samples. Furthermore, the data set was transposed and DCA used to group similar (i.e. similarly behaving) species.

Species ordination was revealing in that it demonstrated that past associations between species were virtually identical to those that would be expected in the present day. Six groups were identified: Group A, consisting solely of *P. muscorum*, normally a xerophytic species; Group B, consisting of catholic Mollusca; Group C, consisting of catholic Mollusca with a preference for more shaded ground; Group D, Mollusca with a preference for wet ground; Group E, consisting of amphibious Mollusca; and Group F, consisting of aquatic species with a tolerance for 'slum' conditions. In effect, species ordination demonstrates that the ecological relationship between species in the past is similar to that in the present. Uniformitarianism at a general species level, proves valid.

However, research on modern molluscan distributions in wetland areas demonstrates that it is difficult to take uniformitarianism to the level of habitat equivalence. It is difficult to compare molluscan data from present-day non-alluviating wetlands to subfossil data from alluviated wetland contexts. Although at the level of ecological relationships between molluscan species uniformitarianism seems valid, non-identicality between past and present environments still suggests that the interpretation of past environments avoids strict habitat analogy.

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Evidence for food and fodder from plant remains at Causeway Lane, Leicester, U.K.

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(Editor's note: This paper was presented at the Spring meeting of the AEA at Birmingham University, April 17th 1996, but is more substantial than the summaries presented by other authors, and so is included here as a 'short contribution'.)

Introduction

A large urban excavation at Causeway Lane, Leicester (National Grid Ref. SK 584 048) was carried out by the Leicestershire Archaeological Unit from April to September 1991, directed by Aileen Connor, and with Richard Buckley as project manager. This was funded by the Inland Revenue, the developer of the site. The excavation was located in the NE quarter of the previously walled area of the town (Connor 1992) not far from the sites collectively known as The Shires (Lucas and Buckley, forthcoming). The site produced Roman and medieval features including some evidence of buildings of both periods and abundant evidence of back-yard activity with rubbish pits, cesspits and wells. The excavation provided an opportunity to take bulk samples for the recovery of plant and animal remains. The objective was to sample deposits with good bioarchaeological potential, and covering all phases and types of feature if possible. A total of 277 context groups was sampled amounting to some 12,000 litres (15 tonnes), of which the Roman deposits comprised about half the volume. All the samples were processed in a 'York' tank (Kenward *et al.* 1980).

The deposits encountered at this site were free-draining sands and gravels above Mercian Mudstone so that, although bone was well preserved and plant remains were charred or mineralized, there was only a very little waterlogged material from the deeper features. The range of remains recovered included fish bones and scales, mineralized fly puparia and woodlice, eggshell, oysters, charcoal and plant macrofossils. In addition to samples taken for a wide range of macrofossils, samples for analysis of pollen and parasite eggs were also taken (Monckton 1995). It was hoped that the results would add to evidence from The Shires sites, particularly to The Shires plant macrofossils (Moffett 1993). The analysis of the plant and

animal remains was completed in September 1994 and is to be included in the site report (Connor and Buckley, forthcoming).

The most productive phases of the site for environmental evidence were medieval cesspits of 11th-13th century date and a deposit from the Roman period (AD 250-300) which produced the abundant charred material which is the subject of this paper.

These charred remains were from a single sample from a rubbish pit (F255, Area 1) which was thought by the excavators to have evidence of *in situ* burning with burnt pottery and oyster shell present in the deposit (layer 1023). The pottery was described as indicative of people of a higher status than that from the rest of the site and the small finds included a spur. Other features from this phase included post-holes of a fence or possibly an outbuilding, and a stone-lined well nearby.

Analysis of the plant remains

The analysis of the plant remains was carried out in consultation with Lisa Moffett of Birmingham University, during which all the samples were scanned and 54 selected for further analysis; it is one of these 54 which is described here. Analysis of the whole flotation fraction (44 cm^3) from a 21 litre sample of the charred deposit produced about 6,000 seeds which were mainly very small. Remains were identified as far as possible taking into consideration the condition of the material and constraints of time. The lack of preservation of pod remains meant that the small Fabaceae seeds (including *Lotus, Medicago, Melilotus* and *Trifolium*) could not be identified in detail and were only separated by size and shape whilst, of the small grasses, only those with obvious surface characters could be identified. The remains were counted and listed in Table 86. Plant names follow Stace (1991) and the remains are all seeds in the broad sense unless otherwise stated. The plants are grouped according to their most usual modern habitat type.

Grassland plants

The abundant remains from this sample included many grassland herbs, among them yellow-rattle (*Rhinanthus* sp.), knapweed (*Centaurea nigra*), fairy flax (*Linum catharticum*), ribwort plantain (*Plantago lanceolata*) and ox-eye daisy (*Leucanthemum vulgare*), which were found together with a large number of small grass seeds, some of which could be identified as timothy type (*Phleum* sp.) and crested dog's-tail (*Cynosurus cristatus*). Many charred Poaceae stem fragments which were too small to be from cereals were also found. The *Primula* seed found with this material, though only tentatively identified beyond genus, is most likely to be cowslip (*Primula veris*) and eye-bright or bartsia (*Euphrasia/Odontites*), self-heal (*Prunella vulgaris*) and heath grass (*Danthonia decumbens*) also belong to this grassland group (Greig 1988a), giving a total of 11 taxa. A pod of bird's-foot (*Ornithopus perpusillus*), identified by James Greig, was also found; this is a plant of rather bare, sandy or gravelly ground (Stace 1991) and such soils are found in and around Leicester. Some of the smaller Fabaceae which cannot be identified further from charred seeds at present are probably bird's-foot-trefoil or clover (*Lotus* or *Trifolium*), the native species of which are mainly plants of grassland. This is also true of a number of *Potentilla* species and the material here was of *P. erecta* type (common tormentil).

Considering the composition of the sample (Table 86) the grassland plants form 46% of the seeds when *Lotus/Trifolium* and *Danthonia decumbens* are included, with unclassified small grasses forming a further 20%. Unclassified plants which could not be identified further from this material may also be from grassland and include *Medicago/Trifolium*, buttercups (*Ranunculus acris/repens/bulbosus)* and sedges (*Carex* spp.), which together form an additional 12% of the sample. These may of course be from damp pasture or damp areas of cultivated fields. The same may be true of the plants which are more clearly from damp habitats (2%), although ditch sides and hedgerows are a further possible origin in this case.

The sample thus consists of a high proportion of grassland plants and is interpreted as containing fodder which includes hay, burnt possibly for disposal of old fodder or as fuel or kindling. The survival of the large number of small seeds may indicate that the material suffered very little disturbance after burning.

Other plants

The presence of 3% of cereal remains shows the cereals in use at the time and suggests that the arable weeds were brought in with them. The weeds of arable and disturbed ground form 7% of the sample. They include the autumn-germinating weeds of cereal fields such as stinking mayweed (*Anthemis cotula*) and cleavers (*Galium aparine*) with brome grass

(*Bromus hordeaceus/secalinus)* probably also in this group. Spring-germinating weeds such as goosefoot (*Chenopodium* spp.) and chickweed (*Stellaria media* type) were more numerous. The mixture may be explained by the mixture of cereals, as barley is often spring sown while spelt and bread wheat are usually autumn sown. However the spring-germinating weeds here are mainly of the nitrophilous type common in gardens and around settlements and may be from this habitat type.

There is a small element of plants of trodden places including greater plantain (*Plantago major*) and sheep's sorrel (*Rumex acetosella*) and the thermophilous weed common mallow (*Malva sylvestris*) and possibly the thistles (*Cirsium* spp.). These three groups may represent the weeds of the surroundings of the settlement and be part of the urban flora (Hall 1988); some however may have been brought in with the fodder.

Cultivated and collected plants

The flax or linseed (*Linum usitatissimum*) may be an element of domestic rubbish showing the use of this crop which may have been grown for oil or fibre, but as the seeds are also edible this may represent human food remains or be part of the animal fodder. Columbine (*Aquilegia vulgaris*) has been thought to have been a garden flower when it has been found at other Roman sites (Moffett 1988), suggesting that garden waste may also be an element of this sample. The cereal remains probably originated as domestic waste and included grains, chaff and arable weed seeds; it is possible that the heath grass was an arable weed brought in with the cereals rather than a grassland plant, as it has been suggested that it is associated with ard cultivation (Hillman 1982).

Other food plant remains include lentil (*Lens culinaris*) and coriander (*Coriandrum sativum*) which may have been grown locally or possibly imported. Hazel (*Corylus avellana*) nutshell and a bullace (*Prunus domestica* ssp. *insititia*) stone were found as further remains of collected or cultivated foods.

Discussion

This sample, interpreted as mainly burnt fodder, contained at least 11 grassland taxa, including plants such as common knapweed, yellow-rattle and ox-eye daisy which are tall herbs which do not tolerate much grazing and are characteristic of modern hay meadow communities (Greig 1988a). This suggests that the sample may be interpreted as including hay, although the mixed nature of the remains means that some of the grassland taxa may be derived from other plant material, possibly as arable weeds, and the incomplete identification of some taxa makes detailed conclusions unwise.

Comparing the range of plants found here with descriptions of grassland communities (Rodwell 1992, Greig 1988a) the grassland taxa found in this Roman material are nowadays found in the *Cynosurus cristatus-Centaurea nigra* plant community of traditional grazed hay meadow, suggesting a source in a similar kind of grassland. This grassland community occurs throughout the British lowlands with the centre of distribution on the claylands of the Midlands of England (Rodwell 1992). This community has a complex range of sub-communities depending on soil type, moisture, nutritional status and management (Greig 1988a) and more detailed identification of unmixed material, and possibly detailed comparison with modern charred material, would be necessary to make further conclusions. Furthermore there is some overlap between species found on wet grassland, meadows and pastures but, even if this fodder is from mixed sources, the plants found suggest the presence of hay meadows. Hay meadow is a type of grassland maintained by mowing and limited grazing which returns nutrients to the soil as dung (Greig 1988a). Additional evidence from the analysis of pollen, which, although not abundant, includes that of Poaceae, Cichorioideae, *Centaurea nigra, Plantago lanceolata* and other grassland plants such as *Trifolium* sp., was found in a sample from a quarry in this same phase (Greig, forthcoming). Pollen of these kinds was also found in a sample from the fills of a ditch of the previous phase (AD 120 to 200) which also produced small numbers of charred seeds of some of the same plants discussed above.

Other, similar material from Leicester is of medieval date—from The Shires site at Little Lane where a group of charred plant remains consisted mainly of seeds of grassland plants, including those typical of hay meadow (Moffett 1993). Within the Midlands, comparison can be made between this sample and material from a 1st-2nd century AD well at Tiddington, Warwickshire (Greig 1988b) where 18 grassland taxa found in a waterlogged deposit were interpreted as hay or dung. The sample here, although less diverse (partly because of the charred preservation resulting in a less detailed

Taxon	No.	Vernacular name
CEREAL CHAFF		
Triticum spelta L. (glume fragments)	3	spelt wheat
— (rachis fragments)	2	—
T. cf *spelta* (glume fragments)	3	?—
T. dicoccum/spelta (glume fragments)	13	emmer/spelt
T. spelta/aestivum (rachis fragments)	4	spelt/bread wheat
Triticum sp. (free-threshing rachis fragment)	1	wheat
cf. *Triticum* sp. (free-threshing glume fragments)	2	?free-threshing wheat
— (free-threshing spikelet fork)	1	—
Triticum sp. (rachis fragment)	1	wheat
cf. *Hordeum vulgare* L. (rachis fragment)	1	?barley
CEREAL GRAINS		
Triticum dicoccum/spelta	2	emmer/spelt
— (germinated grain)	1	—
T. cf. *aestivum*	3	?bread wheat
Triticum sp. (free-threshing)	6	free-threshing wheat
Triticum sp(p).	23	wheat
Triticum (germinated)	1	—
Triticum sp. (tail grain)	1	—
Hordeum vulgare L.	15	barley
— (hulled)	19	—
— (germinated)	1	—
Cereal grains indet.	63	cereal
CULTIVATED/COLLECTED		
Lens culinaris Medikus	1	lentil
Aquilegia vulgaris L.	1	columbine
Linum usitatissimum L.	85	flax/linseed
— (capsule fragment)	1	—
Coriandrum sativum L.	2	coriander
Corylus avellana L.	3	hazel nutshell
Prunus domestica cf. ssp. *insititia*	1	?bullace
ARABLE OR DISTURBED GROUND		
Urtica urens L.	3	small nettle
Chenopodium sp.	42	goosefoots
C. bonus-henricus L.	4	good-King-Henry
C. murale L.	6	nettle-leaved goosefoot
C. album type	61	'fat-hen'
Stellaria media type	122	'chickweed'
Persicaria maculosa/lapathifolia	18	redshank/pale persicaria
Polygonum aviculare L.	20	knotgrass
Fallopia convolvulus (L.) Á. Löve	1	black-bindweed
Rumex sp.	19	docks
Rumex acetosella L.	10	sheep's sorrel
Malva sylvestris L.	11	common mallow
Thlaspi arvense L.	3	field penny-cress
Brassica/Sinapis	2	cabbages, charlock, etc.
Vicia tetrasperma/sativa	2	smooth tare/common vetch
Plantago major L.	1	greater plantain
Veronica polita/agrestis	2	field-speedwell
Galium aparine L.	10	cleavers
Anthemis cotula L.	9	stinking mayweed
Poa annua L.	1	annual meadow-grass
Bromus hordeaceus/secalinus	68	lop-grass/rye-brome

Table 86 (above, opposite and following page). List of charred Roman plant remains from Causeway Lane, Leicester, F255, context 1023.

Taxon	No.	Vernacular name
GRASSLAND		
Primula cf. *veris*	1	?cowslip
Potentilla erecta type	85	tormentil
Lotus/Trifolium (small)	1455	bird's-foot-trefoil/clover
cf. *Lotus* sp.	29	?bird's-foot-trefoil
Lotus sp. (pod)	1	bird's-foot-trefoil
Trifolium (small, germinated)	1	clover
Ornithopus perpusillus L. (pod)	1	bird's-foot
Linum catharticum L.	1	fairy flax
Plantago lanceolata L.	105	ribwort plantain
Rhinanthus cf. *minor* L.	4	yellow-rattle
Rhinanthus sp.	115	—
cf. *Rhinanthus* sp.	15	?—
Euphrasia sp.	1	eyebright
Euphrasia/Odontites	191	eyebright/bartsia
Centaurea nigra L.	8	common knapweed
Leucanthemum vulgare Lam.	8	ox-eye daisy
Cynosurus cristatus L.	193	crested dog's-tail
Phleum type	449	cat's-tails type
cf. *Phleum* sp.	66	?—
Danthonia decumbens (L.) DC	39	heath grass
cf. *D. decumbens*	53	?—
DAMP OR WET GROUND		
Ranunculus lingua L.	1	greater spearwort
R. flammula L.	11	lesser spearwort
Stellaria palustris Retz.	48	marsh stitchwort
Lychnis flos-cuculi L.	5	ragged-robin
Galium palustre L.	6	common marsh-bedstraw
Juncus sp. (capsule)	1	rush
Luzula sp.	6	wood-rush
Eleocharis palustris/uniglumis	24	spike-rush
cf. *Schoenoplectus*	1	club-rush
HEDGE OR WOODLAND		
Sambucus nigra L.	7	elder
UNCLASSIFIED		
Ranunculus sp.	1	buttercup
Ranunculus acris/repens/bulbosus	279	—
Caryophyllaceae	177	pink family
Cerastium/Stellaria	29	mouse-ear/stitchwort
Brassicaceae (small)	2	cabbage family
Medicago/Melilotus/Trifolium	137	medick/melilot/clover
cf. *Medicago* sp.	33	?medick
Apiaceae	1	carrot family
Prunella vulgaris L.	1	self-heal
Plantago sp. (capsule)	1	plantain
cf. *Plantago* sp.	2	?—
Valerianella sp.	3	cornsalad
Asteraceae	7	daisy family
— (capsule)	2	—
Carduus/Cirsium	18	thistles
Carex spp. (2-sided)	223	sedges
Carex spp. (3-sided)	167	—
cf. *Poa* sp.	1	meadow-grasses
Poaceae (small caryopses)	1265	grasses
Poaceae (small, germinated caryopses)	1	—
Poaceae (small, flowers)	3	—
Poaceae (medium caryopses)	72	—

Taxon	No.	Vernacular name
Poaceae (large caryopses)	55	—
Poaceae (embryo)	1	—
indeterminate seeds	91	
other charred fragments	25	
TOTAL	6202	

level of identification being possible) was interpreted as including burnt hay. This, like the samples from Tiddington, also contained domestic rubbish and other material with which the hay was mixed. As hay is a bulky product and is unlikely to be transported far this suggests hay meadows near the town to supply fodder for animals kept in the town and, considering the higher status indicated for this particular deposit, the stabling of horses nearby may be suggested.

Conclusions

The high proportion of grassland plants in the sample including those typical of hay meadow lead to the interpretation of the sample as consisting largely of fodder. It occurred with a mixture of domestic and possibly garden rubbish from the site which give evidence of the plants utilized at the time. The housing of animals in the town is indicated and the presence of hay meadows near the town is suggested.

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Summary: A sample from a Roman pit (dated AD 250-300) at Causeway Lane, Leicester produced over 6,000 charred seeds, including a high proportion of grasses with hay meadow plants, and was interpreted as mainly burnt fodder mixed with domestic and possibly garden rubbish.

CONFERENCE REPORT

Report on the 8th Meeting of the Fish Remains Working Group of ICAZ, held at Cantoblanco, Madrid, October 3rd-6th 1995

With 67 participants from 27 countries pre-registered, and more coming to some of the papers, this conference was the largest meeting of the fish bone working group to date, indicating the growing popularity of the subject in the sixteen years since the then small group was founded. The meeting was expertly organised by Professor Arturo Morales Muñiz and Dr Eufrasia Roselló Izquierdo, aided by a legion of students, and was held in the modern archaeozoological research area of the Biology Department of the Universidad Autónoma de Madrid, situated several miles out of the city. Over thirty papers and about a dozen posters were presented, dealing with a range of fishy topics some but not all directly relating to the conference theme of fishing and overfishing in the past. Despite the numbers of papers, a selection of social events was also scheduled including a sightseeing trip around Madrid (without too much fish), a chance to look around the Natural History and Archaeological Museums (some fish), and tour of the extensive departmental facilities and archaeozoological reference collections (lots of fish). For those staying on (sadly not this delegate), a coach trip around the Bay of Cadiz ensured a companionable—if very hot—end to the conference.

The conference sessions were themed as far as possible, with a day and a half devoted to papers of direct relevance to the conference theme of overfishing in the past. Sophia Perdikaris confronted the problem of recognizing 'commercial' fisheries from collections of fish bones, based on a Norwegian example but of considerable interest to archaeo-ichthyologists working in other regions, including Northern Scotland. By combining written and archaeological evidence for freshwater fish consumption with that for environmental stress and river pollution Richard Hoffmann addressed the key question of human impact on freshwater ecosystems, concluding that by medieval times over much of Europe freshwater water bodies had become greatly depleted in fish stocks, and that pollution had particularly reduced the populations of species preferring clean, fast flowing water, including the anadromous Salmonidae, shads (*Alosa*), eel (*Anguilla*) and sturgeon (*Acipenser*). Lembi Lôugas discussed fishing in Estonia during the Stone Age, while Norbert Benecke described fish remains from some Neolithic sites in East Germany. Oliver le-Gall gave a comprehensive synthesis of the evidence for fishing from the Palaeolithic to the Neolithic in western Europe which left at least this delegate wishing she had spent longer studying French at school! Foss Leach and Atholl Andersen gave characteristically robust syntheses of Maori fishing technologies and catches. Arguing for the former, Atholl addressed the question of whether single-species fishing was a deliberate strategy, pursued by technological innovation or a product of fish behaviour. Foss proved that detecting overfishing in prehistory is no easy task and demonstrated the political implications of working as an archaeo-ichthyologist in New Zealand. Turning to South America, Amelia Sánchez-Mosquera described the culmination of several years work examining fish bones representative of coastal and later offshore fishing, from multi-period coastal sites in Manabi, Ecuador. The sightseeing trip and museums followed a hearty, fishy and lengthy Spanish lunch; miraculously no one fell asleep on the bus or failed to find their way back by public transport—a credit to Arturo's detailed instructions!

Illustrations of herring *Clupea harengus* preparation in Denmark greeted conference participants after breakfast on day 2: Inge Bødker Enghoff demonstrated the continuity of tradition from Medieval times to the present day. The impact of Romanisation on fishing in the Mediterranean was discussed by Miriam Sternberg, while light was shed by Omri Lemau on the range of fish sauces available to the Romans. Wim van Neer discussed the investigation of age and season of capture by otolith growth band analysis, using a collection of plaice believed to have originated from a single catch. This paper provoked considerable discussion and the value of the technique was