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# • circaea



**This Issue:** West revisits chicken legs, Badham and Jones sieve for plant remains, O'Connor quantifies vertebrates and Mitchell and Dickson report on plant remains and other items from medieval Drogheda.

The Bulletin of the  
Association for  
Environmental Archaeology

CIRCAEA is the Bulletin of the Association for Environmental Archaeology, and is published three times a year. It contains news and short articles as well as more substantial papers and notices of forthcoming publications and conferences. Editorial policy is to include material of a controversial nature where important issues are involved. Although a high standard will be required in scientific contributions, the Editors will be happy to consider material the importance or relevance of which might not be apparent to the editors of scientific and archaeological journals, such as papers which consider in detail methodological problems like the identification of difficult bioarchaeological remains. Circaea is edited and assembled by Allan Hall, Harry Kenward and Terry O'Connor, and is printed at the Printing Unit of the University of York. Circaea is distributed free to members of the AEA and available to institutions and non-members at £6.00 per annum. At present, copyright resides with individual authors. Circaea is published by the Association for Environmental Archaeology, c/o Environmental Archaeology Unit, University of York, Heslington, York, YO1 5DD. Enquiries concerning membership of the AEA should be sent to Bruce Levitan, City Museum and Art Gallery, Queen's Road, Bristol.

#### Notes to contributors

Articles for inclusion in Circaea should be typed double spaced on A4 paper. Line drawings should be in black ink on white paper or drawing film to fit within a frame 165 x 245 mm. 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 idiosyncracies 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 check-list. 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 has a definite preference. For guidance as to the preparation of material for publication, contributors are referred to The British Ecological Society's booklet 'A Guide to Contributors to the Journals of the BES', and The Royal Society's 'General Notes on the Preparation of Scientific Papers' (3rd ed. 1974, The Royal Society). Text proofs of papers will be provided and should be returned within three days of receipt. **Ten free 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 3p per side plus postage.**

Back-numbers and a limited supply of articles can be purchased at the following rates: back-numbers - £2 per part; articles - 5p per side, plus postage.

Copy dates: Spring issue - 15th November; Summer issue - 15th March; Autumn issue - 1st July.

The Editors, CIRCAEA, c/o Environmental Archaeology Unit, University of York, York YO1 5DD, U.K.

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 Editorial
 

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As a young journal, we find ourselves in the happy position of welcoming an even younger one. The Archaeological Computing Newsletter is produced four times a year, at the Department of Computing of North Staffordshire Polytechnic, and contains short articles which do not presuppose a high standard of technical knowledge. The first two issues suggest that at least some of the Newsletter's contents will be useful to most Environmental Archaeologists, so it is certainly worth a look. A subscription form is enclosed with this issue of Circaea.

Rather more cosmopolitan are two Handbooks for Archaeologists published by the European Science Foundation. These cover dendrochronology and thermoluminescence dating, and we understand that they are available free from the British distributors, the C.R.A. (112 Kennington Road, London SE11 6RE) or direct from the E.S.F. (1 qual Lezay-Marnesia, F-67000 Strasbourg, France).

Speaking of whom, an ear pressed firmly to the ground will detect vibrations which suggest that a series of papers concerning research priorities in Archaeological Science may be nearing completion. A number of AEA folk have been involved in this venture, and the Editors have been fortunate to see drafts of the more relevant papers. We look forward to seeing some eminently sensible ideas presented, and, more to the point, acted upon. What with this and the recent day-conference for bone specialists, we may be entering a long-overdue period of introspection and rationalisation.

The AEA at large met in London recently for its annual spring day-meeting (and splendid lunch - all praise to the catering team). The usual diverse collection of papers was presented, and it was good to see that the opportunity to present work in progress and developing ideas was eagerly taken.

When Circaea was first launched, the Editors were irrationally cautious about not contributing papers to the first few issues, although colleagues at the University of York have done so. The danger of appearing to use Circaea as an in-house journal was only too obvious - as if we would! However, this issue contains a short paper (well, more of a riposte) from one of us, with the assurance that this constitutes the thin end of only the most slender of editorial wedges.

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 Miscellany
 

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From the Mary Rose Trust

Joint Seminar, Mary Rose Trust/AEA

This event has been re-scheduled from 17th November 1984 because of security problems at R.M. Dockyard, Portsmouth. The seminar will now be held on MONDAY 14TH OCTOBER 1985 and applications are invited from those wishing to attend.

 (continued over)
 

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Cover illustration: mystery object, presumed to be arthropod, often found in Viking Age deposits at York. Length of appendage is about 1.5 mm. Any suggestions as to what this is? Please contact Harry Kenward, E.A.U., York, if you can help. Drawing: Alan Robertson.

VENUE: The Old Bond Store, Portsmouth.

AGENDA: 09.00 Assemble in Exhibition Area, Old Bond Store

10.00 Introduction by Margaret Rule  
Short talks:  
1. Site, context and processing I. Oxley  
2. Faunal remains J. Coy  
3. Botanical remains F. Green

11.00 Coffee and informal discussion

11.30 Visit to Ship Hall, viewing of 'Mary Rose',  
conducted by Margaret Rule

12.30 LUNCH

14.00 Visit to Mary Rose Museum Exhibition,  
Portsmouth Dockyard

15.00-17.00 Reassemble in Exhibition Area, Old Bond Store,  
for full discussion and examination of material  
from the 'Mary Rose'

15.30 TEA

17.00 Disperse

The fee for the seminar will be £12, payable to 'The Mary Rose Trust' and sent to Ian Oxley, The Mary Rose Trust, 48 Warblington Street, Portsmouth, Hants. PO1 2ET.

A gem from the malacological literature...

'Others like myself, since the publication of H. Wallis Kow's valuable paper "On the pairing of Limax maximus" in the Naturalist, August, 1901, have probably been more desirous of observing the pairing of those slugs and have made frequent excursions at night for that purpose. It was not, however, until the summer of 1906, my desire was gratified by that curious phenomenon...'

Carter, G. S. (1909). Notes on the pairing of Limax maximus. Lincolnshire Naturalists Union Transactions 1905-08 4, 117-9. [Spotted by Terry O'Connor]

...and a typist's error found by Bill Boyd in one of his reports

Regarding a summary table giving charcoal analysis data: '...abundance is a vaguely defined relative term, but generally means greater than 20-30 g of charcoal, or more than several tons of fragments...' All very well for a Middle Eastern site, but in a Scottish Mesolithic one??

For sale and wanted section

Bill Boyd, Department of Botany, The University, Glasgow, G12 8QQ writes to ask if there are second hand copies of the following to be purchased:

Beijerinck, W. 1947. Zoönotatlas der Nederlandse Flora. H. Veeman and Zonen, Wageningen.

Jessen, K. & Helbaek, H. 1944. Cereals in Great Britain and Ireland in prehistoric and early historic times. Det Kongelige Danske Videnskaberne Selskab, Biol. Skrifter II/2.

Khrber-Grohne, U. 1964. Bestimmungsschlüssel für subfossile Juncus-Samen und Cramineen-Früchte. Probleme der Küstenforschung in südlichen Nordseegebiet, 7. August Lax, Hildesheim.

van Zeist, W. 1970. Prehistoric and early historic food plants in the Netherlands. Palaeohistoria 14, 41-173.

**Book Notices and Reviews**

The Editors have received notice of the following recently published BAR volume:

Gilbertson, D. D. (with D. J. Briggs, J. R. Flenley, A. R. Hall, C. O. Hunt and D. Woodall, and contributions by A. Blackham, S. J. Gale, R. D. S. Jenkinson, H. K. Kenward, P. A. Mellars, F. N. Pyatt, E. M. Thew, V. R. Switeur and C. Williams) (1984). Late Quaternary Environments and Man in Holderness. British Archaeological Reports British Series 134, 234 pp. ISBN 0 86034 287 4. Price £14.00 incl. postage.

**Reviews**

K. Andrew (1984). A practical pollen guide to the British flora. Quaternary Research Association, Technical Guide No. 1. Price: £5.50 to non-members of the Q.R.A., available from Dr P. L. Gibbard, Sub-Department of Quaternary Research, Botany School, Downing Street, Cambridge CB2 3EA.

This is a small, soft-cover book, based upon the privately-circulated photocopied handwritten pollen file from the same author. It has 139 typed pages in which the pollen is described, with measurements for both silicone oil and glycerine jelly preparations, and numerous little sketches to illustrate particular features of pollen grains. It is grouped into 12 sections, according mainly to the number of pores or furrows, and within each section the species are listed in taxonomic order following Dandy's (1958) list and perhaps with his nomenclature: certainly some of the names have an archaic flavour, like *Cuttiferæ* for Hypericaceae, although it is difficult to accommodate name changes which appear in every new flora.

The descriptions of the pollen are a very individual feature of the Guide. Non-technical terms are used which convey the appearance of the

grains very well. I often find that, when using other pollen keys, the technical terminology, often different from work to work, is a considerable hindrance, but this is a delight to use. I have heard that terms like 'wet otter' were used at Cambridge to describe a certain kind of exine sculpture and am a little sorry that this gem has not appeared in print.

The obvious use for the Guide is as a standard reference work to complement a comparative reference collection for the identification of pollen. It has many advantages over the books already available, especially for those who find that dichotomous keys seldom work well for material like pollen. The main way in which I use the guide is to check quickly what the possibilities are when I find an unusual pollen grain. I may think what I know what it is, but the Guide shows whether there are similar grains in other families which I ought to examine as well, and sometimes it shows that I need to obtain herbarium material and make some new preparations to fill the gaps in my collection. The earlier loose-leaf edition is somewhat easier to use one-handed beside the microscope than this typed one, however.

The Guide has been produced to do a particular job, which it does very well. It naturally does not have the detail and authority of North West European Pollen Flora (Punt 1976-), which splits all pollen to the nth degree in very expensive volumes; nor does it set out to introduce the subject of pollen analysis as a whole, as does Moore and Webb's (1978) book. The level of identification and naming of the appropriate pollen type is left entirely to the reader, and this is information that I shall probably start pencilling into my own copy (there is more information about pollen types in the other books I have mentioned). The Guide gives no references, though this might have been useful, as in the case of Beug's (1961) key to Cerealia, which deals with the subject in elegant detail. Likewise, certain pollen such as Vicia faba and Cydonia oblonga, which might occur in an archaeological context, is not included. However, I accept that the Guide is a very individual kind of book having just the scope which Miss Andrew thought it should. The Guide has a small number of typographical errors in the texts and rather more in the index.

In conclusion, then, I find this a very useful and reasonably priced book which lives beside the microscope rather than on the bookshelf.

James Greig

#### References

Beug, H.-J. (1961). Leitfaden der Pollenbestimmung. I Fischer, Stuttgart.

Dandy, J. E. (1958) List of British Vascular Plants. British Museum (Natural History) and Botanical Society of the British Isles, London.

Moore, P. D. and Webb, J. A. (1978). An illustrated guide to pollen analysis. Hodder and Stoughton, London.

Punt, W. (ed.) (1976-). The Northwest European Pollen Flora, parts 1-37, appearing in Review of Palaeobotany and Palynology and reprinted by Elsevier, Amsterdam.

Clutton-Brock, Juliet (1985). Excavations at Grimes Graves, Norfolk 1972-1976. Fascicule 1. Neolithic antler picks from Grimes Graves, Norfolk, and Durrington Walls, Wiltshire: a biometrical analysis. British Museum Publications Ltd. 47pp. £10.00

The deep flint mines at Grimes Graves were excavated between the wars, and then again in 1972-1976 to try to settle a number of points which are set out in a short preface by the Keeper of Prehistoric and Romano-British Antiquities at the British Museum. Within that framework, Dr Clutton-Brock has tried to clarify eight biological, economic and archaeological points about the antlers. These range from 'Relationships between red deer and man' to 'Assessment of the size and conformation of the antlers from Grimes Graves and Durrington Walls: their similarities and differences'.

As a description of the number, wear and use of antlers at these two sites, one a deep mine and the other a trench, I found the account succinct, to the point, and enjoyable. There were 283 picks from Grimes Graves, 322 from Durrington Walls, and the former were somewhat larger on average, somewhat less variable. Most (80-90%) were shed antlers, rather than antlers from dead animals. Histograms are given, unfortunately side by side, of the various measurements from the two sites, and a dozen photographic plates indicate, primarily, the close similarity in shape and patterning of some antlers. There is a little bit on chemical composition and physical attributes of antlers, though unfortunately no reference is made to the important papers in Journal of Archaeological Science in 1983 and Journal of Biomechanics in 1979. Maybe the fascicule was written earlier: the only date is the copyright date, which is not even the year of publication.

From the text, it can be seen that some multivariate work has been done, but none is presented. The tables give the numbers in various qualitative categories, e.g. cut between burr and bezel, but the measurements are only available from the British Museum (Natural History).

I would not, myself, call this a biometric analysis. It is certainly not possible to say anything about differences in conformation at the two sites. Whether the size difference reflects differences in the deer populations or the method of selection of antlers would be difficult to test with more sophisticated methods. Whether the Grimes Graves miners protected their deer to supply a plentiful crop of fresh antlers is an interesting hypothesis on p. 16, but it is hardly consistent with 18.4% killed there compared with 12.3% at Durrington Walls. Or were the amateurs in Wiltshire less efficient when they did go hunting? I've no objection to speculation, but I would like to see speculations tested as far as the data allow.

So while my feeling is that the report is to some extent an opportunity missed, I nevertheless think it is well worth reading, and an interesting contribution to the study of the neolithic.

Mark Williamson



Grigson, C. and Clutton-Brock, J. (eds.) 1984. *Animals and Archaeology: 4. Husbandry in Europe*. B.A.R. International Series 227. 270pp. £17.00  
ISBN 0-86054-295-5.

This collection of 25 papers is the last to derive from the 4th Conference of the International Council for Archaeozoology, which was held in London in 1982. The purpose of this review is to summarise and to assess the volume, and to give an overview of the published proceedings as a whole.

The first thing to be said about these papers is that none engendered critical disquiet. Two of them could, in fairness, be described as dull, and a few others show unprofessional lapses, but generally the standard of scholarship and presentation is high, with two papers striking this reviewer as particularly stimulating, although other readers might strongly disagree with the choice.

To start with the plums in this nutritious pudding, John Mandris contributes a lengthy, complex and philosophical argument for the extensive and more carefully thought-out use of ethnographic parallels (or generative analogies) in studies of man-animal relationships. He illustrates his point by examining the cultural fossils of modern herding communities in the highlands of S.E. Europe, then uses these data as a basis for constructing possible explanations of Neolithic activity in the same area. This is not an easy paper to read - Mandris' vocabulary is extensive and recondite - but the effort is fully rewarded. I particularly liked his comment (p. 13) that:

'...archaeology is as much about what archaeologists do and assume in common, as it is about the past.'

Much easier to read, indeed worth reading as such for its style as for its content, is Achille Gautier's contribution to the species quantification debate. Those who tire of fragment counts, MNI, NRI, bone weights and weighted elements, will enjoy the carnage as Gautier lays into these methodological corpses with surgical precision, admirable clarity of purpose, and 77 references. In the end, only good old-fashioned fragment counts are still standing, albeit rather bruised, and one is left wondering why nobody has performed this carve-up before.

The remaining papers start chronologically with two discussions of possible human control of livestock in the Upper Palaeolithic. Musil argues that the domestication of the wolf was a necessary adjunct to efficient hunting, while Paul Bahn presents an almost convincing case for the early use of bridles to control horses. The Neolithic and Bronze Age periods merit only four papers, perhaps surprisingly, amongst them a detailed biometrical analysis of cattle astragali from a Bronze Age pit in Hungary. Bartosiewicz lays out his experimental design clearly and presents all his raw data, with the result that his conclusions are all the more plausible. Cynics might suspect a circular argument in his use of discriminant function analysis to confirm and define a priori groupings, but the methods employed are sufficiently rigorous to allay such fears in all but the most sceptical. Staying with the Hungarian Bronze Age, Alice Choyke's discussion of the use of ruminant metacarpals as artefacts is a laudable attempt to link the dry bones with real people and their behaviour patterns.

The imperial shadow of Rome falls across four papers, with discussion of the possible effects of centralized authority on stock breeding and marketing. Maltby is typically thorough, giving the question of market economies a theoretical going-over before turning to the archaeological data, while Noddle reviews 10 Iron Age and Roman sites in Britain, offering explanations based on soil and topography to account for differing husbandry patterns. Udrescu and Teichert consider the impact of Rome on Dacia and Germania respectively, with Udrescu's account being the clearer, albeit in French.

Turning to the medieval period, Lasota-Moskalewska offers a particularly interesting discussion of the distribution of different carcass elements around Ciechanow Castle, supporting her conclusions with chi-squared tests then letting them down flat by omitting any references. A good example of the potential of historical documents is given by Biddick's study of pigs at Peterborough Abbey, evidenced by account rolls rather than bones. Grant's paper on medieval animal husbandry is ill-served by its sweeping title. What is presented is not the archaeozoological evidence, but a deliberately limited preliminary scan through some of the literature, with proposals for future research.

The last eight of the papers are a mixed bag which range over animal sacrifices, disease and injury symptoms, footprints, and a practical experiment in bone taphonomy. Van Wijngaarden-Bakker gives a useful review of meat preservation techniques, then examines bones from Spitzbergen known to have derived from dried and salted meat. Cram on footprints conjures up a charming image of Roman dogs and cats wandering hither and thence over still-soft clay tiles, although somebody should have told him that Diplopoda are millipedes, not centipedes (p. 229). Baker's survey of bone disorders which can possibly be linked to human exploitation is perhaps a little too brief, although a really comprehensive account could have overwhelmed reader, editors and author alike. This compromise between brevity and thoroughness arises repeatedly in this volume, and one feels that perhaps sometimes a striking title could have been replaced by a more accurate one which honestly described the limits of the paper.

Animals and Archaeology 4 is a worthy successor to the other three volumes. There is something of interest and relevance in every paper, and the mixing of text, figures and tables is adequate considering the limitations of B.A.R. format. A few typographical errors have slipped through, but none of them really matters, and in any case many human societies have regarded perfection as a form of blasphemy.

Looking back over all the published proceedings of the ICAZ conference, two main points emerge. The first is the very creditable diversity of approach which those who study bones are bringing to their work, and the second is the lamentable extent to which 'archaeozoology' has become synonymous with bones. A few shells crept into these volumes, but even these were mainly shells as food debris, more or less bones manqué. Many other groups of animals are being used in palaeo-environmental reconstruction, and their study is as much archaeozoology as is tinkering with bones. This is not to criticise the conference organisers, who could not timetable papers which were not offered. Rather, invertebrate archaeozoologists must be encouraged to overcome their timidity, to emerge from beneath their stones, and to add their potentially important contributions to this fast-developing field.

Meanwhile, there are signs of a rigorous scientific approach being applied to bone studies. Statistical tests of significance are springing up, not only applied to biometrical data, but to non-parametric problems as well. This can only be a good thing: much of our work is concerned with the detection of patterning in data sets, and objective numerical methods will take out at least some of the 'perhaps' and 'maybe'.

The chosen format for publication permitted rapid dissemination of information, and bald statistics underline the editors' considerable achievement. 96 papers, occupying 1290 pp., have been published within less than three years of the conference being held. The four volumes have together cost £65, however - at least as much as the two substantial hardback books which would have been required to encompass the whole proceedings. One suspects that a choice had to be made between speed of production and quality, with cheapness not an available option, an unsatisfactory compromise which says much about the state of technical publishing in Britain. The next ICAZ conference will be in France in 1986, and Caroline Grigson and Juliet Clutton-Brock have set a challenging standard for the organiser, Pierre Ducos, to follow. The archaeozoological world awaits...

Terry O'Connor

**STOP PRESS+++STOP PRESS+++STOP PRESS+++STOP PRESS**

**AEA workshop in mammal palaeopathology**

There will be a meeting in Liverpool to consider bone pathology on April 11th 1986, with the kind co-operation of Dr John Baker. Lectures and demonstrations will be followed by a period for the display and discussion of archaeological bone pathology brought by participants. If interested, please contact:

Dr Terry O'Connor, EAU, University of York,  
Heslington, YORK YO1 5DD

for further (eventual) information, saying whether you would have specimens to bring for discussion and any aspects of pathology on which you particularly want information.

### Chicken legs revisited

Barbara West \*

After considerable searching, without success, through the available literature for information on spur development in juvenile domestic fowl, the author decided to publish the findings for adult fowl (West 1982), in which 'spurred' tarsometatarsi indicated males or capons, 'unspurred' indicated females, and those with 'spur scars' also indicated females. The resulting correspondence with various colleagues, some of whom were puzzled by the occurrence of very large tarsometatarsi with spur scars, initiated yet another long search to answer the questions of juvenile spur development, which has at last met with success from an unlikely source.

The answers are once again to be found in the biological experiments conducted on domestic fowl in the 1950s, particularly those testing the drug thiouracil, which interrupts the activity of the thyroid gland. Fortunately, the normal control groups were measured as carefully as the experimental ones, and the following description of development is a synthesis gleaned from Juhn's study of 28 normal adult cocks of various breeds (Juhn 1952).

The rough sketch in Figure 1 not only illustrates the stages of development, but also the extreme variability among different breeds and individuals of the same age. Thus, some 7 month old birds were at a very advanced stage, while some 9 month old birds had only begun the initial stage. Despite this variability, the general progress is from keratinous sheath to beginning ossification 4-6 mm from the tarsometatarsal surface. The spur core then grows toward both spur tip and tarsometatarsal surface until, at a 'certain point of its advance toward the shank', it throws forward slight swellings.

'Simultaneously, the hitherto smooth surface of the shank gives rise to two small thickenings ..., which increase in size and expand to fuse with each other while leaving the centre free, thus forming a ring-shaped structure - the socket primordium. At the same time a delicate series of fibres arise, connecting this primordium with the adverted core surface. These fibres are the scaffolding, so to speak, for the final developments, in which the socket wholly embraces the basal section of the spur core.' (Juhn 1952, 153)

Two points are of prime importance here. The first is that the spur appears to induce the shaft to develop a socket primordium (Kozelka

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\* Barbara West, Department of Urban Archaeology, Museum of London, London Wall, London EC2Y 5HN, U.K.

1933); however, Juhn's study indicates that it is not the spur, but the spur core which is responsible. Secondly, the initial development of the spur core and fusion with the shaft occurs not in juveniles, but in adults:

'Although growth of the male spur is apparently continuous from early periods onward, differentiation of the central core and the following connections with the tarsometatarsus are initiated only in the adult. The appearance of these developments at a time when the bird has come to full maturity is remarkable. Even more remarkable is the capacity for induction, at this stage of life, which characterizes the spur core.' (Juhn 1952, 159)

Therefore, since the rudimentary spurs of the female are usually entirely keratinous and lack a spur core, they cannot cause a scar or socket primordium on the tarsometatarsus, as previously suggested by West (1982). Unfortunately, there are rare exceptions. Morales (pers. comm.) has observed very small ossifications within the rudimentary spur of Spanish hens which have produced slight changes on the tarsometatarsal shaft, though not a socket primordium. Also, as pointed out in the previous paper (West 1982), hormonal disturbances such as defective ovaries can cause spurs and cores to develop in hens.

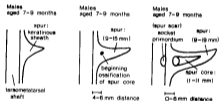


Figure 1. A rough sketch of spur development. Note that Juhn's study found variation not only among breeds (New Hampshire, Barred Rock, White Plymouth Rock and cross-breeds), but also among individuals of the same age and breed.

Two further conclusions can be drawn from Juhn's discussion and tables of measurements:

1. the induction of the socket primordium must depend on the spur core attaining a critical distance from the shaft (which has not been determined);

2. the spur core fuses to the shaft after it reaches a critical length, which was 17-19 mm in the control group. Thus the fusion process appears to be determined by the length of the spur core, rather than by age. Capons would attain this critical length at an earlier age than cockerels, since (as discussed by West 1982) the spurs and spur cores of capons have been proven to grow faster than those of males (Quigley and Juhn 1951).

An attempt to determine the relationship between the fusion of the spur core to the shaft and the fusion of the proximal and distal epiphyses to the shaft brings us to the thorny problem of exactly what is meant by 'adulthood' in domestic fowl. Usually fowl are considered adults at approximately 6 months old; however, the author can still find no references in the literature for exact fusion times for the proximal and distal epiphyses of the tarsometatarsus. Nevertheless, clues can be found in the archaeological material: first, by looking for socket primordia on tarsometatarsi with unfused epiphyses. At least four examples have appeared (and the author would be grateful for information on others): two 11th century specimens from Oxford (Church Street, Locker 1984), one of medieval date from London (Trig Lane, West unpublished) and one of Roman date from Ortona, Italy (van Neer, pers. comm.). All four examples are fused distally and unfused proximally.

Secondly, it is useful to compare measurements of tarsometatarsi with fused epiphyses and socket primordia to those of spurred and unspurred specimens. Since capons' spurs grow more quickly, they fuse earlier to the shaft, but caponisation delays epiphyseal fusion. Thus one would expect capons to have longer fused tarsometatarsi with fused spurs. Since males' spurs grow less quickly, but epiphyseal fusion is NOT delayed, one would expect shorter fused tarsometatarsi with unfused spurs (spur scars). In other words, large fused specimens with spurs are more likely to be capons, while smaller fused specimens with spur scars are more likely to be males. Interestingly enough, two small sets of data lend support to this idea:

		<u>Unspurred</u>	<u>Socket Primordium</u>	<u>Spurred</u>
Mean	A	65.3	76.8	83.0
	B	68.7	78.8	83.5
Range	A	55.5-76.2	69.2-83.0	75.8-93.8
	B	63.7-70.4	76.3-81.1	71.7-95.6
Number	A	29	6	12
	B	6	6	8
Standard deviation	A	5.28	4.63	5.00
	B	3.60	1.80	6.95

Table 1. Fowl tarsometatarsi: measurements of greatest lengths (mm). A: Church Street, Oxford, C11-15th (Locker 1984); B: Trig Lane, London, C14th (West unpublished)

As can be seen from Table 1, the two groups A and B with socket primordia are intermediate in size between spurred and unspurred, and possibly indicate males intermediate between smaller females and larger capons; however, larger samples are needed to test the validity of this idea.

In conclusion, then, it is hoped that some of the complex mechanisms of spur development have been clarified by this discussion. Contrary to the author's earlier assessment (West 1982), tarsometatarsal bearing spur scars or socket primordia represent males (with the very rare exceptions of females with hormonal defects), but whether caponised or not remains to be determined.

#### Acknowledgments

I would like to thank Enid Allison (Environmental Archaeology Unit, York) and Gaenor Morris (Grosvenor Museum, Chester) for providing examples from their collections, and Alison Locker (Ancient Monuments Laboratory, London) for allowing me to use unpublished data. I am particularly grateful to Dr Juliet Clutton-Brock (British Museum (Natural History)), Graham Cowles (Subdepartment of Ornithology, B.M.(N.E.)), Tony Dyson (Museum of London), Dr Arturo Morales (University of Madrid) and Dr Wim van Neeer (Katholieke University of Leuven, Belgium) for their helpful comments and discussion.

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**An experiment in manual processing  
of soil samples for plant remains**

K. Badham and G. Jones \*

This paper deals with the manual processing of soil samples for plant remains preserved in a variety of different ways. Where plant material is preserved by carbonisation alone, simple flotation techniques may be sufficient but these will not usually recover the majority of, for example, waterlogged remains. It is common practice to process a standard weight or volume of soil and the advantages of using a volume standardisation have been pointed out by Green (1979), who suggested a volume of 5 l as appropriate for recovering material preserved in a variety of ways. (A smaller volume is recommended for the recovery of waterlogged remains only.) Kenward *et al.* (1980), on the other hand, vary the weight of soil (from 0.1 to 5 kg) to be processed according to the concentration of material. Clearly some form of sample size standardisation is desirable if samples are to be directly comparable, but it should be remembered that it is plant material that is being sampled and not soil. It seems more appropriate, therefore, to standardise the size of samples in terms of the plant remains themselves, i.e. according to the numbers of 'seeds', where these make up the bulk of the plant material found (cf. van der Veen and Fieller 1982; Orton 1983). The volume of soil processed should, nevertheless, be recorded as the density of plant material in the soil can provide useful information (Jones 1981).

A figure of around 400 to 500 seeds has been suggested by van der Veen and Fieller (1982) as being necessary to give estimates of the relative proportions of seeds in a sample with an accuracy of 5% (in absolute terms) at a confidence level of 95-98%. Much larger samples (in terms of numbers of seeds) may be needed to be sure of recording most of the species present in the deposit sampled. The appropriate number of seeds would have to be decided on the basis of the questions asked of the material. It is difficult, however, to standardise accurately the number of seeds without introducing bias into the sampling (Orton 1983) but it is possible to make an approximate standardisation by first processing a small subsample and then processing enough of the remainder of the sample to give approximately the required number of seeds.

At the Department of Urban Archaeology, London, it was found that many deposits produced so few seeds that it would not be possible to obtain 500 seeds even from a 10 l sample (the maximum available). In order to recover a satisfactory number of seeds from such deposits, it

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would be necessary to process larger volumes of soil which would be best achieved using a water-separation machine of the type described by Kenward *et al.* (1980) - a modification of an original design by French (1971). This machine has the advantage that it recovers most of the sinking material as well as the float. Given that a limited volume of soil was available, however, and that time was (and usually is) a limitation, it was thought that it would better spent on processing larger samples from productive deposits than on processing by manual methods even as much as 1 l from unproductive deposits.

To this end, a policy of taking initial 0.25 l subsamples of soil, to determine the productivity of the sample, was decided upon. This initial subsample allows an assessment to be made of the value of processing more of the sample and, at the same time, allows an estimation of the volume of soil needed to obtain 500 seeds or whatever number is desired. So, subsamples which produced, say, less than 12 seeds (effectively 50 per l) need not be processed further, while up to 10 l of the more productive samples could be processed in order to give approximately 500 seeds. Some method of efficiently processing samples, especially the larger of the samples indicated above, is clearly desirable. The aim of the experiment presented here was to choose a processing procedure which was relatively fast but which did not result in an unacceptable loss of plant material.

#### Methods

Advice was sought on processing methods from a number of archaeobotanists (see below) and it was decided to compare the efficiency of three different techniques: wet-sieving (Kenward *et al.* 1980; J. R. A. Greig *pers. comm.*); wash-over (Kenward *et al.* 1980; M. A. Robinson *pers. comm.*) and peroxide flotation (G. C. Hillman *pers. comm.*). These methods seem to cover the range of manual techniques currently employed by archaeobotanists in Britain for the recovery of plant remains preserved in a variety of ways.

Four questions were asked of the experiment and constitute the main aims:

1. Is one technique consistently faster, either at the sieving stage or at the sorting stage, than the others?
2. Does one technique consistently recover more seeds than the others?
3. Are there significant differences in the ability of the different techniques to recover material preserved in different ways (i.e. by waterlogging, carbonisation or mineralisation)?
4. Are there significant differences in the types of seeds (i.e. taxa) recovered by the different techniques?

It was rather unlikely that one technique would emerge as a clear favourite. Rather, each technique is likely to have advantages and disadvantages and it was hoped that these would become apparent so that a procedure could be worked out, using the best from the three techniques. The new procedure should aim to achieve optimum recovery in optimum time.

Sixteen soil samples from urban archaeological deposits at medieval sites in the City of London were selected for the experiment. They were chosen to encompass a wide range of characteristics:

1. Deposit type, ranging from loose powdery to heavy clay deposits (peat samples were excluded as these present special problems);
2. Volume of soil, ranging from c. 1 l to c. 5 l (each divided into four subsamples - see below);
3. Type of preservation of plant material, including samples rich in both waterlogged and mineralised seeds (no samples rich in carbonised remains were available though carbonised material was present in some samples);
4. Number of seeds, ranging from a predicted 350 to 700 per sample (samples with fewer than 200 seeds were excluded as they would yield too few seeds when subsampled).

Estimations of 3. and 4. were based on evidence from subsamples already processed for plant remains by the wet-sieving technique.

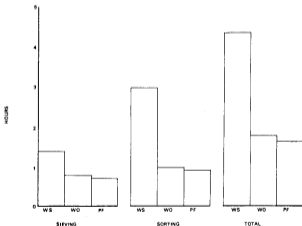


Figure 2. Average time taken to process samples. Key: WS - wet-sieving; WD - wash-over; PF - peroxide flotation

Each sample was then split into four random subsamples using a riffle-type sample splitter, where possible, or by coning, for more difficult samples, and three of these subsamples were used in the experiment. Most practitioners recommend a visual examination of the sample for particularly fragile plant remains, before further processing. The techniques then applied to the subsamples were modified versions of the three techniques mentioned above and are as follows:

### 1. Wet-sieving

This technique is designed to recover all material greater than the size of the finest sieve mesh used (in this case 250  $\mu$ m). The sample was soaked in a bucket of water overnight, sometimes with the addition of washing soda to help break down difficult samples. The sample was then washed through a stack of sieves of mesh sizes 4 mm, 1 mm, 500  $\mu$ m and 250  $\mu$ m with the aid of a hose applied gently at first but gradually becoming more vigorous. The sieve residues were then sorted in alcohol (Following J. R. A. Greig, pers. comm., although Kenward *et al.* (1980, 8) specify water as the sorting medium for plant remains). The time taken to sieve the sample and to sort the resulting residues was recorded separately. In practice, it was known from the original subsample that there was very little identifiable plant material in the 250  $\mu$ m fraction and so this was not sorted.

### 2. Wash-over

This technique is designed to separate organic from inorganic material. Because the aim of the experiment was to recover plant material preserved by mineralisation as well as by waterlogging and carbonisation, the basic technique was followed by partial wet-sieving. As before, the sample was soaked overnight, with or without washing soda. It was then washed with water and stirred by hand, the muddy water and organic material being poured into a stack of sieves of mesh sizes 1 mm, 500  $\mu$ m and 250  $\mu$ m until only sand and gravel remained in the bucket. The stirring was gentle at first, but gradually became more vigorous. The residue in the bucket was then wet-sieved, using sieves of mesh sizes 4 mm and 1 mm so that inorganic material greater than 1 mm could be recovered. The organic material was then sorted in alcohol and the inorganic material was dried and sorted. The time taken to sieve and sort both (excluding the 250  $\mu$ m fractions) was recorded. As a check on what was being lost, the material passing through the 1 mm wet-sieve was washed through a 500  $\mu$ m sieve and a portion of it sorted.

### 3. Peroxide flotation

This technique is designed to recover waterlogged seeds. As well as acting as a deflocculant, the oxidising action of the hydrogen peroxide releases bubbles of gas which fill the hollow cases of seeds preserved by waterlogging and carry them up. Heavy or solid seeds can then be recovered by partial wet-sieving. For this technique, the sample was soaked in a one in ten dilution of 30 vol. hydrogen peroxide solution for half to one day, stirring every hour to release trapped seeds. When the sample was completely broken down, the bubbles on the surface were dispersed using a drop of octanol. The flot and suspended material was then poured into a stack of sieves of mesh sizes 1 mm, 500  $\mu$ m and 250  $\mu$ m. These two fractions can be collected separately to speed up the subsequent sorting of samples rich in seeds. The residue was then wet-sieved using sieves of mesh sizes 4 mm and 1 mm as routinely practised by Gordon Hillman (pers. comm.). The flot and suspended



VOL. SOIL ML.

Figure 3. Effect of volume of soil on time taken to process samples.  
 Key: see caption to Figure 2.

material was sorted in alcohol and the residue was sorted dry. The time taken to sieve and sort all except the 250  $\mu$ m fraction was recorded. As before, the material passing through the 1 mm wet-sieve was washed through a 300  $\mu$ m sieve and a portion sorted as a check on what was being lost.

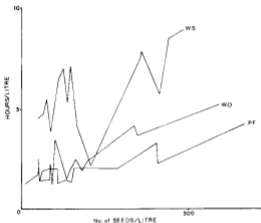


Figure 4. Effect of seed density in soil on time taken to process samples. Key: see caption to Figure 2.

### Results

Histograms were plotted of the time taken to sieve and sort each sample. The samples all gave similar results and these are combined in Figure 2 which shows the average time taken to process samples by each of the three techniques. It is clear from the figure that, at both the sieving and sorting stage, the wet-sieving technique is by far the slowest. Wet-sieving takes, on average, twice as long as peroxide flotation while sorting the material from wet-sieving takes, on average, three times as long as it does for the other two techniques. Peroxide flotation is, on average, slightly faster than wash-over at both stages though this advantage should be offset against the cost of the chemicals used.

Figure 3 shows how these processing times are affected by the volume of soil processed. It is clear from the graph that, for small volumes of soil (around 0.25-0.3 l), there is relatively little difference in the time taken to process samples by the three techniques. Moreover, the time taken to process samples by the wash-over and peroxida flotation techniques increases only slightly with increased volume of soil. The time taken to process larger volumes of soil with the wet-sieving technique, however, is much greater. This is largely due to an increase in sieving time, presumably because the time taken to sieve samples is more dependent on volume of soil when all, rather than some of the soil must pass through the sieves.

Figure 4 demonstrates how the time taken to process a litre of soil tends to increase, for all three techniques, as the number of seeds per

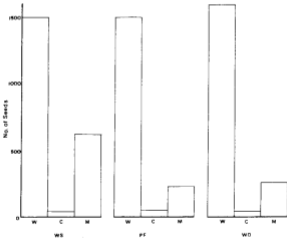


Figure 5. Total quantity of seed recovered for each of the preservation types. Key as in caption to Figure 2 plus: W -waterlogged; C - carbonised; M - mineralised.

litre of soil increases. For low densities of seed, there is very little difference in processing time between the wash-over and peroxide flotation techniques (though both are much faster than the wet-sieving technique). As the density of seed increases, however, the peroxide flotation technique emerges as the fastest of the three. This is apparently due to the fact that sorting time for peroxide flotation is very little greater for larger numbers of seeds since most of the flot is made up of seed.

For all three techniques, processing time was slightly greater for clayey than for light soils (not shown).

Histograms were also plotted, for each sample, of the numbers of waterlogged, carbonised and mineralised seeds recovered by each of the three techniques and these results are combined for all samples in Figure 5. There is clearly very little difference in the recovery of waterlogged and carbonised seeds by the different techniques, with very slightly more waterlogged seeds being recovered by the wash-over technique than by the other two. For mineralised seeds, however, wet-sieving is clearly more effective, recovering two or three times as many seeds as the other techniques. This results from the recovery, by wet-sieving, of heavy (especially mineralised) seeds of less than 1 mm.

The percentage of seeds 'lost' when using the wash-over and peroxide flotation techniques (i.e. those recovered in the 500  $\mu$ m sieve during subsequent wet-sieving: see above) was calculated for both waterlogged and mineralised seeds. These results are presented in Table 2 for samples where at least one of the subsamples produced 100 or more (and the other at least 50) seeds of the preservation type concerned. The difference between the recovery of waterlogged and mineralised seeds is again clear - while both techniques show poor recovery of mineralised seeds, the losses of waterlogged seeds rarely exceed 10%. If there is a difference between the two techniques, it is in the recovery of waterlogged seeds, with wash-over tending to recover a greater proportion of seeds.

The percentages of both waterlogged and mineralised seeds lost by the wash-over and peroxide flotation techniques were plotted separately against (a) the volume of soil, (b) the number of seeds per litre, and (c) the type of deposit, but there was no evidence that losses were related to any of these factors (not shown).

The numbers of seeds recovered by the different techniques are plotted, for each of the commoner species, in Figure 6. Certain anomalies are apparent, some of which can be explained by reference to the technique used. So, for instance, the greater recovery of fig (*Ficus carica* L.) seeds by the wash-over technique can be explained by the fact that many of them were preserved by mineralisation and some of these would have been too small to be recovered in the 1 mm mesh wet-sieves used with the other two techniques. Similarly, achenes of stinging nettle (*Urtica dioica* L.) were rather fragile as were the (mostly carbonised) achenes of stinking mayweed (*Anthemis cotula* L.) and both species were under-represented by the rougher wet-sieve technique. The recovery of bladder campion (*Silene vulgaris* (Moench) Garcke) seeds was best with peroxide flotation perhaps because the seeds, being hollow (and fragile), were recovered more effectively than by simple wash-over or by the more destructive wet-sieve technique.

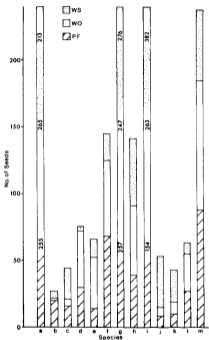


Figure 6. Quantity of seed recovered for each of 13 common taxa. Key as in caption to Figure 2, plus: a - *Chenopodium album* L.; b - *Silene vulgaris* (Moench) Garcke; c - *Spergula arvensis* L.; d - *Urtica dioica* L.; e - *Rubus fruticosus* agg.; f - *Fragaria vesca* L.; g - *Sambucus nigra* L.; h - *Lithospermum arvense* L.; i - *Ficus carica* L.; j - *Vitis vinifera* L.; k - *Lapsana communis* L.; l - *Anthemis cotula* L.; m - *Eleocharis palustris* (L.) Roem. & Schult.



### Conclusions

It now remains to suggest a procedure, based on these three techniques, which can be used to recover the maximum number of seeds in the minimum of time. The results presented above clearly demonstrate that these two objectives are conflicting and that some compromise solution must be found.

Given that the time taken to process small samples varies little between the three techniques (Figure 3) it makes sense to process the initial 0.25 l subsamples by wet-sieving, which provides the most comprehensive recovery, despite some under-representation of the most fragile remains (Figure 6). Samples can then be assessed, on the basis of this subsample, according to the types of remains they produce. Samples with significant quantities of small (< 1 mm) mineralised seeds must clearly be processed by wet-sieving to avoid unacceptable losses, but samples with no or very few small, mineralised seeds could be processed more effectively by one of the other techniques, especially when fragile plant remains are present. It would, of course, be possible to follow the wash-over and peroxide flotation techniques by wet-sieving using a finer mesh than 1 mm, but then much of the advantage of these techniques in time saved would be lost.

There is little to choose between wash-over and peroxide flotation, with the former perhaps recovering more seeds (Figure 5; Table 2) but the latter being slightly faster (Figure 2). Given that peroxide flotation involves the cost of chemicals, it would perhaps be most convenient to use wash-over as a standard technique for processing large samples of the type encountered here. It would also be necessary to use the wash-over technique, rather than peroxide flotation, when plant remains other than seeds (e.g. stems and leaves) are required in quantity.

Waterlogged		Mineralised	
Wash-over	Peroxide flotation	Wash-over	Peroxide flotation
7.1	11.1	-	-
4.9	4.9	-	-
4.1	5.9	-	-
0	0	-	-
0	0	-	-
0	0	88.8	87.9
0	8.6	13.2	22.5
-	-	89.9	91.0

Table 2. Percentage of seeds 'lost' - i.e. recovered in the 500  $\mu$ m wet sieve - for the richer samples.

There are three possible exceptions to this. Firstly, if hydrogen peroxide is needed as a deflocculant, then it would involve little extra work to collect the peroxide flut before applying the wash-over technique. Secondly, as peroxide flotation seems to be particularly fast for samples with a high density of seed (Figure 4), it may be the best technique to use in such cases. Thirdly, as Gordon Hillman has noted (pers. comm.), the time saved by peroxide flotation is greater for samples with a high organic content (including root, stem and leaf, as well as seed) and such samples are probably best processed (for seeds alone) by this technique. Indeed, peroxide flotation may be less damaging to waterlogged seeds than, at least, wet-sieving since the two techniques recovered equal numbers of seeds (Figure 5) despite the advantage of total wet-sieving for the recovery of small sinking seeds.

To summarise, then:

1. Small initial subsamples (of, say, 0.25 l) can be processed by wet-sieving to allow an assessment to be made of (a) the value of processing more (and if so, how much more) of the sample and (b) the nature of the plant material recovered.
2. If a significant quantity of small mineralised seeds is recovered, the 'remainder' of the sample (enough to give 500 seeds, or whatever number is required for the particular application) should also be processed by wet-sieving.
3. If largely only waterlogged and/or carbonised seeds are recovered, the 'remainder' of the sample can be processed by the wash-over or peroxide flotation techniques, as appropriate. These techniques should also be used for samples containing very fragile remains.
4. If fewer than, say, 12 seeds (approx. 50 per l) are recovered, the remainder of the sample need not be processed.

This procedure should satisfy the original aim of the experiment and ensure optimum recovery in optimum time.

#### Acknowledgements

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### On quantifying vertebrates - some sceptical observations

T. P. O'Connor \*

In previous issues of *Circaea*, the subject of quantifying bone samples in terms of taxon abundance has been well-aired (for example see Turner and Levitan in *Circaea* 2(2)). It is not the intention of this short paper to re-examine these old bones, nor to present further numerical twists and turns to the already tortuous path of minimum number or killed population estimation. Instead, I wish to question the reliability of one stage in the methodologies involved, and then to suggest a rather different procedure for numbering the beasts which may be more readily applicable to some, but by no means all, archaeological bone assemblages.

Procedures which lead to calculation of the minimum number of individuals of a taxon present in a given sample or to estimation of killed population size mostly have in common that they require knowledge of the number of left-side (L) and right-side (R) specimens of a given paired skeletal element and the number of left-right pairs (P) present in the sample. The weak point here is the accuracy with which pairs can be reconstructed. Pieller and Turner (1982) rightly point out that P represents enantiomorphic rather than actual pairs, that is, they are left and right side specimens which appear to constitute a pair. Estimation of P requires a visual assessment of the specimens, possibly supported by measurements, and a subjective judgement that two specimens are sufficiently similar to each other probably to have come from the same individual. Such a procedure might be acceptable if, for example, the left and right astragali of one pig could be predicted to be identical in size and proportions within narrow, known limits. This is not the case: skeletons are not symmetrical. I grant that in the case of mandibles matching attritional patterns and attempting to re-associate the mental symphysis where present may allow quite reliable estimation of P, but number estimation all too often has to be based on appender elements.

As the basis of a study of sheep limb morphology (O'Connor 1982), I measured numerous samples of ancient and modern sheep bones, and was thus afforded ample opportunity to check my own reliability in reconstructing pairs, both by eye and with the aid of metrical data. In modern samples where the identity of actual pairs in the sample was known, the results were far from reassuring. The degree of asymmetry shown between left and right sides of one individual was sometimes considerable, and the low variance which is commonly seen in osteometrical data often produced 'obvious' pairs from bones of two individuals. After several years of such depressing observation, I was drawn ineluctably to the conclusion that enantiomorphic pairing only

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seldom represents the actual pairs in a sample, and then usually by accident.

The effect which inaccuracies in the estimation of P will have on the final quantification depends upon the procedure being used and upon the proportion of elements involved in the pairs, or in other words on the ratio of P to L+R. Minimum Number of Individuals (L+R-P; Chaplin 1971) varies linearly with small changes in P. For the population estimates described by Krantz ( $(L^2+R^2)/2P$ ; Krantz 1968) and Fieller and Turner ('Petersen Index', LR/P; Fieller and Turner 1982) the influence of a small misestimation of P can be very considerable. To give an example, where L=15, R=20 and the actual number of pairs in the sample is 10, MNI is 25, the Krantz estimate gives a likely killed population of 31.25 and the Petersen Index gives 30. If the osteologist errs on the side of caution and only 'recognises' 5 pairs, MNI rises slightly to 30, and the population estimates to 62.5 and 60 respectively. With smaller values of L and R, a misattribution of only one or two pairs either way can result in a seriously inflated or reduced value for whichever measure of abundance is in use. This effect is demonstrated in Table 3.

P	If L=25, R=25:			If L=10, R=40		
	C	K	PT	C	K	PT
3	47	208	208	47	283	133
5	45	125	125	45	170	80
7	43	89	89	43	121	57
10	40	63	63	40	85	40

Table 3. Values obtained for three bone quantification procedures, given various numbers of left-side elements (L), right-side elements (R), and enantiomorphic pairs (P). C = minimum number of individuals (Chaplin 1971); K = population best estimate (Krantz 1968); PT = population estimate from Petersen Index (Fieller and Turner 1982).

This brings us conveniently to the question of whether abundance is necessarily the best measure of taxon 'occurrence' in all cases. Given large samples of the sort considered by Levitan (1983), there may be some point in essaying an estimate of the relative abundance of taxa in the sample. If we reject any procedures which involve pair-attribution as being too subject to observer error, this still leaves abundance estimates based on fragment totals per taxon or counts of several homologous parts for a pair of taxa to provide a 'mean ratio' of, say, cattle to sheep. A different problem is posed by assemblages composed of large numbers of 'samples' (i.e. excavation context-groups), each of which has produced only small numbers of identifiable bones: the nightmare of 'lots of little bag-fulls'. To obtain a sample large

enough to be amenable to methods of abundance quantification may require merging data from tens of different contexts. Whilst these contexts may all belong to the same archaeological phase, it is unlikely that all of them will be sampling the same depositional event, and so much of the theory which underlies quantification by fragment counting or number estimation rapidly breaks down. Again, this is a personal 'loss of faith' with which other may choose to disagree, but I am increasingly disinclined to merge data from more than one context for taxon quantification purposes except where it is quite clear that the two or more contexts are part of the same original deposit. Instead, the quantification problem might be better approached by considering frequency rather than abundance.

If one phase of a site has yielded 200 separate context-groups (henceforth samples) of bone fragments, and brown hare is represented in 10 of them, hare can be said to have a relative frequency of  $10/200 = 5\%$ . It matters not that 9 of these records each comprised a single bone whilst the tenth was a complete skeleton: the value of  $5\%$  expresses the frequency of occurrence of this species no matter how the bones were counted. If in another phase hare was present in 15 samples out of 160, the species was clearly more frequent ( $9.4\%$  against  $5\%$ ) and appropriate conclusions can be drawn without making any reconstruction of the number of hares originally present, without over-emphasis of the complete skeleton in one sample, and without questionable assumptions being made about the way in which the bones in the original population were distributed amongst all the different samples. Changes in exploitation can be traced from phase to phase within a site with fewer allowances and corrections than would be necessary with many conventional abundance estimates.

Difficulties in using relative frequency may be encountered in circumstances where there is a wide disparity between the average sample size in each of the sample groups being compared. Clearly, a sample comprising 200 bones is likely to contain more taxa than a sample containing only 50, and a group of samples which average 200 identified bones per sample will probably show consistently higher frequencies for all taxa than will a group of samples averaging only 50 bones each. In practice, though, this rarely seems to be a problem. Only when the average sample size in one group is 2.5 - 3 times of the other do relative frequency values appear to become noticeably disparate, and the changes in taxon frequency which can be regarded as archaeologically significant are usually of a magnitude which greatly exceeds that caused by sample size differences. A crude method of standardising the inflated relative frequencies for a group of large samples is to multiply each by an index obtained by dividing the relative frequency of the most frequent taxon in the smaller samples by the relative frequency of the same taxon in the larger samples. In real life, this usually means deriving the index from the relative frequency values for cattle, and it should be stressed that such procedures have rarely been found to be necessary.

The use of relative frequency as a quantification method in certain types of bone assemblage has much to recommend it, in particular simplicity. It avoids the familiar pit-falls of different methods of abundance quantification whilst still providing a measure of the occurrence of different taxa within the assemblage. The relative frequency scores are independent of each other, so that dramatic changes in the occurrence of one taxon will not wreak havoc with the rest of the

dataset. Different workers' results may be compared without the concern that Dr A identifies small diaphysis fragments and Prof. B does not, whilst Ms C is notoriously profligate when reconstructing pairs for number estimation. What relative frequency does not provide is a measure of the size of the killed population. However, in the circumstances outlined above where the assemblage is made up of a few bones from each of many contexts, it is highly questionable whether MNI or population estimates should be attempted at all.

Despite, or, more truthfully, because of, all that has been written on the subject of taxon quantification in archaeological bones, there does not appear to be an agreed solution to the problem of turning old bones into meaningful patterns of exploitation. This paper has expressed scepticism about one group of procedures and has suggested further consideration of another approach. It is hoped that other workers in this field will try out relative frequency as a quantification method, and I eagerly anticipate reading a refutation of the whole idea in the near future.

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**Plant remains and other items from medieval Drogheda**

G. F. Mitchell \* and Conilla A. Dickson \*\*

Drogheda is about 50 km north of Dublin, Ireland, and straddles the river Boyne 6 km west of the point where the river enters the Irish Sea. The Vikings established themselves here in the early 10th century, but no material of this age has yet been found. The Anglo-Normans built a motte castle on the south side of the river, and a bridge across it, before the end of the 12th century. Rival municipalities sprang up on each side of the river, and these were walled during the 13th century. In 1412 they were united into a single town.

Two sites on the north of the river, rescue excavations in Shop Street (Sweetman 1984) and in James's Street (K. Campbell in prep.), will be published elsewhere with lists of identifications. A third site, on the south of the river, in John Street, was a casual exposure of a temporary hole dug in the street. This communication offers an opportunity to draw the three sites together, and identifications from Trin Castle (higher up the River Boyne, 35 km south-west of Drogheda), already published (Sweetman 1978), are added for completeness. The list of taxa identified is given in Table 4. In drawing up the list, cereal crops and their associated weeds are grouped successively, as are minor food-grains (*Chenopodium* etc.) and their weeds. General weeds also form a group.

The Anglo-Norman fortifications of Trin began with the erection of a motte-and-bailey castle in 1172/3. This was soon thrown down but was replaced about 1200 by a magnificent stone keep and curtain wall.

The material from Trin was 13-14th century in age and was all carbonised. It was perhaps spoiled material, thrown out of an overheated grain-drying kiln.

The material from James's Street came from excavations where street-widening was taking place. There was 13-14th century material, both charred and uncharred, from urban rubbish. There was also 16th century material with human foodstuffs.

The material from Shop Street was from an excavation where a bridge over the Boyne was being replaced. It was urban rubbish of 13-14th century age.

The John Street material came from a temporary hole in the street. It was not dated, and was rich in debris from hay.

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From the 19 samples examined from these four sites, 73 identifications of higher plants, and 6 of mosses (by Dr J. W. Dickson), were made. In Dublin, from about 100 samples, 155 identifications were made (Mitchell in prep.). Examining more samples does not extend a list *pro rata*.

Nine plants not seen in material from Dublin were recorded. Eight of the nine, but not Reseda, also occurred in York (Hall *et al.* 1983). From wet places there were Epilobium sp., Pedicularis palustris and Potentilla palustris; from grassland cf. Achillea sp., Hypochoeris radicata, Potentilla erecta and Ranunculus acris/bulbosus; of useful plants Hyoscyamus niger (henbane), formerly used as a drug, and Reseda luteola (weld or dyer's rocket), used in dyeing to give a yellow colour.

Because of the occurrence of charred material, cereals and pulses were more common than in Dublin. On the other hand minor food-grains and their associated weeds were less common.

Grape pips occurred in both earlier and later material, but fig seeds and walnut shell were found only in 16th century material. Here they were accompanied by coal in quantity. Coal as a domestic fuel began to reach Ireland early in the 16th century, and after the middle of the century imports were common (Longfield 1929).

Achenes of Cannabis were more numerous in Drogheda than in Dublin. Pollen of Cannabis has not been identified in Ireland, and large-scale cultivation of hemp has not been successful. Achenes found in Ireland may well have been carried in hemp fibre imported for weaving and rope-making.

Plants of grassland and plants suitable for litter were well represented in the Drogheda material. There were also plants from wet places; these may have grown locally, or were perhaps carried in with retted flax. One sample from Shop Street was rich in fragments of capsules and immature seeds of flax.

Six mosses were identified by Dr J. W. Dickson; these are Calliergon sp., Hypnum copressiforme, Orthotrichum/Ulota sp., Rhytidiadelphus sp., Sphagnum imbricatum and Sphagnum sp.

One scrap of cereal bran (Triticum or Secale) from James's Street had an egg of an intestinal parasitic worm (Trichuris sp.) adhering to it.

There were also mammal bones, fish bones, eggshells, fragments of adult insects and fly puparia, mites, cockle and oyster shells.

The James's Street site produced a lump of massive cinnabar, the sulphide of mercury (probably from Spain), and also some powdered cinnabar, or vermilion, used as a pigment, and also in medicine. The red powder, mixed with sand and clay, was found inside the concave valve of an oyster (Ostrea edulis). It had the appearance of having originally been a paste, which had been kneaded by fingers. The identification as vermilion was kindly confirmed by Dr W. J. Davis, Department of Chemistry, Trinity College, Dublin.

Table 4. Plant remains from Tril Castle (TC), and sites in James's Street (JmS), Shop Street (SS) and John Street (JS), Drogheda.

Date	C13-14				C16	?
	Charred		Uncharred			
	TC	JmS	SS	JS		
Number of samples	7	1	2	4	2	1
<b>PLANTS GROWING NEAR HABITATION</b>						
<u>Conium maculatum</u> L.		+		+		+
<u>Rumex</u> spp.					+	
<u>Sambucus nigra</u> L.					+	
<u>Urtica dioica</u> L.	+			+		
<u>V. urens</u> L.					+	
<b>CEREALS</b>						
<u>Avena</u> sp.(p).		+		+		oats
<u>Hordeum</u> sp.(p).					+	barley
<u>Triticum/Secale</u>				+		wheat/rye
<u>Cerealia</u> indet.	+	+		+	+	
<b>CEREAL WEEDS</b>						
<u>Agrostemma githago</u> L.				+		corncockle
<u>Chrysanthemum segetum</u> L.	+	+		+		corn marigold
<u>Spergula arvensis</u> L.				+		corn spurrey
<b>PULSES</b>						
<u>Pisum</u> sp.		+			+	peas

(continued over)

## MINOR FOOD-GRAINS

Atriplex sp(p).  
Chenopodium album L.  
Polygonum spp.

## WEEDS OF MINOR FOOD-GRAINS

Anthemis cotula L.  
Stellaria media (L.) Vill.

## WEEDS

Labiata sp.  
Lapsana communis L.  
Papaver dubium L.

## FRUITS AND NUTS

Corylus avellana L.  
Ficus carica L.  
Fragaria vesca L.  
Juglans regia L.  
Promus cerasus L.  
P. spinosa L.  
Rubus fruticosus L.  
R. idaeus L.  
Vaccinium myrtillus L.  
Vitis vinifera L.

## USEFUL PLANTS

Brassicaceae (undiff.)  
Brassica nigra L.  
Raphanus raphanistrum L.  
Cannabis sativa L.  
Prunus spinosa L.  
Dipsacus cf. fulloides L.  
Synsyrphus nigra L.  
Linum usitatissimum L.  
Reseda luteola L.

oraches  
 fat hen  
 knotgrass etc.

stinking mayweed  
 chickweed

deadnettle  
 nipplewort  
 long-headed poppy

hazel nut  
 fig  
 strawberry  
 walnut  
 cherry  
 sloe  
 blackberry  
 raspberry  
 bilberry  
 grape

black mustard  
 wild radish  
 hemp  
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## GRASSLAND

Gramineae (caryopasae undiff.)					grasses
Compositae (undiff.)			+		
cf. <u>Achillea</u> sp.			+		knarweed
<u>Centaurea nigra</u> L.				+	thistle
<u>Cirsium</u> sp.					hawk's beard
<u>Grepis biennis</u> L.				+	cat's ear
<u>Hypochaeris radicata</u> L.				+	hawkbit
<u>Leontodon</u> sp.					ragwort/groundsel
<u>Senecio</u> sp.				+	dandelion
<u>Taraxacum</u> sp.				+	legumes
Leguminosae (undiff.)					vetchling
<u>Lathyrus pratensis</u> L.				+	torrentil
<u>Potentilla erecta</u> (L.) Kausch				+	self-heal
<u>Potentilla vulgaris</u> L.				+	meadow/bulbous buttercup
<u>Ranunculus acris</u> L./ <u>R. bulbosus</u> L.				+	violet/field pansy
<u>Viola</u> sp.					
LITTER					
<u>Calluna vulgaris</u> (L.) Hull			+		ling
<u>Carex</u> spp.				+	sedges
<u>Cerealia</u> straw				+	straw
<u>Juncus</u> spp.				+	rushes
<u>Pteridium aquilinum</u> (L.) Kuhn				+	bracken
NEEDS					
Caryophyllaceae (undiff.)					
<u>Cerastium</u> sp.			+		mouse-ear chickweed
<u>Sagina</u> sp.			+		pearlwort
<u>Potentilla anserina</u> L.				+	silveweed
<u>Ranunculus repens</u> L.				+	creeping buttercup

(continued over)

## ACCIDENTALS

Rumex acetosella L.

## PLANTS OF WET PLACES

Epilobium sp.Glyceria sp.Nemophyes trifoliata L.Pedicularis palustris L.Potentilla palustris L.Ranunculus flammula L.Sphagnum sp.

+	+	+	+	+	sheep's sorrel
				+	willowherb
				+	float-grass
				+	bogbean
			+		marsh lousewort
			+		marsh cinquefoil
			+		lesser spearwort
			+		Sphagnum

## TOTAL FOR EACH GROUP

9

3

16

46

38

10

Mosses

Bones

Puparia

Charcoal

Coal

Trichuris egg

+

+

+

+

+

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### The Inside Back Page

The bleak midwinter has brought a new member of staff, indeed a whole new sub-department, to the effervescent academia of the University of Lowestoft. Following a substantial endowment from a little-known American foundation, the Chancellor and Court of the University have advertised, and filled, the Hermann Melville Chair of Parastatistics, thought to be the first appointment of its kind North of the Alps. The new appointee is the glittering Rumanian emigré Bela Yeast, formerly Chief Librarian at Wisley Polytechnic, where he is best remembered for procuring a rare signed first edition of Beachcomber's 'List of Huntingdonshire Cabmen'.

But what is parastatistics, I hear you ask, and furthermore why? Parastatistics arose as a discipline amongst scientists dissatisfied by the failure of conventional statistics to take account of human intuition. For example, when the proper outcome of a statistical test is transparently obvious to the researcher but the conventional results fail to confirm the pre-hoc deduction, parastatistics offers a set of procedures which generate weightings for the original data, thus bringing the miscreant numbers into line to give the required, and intuitively correct, result. Despite being dismissed by a few narrow-minded numerologists as 'fudging', parastatistics has led to many important new discoveries, some of them directly relevant to the *Circaea* readership. Best known amongst these theorems and constants is Abschmitte's Number, a measure of the probability of being able to calculate mean wind velocity from a particle size analysis of loessic sediments. Abschmitte's Number is obtained as a reciprocal of  $l^f$ , where  $f$  is a function of the sample size. Yeast rose to prominence by his brilliant demonstration that Abschmitte's Number is an intuitively acceptable approximation of the frequency with which a conventional statistical test gives a clear-cut result. Hence parastatistics.

Professor Yeast's first duty will be to appoint a lecturer in Likelihood Theory, who will organise the 1985-6 lecturing program for an intuitively predicted undergraduate intake of  $P$ , where  $P$  is an integer between 1 and 3 or thereabouts. It is hoped that there will be at least one postgraduate student as well, as the Moby Dick Foundation have also agreed to fund a three-year programme to search for the fundamental theorem which underlies Nibble's Conflation of Parkinson's Law. This is perhaps best known in the form 'The frequency of disruptive telephone calls is directly proportional to the volume to which work has expanded in order to fill the time available for its completion'. To obtain a numerical expression of this principle would be a truly invaluable contribution to the academic process, allowing us for the first time to predict with confidence whether it is worth leaving the phone off the hook after 3 p.m. on a Friday.

It may be some years before such parastatistical concepts as Leishmann's data unsuitability test or the cloven hoof model of sample representativity become commonplace in environmental archaeology. However, we can be sure that under Yeast's direction, this new sub-department will ferment many valuable and insightful ideas.