P. In the filling. Date probably but not certainly 3000-2000 BC.


P83 11 Barley & 4 wheat grains J.N.P. No. 11 above shaft no. 1. C. 3000 BC. Scorched by fire.

P82 12 Barley & 3 or 4 wheat grains F.S. A. 207 c. 2400 BC.

P84 13 Barley No. 13 F.S. Level A.2.

P85 14 Barley '1922 dig' CRH. Probably 2400-2000 BC.

P85 15 Barley & a few wheat grains Suro E.R. c.2400 BC (some emmer).

P87 16 Barley scorched by fire. N.H. Mix c.1350-1500 BC.
P24 Wheat grains Gaster gravey c.1000BC. From Prof. Macalister, Dublin 1930.

P110 Barley & wheat (3) in b. excavations. Late Bronze Age c.1400BC.

G. ISTAN

P39 Wheat from Robenshausen. From Dr Heer Scceu.

P37 Wheat, dino.

P38 Wheat Swiss Lake Dwelling.

P37 T. vulgare antiquorum Robenshausen.

P36 Wheat Robenshausen Lake Dwelling.

BRITISH ISLES

P34 Wheat Neolithics from Pembury Fort. Pit 15 CXI 1952, Miss Liddell.


SOMERSET


P45 Wheat, lime.

P46 Wheat II, dino.

P41 Avena avene Meads Lake Village. 'some Bromus secalinus caryopses' * Bromus secalinus or voile, 2 T. excreme, no floral H.H.

P40 V. faba c.650 Meads Lake Village.

P41 Barley & beans Wrinklebury Hill, Weymouth-supers. Mead. Age. La Tene II & III. 'evidently carbonised by fire action'.

P42 Wheat Little Sodbury. Bath.

DORSET


P106 Wheat grain (shallow) with small celtic bean (V. faba) from Marshhall, Iron Age with Black Belgian ware. From M.C.S. 18. March 1837.

P49 Wheat & barley Romano-British village, Woodlands, Dorset, Pit 4 Cmn. Pitt-Rivers.

P104 Wheat 1-2 grained spikels. Inverse General Pitt-Rivers.

P105 Wheat II evidently subject to fire. Inverse.
BERKSHIRE

P26 Wheat (T. aestivum) grown from small kernel in gravel
pit at Thame, nr. Reading, c.1990. Reading
Museum. Late Bronze Age or Early Iron Age.

BUCKINGHAMSHIRE


MIDDLESEX

P29 Barley from foundations of a Roman building, Threadneedle Street, London, 1843.

P29 Harrow sugarcane barley from Roman pavement under French Protestant Church, Threadneedle Street.

P28 Wheat St John's Back church (London). 16 foot below Lime Street under site of S aisle of the
ancient church (now gone).

YORKSHIRE

P31 Wheat Rotten excavation at Malton, Yorks. T.
Sheppard.

GLAMORGAN

P108 Wheat & Barrow acanthe Middle Bronze Age
barrow (c.1400 BC) from Bridgend. August 1937,
Sir Cyril Fox.

JERSEY

P109 Small celtic bead, barley & 1 or 2 wheat grains
from le Pinacle, Jersey. Chalcolithic or very late
Neolithic period. Prof. J. Bundo.

IRELAND

P5 Wheat Bronze Age cairn, Ballynaglass County
Museum Dublin.

HERTFORDSHIRE

P65 Wheat from burnt debris on floor of canary. Park
Street Roman villa, nr. St Albans, October
1943-March 1944. c.267AD.

SCOTLAND


P98 Wheat & barley, disho.


P63 Oats Maude la Law. Lanark. Fr 218. Edinburgh
Museum.

P60 Wheat Nr. Roman wall at Caerlaverock. From John
Mack, Kents, comynanley Museum.

P64 Chiefly barley & wheat Forth on Lawes Hills.
Mumford, Anglia GN448, Edinburgh Museum.

P61 Wheat & barley from Roman Fort at Lyne
Edinburgh Museum.

P57 Barley Fort on Lawes Hills, Montrose, Angus.
GN49, Edinburgh Museum.

P56 Barley chiefly Roman Fort, Birrens, Dumfries.
Edinburgh Museum.

P55 Barley & wheat Roman Fort nr. Failaka. F.R.
217, Edinburgh Museum.

P54 Wheat & barley from Roman Site 21 by Fort, Clyde Canal. F.R. 217, Edinburgh Museum.

P53 Roman wheat F.R. 216 Edinburgh Museum.

P52 Barley & wheat Roman Fort at Caerlaverock.
FZ 130, Edinburgh Museum.

P48 Barley, disho. FZ 131, Dr Callender.

P51 Barley & wheat, rino. FZ 84, Edinburgh
Museum.

P50 Wheat & barley, disho. FZ 135.

P49 Wheat & barley, disho. FZ 136.

P47 One wheat grain from the breach of Burrian,
North Ronaldsay, Shetland. GB 317, Edinburgh
Museum.

P45 Wheat from the breach of Burrian, North
Ronaldsay, Shetland. GB 318, Edinburgh
Museum.

P44 Wheat, ches or Barrow acanthe. Rye-like
broons (barley), common cereal crop weed. From
Nnybrook Broch, Caithness GA 608, Edinburgh
Museum.

P43 Barley from the breach of Insgow, Seaks,
Orkney. GE 28, Edinburgh Museum.

P40 Barley from the Ridey breach, Keith, Caithness.
Edinburgh Museum.

[Also present—H numbers, presumably Herbel's
collection]

H4 Saggarah, Egypt. Stepped pyramidal Icett tomb, 4th
Dynasty. Excavated J. P. Laver, 1926. H
terracing, Leliat terracing (one grain). 1958.
not published. c.2268BC.

H11 Harrodian terracing from tomb of Queen Icett,
Egypt c.2300BC.

H3 Nimead, Iraq. exc. M. E. L. Mallowan, 1953,
date 7th BC. Assyrian. Lens excellent, 1958,
not published.

H14 As above. Paslemium museum 1958 not
published.

H5 Nimpad, Iraq. exc. M. E. L. Mallowan, 1955,
date. H. terrasi. grains in between 1958 not
published.

I have been engaged in a gentle match of wits with one of the editors of *Circass* during the last few years over a subject dear to the hearts of many of us who work on urban archaeo-
logical sites—namely what (in a respectable scientific journal) to call pit fills which, on the
basis of their suite of foci remains and intestinal parasite eggs, clearly contain human
faces. It is a subject clothed very modestly in swathes of euphemism and I hope that unraveling some of them here will not offend the reader.

The way in which I shall tackle the problem is to go back through the shifting sands of
linguistic evolution and look at the history of some of the words which were or are used in this
context, and to consider some others which might be. Words so be used in a
scientific context such as environmental archaeology should be precise, clear and easily
understood (or easily looked up in a
dictionary) by non-native speakers of English.

I hope I can provide some suitable terms. Etymology is a tricky area for a botanist to
wade through, and I have been glad of the help of Dr C. C. Dyer of Birmingham University, as well
as that of the Editors of *Circass* and an anonymous referee. I cheerfully admit that any
grave blunders will probably be mine.

I have used two main sources of Information: The *Oxford English Dictionary* (1978 edition)
and The *Middle English Dictionary* (Kurath and Kuhn 1954-), hereafter abbreviated to *OED*
and *MED*. The written record prior to the fourteenth century is sparse and most of this
medieval documentary evidence is about financial transactions or litigation, so that
references to such a person subject as defecation are naturally somewhat rare, and
citations in the *MED* are therefore especially useful.

The story starts with priot, which is one of the terms still understood today in its original
medieval sense as a private (place) and, by extension, as the place where various bodily
functions could be carried out in private. Most of the other words for this are indirect as
modern ones: one such is excrement, used by Chaucer in *The Reeve’s Tale,* among others.
An example of its use dated 1513 instructs: “... and se the house of hem sette to vewele and cloote
(*OED*). The word was still used in its more general sense (the process of giving relief), too.

*Latin* (and the more modern *latrinary*) derives from Latin *latraria,* itself from *laetus,* to wash.
In its Latin form it was very commonly used in the fourteenth and fifteenth centuries in
official documents, and this probably led to its adoption by the English language. The English
word *latrine* is recorded only from 1642 (*OED*).

With such a pedigree, it seems a not entirely unsuitable word to use in the context with
which we are dealing, it is one of many examples of euphemism in which words
meaning ‘a washing place’ are used to describe a place of defecation and/or
urination.

Another cud word in regular use was *garderobe.* Its use, to signify a privy within a
house, is almost exclusively a sense adopted by historians; for example Ernest Bohne
(1934), who used the term extensively, but always illicited. Garderobe really means a
place for storing clothes (from *French garde*
and robes), and is still used in this sense in modern French and German (and in modern English wearing). I caused confusion to one of my continental colleagues by using the term incorrectly (along with most of the other words of the title, as it turned out) in the article Garderobes, Senors, Cesquets and Latrines (Craig 1983). A search of the MED has failed to produce any clear quotations suggesting that garderobes were anything other than clothes stores, and the stemmatically confusing meaning is probably a nineteenth century euphemism (C. C. Dyer, pers. comm.). Garderobe, then, seems a bad word for us to use for a medieval privy.

The material deposited into privies and easements often went directly into flowing water which would carry it away (as in medieval London—see Sabine 1934), but in towns the shortage of space often made other means of disposal necessary—in pits, for instance—and the preservation of the contents of some of these has provided archaeobotanists and archaeozoologists with excellent study material. It is also an area of linguistic difficulty which I shall attempt to clarify a little.

The basic process of waste disposal was simple, as shown by a statement from 1387: 'they would make him a pitte ... whan they wold schite, and whanne they hadde i-schete bey would fill be pitte agyn'. Such pits are commonly called cesquets or cespeuds in archaeological reports. The origin of this term is obscure according to the OED. Some have suggested derivation from French soupirole, as in the context: 'avoir nettoyé toutes les gouze a ordure ... et nettoyé le soupirole', translating as 'having cleaned all the filth and ordure ... and cleaning the cespeud' (from accounts of works from May 1412, Godfrey 1892). The word seems to appear in the 1383 quotation 'Cesperalbe to be made for stopping the filth by the brooks' (OED). The original bone of contention which I raised with my York colleague was that the dictionaries do not have the word ces for the contents of a cespeud in the way that ces had been used in archaeological reports. This is made clear if the origin of the word is as given above, and has nothing to do with pits. I therefore considered the word ces to be incorrect in this context. I still do. Now I find that cesquet, which I had been using myself, is somewhat suspect as a good medieval term, although perhaps this and cespeud are permissible, since both are so widely understood (though their derivation remains obscure).

The contents of these pits has been described in medieval documents by the Latin word putridines, literally 'rotting matter', which Sabine (1934) has translated as 'filth'. The word 'ordure' seems more commonplace according to my limited searches. It has come from Old French, derived from a term Latin hordurae, meaning that which makes the hair stand on end'. I have seen a sign in a town in France forbidding the deposition of 'ordure' and assumed it just meant 'filth' in French, but the dictionary tells me that it still retains, its medieval sense, as illustrated by a quotation from the Wycliff Bible of 1386: 'The Lord sayte the part of the body whereby ordure be ben voyded... (MED). In the context of medieval pit fills, it is very descriptive, since it covers a wide range of foul waste products, including those of the human digestive system, as shown by the quotation. Another word used in medieval writing is drift, which has since changed its meaning to dirt, though it remains drift in Icelandic (Cleasby 1957). Its principal meaning was 'human waste', as in a quotation from 1387: 'Arius scheid our his bowels and his let vil be drift for he schat' (MED). Otherwise, it just meant dirt in the modern sense.

The most direct word used for the main component of these pit fills—shit—has strong folk, if not literary, use today and is of Germanic origin. As in the case of jet (see above), the degree of foulness conveyed by the word shit varies with place and time. From the Middle Ages to the sixteenth century in Britain shit was used as a generic term for dirt, as well as having its present-day connotations (C. C. Dyer, pers. comm.). This generic meaning exists today in mainland Scandinavian skitt (with sk pronounced as sh), which can also just mean 'dirt'. In English, however, words of French or other non-Germanic origins have been regarded as being more refined or polite than their ' rude Anglo-Saxon' predecessors, so that words such as shit and soot came to be avoided in polite conversation and writing. The 'dirt' meaning is also retained in the most conservative Scandinavian language, Icelandic, in the word skítur (Cleasby 1957).

The word shit has been recorded in Anglo-Saxon as the verb siten and the OED gives a quote from a leechbook of about AD 1000:
'Wf Don be man mete unite melte & getre on yeole warre & scillare'. This is the alternative meaning of the word, now modified to shitt or shitt, i.e. diarrhoea. In 1115, Florence of Worcester recorded that 'Lues animalium quae Anglice Scilla vocatur, Latine autem fluxus interaneorum dici potest', which can be loosely translated as 'the flow from the animals which the English call Scilla could however be called diarrhoea in Latin'. The modern versions of these words are perhaps more often heard 'on the Clapham omnibus' than seen in print or heard in broadcasts. Maybe in Middle English the distinction between the spoken and the written forms of the language had not developed in this way. Chaucer could use the word and in 1484 Caxton, in his Fables of Reyn, could have 'I dyde styte there grete toodse' (MED). Shakespeare, however, does not seem to have had occasion to use this word, but this may be because the whole subject was by then generally one that was avoided.

The next most direct word has been relegated to dialect by the lexicographers, though widely known (if not understood) for its true meaning in the expression 'cack-handed' or 'cacky-handed' (for left-handed, or just clumsy). The word has a long history, however, and the Saxon word cac-niug (Bowsworth 1882) should need no explanation. Cack has appeared less often in print, but one quotation from 1600 given by the OED is: 'Hee hath a face like one that is at eke'. On the whole, this word seems a little rarer, or perhaps more local in English than shit; it is certainly very much used in certain regions, such as the Black Country of the West Midlands. It is also present in German and Dutch as a noun and a verb (lachen) in almost identical form to English. I am given to understand that it is more usual there than the equivalent words for shit, and this is confirmed by its presence in modest-sized Dutch and German dictionaries, but not in English dictionaries of equivalent size. Skeat (1862a) traces it back through Latin to Greek.

Of the words that are regarded as acceptable in polite company today, most are strongly euphemistic. Farts is an official, written term now. Originally it came from the Latin fartus or 'drops', and still had that meaning in the medieval period, as can be seen from a quotation from 1460: 'Rotun fartis of wirop', and this usage continued into the eighteenth century, although increasingly the word came to be used for human wastes, from abscesses as well as from the bowels. Another relatively acceptable word in written English, excrement, also derives from Latin and originally meant 'that which had been sizzed out'. Later meaning waste matter (including faeces), as is clear from a quotation from 1533: 'Breele hauing much branne doth fylleth the body with excrements' (MED). The present meaning is a comparatively recent use of the word.

I have also used the word sewer and, on receiving a caution from York, I checked and was horrified to see that this meaning (as shit) is only recorded back to 1834. The word sewer originally applied to any drainage channel (C. C. Dyer, pers. comm.); the word sewage now means 'flowing contents of a sewer', and that is no good for describing medieval pit fills, I am afraid, so I retract this term.

There are many other words which have been used for our present purpose. The Latin stercus, as in the subtitle of this piece, is but one, as shown by some Middle English and Latin equivalents given in the MED: 'eyyn, or cukyn, or schytty: stercorius, merdo, egero'. The Latin merdo is alive and well in modern French, but in English another cognate word to menu refers specifically to falconry. Similarly, the word jument, which is mainly remembered from Lewis Carroll's poem The Hunting of the Snark, was applied to the droppings of animals that were hunted, deer especially; the word crotty was also used in this way.

'Coprolite' is more a purely geological term that has been applied to archaeological material, but is more appropriate to hardened and more or less mineralised sediment rather than the softer and unconsolidated pit fill with which we are largely concerned here.

A number of other words seem to have been used either in the farmyard or domestic sense. Tard (as in the Colloquial quotation, above) comes from the Old English lord (dung) and survives from the Old Norse in the word tard-gylf for dung-beetle. Tard seems to be one of the few more-or-less acceptable words for written use today. Dung, another Old English word with Norse origins, was mainly used (as now) for the products of farm animals, so it could be written in 1534 that sheep should be folded on the fields so that they would 'pyss and dunt there' (Skeat 1862b). Its second meaning is for human faeces (MED). Amongst the Scandinavians, Norwegians now prefer the
work muc. The English language has retained all these words, the last in the form muck.

In conclusion, many of the words mentioned here have been used (by myself, as well as by others) either wrongly or without due regard for their history. Latrines seems a perfectly good, if rather euphemistic, word that has hardly changed its meaning over the years. Likewise, cesspit has a fairly clear meaning in English nowadays, though its ancestry and medieval use are rather uncertain. Rubbish pit is equally apt, but dare we allow shit pit (or shitpit or shit-pit)?

Words such as faces and excrement are perfectly correct and well understood now, although they have only taken on their modern meaning fairly recently. Turd appears to be the only English word of clear meaning that is even partly ‘respectable’ (though the 1944 edition of the OED (corrected and revised to 1976) states that it is not now in polite use!). The most apt and ancient word that has been used in England, at least from Saxon times—shit—is, unfortunately, widely considered unprintable in full, although such words are now occasionally to be seen in ‘quality’ newspapers.

The fills of medieval pits contained a mixture of remains—of human turds, perhaps animal dung, and a range of household rubbish, including flooring material and larger bones. It is very difficult to find a word that covers all this accurately. Sabine used shit, which is quite descriptive, but ordure is what the stuff was actually called in the Middle Ages. Is this then, what we analyse?

References


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[Editors' note] James Greig sent us the text on which this piece is based an extremely long time ago and we apologise for the delay in getting it into print. With regard to the spellings faces and defecation, we have followed the first spellings in the citations used by OED, even though the latter is more archaic and the former spelling has the ring of American English.

[Editor's aside] more millimetres beneath the OED entry for 'shit' comes another very interesting and useful word: shine (to rhyme with English serve), whose plural means 'the refuse of hemp or flax'. Here is the word we have been looking for to stand for the German Schloef in wide currency in Professor Krober-Grohne's reports on the Feddersen Wierde, for example; no doubt shine is a survivor in English from a common Germanic ancestor. — Allan Hall]
Small-vertebrate and molluscan analysis from the same site

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Summary

Small-vertebrate and molluscan data from the same two sequences about 55 m apart through Neolithic deposits at Maiden Castle, Dorset, England, are described. The small-vertebrate analysis was done to amplify the molluscan data and extend the spatial range of evidence. The molluscan sequences are matched through their similarities, and the litho-, archaeo- and 14C stratigraphies.

The two small-vertebrate sequences match well, showing that they have at least site if not wider relevance. It is suggested on the basis of their fragmenary nature that the remains are from bird of prey predation and, specifically (in view of the absence of complete bones and skulls and a prey spectrum which suggests a diurnal raptor), from kestrel. They may be interpreted in site and local terms accordingly. From, the point of view of the locality, the data probably reflect the selection of prey from areas of terrain such as hedgerows, field edges and river margins rather than randomly from around the room, and this has to be borne in mind in environmental interpretation. All taxa were present throughout, with the significant exception of newts, which occurred in the lower part of the bank barrow ditch, perhaps reflecting the presence of an on-site permanent pond, and shrews, which occurred at the top of the sequences in a horizon which saw renewed human activity after a period of quiescence.

Interpretation is difficult because of the low numbers. Five kilogramme samples (not 1 kg, as used here) are recommended for future work. Species identifications are the most useful ecological data, so a good reference collection is essential. Identifications to higher taxa such as "Ampullibia" and "total numbers" can give information of a more general nature and about roost-site activity, and skeletal element proportions can suggest the nature of the predator species.

Introduction

Subfossil Mollusca usually give information about the environment at the sampling spot, but it is seldom possible to extrapolate beyond that to the locality. This is because of the very local significance of the molluscs, and modern work has shown that boundaries between communities can be very sharp (e.g. Joag and Wishart 1982). This is especially true of the later Holocene, from the Neolithic onwards, when most contexts on archaeological sites are from spot or linear features like pits and ditches (Evans 1972). On a wider, regional, scale, broad chronologies of introductions have been detailed for southern and eastern England (Kerney et al. 1980), but they relate to long time and geography, not environment per se, and are therefore largely irrelevant to local issues in environmental archaeology.

One way of obtaining information about a larger area is to take more than one sample column from equivalent chrononstratigraphical sequences. Another is to use other types of biological indicator which, although not giving the very local—or on-the-spot—detail that molluscan assemblages do, are of more general, i.e. local or micro-regional, environmental significance. Pollen and insects are unsuitable in the usual preservational context for land molluscs (aerobic calcareous conditions) because they are not generally preserved, while charcoal, since it is mostly of anthropogenic origin on archaeological sites, is subject to the vagaries of human selection (although see Ashbee et al. 1979, table 2, and Dumbleby and Evans 1974).

Small-vertebrates offer a suitable possibility because they are well preserved, although in smaller quantities than mollusc shells, and they reflect a bigger area than molluscs because they have larger home ranges. In some cases they reflect the site environment, as when they have fallen into pits or ditches and died there. In others, they are derived from raptor pellets, in which case they reflect
subsequently, suggests that this was primary. Later there was slight clearance, probably for the construction of the causewayed enclosure and bank barrow.

MC III. This is through the inner ditch of the causewayed enclosure, about 55 m away from MC XIII. The deposits are not overlain by the bank barrow, so they continue the sequence until the construction of the Iron Age rampart which seals them. The horizon at which the bank barrow was built is indicated archaeologically (by pottery) and by 14C dating, and there is an increase in open-country snails, specifically Vellema costata, at this point. In the upper part of the sequence the site was abandoned and woodland spread in: Astildea glandulosa was characteristic. In the Later Neolithic there was renewed human activity, still in woodland, with Pomaria elegans characteristic, followed by clearance and ploughing across the ditch in the Beaker period. The Bronze Age environment was grassland on a decalcified soil.

MC IV. This is a sequence through the bank barrow ditch in the same trench as the MC XIII sequence, the whole of which corresponds to the MC II sequence between 90 and 0 cm. The same lithostratigraphy, archaeology, 14C dates and mollusc sequences are present, but in an expanded form. Particularly distinctive is the dichotomy within the woodland phase, initially with Astildea and later with Pomaria. This dichotomy was recognised from two other sequences on the hilltop spanning the same time range, and although its significance in ecological terms is not clear, it serves to demonstrate the relevance to the site (i.e. hilltop) of the mollusc data.

Extraction and identification

All bones and teeth greater than 0.5 mm were extracted from the 1.0 kg mollusc samples and identified using the reference collections of the Environmental Archaeology Unit, University of York.

Results

Taxa

Most of the identifications were for teeth, although a few long bones, podials, scapulae, innominate, vertebrae, spines, scales and
Figure 15. Maiden Castle: combined land-snail and small-vertebrate sequences, MC XIII and MC III. S = stickleback; W = includes one wrasse. Habitat, archaeological and molluscan sequences from Evans et al. (1988).
Figure 16. Maiden Castle: combined land-snail and small vertebrate sequences, MC IV $S =$ stickleback. Habitat, archaeological and molluscan sequences from Evans et al. (1988).
skull fragments were determinable. Much, however, could be identified only to groups such as 'mouse/voe', which is useful only for the information it gives on total numbers of fragments and the composition of the assemblages in terms of skeletal elements (Fig. 17).

The following taxa were identified:

(i) fish, all very small, including stickleback, *Gasterosteus aculeatus* (L.).
(ii) toad, *Bufo* sp.
(iii) frog, *Rana* sp. Some material was identified only to toad/frog but both groups were present in all profane.
(iv) newt, indet. (*Amphibia, Salamandridae*).
(v) bird, all very small, of pipit/wagtail size, and one wren, *Troglodytes troglodytes* (L.).
(vi) probably grass snake, cf. *Natrix natrix* (L.), identified from a vertebra (cf. Holman 1985).
(vii) probably adder, cf. *Vipera berus* (L.), identified from a tooth.
(viii) slow-worm, *Anguis fragilis* (L.).
(ix) shrew, probably all common shrew, *Sorex araneus* L.
(x) water shrew, *Neomys fodiens* (Pallas).
(xi) bank vole, *Clethrionomys glareolus* (Scheeber).
(xii) field vole, *Microtus agrestis* (L.).
(xiii) mouse, probably wood mouse, *Apodemus sylvaticus* (L.).
(xiv) probably yellow-necked mouse, *Apodemus flavicollis* (Melchior), identified from a distal end of a humerus plex shaft and an upper first molar. In view of the difficulties in identifying his species even with complete mandibles (e.g. Brainweil et al. 1990), these identificators must remain tentative.

Taphonomy and origin of the material

All the material was fragmentary, usually only the smallest bones, the phalanges, being complete. Mostly there were single teeth, parts of long bones and skull and mandible fragments, the last two categories with never more than two or three teeth in size. There were no complete skulls and jaws. Most of the long bones were incomplete, often with epiphyses partly destroyed and the shafts with long oblique breaks. These data, together with the general paucity of fragments (Figs. 15 and 16), indicate that the material is not from animals that died in their place of deposition but from predator debris, and specifically from bird of prey pellets. Elsewhere on the site, in Iron Age storage pits, complete skeletons (including those of weasels) were preserved, and these are from animals caught in the pits (information from Miranda Armou-Ghedi, who has worked on the Maiden Castle bone), but this is not the origin of the material discussed here. The contexts, too, are wide ditches which, after a small amount of infilling and weathering of the sides, would have allowed easy escape; they would not have functioned as natural pitfall traps.

Most of the material is probably from kestrel, *Falco tinnunculus* Linnd, pellets, as suggested by the small size of the prey (absence of larger vertebrates such as squirrels, muskets, etc.), the prey spectrum (which suggests daytime hunting), the very varied diet (Village 1990) and the very fragmented nature of the material. Owls, for example, and especially the barn owl, *Tyto alba* (Scop., produce pellets with relatively complete long bones, and skulls with teeth often in place (Andrews 1990). Diagrams of skeletal element proportions (Fig. 17) do not match those of either barn owl or kestrel as presented by Andrews (1990). His data show more skull fragments and fewer phalanges for kestrel; however, these are from modern pellets and it may be that, in soils, skull fragments become broken down. There is also the point that the Maiden Castle material may be from more than one predator species.

With regard to the last point, the possibility must also be considered that the amphipod bones are from a different source, specifically from animals that lived (even if transiently) and died on the site, especially since they are rarely taken by kestrels today (Village 1990). The topography of the site and the porosity of
the chalk would not have allowed the ditches to have held water long enough for amphibia to breed in them, and there are no aquatic mollusc assemblages, but it is possible that they were suitable sites for hibernation. However, the amphibian remains are as fragmentary as the mammalian and other material and, although more abundant in some levels, this abundance is low by comparison with what might be expected from the remains of complete skeletons. Furthermore, although there is a concentration of amphibian remains in the lower part of the MC IV sequence, this location is fortuitous, being matched by a similar concentration at the same chronological level in the MC III sequence, but much higher up in the ditch. We therefore conclude that the amphibian remains are likewise from raptor pellets, although not discounting the possibility that they may be from a different, perhaps more local, origin than some of the mammalian material. Certainly, it appears that freshwater habitats were being exploited by the raptors, if the fish bones, too, were from pellets.

Examination of the types of corrosion to distinguish different types of raptor (e.g. Mawby 1977) and to separate the effects of pedological processes from stomach acid corrosion (e.g. Andrews 1990) was not made, in view of the small amount of material, the probability that more than one raptor species was involved, the uncertainties of distinguishing diurnal and nocturnal raptors (Andrews 1990) and the variety of deposits.

The sequences

The main features of the sequences are as follows:

(i) allowing for absences which can be attributed to small sample size, almost all taxa are present throughout. The two exceptions are newts and shrews. Some taxa, such as frogs and toads, are abundant and continuously present; others, such as fish and bird, are in low numbers and sporadic. Field vole and wood mouse are more uniformly present than bank vole.

(ii) the earliest deposits (MC XIII) are characterised by bank voles, contrasting them with later levels.

(iii) newts are characteristic of the bank barrow horizon.

(iv) frogs and toads are abundant in the woodland horizon between the Early and Late Neolithic.

(v) shrews, including water shrew, are present mainly in the Late Neolithic horizon.

(vi) the MC IV sequence is broadly similar to the equivalent part of the MC III sequence 55 m away.

Discussion

Size of area represented by the material

Various indications suggest that the small-vertebrate sequences reflect the local rather than solely the sampling spot environment, and in this respect they differ from the molluscan data:

(i) The home ranges of the small vertebrates are large, especially when compared with those of land mollusca.

(ii) As argued above, in the specific case of Maiden Castle, the material is probably of bird of prey pellet origin, and this implies a greater sphere of reference with regard to environmental interpretation than would be the case if the bones had derived only from animals whose home ranges had encompassed the sampling spots. For kestrels, the home range varies from about one to about ten square kilometres (Village 1990).

(iii) There are two similar sequences which match chronologically from the bank barrow level upwards, 55 mm apart, illustrating that the individual sequences are of more than sample spot significance. This is deemed to be the most important result of the investigation.

In addition, the remains are giving information about roosting/nesting sites (or, at the very least, pellet-regurgitation sites), usually well above ground on posts, in trees or in buildings. Thus the increase in abundance of remains in the period of human abandonment between the Early and Late Neolithic is probably a reflection of the increasingly wooded nature of the site at this time.
Figure 17. Maidens Castle. Skeletal element proportions of small vertebrates as percentages of fragments whose skeletal element was identified (not of total fragments).
General environmental interpretation

Because the material probably derives from bird of prey pellets, it does not reflect a uniform area, for particular raptors select particular parts of the landscape for their hunting and have particular prey preferences. The kestrel, for example, argued as being the main species responsible for the accumulations at Maiden Castle, hunts scrubby hillside and woodland edge, as well as grassland, and has a very varied diet, although concentrating on field vole. *Microtus agrestis* (Masman et al. 1988; Villagé 1990); barn owls, on the other hand, select long strips of open land along field edges, streams or woodland/arable interfaces, and also prey very heavily on field voles (Shawyer 1987). These aspects of raptor behaviour need to be borne in mind when considering the results.

The assemblage is a mixed terrestrial and amphibious one, with a few aerial and aquatic representatives. The terrestrial taxa reflect a heterogeneity of local habitats—open (field vole), scrub (bank vole, shrew) and woodland (mice)—although species should not be assigned too rigidly to habitats. The amphibious species may have been living on the hilltop in artificial ponds and/or taking advantage of the Neolithic ditches for shelter and hibernation, while breeding by the South Winterbourne stream, 500 m away. Whatever the case, they were part of the raptor spectrum, not living and dying in the Neolithic ditches in their place of burial. The aquatics (fish and, to a lesser extent, water shrew) at least are clearly from further afield.

The temporal sequence

Little can be said about the pre-enclosure and Early Neolithic enclosure levels because numbers of bones are low, but the abundance of bank vole in Phase III against the paucity of field vole (and in contrast to the situation in the later part of the bank barrow ditch fill) is perhaps significant and indicative of good scrubby ground cover in and around woodlands.

The distinctive feature of the bank barrow horizon, the abundance of newts, suggests the presence of a pond on the hilltop, although there is the alternative possibility that these and other amphibians were breeding in water bodies further afield. If a pond had been present on the hilltop in the Neolithic period it would certainly have had to have been an artificial, clay-lined one. A pond would have been a not unlike feature of the site in view of the predominantly cattle-raising economy of the Early Neolithic, and especially the importance of causewayed enclosures in this.

Allowing the pond hypothesis, the later absence of newts in the earlier part of the secondary woodland stage when the hilltop was abandoned suggests that the pond became infilled. This was a period of considerable diversity in the small-vertebrate assemblages, indicating an undisturbed environment for raptor roosting and nesting, and supporting the archaeological and molluscan evidence for human abandonment and woodland regeneration on the hilltop.

In the upper, Later Neolithic, parts of the sequences, toads and frogs decline, suggesting water was further away. Shrews are characteristic at this time, although the ecological significance of this is unknown. Their appearance with the land snail *Pomatias elegans* may be commented on, with the implication of a possible predator-prey relationship. Terry O'Connor has suggested a relationship with human activity and, as this was a period of renewed human activity, first in woodland, and later in a cleared and cultivated landscape, the shrews may in some way be reflecting this.

Width implications of the results

The small-vertebrate data do not reflect the detailed story shown by the molluscs for the site (Evans et al. 1988). Instead, they indicate a heterogeneous landscape around Maiden Castle from the very beginning of the sequence, that is prior to the construction of the causewayed enclosure, and this is backed up by other evidence. For example, surface scatters of flint flakes, studied by Peter Woodward, show localised areas of activity at the eastern end of the hilltop and on the valley sides in the Early Neolithic, probably prior to the causewayed enclosure. So there was probably some clearance of woodland in the locality. The enclosure itself was probably sited on the edge of this activity, at the woodland edge, and there is molluscan evidence that the eastern end of the enclosure was in more open country than the western end, where the sample series described in this paper come from. Indeed, evidence generally from causewayed enclosures in southern England suggests them to have been sited on the edge.
of territories, in woodland clearings (Evans et al. 1988).

Wood charcoal, studied by Rowena Gale, amplifies the picture further. Oak and other woodland trees were exploited in the Early Neolithic and continued in use into the bank barrow horizon and secondary woodland stage. By the time of the Late Neolithic clearance, however, shrubs of wet and acidic soils were being utilised, indicating that people needed to exploit areas further afield than previously for timber and reflecting progressive clearance of the area and the need to go further afield than previously for timber.

All this suggests that the Later Neolithic woodland in the ditches at Maiden Castle, and perhaps too as recorded at other sites in southern and eastern England (Evans 1990), was specific to these sites. This is not to say that abandonment or relaxation of use of the land was not a general feature of the landscape at this time, only that such practice was being registered more fully in the ditches of monuments than elsewhere.

Conclusions

Small vertebrates, when derived from raptor pellets, give information additional to that from molluscs at the local and small-regional scales. The most important observation to emerge from the work at Maiden Castle is that two later sequences, from points 55 m apart, are similar. But bigger samples, at least 5 kg, are needed to provide more precise data. The sort of information about subtle environmental changes in vegetation cover that are revealed in modern studies of raptor pellet debris can only be obtained with much larger data bodies than used in this paper (e.g. Yalden and Morris 1990). Reference material is crucial because information at other than the species level is only useful for indicating general trends in input and possibly raptor species.

Acknowledgements

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The effect of recovery techniques on faunal data at Klithi, North West Greece

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Summary

The palaeolithic rock shelter of Klithi, North Greece, has been undergoing investigation by archaeologists and geologists since 1983. During this period excavation strategies and in particular recovery techniques have been occasionally revised as the condition, type and density of the artefactual material was realised and further information was gained about the deposits within which the artefacts were contained. This report outlines recovery techniques practised at the site, and also presents the results of a short series of experiments designed to establish the cause and extent of fresh fragmentation and other types of damage which occurred on some of the bone material during the 1988 season.

The results of the experiments suggest that the damage may be attributed to the weight of overlying sediment etc. during post-excavation transportation and the rapid wetting/draining to which the faunal material is subjected. However, the sample used was too small to produce conclusive results. Finally there is a brief discussion of the need for more experimental work and fuller publication of recovery and recording techniques on early prehistoric sites.

Introduction

The rock shelter of Klithi is situated within the lower part of the Vikos Gorge in the Epirus region of Northern Greece. It is one of several palaeolithic rock shelters in the Epirus region and the largest so far known. Excavation of the site has been carried out since 1983 and is an integral part of a programme of research on the palaeolithic of the Epirus region which includes geological and palaeobotanical studies both within the Vikos region and beyond (Bailey et al. 1993; 1984; 1986a; Bailey and Thomas 1987; Sturt and Webley 1987). The dates so far obtained on excavated material from Klithi bracket the prehistoric occupation of the site between 17,000 ± 400bp and 10,420 ± 150bp (Bailey et al. 1986b).

Major factors which have influenced the excavation and recovery techniques used on the site have been the overall objectives of the excavation and research project, the size of the site, the richness of the artefacts (i.e. their density within the sediment) and also the general inaccessibility of the site and the 'primitiveness' of its immediate surroundings in terms of facilities available.

The overall objectives of the excavation and the research programme of which it forms a part are fully described by Bailey et al. (ibid.) and it is only necessary here to note that these objectives include the detailed investigation of the spatial distribution of the cultural materials within the shelter, the identification of features such as hearths, 'dumpy' areas and other special activity areas, and therefore necessitate the fullest possible recovery of the artefactual material accompanied by recording and understanding of the microstratigraphy within which the material lies.

As has been stated, the shelter itself is the largest of this period in Epirus; currently the shelter opening is 25 m wide and 10 m deep although this may well have varied in the past. Until recently the shelter was used by a modern goat herder and this has produced a flat topped layer of dung over the whole area of 450 m²—extending slightly out of the overhang. Although the exact depths of archaeological deposit within the entire shelter have not yet been obtained these certainly reach a depth of over 1 m in places and may reach 2 m, whilst seemingly 'sterile' screen deposits have been recovered to a depth of more than 7 m (Bailey and Thomas 1987). The problems of devising strategies and techniques to cope with such a large volume of complex deposits are several, including those of storage.
and safety, but perhaps the one that dominates is that of time (Bailey in press).

Inaccessibility of the site also dictates to a certain extent the post-excavation techniques used. The site is approximately 15 minutes by goat-track to the nearest point which is accessible to a car, and there is a further 20 minute drive to the project house in Aristi where the majority of finds are currently stored and where detailed analyses of the artefacts is carried out. Therefore, it is highly desirable to remove all sediment from the artefactual material at, or close to, the shelter (although a few bags of sediment are carried back each year for specialist analysis/examination).

The excavation is fortunate in having access to running water in the form of the Vikos river which runs directly past the site 30 m below, but it is necessary to walk approximately 500 m over very steep terrain to arrive at a point where the river is accessible for sieving or for use in flotation. In 1988, as staffing was limited, it proved necessary to dry-sieve on-site to remove the majority of sediment (<3 mm) and large limestone fragments (>10 mm) before this journey was made. However, this has not always been the case (see below).

Density of artefacts varies greatly across the site and according to context. However, it has been estimated that a single cubic metre of deposit within the shelter can yield as much as 160,000 recoverable specimens of flint and bone (Bailey in press) and during the 1984 season, when all bone material over 3 cm and all flint over 2 cm was individually plotted to the nearest centimetre, one area of the shelter contained approximately 800 plotted flints and bones in a deposit of 1 m² x 5 cm deep. This density is partly a function of the richness of the site (i.e. absolute numbers of artefactual debris) but it is also a relative product of the very slow sedimentation rate within the shelter’s upper levels, estimated at an average of 0.4 mm per year (Bailey ibid.).

Although small mammal and bird bones are comparatively rare—the faunal assemblage is overwhelmingly dominated by ibex, Capra ibex, and chamois, Rupicapra rupicapra (Gambie, in Bailey unpublished)—recovery of the full size range of material has always been a recognised objective. Faunal material is analysed by quantity, weight and size of fragments (in addition to species, etc.; C. Bailey pers. comm.). In particular, with relevance to these experiments, it is felt that size can give a guide to both determination of activity types and destruction patterns pre- and post-deposition (but importantly pre-exvation).

Recovery Techniques

1. Pre-1988 Recovery Techniques

Prior to the 1988 season recovery techniques had changed several times in response to results of on-going analysis of the recovered material and changing circumstances on site. Some discussion of this is contained in the interim reports for each field season and the major changes are briefly presented below.

Since 1984 actual tools used in excavation have always remained soft brushes and plastic scoops supplemented occasionally by small metal tools to loosen the more compacted sediments; these tools are felt to ensure that minimal damage is caused to fragile bones or the edges of the flint artefacts.

1983: This was the first season of excavation and the main objective was to evaluate the potential of the site. The team was fairly small and it was desirable to excavate one experimental trench to the base of the archaeological deposits. Spits of 5 cm and occasionally 10 cm were used for recording, with respect for layer changes, and there was no individual plotting of artefacts. The majority of the deposit was passed dry through 20 mm, 8 mm and 2 mm sieves and further samples were selected for water separation and flotation.

1984: Excavation in this year was concentrated in the parts of the shelter which it was believed were largely undisturbed since prehistoric occupation and which contained spatially distinct activity areas. Following the results of the previous year it was felt desirable to commence individual plotting of all bone material above 3 cm and all flint material above 2 cm. A combination of spits and layers was again used for recording and analysing artefacts under the size ranges above, with spit depth being restricted to 5 cm. In the report on the 1984 season it was
stated that ‘this method also ensures as complete a sample as possible of undamaged specimens, and has already in some cases altered our interpretations of the cultural material’ (Bailey et al. 1986a). All material was dry-sieved through 10 mm and 2 mm sieves and again there was selective wet-sieving.

1985: Individual plotting was abandoned in this year as it had found to be extremely time-consuming given the density of artefacts and that examination of the deposit and sediment types suggested some vertical and possible horizontal movement may have taken place post-depositionally. Instead material was plotted to the quadrant (of size 50 x 50 x 5 cm, a quarter of an excavation area) and occasionally to mini-quadrants (25 x 25 x 5 cm)—again respecting layer changes. All deposits were now wet-sieved through 1 mm meshes on a flotation unit. This change in wet-sieving practice was made in the light of results gained by wet-sieving 1984 samples, which had been set aside for further analysis. Wet-sieving of these samples had shown that informative material in the 1–2 mm range was being lost by the practice of only dry-sieving. Dry-sieving was felt unnecessary prior to the wet-sieving stage.

1986: As much as possible was recovered at the excavation stage with all finds being provenanced to the mini-quadrant rather than the quadrant to simplify excavation procedures and subsequent statistical analysis. All sediment was again wet-sieved through 1 mm meshes.

1987: No excavation took place but work was commenced on a re-fitting programme for the lithic materials excavated in previous years and trampling experiments also took place to help assess horizontal and vertical movement within the type of loose deposit (Bailey in press. F. Wenban-Smith pers. comm.)

2. 1988 Recovery Techniques

The major changes in recovery techniques that were implemented in 1988 were the decision to bulk sample (within quadrants) rather than attempt to recover any material during excavation, and the re-introduction of dry-sieving through 10 mm and 3 mm meshes on-site prior to wet-sieving through 1 mm meshes at the river. Flotation was not used—and had been abandoned since 1985 as results were so poor.

Individual plotting of material had also been discontinued since 1985 as the immense time consumed by this activity was not considered justified when balanced against the loss of overall information caused by restricting the time and therefore the area of the site that could be excavated. Since it had been noted (from analysis and experimentation) that certain areas of the site had also undergone a degree of mixing, this made exact plotting meaningless in some deposits, although it was obviously impossible to state prior to excavation which particular deposits had been disturbed. Results of lithic re-fitting carried out during the 1988 seasons by Wenban-Smith will shed further light on the integrity of the deposits and may again lead to modification of techniques in subsequent years. Bulk sampling by quadrants, followed by complete recovery through sieving in a way a natural extension of the policy of not recording exact artefact placement. It had also been noted in 1986 that a two-tier system of some recovery within the trench and some at the sieving stage was time-consuming and generally decreased efficiency as artefacts recovered on-site had to be ‘matched up’ at a later date with material from the same quadrant (or mini-quadrants) recovered in the wet sieve.

Excavation techniques used in 1985 had been seen to be causing some damage to non-lithic material as it was recovered within the trench, in particular the fragile carbonised remains, and Bailey et al. (1986a, 18) stated that it was ‘difficult to lift a bone without breaking it’. In 1988 the bulk sampling method was introduced mainly to speed up operations but also in the belief or hope that there would be no great damage to bones, and perhaps less damage than previously noted.

I produce below a brief resume of the stages of 1988 post-excavation recovery procedure subsequent to removal by bulk excavation:

(a) Immediately after removal all sediment (and archaeological materials contained therein) were placed in a plastic bag (‘soil sample’ type); three of these bags were usually necessary for removal of a layer from a quadrant, and each bag was given an

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individual number which recorded the provenance of the material. Each bag contained up to 8 kg of sample.

(b) The contents of each bag were poured onto a standing stack of dry sieves in a shaker frame and agitated for approximately one minute. Sieves were 10 mm and 3 mm mesh (square holes) The bone material retained in the 10 mm sieve was extracted and placed back in the bag along with lithic material retained in this sieve (other than limestone fragments, which were discarded after brief examination). Faunal material and other residues caught in the 3 mm sieve were poured back into the bag. Towards the end of the excavation care was taken to place the >10 mm material back into the bag after the rest of the residue as it was feared that the pressure of the material from the 3 mm sieve might be damaging the bone already placed in the bag.

(c) The bags, now weighing 1-5 kg were placed in a sack with about four others and carried down to the wet-sieve—a journey of about 500 m over rough terrain.

(d) The sediment was poured onto plastic meshes (1 mm mesh size) and agitated in the river. The remaining bone and lithic materials were then laid out in the sun on the plastic meshes and left to dry in the sun for 3 or 3 hours (given the cold damp nights this was the only method of drying available); it was also necessary to lay out the meshes for as short a time as possible as in the afternoons the goat herder came through the valley and goats appear to regard plastic meshes as a legitimate part of their diet.

(e) The dry material was poured back into the marked bags (now weighing 0.5–3 kg) loaded into sacks six at a time and carried back up to site.

(f) The contents of each bag were poured onto a table and sorted by hand.

Often there were extended periods of time between one post-excauation stage and the next and bags containing sediment were often moved around the site as on-site activities demanded.

It was at the hand-sorting stage during the 1988 season that fresh breaks were noticed on some of the faunal material. Material was often sorted by the person who excavated it originally and therefore not only were breaks visible by their clean whiteness, but particularly large or 'interesting' pieces might be remembered and so any damage to them commented on.

It is interesting that no fresh breaks were ever noted in the lithics, although they were not specifically examined at this stage for fresh chipping or edge damage.

Report on experiments carried out in 1988

Aims

Since observation of fresh breaks suggested the possibility of the 1988 bulk sampling technique causing damage to bone material, it was decided to carry out a short series of experiments to establish if bone fragmentation was occurring and, if so, to attempt to isolate the main causal factors and roughly to quantify the effects on individual bones, bone 'types', and ratios of bone fragment sizes. It was considered that if bone fragmentation was occurring this would have important consequences: reducing the numbers of pieces that were identifiable and also complicating the interpretation of variation in absolute bone numbers and sizes of fragments between archaeological contexts. It is possible that breakage had occurred in previous years and some idea of this should have emerged in the bone analysis when it was completed for each season, but this had not previously been specifically studied or quantified on site.

Method

To isolate and quantify the effects of the several post-excauation stages fully would have entailed several experiments being run, as each stage would, ideally, be undertaken on freshly excavated material of as near similar type as possible. However, as ever, the time available for this work was extremely limited. The following three experiments were therefore devised to be undertaken during the normal course of excavation on site.

Each experiment took place using the equivalent of a bag of archaeological deposit which was removed from the same quadrant and layer (removal of a quadrant usually necessitating filling three bags).
Experiment 1

This experiment was designed to assess the overall effects of post-exavcation treatment on a sample of faunal material. The stages were as follows:

(a) excavation in usual manner of one-third of a quadrant with resulting sediment, etc., placed carefully in a large flat container rather than in a bag, thus minimising the weight placed on the bone material.

(b) measurement and recording of faunal material extracted—this produced the 'baseline' against which breakage was recorded, and also gave an indication of damage caused by excavation technique. All material was then placed in a bag and proceeded through post-exavcation in the normal manner as described above.

(c) after sorting, the bone material was re-examined and measured and any breakage or other damage noted.

(d) comparisons were then made between results from stages (b) and (c).

Experiment 2

This was designed to assess the effect of dry-sieving (alone) and wet-sieving (combined with dry-sieving) on the bone material, but without the material being poured in and out of sacks, so minimising the weight factor throughout the whole recovery procedure.

(a) material was excavated into a large flat container and bone material extracted, measured and examined as in Experiment 1.

(b) the bone was placed gently back into the container and re-amalgamated.

(c) material was then put in the dry sieves and agitated, and then placed again into the flat container and the bones extracted and measured again.

(d) material was then placed again into the container, and taken to be wet-sieved as normal and left to dry.

(e) artefacts were then carried back up to site using a large container and sorted in the normal way, the bones being re-examined, measured, etc.

Comparison was made of results at stages (a), (c), and (e).

Experiment 3

This was designed to assess impact of wet-sieving (solely) on the bone material. It was carried out in the same way as Experiment 2, but omitting stage (c). Comparison was to be made before and after wet-sieving.

The information recorded at each examination stage was as follows:

(i) for all bone over 3 cm, and bone under 3 cm but identifiable to bone element, i.e. humerus, tibia, etc. (on brief examination):

- maximum length
- maximum width
- maximum thickness
- burnt or unburnt
- signs of fresh breakage or other damage
- articulations present
- identifiable or not
- comments

(ii) for all bone over 1 cm but less than 3 cm, not identifiable:

- fragment count

(iii) bone under 1 cm was not examined unless it was identifiable to bone type (i.e. small mammal bones)

Each category was also weighed as a group, but sensitive scales were not available so it was felt that it would be misleading to weigh the <1 cm material as accuracy was only in the region of ±5 g. The results of the experiments are shown in Table 6. Note that bone measurements are not reproduced here.

Discussion of experiments

The main conclusion from the experiments was that damage to the bone material was not as extensive as had been expected from the casual observations that had prompted the whole exercise.

There could be several reasons for this, but I would suggest two main factors. Experiment 1, despite being based on 'normal' post-exavcation procedures did not mimic...
Experiment 1 (all the bone was lightly burnt)

<table>
<thead>
<tr>
<th>Number</th>
<th>Weight (g)</th>
<th>No. Damaged</th>
<th>No. Articulated</th>
<th>No. Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone &gt;3 cm and bone &lt;3 cm identifiable to type</td>
<td>41</td>
<td>100</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Bone &gt;1 cm &lt;3 cm</td>
<td>54</td>
<td>40</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Teeth fragments</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

2. Results at stage (c)

| Bone >3 cm and bone <3 cm identifiable to type | 36 | 90 | 23(±3)* | 11 | 30 |
| Bone >1 cm <3 cm | 62 | 30 | - | - | - |
| Teeth fragments | 4 | - | - | - | - |

Table 5 (above and opposite). Results of the experiments carried out in 1988. Notes: *—two bones showed signs of cracking and one of surface peeling; †—two bones showed signs of cracking, two of surface peeling, and four of ‘edge nibbling’. Experiment 3 (in which all the bone was lightly burnt) was abandoned in view of the lack of damage in Experiment 2.

either more resistant to damage or has already been as fragmented and damaged as it is likely to get.

As mentioned above, comparison of results from Experiments 1 and 2 suggests that more damage (particularly breakage) takes place when faunal material is subjected to an overlying burden of loose sediment and other artifactual material. Although it would be extremely difficult to replace the soil sample type bags with a receptacle that reduces this weight load (the large washing-up bowl used for the experiments would have been impossible to use during the normal course of recovery), perhaps it should now be considered whether the damage from this factor is great enough to outweigh the advantages of bulk sampling.

Cracking and peeling did occur as a direct result of the washing and drying of the bone. This is obviously a problem that should be considered and, if possible, within the restrictions imposed by the climate and situation, post-extraction procedures altered. Although at this stage it was not severe enough to affect identification it is not known whether further degradation will occur during storage.

The following additional points were also noted and emphasise the difficulty of such on-site experiments as much as giving any absolute results:

(a) More breaks were identified after wet-sieving—but this may well reflect the fact that breaks and damage are difficult to recognize whilst the bone is still covered in sediment and therefore may not necessarily mean that it is the wet-sieving that is causing the damage. This also makes it difficult to ascertain if the excavation techniques alone are causing damage. Further experiments on comparative damage by excavation techniques would be interesting particularly in view of the comments by Bailey et al. (1986a) about problems with lifting and my comments above.

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Experiment 2 (all the bone was lightly burnt)

<table>
<thead>
<tr>
<th>Number</th>
<th>Weight (g)</th>
<th>No. Damaged</th>
<th>No. Articulated</th>
<th>No. Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Results at stage (a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bone &gt;3 cm and bone &lt;3 cm identifiable to type</td>
<td>44</td>
<td>120</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Bone &gt;1 cm &lt;3 cm</td>
<td>46</td>
<td>30</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2. Results at stage (b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bone &gt;3 cm and bone &lt;3 cm identifiable to type</td>
<td>45</td>
<td>110</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Bone &gt;1 cm &lt;3 cm</td>
<td>49</td>
<td>50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3. Results at stage (c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bone &gt;3 cm and bone &lt;3 cm identifiable to type</td>
<td>45</td>
<td>110</td>
<td>3+4+</td>
<td>20</td>
</tr>
<tr>
<td>Bone &gt;1 cm &lt;3 cm</td>
<td>59</td>
<td>40</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

and therefore may not necessarily mean that it is the wet-sieving that is causing the damage. This also makes it difficult to ascertain if the excavation techniques alone are causing damage. Further experiments on comparative damage by excavation techniques would be interesting particularly in view of the comments by Bailey et al. (1980a) about problems with lifting and my comments above.

(b) More material was recovered at each stage in terms of numbers (and occasionally weight) especially in the 1-3 cm range. Again this might be caused by material becoming easier to recognise as it passed through each stage and sediment is removed. It may mean, however, that material was breaking down into this category.

(c) Loss of identifiability of fragments seemed minimal except in the categories of rib fragments and two vertebral epiphyses which were lost in Experiment 1 from the >3 cm category. Fragmentation where it occurs appears to be selective, in that certain skeletal elements appear more susceptible to breakage; this may, of course, bias the final analysis in several ways.

Obviously it would have been preferable to repeat the experiments several times to gain a larger sample and also to use unburnt material. However, further time on site was not available. It would also have been difficult to ensure, in advance, that the material about to be recovered would be unburnt.

Conclusions from the experiments

Despite the very small scale of the experiments, and the consequent problems of interpretation of results, they did prove useful in suggesting the main causes of the bone fragmentation that had been previously noted at the sorting stage, namely crushing by weight and the peeling/cracking caused by rapid wetting and drying. The fact that the damage was less than expected is particularly interesting—this may have been a factor of the experiment design as discussed above or it
may be that the sorters had over-estimated the amounts of breakage, as the bones damaged tended to exhibit fresh 'white' areas that were easily visible.

When the detailed specialist analysis is completed on the 1998 faunal material as a whole (including quantification of breakage) then we should be able to compare this with previous seasons and detect any gross changes in patterns of 'fresh' damage although, obviously, comparability will be an even greater problem than was the case for the experimental material which was all specifically taken from the same quadrant and context.

Discussion

The original aim of this article was to present the results of the short experiment on bone fragmentation. The secondary aim which grew from the background reading for the original theme was to make available for discussion the methods of recovery used at Kliithi with accompanying record of the changes that have occurred in these methods over the course of the five years of excavation and analysis, in the hope that this would encourage discussion of the techniques used, and subsequent problems and responses to them at other sites, particularly sites of the same period or type.

The very factors which have contributed to the enormous archaeological value of Kliithi—namely the richness of the site and wealth of information potentially available, the type, condition and distribution of the artefactual material present, and also the relative inaccessibility of the area—have resulted in the recovery problems which I have outlined above. These are all factors which must have been tackled time and time again in archaeology and face directors at the start of many excavations when decisions on levels of recording and type of recovery practised have to be made. The techniques utilised on a site, subsequent changes and developments in response to pressures of time (and money) and results of on-going analysis are of interest to all who are attempting to formulate their own methods.

With reference, in particular, to early prehistoric sites the decision to bulk sample rather than recover material in situ, and not to record the position of each artefact to the centimetre, is one that merits discussion. The majority of palaeolithic and mesolithic sites undergoing excavation in Europe at present favour a system of three-dimensional recording, usually to the centimetre, occasionally to the millimetre and often with comments on angle of declination, axis, and so forth. The decision at Kliithi not to continue this practice (following from the results of analysis of breakage, re-fitting, examination of matrix type and assessment of time and information loss at the meso-spatial scale) is one that may encourage wider discussion of reasons for continuing this practice and justifications for it.

There may be a reluctance to change recording or recovery systems part way through an excavation, even as a result of on-going analysis, but overcoming problems caused by changing techniques several seasons into the excavation may not be as time-consuming as the continuation of those techniques if they are more detailed than can be justified—for example, if the matrix was subjected to much post-depositional mixing. It will be realised that this approach puts emphasis on on-going analysis with results of previous season’s excavation having to be available when decisions are being made as to techniques to be used in the following season.

On-site ‘experiments’ such as those of Sebastian Payne (1972; 1978) were of vital importance to the development of currently accepted standards and recovery techniques but, although this work on development of techniques is still carried out by various workers, there are few examples of on-site experimentation and assessment of recording and recovery techniques on ‘artefacts’ in general. If there appears to be a problem with fragmentation or edge damage, or indeed with the pace or scale of recovery, it is easier to quantify, analyse and successfully address these problems if experiments can take place alongside excavation with exact duplication of techniques in the particular circumstance of the site than if analysis and experimentation take place at the close of the season away from the site (often in laboratory conditions) or even after the completion of the excavation of the site entirely.

Perhaps the arena in which work of this kind could best be presented and discussed would
be within interim site reports. In a discussion on publication Barker (1977, 244) commented that 'A deficiency of almost all interim reports is that they carry little information regarding the techniques used to recover the results which are summarized so that dissemination of new methods or refinements of old ones is slow and intermittent'.

This article was made possible purely because the interim reports from Kiliti do include discussions of the recovery techniques used and the reasons for those specific techniques being used. A very brief foray into some interim site reports of palaeolithic and mesolithic sites currently under excavation shows that the Kiliti reports are in a minority in this respect. Although description is usually made of the recording system (usually with steps on how much detail has been achieved) little if any comment is made on the recovery system, justification of its use (e.g. factors involved in the choice; reports of experimental work) or assessments of the relationship between time, information and finances which must have been made.

Obviously every site is very different and each director will have to make their own assessment (and re-assessments as the excavation continues) of the appropriateness of particular recovery techniques and scale of recording. Surely these important decisions and the factors which influenced them should be recorded alongside the results that were obtained by their use, both to aid the evaluation and interpretation of those results and to assist those who are themselves involved in making their own difficult decisions.

Acknowledgements

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I am personally indebted to Dr Geoff Bailey for his support and encouragement both during the 1986 field season and subsequently and for allowing me to quote from unpublished reports. I would also like to thank Steve Kemp for his help at the excavation and sieving stage and discussions on the experimental work, and Bill Sillar for allowing me to abuse his word-processor. The views in this article and the shortcomings and faults within the experiments are, of course, all mine!

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Revised disk copy received August 1991
101 ways to deal with a dead hedgehog: notes on the preparation of disarticulated skeletons for zoo-archaeological use

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Summary

Two methods of preparing skeletons are described. After skinning, gutting and defleshing, large animals are buried for two months to two years in nylon mesh bags in leaf mould. Smaller animals are simmered in water for approximately 15 minutes and then allowed to macerate in warm water with a proteolytic enzyme for one to several days (fish should not be simmered). The resulting disarticulated bones are then thoroughly washed, dried and degreased with acetone or a mixture of methanol and trichloroethylene.

Introduction

Over the past twenty years we have between us prepared over 2000 skeletons, working in very varied conditions. The purpose of this note is to offer some suggestions, based on this experience, about how to get hold of animals, how to prepare better skeletons, and how to make the job simpler and less antisocial. It is not intended as a full guide to all the available methods; there are many ways to produce good skeletons depending on the animal you start with, the equipment available, space, climate and so on. All we intend to offer here are some methods that have worked well and reasonably reliably for us, advice that we hope may be useful, and some comments on mistakes to avoid.

Two general points at the outset. First, there are some risks associated with handling dead animals and preparing skeletons. It is important to be informed about risks from animal-borne diseases such as leptospirosis, psittacosis, tuberculosis and rabies, and pathogens associated with decomposing animal matter. Take sensible precautions such as not handling animals that died from disease or are likely to have died from disease, wear gloves and lab coats or overalls, cover broken skin, avoid and treat sharps injuries, and wash hands before eating, drinking or smoking. Risks should be formally assessed under the recent COSHH (safety) regulations, but should not be exaggerated—neither of us has had any problems, and the worst we know of is a septic finger caused by driving a bone splinter under a nail and ignoring it.

Second, everything is easier and less unpleasant if the animal is reasonably fresh. Never put off dealing with a dead animal: one of us still remembers all too vividly the awful job of finally dealing with a dead hedgehog left in a polythene bag in the engine compartment of a van and half-forgetten for three weeks during a Turkish summer. A deep freeze is an invaluable aid, but large or long backlogs should be avoided: we have cleaned out too many freezers full of half-rottten ten-year-old bodies.

Don’t leave animals in the deep freeze too long

There’s no reason not to eat an animal before you prepare it if it’s edible—and you’ll find
out what it tastes like. If you do, stewing does less damage than roasting or frying (we haven’t yet tried microwaving); and remember to take notes, measurements, weights and photographs first.

There’s no reason not to eat an animal first

Sources of animals

Tunes and attitudes have changed since Gilbert White wrote in 1767 (Letter 11): Three gross-beaks (Loxia coccothraustes) appeared some years ago in my fields, in the winter; one of which I shot . . . . But there are many other ways of getting hold of dead animals without going out and killing them. First and most important is to ask for help. A wide variety of people come across or deal with dead animals, including amateur naturalists, fishermen, professional zoologists, conservation workers, gamekeepers, people who work on the roads, farmers and animal-breeders, vets, butchers, game dealers and fishmongers. Organisations that may be helpful include societies, museums and zoos.

It’s important not to feel that you have to prepare every animal you get hold of. Preparation takes time and effort. It’s not worth spending time on a skeleton that is poorly-documented, uncertainly identified, or

First catch your hedgehog

It’s important not to feel that you have to prepare every animal offered to you
unlikely to be useful; better to spend the time getting hold of and preparing something you really will use. So, if someone gives you something you don’t want, thank them kindly (they may bring you something you do want next time), phone round colleagues in case they want it, and, if not, dispose of it.

Sending dead animals by post or rail

If someone tags you up and offers you a dead animal, but it’s too far away to collect, or if you find an animal when you are a long way from base, it can be carried or sent reasonably easily by post or rail as long as it isn’t too large or smelly. The golden rule is to make sure that it is wrapped up well, first with several absorbent layers (newspaper or kitchen towel) in case it starts to drip, then with two or three layers of polythene to contain any smell, and finally with a protective outer cover (‘jiffy bag’ or box). This should hold things well enough for two or three days. First class post is advisable; in warm weather avoid posting just before a weekend—better to hold the parcel in a deep-freeze and post on Monday. If you aren’t there to receive the parcel, make sure that it is clearly marked (e.g., “perishable specimen”), and that you have arranged for someone to put it in the deep freeze when it arrives: you won’t be popular if you arrive back from holiday to find a long-dead pigeon in your pigeon-hole.

If at all possible, it’s better to take notes, weights, measurements and photographs (see below) and to get and note sex and reproductive state before packing and sending animals. All these jobs become less pleasant and more difficult when a carcass is a few days older, and the gut and reproductive organs deteriorate particularly rapidly.

Documentation

As with any other scientific collection, good documentation immensely increases the value of a reference collection of skeletons. Useful information includes locality, habitat, date and cause of death, weight and standard measurements, identification, sex and breeding condition, any other comments, a good colour photograph, and a record of the preparation method. It’s important to record your reasons for identification in case there are any later doubts, and, if you are in doubt at the time, to get an expert opinion. We accumulate (in the deep freeze) birds that we have difficulty in identifying, and periodically take them to be identified by an expert. For domestic animals, get as much information as possible about breed (including registration and flock/breed number) and history (age, diet, state of health, weight at different ages, and, if female, reproductive history). A copy of the catalogue sheet that we use is reproduced as Fig. 18 at the end of this paper (with a ‘mock-up’ as Fig. 19).

Small bodies can be sent by post

Labelling and marking are equally important—good documentation is no use if you can’t link it to the specimen. Labels must first survive whatever preparation method you use. At the moment we use aluminium foil (0.15 mm thick, supplied by J. Smith and Sons (Clerkenwell) Ltd., 42–50 Tottenham Road, London N1 4KZ; tel. (01) 253 1277), scratching or pressing heavily with a defunct biro. In the past we have successfully used ‘Dymo’ tape (it sometimes loses colour, but the embossing survives), aluminium garden labels (with pencil or scratched), and squares of plastic from yoghurt containers (important to choose a really permanent marking pen!). Once the skeleton is prepared, mark as many bones as you can, preferably with India ink. To make this quicker (and take less space on the bone), give each skeleton a number or other short code, and write identification, sex and locality.
on one of the larger bones as well as the number so that the skeleton is not useless if the records are lost or inaccessible. Indian ink doesn’t take properly on porous bone, which should be de-fatted before marking (see below); if the ink ‘spreads’ on porous bone, the area to be marked can be prepared with a thin coat of a consolidant such as Paraloid or Primal.

Preparation

There are many ways to produce good skeletons, often by taking advantage of local conditions and of equipment or facilities that are available to you. We start by describing two ‘tried and tested’ methods that are reasonably easy and usually give good results: maceration in warm water (preferably with an enzyme), which is quick but mildly antisocial and more suitable for smaller animals, and burial in leaf mould, which is slow but less antisocial and better for larger animals. We then comment briefly on a number of other methods.

Warm water/enzyme maceration

Skinning, gutting and defleshing:

Having first taken notes, weights, measurements and photographs, the next thing to do is to skin a mammal, or bird, to skin it. There is no need to pluck birds before skinning, and no need to remove a neat whole skin (unless you want to keep it); but it’s important not to cut into the bones (danger points include the muzzle, wrists and ankles) or to cut away the os penis. Wetting a bird’s feathers before you start reduces the risk of disease. With small animals (rodents and most birds), it’s usually easier to tear the skin gently away from the body rather than dissect it off; with larger animals it’s often simplest to start by cutting off a wide strip of skin down the back, starting from a skin-fold at the nape of the neck, then either tear or cut down from the exposed edges. Small areas of skin, hair and feathers can be left on feet, at the ends of tails, and around eyes, muzzles and beaks, and there is no need to try to skin the ‘scaly’ parts of smaller birds’ legs.

Next gut the animal, remembering to look for and make notes on the condition of the reproductive organs—you may need a lens or binocular microscope to do this for small birds, but won’t be able to do it if the animal isn’t reasonably fresh. Unless the animal is very small (mouse/voles/thrush and smaller), it should then be roughly defleshed: up to about rabbit size, all that’s needed is to cut away the larger muscles, while for larger animals try to leave no more than a centimetre depth of meat anywhere on the skeleton, and remove the diaphragm, heart and lungs. Again, take care not to cut into the bones or remove bones that ‘float’ in soft tissues—parts at particular risk include the pataa (don’t strip it away with the muscles), the pelvis and shoulder girdle (remember the clavicle in species that have one), the vertebrae, and the hyoid bones (at the base of the tongue).

If you want to keep the vertebrae in sequence, this is the time to thread a nylon line through them. If you want to keep the bones of different feet separate, you’ll need to cut them off, label them, and put them in separate containers or in separate mesh bags (we use lengths of old stockings or tights, tied off at both ends) in the same container.

Fish can be dealt with in much the same way, but remember to take a scale sample or to include the skin in the preparation.

Dispose of skin, guts and meat quickly and in a way that won’t cause later problems. Small amounts can be treated as kitchen waste, but larger quantities should be incinerated, taken to a suitable dump, or buried: one of us buries waste in trenches below next year’s runner beans.

Simmering (mammals and birds only):

Next, heat the whole defleshed carcass in water and bring it to near boiling point for long enough for the heat to penetrate fully. This helps to soften ligaments and tendons, speeding the next stage considerably. Avoid boiling as this may soften young or weak bone, avoid very rapid heating, as this may crack the teeth, and don’t be tempted to use a pressure cooker. Simmering is unnecessary for fishes, and should be avoided as it may damage their bones.

Maceration:

The defleshed carcass (and label) should then be put into a container with water or an enzyme solution. Water by itself is much slower and the results not as dependable. We use an enzyme concentrate called Neutrase (available from Novo Nordisk Bioindustries

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UK Ltd., 4 St George's Yard, Castle St., Farnham, Surrey GU9 7LW; tel: 0252 711212), kept between about 20°C and 30°C. It should not be allowed to go too high in case enzymes are deactivated and bacteria are killed, and should not be allowed to drop below about 15°C because activity will be too slow and may follow alternative pathways with poorer results. There are various ways of maintaining temperature at the right kind of level: we have used incubators, an aquarium heater, a commercial pie-warmer, radiators, and warm climates; it would also be fairly simple to set up a basic incubator with an insulated container (perhaps a plastic dustbin) and a light bulb. pH should be reasonably close to neutral, but this isn't usually a problem.

Evaporation will be fairly rapid: each container should be checked every two or three days and topped up with fresh enzyme solution if necessary. If enzyme solution is used and temperatures are at the right level the skeleton should be ready within a few days, by which time clean bones will be lying at the bottom of the container in a thin soup of breakdown products. (Fish are particularly quick to prepare) If water is used by itself, or if temperatures are lower, maceration may take much longer and it may be necessary to change the water; if so, avoid losing bones by pouring off through a sieve. A kitchen sieve is useful for medium-sized mammals, and a fine sieve-strainer for small animals.

Once the skeleton is ready, pour off the 'soup' (think about where it's going!) and rinse in several changes of clean hot water, again taking care not to lose bones by pouring off through a sieve. Any remaining hairs or feathers usually come to the surface or stay in suspension at this stage, and can be discarded, but take care not to lose floating bones. The hot water deactivates any remaining enzyme and helps to remove fat, which rises as globules to the surface. Repeat until the rinsing water is clear, and leave soaking for several hours; if still cloudy, repeat the process. Check that the skeleton is really clean (if not, return it to fresh enzyme solution for another day or two), then drain and set to dry slowly. Avoid rapid drying (sun or heat) as this may make bones crack.

Burial in leaf mould

This method is only recommended for larger animals. It's slow, and slightly more trouble, but gives good results and is relatively inexpensive.

Skinning, gutting and defleshing:

Animals are skinned, gutted and defleshed as above, and put (with labels) into mesh sacks so that bones are not lost. It is important that the mesh used will survive two or three years of burial. Nylon curtain mesh can be used but isn't really strong enough for very large animals (and it's hard to find plain mesh); we use mesh manufactured for use in parachutes ('Quality 186', available from Swiss Net UK, Hartley House, Hucknall Road, Nottingham NG5 1FD, U.K.; telephone: 0602 692500). Very large animals can be cut up and buried in sections. If flies are active, it's worth leaving the defleshed carcass exposed for an hour or two to encourage fly-strike before burial; the maggots will hatch out after burial and do a good job cleaning the skeleton.

Burial:

The mesh sacks are then buried in piles of well-rotted leaf mould (or in pits full of leaf mould), open to the rain. Possible substitutes for rotted leaf mould include well-rotted compost and coconut peat. Fresh leaves, fresh
green matter and sawdust should be avoided as they are acid and will slow decomposition and attack the bones. Don’t let plants get established on the leaf mould as roots will grow down through the pile and may damage the sacks and the bones; and be careful to cover sacks with at least a foot of leaf mould, otherwise rats or foxes will be attracted and may dig the sacks up and do damage. Medium-sized animals buried during warm weather may only take a few weeks; but larger animals and animals buried during the winter will take longer—perhaps as much as two years. Once a skeleton is ready (leaf mould is so light that it’s fairly easy to dig a sack up, look at its contents and ref bury it), it should be soaked in water for a few hours, cleaned by brushing as needed, rinsed in clean water, and laid out to dry. (As above, don’t dry too fast or in the sun.)
Comments on other methods

Chemical methods:

In our experience these are not to be recommended. Sodium petroate tends to leave bone soft and "chaky" unless very carefully contorted; sodium and potassium hydroxide damage bone. Maceration in warm dilute ammonia can give reasonable results but is antisocial and tends to produce a very fatty skeleton.

Retting in the sea:

'She weighted her brother down with stones, and sent him off to Davy Jones. All they ever found were some bones and occasional pieces of skin.' (Tom Lehrer: The Irish Ballad)

This can give good results. Defleshed carcases are put in mesh sacks or cages and placed in the sea so that small marine organisms can clean the bones. The main problem is to secure sacks or cages so that they are safe from storms, tides and disturbance by people. A cat prepared in this way in Greece, in a sack tied to the anchor chain of a disused mooring buoy, took about three weeks. This method may, however, take considerably longer in colder water.

Burial:

Burial in earth gives rather variable results, depending mainly on soil conditions; it's worth experimenting with if you have a reasonably neutral silty soil, but less likely to give good results with acid or shallow alkaline soils or with clay. We are experimenting at present with burial in silver sand to which some crushed calcite or apatite has been added to buffer any acidity; crushed shell might also be used. Burial in blown shell-sand would probably also give good results. Again, plants should be discouraged to avoid damage by rootlets. Make sure that burials are clearly marked or, if vandals might be a problem, that their positions are accurately recorded. One of us once spent two days fruitlessly digging holes in a Turkish floodplain in search of a buried cow . . .

De-fattting

Greasy skeletons are unpleasant to work with (and possibly also present a minor health hazard). Acid breakdown products of fats and oils may also attack and weaken bone. De-fattting is therefore desirable. Our experience of alkaline hydrolysis is that it is either ineffective or too aggressive to bone. The best solvent we have found is a mixture of three parts of 1,1,1 trichloroethane and one part of methanol, which is able to de-fat small bones in a few days and large bones in a few weeks. We use a sequence of jars of solvent, placing the skeleton in a mesh bag and putting it first in the 'dirty' solvent jar, then in a 'cleaner' jar, and then in the 'clean' jar, each time for a few days (or longer if the bones are large), then removing the sack and letting it drain and then dry. As the solvent mixture is hazardous, everything has to be done in a fume cupboard and gloves have to be worn in case of splashes. To reduce solvent loss, use jars with lids that fit well. When solvent levels go down, the 'dirty' jar is topped up from the 'cleaner' jar, then the 'cleaner' from the 'clean', and finally the 'clean' jar from fresh stock. Alternatively, acetone can be used; it is less effective in removing old grease, but probably to be preferred in dealing with newly-prepared skeletons as it is cheaper, less toxic, and less ozone-unfriendly.

Staining bones with tea

Bleaching and tea-staining

Most preparation manuals will tell you that the final step in preparing a skeleton is to
bleach it with hydrogen peroxide. This may produce a more clinical specimen for museum display, but we have found that it isn’t as easy to see shape on a dead-white bone (especially under a microscope), and we think that bleaching probably also weakens bones.

Instead, we prefer our skeletons to be a fairly uniform pale or mid-brown, produced by staining them with tea (after de-fatting). Strong Indian tea is best, and should be freshly-brewed; pour hot tea over the bones and then leave for a few minutes before draining, rinsing and drying. Left and right may be differentiated by staining one side and not the other.

Storage

Bones should be stored dry; residual moisture encourages fungal attack, which can seriously damage specimens. We have noticed this to be a problem in bones stored in airtight containers. Extremes of temperature and humidity should be avoided as far as possible, and bones and bone containers should not be stored in direct sunlight.

Further reading


Acknowledgements

We are grateful to Michael Bayley for the illustrations, to Justine Bayley and Terry O’Connor for reading and commenting on an earlier draft of this paper, and to Rosemary Payne for commenting on drafts of this paper and for her tolerance of some of the work on which it is based.

Disk copy received: November 1991

Figures 18 (opposite) and 19 (overleaf). Sample catalogue sheets as used by the authors. Figure 18—blank form for reproduction; Figure 19—‘mock-up’. Note that the top line comprises basic information, some of it duplicated in entries elsewhere in the sheet. Abbreviations: Loc—Locality of collection; H+B—head and body length; OAL—overall length; HF/Wing—hind foot or wing length; Intention—those parts of the skeletons required, for example: ‘whole skeleton’ or ‘feet only’.
<table>
<thead>
<tr>
<th>AML No:</th>
<th>Identification:</th>
<th>Sex:</th>
<th>Age:</th>
<th>Loc:</th>
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**OBSERVATIONS AT TIME OF COLLECTION**

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<th>Date:</th>
<th>Weight:</th>
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</thead>
<tbody>
<tr>
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<td></td>
<td>H+B:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OAL:</td>
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<td>Tail:</td>
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<td>HF/Wing:</td>
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<td>Ear:</td>
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<table>
<thead>
<tr>
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<th>Sex, reproductive condition:</th>
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<tbody>
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<td>Breed:</td>
</tr>
<tr>
<td>Date of death or estimate:</td>
<td>Field/Flock/Ring No:</td>
</tr>
<tr>
<td>Cause of death:</td>
<td>History:</td>
</tr>
<tr>
<td>Notes:</td>
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**IDENTIFICATION**

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<tr>
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<tr>
<td>Reasons for identification:</td>
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**PREPARATION DETAILS**

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<tr>
<th>Intention:</th>
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<th>Leaf mould/Neutrase/Biotex</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>De-fatted:</td>
</tr>
<tr>
<td>Notes:</td>
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</tr>
</tbody>
</table>

| State after preparation: | |
| Date: | |
| General: | Damage: |
| | Missing parts: |

**SUBSEQUENT ACTIONS/NOTES**
**Observations at Time of Collection**

- **Collected by:** S. Payne
- **Date:** 30.3.92
- **Weight:** 122.5 g
- **Locality, habitat:** Woodlands Ed, Cambridge
  - Suburban garden, lawn & rough scrub etc. along ditch
- **Condition:** Back of head damaged
- **Sex, reproductive condition:** Adult M
- **Date of birth:**
- **Date of death or estimate:** 30.3.92
- **Cause of death:** Killed by cat
- **Field/Flock/Ring No.:**

**Identification**

- **Identified by:** S. Davies
- **Reasons for identification:** Small mustached, upper parts bright brown, underside white, juvenile wing, no black tip to tail.

**Preparation Details**

- **Intention:** Whole skeleton
- **Date:** 31.3.92
- **De-fatted:** Whole

**Notes:** Saturated 10 mins before macrornade

**State after Preparation:**

- **Date:** 10.3.92
- **General:** Good
- **Damage:** Slight damage to back of skull
- **Missing parts:**

**Subsequent Actions/Notes**
Notes for Contributors

Articles for *Circaea* should be typed double-spaced on A4 paper with generous margins. Line drawings should be in black ink on white paper or drawing film, to fit within a frame 153 x 250 mm maximum. Captions should be supplied on a separate sheet of paper, and labelling on figures should either be in 'Letraset' (or an equivalent) or should be in soft pencil. Half-tone photographs can be accommodated, but authors wishing to make extensive use of photographs, or colour, should note that they may be asked to contribute towards the high cost of production. The editors will modify short contributions to fit the layout and convention of *Circaea*. The same principle will be applied to idiosyncrasies of spelling and punctuation. Scientific articles will be submitted to referees; authors may, if they wish, suggest suitable referees for their articles.

TWO COPIES of scientific articles should be submitted. Authorities must be given to Latin names, either at their first mention or in a comprehensive list, and species lists should follow a named checklist. References should follow the so-called 'modified Harvard' convention, but with journal titles preferably given in full, not abbreviated. *World List* abbreviations will, however, be acceptable if the author indicates a definite preference. For guidance as to the preparation and presentation of material for publication, contributors are referred to the British Ecological Society's booklet *A Guide to Contributors to the Journals of the BEB*, and The Royal Society's *General Notes on the Preparation of Scientific Papers* (3rd ed., 1974). Text proofs of papers will be provided and these should be returned to the Editors within three days of receipt.

Ten tree reprints will normally be supplied to the authors of scientific articles; further copies will be available, if requested at the time proofs are returned, at a charge of 5p per side, plus postage.

Please note: there are no fixed deadlines for receipt of copy; material will normally be dealt with when received and will, if suitable, be published as soon as possible.

The Editors, *Circaea*, c/o Environmental Archaeology Unit, Walied Garden, University of York, Heslington, York YO1 5DD, U.K., Tel. 433848 (Harry Kenward), or 433840 (Allan Hall).
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