Chapter 11
Environmental Archaeology in the East Midlands

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Introduction

Environmental archaeology is now a routine element of archaeological investigations and the relevant results are integrated into the period studies in this volume. However, the information gathered also requires consideration across periods in order to examine changes over time and to investigate regional differences, because studies of organic remains, which provide evidence of the environment and economy, are based on comparison of results from different periods and areas. For this reason, and because much of the work resulting from PPG16 is unpublished or in progress, environmental archaeology is considered separately here. A further problem is that the materials and information recovered from environmental samples are rarely recorded as categories on SMRs. The purpose of this resource assessment and research agenda is to draw attention to such information sources in order to inform and facilitate future work. An integrated approach to archaeology, including environmental archaeology is the long-term aim (Albarella 2001b); only by combining all the available information can reasonable conclusions be drawn about life in the past. Individual period-based research agendas, comprising potential research areas and recognized gaps in our knowledge, follow the resource assessment for each period, whilst the major cross period themes and issues are drawn together in the concluding section of the chapter.

Environmental archaeology is taken to mean the evidence from the study of plant and animal remains, together with other scientific analysis, used to contribute to the understanding of the environment and living conditions of people in the past. There are two main interconnected themes of study throughout prehistory; firstly changes in the environment, both natural and anthropogenic, and secondly the development of farming to produce the crops and domestic animals which provide food. Analysis of remains can also provide evidence about the way of life and land use. As larger settlements and towns developed, remains can provide evidence of trade, diet, health, status, living conditions and activities within settlements. In addition analysis of plant and animal remains can contribute to the investigation of how settlements were provided with food and other commodities. Urban archaeology can therefore make an important contribution to this study.

Many of the remains which provide this information are very small (e.g. seeds, small bones, fish remains, snails) or microscopic (e.g. pollen, insect remains, parasite ova) and so are only found by taking appropriate samples and analysis of the materials recovered. Different methods are used for waterlogged and 'dry' deposits, as described below, and environmental sampling is now a routine part of excavations and some watching briefs. Samples are also taken for study of sediments, and for chemical and other analysis. Comparable data is needed from sites of all periods from all parts of the region to investigate change over time, and differences between areas, site types and situation within the varied landscapes of the East Midlands. Hence it is important that the recovery and analysis of these remains is specified in archaeological briefs or such information will be lost.

Recovery of the evidence and preservation

Waterlogged deposits

Much of the information for the environment is found by sampling waterlogged deposits, which preserve organic remains in anaerobic conditions (Fig. 68). Pollen has sometimes been the only material studied because it originates from a wide area providing evidence of the vegetation type to show whether the landscape is open or wooded. Nowadays a range of remains is studied including plant macrofossils (seeds and other plant parts), and insects, which give evidence of local conditions and land use. Dung beetles, for example, are found on pasture land, while particular groups of beetles and caddis-flies are indicators of different water conditions. Plant macrofossils are likely to represent the local vegetation and so can assist in the distinction of local and regional pollen. Beetles and caddis-flies can also be used to detect climate change. Diatoms, ostracods and foraminifera can also be useful to reveal, for example, hydrological conditions, so analysis should be considered where appropriate. Radiocarbon dating of deposits analysed is essential (see below) and such evidence can contribute to geoarchaeological and land use studies. Analysis of waterlogged deposits from occupation sites can contribute to the evidence for food and activities taking

Fig. 68: *Map of waterlogged and pollen-bearing sites*

place on sites as well as to evidence for the broader environment.

Charred plant remains

Charred plant remains are found on most occupation sites of most periods and they survive in most types of soil conditions. They include charred cereal grains, chaff, weed seeds and remains of other crops and useful plant material. Their analysis can show the crops cultivated and utilised, while the weeds present can provide evidence about methods of cultivation and the surroundings. The proportions and ratios of the types of charred plant remains in samples (i.e. grains, chaff and seeds) can be used to interpret crop related activities such as stages of crop processing (cf. Hillman 1981; 1984). In order for this to be done, sufficient remains must be completely recovered from bulk samples by wet sieving and flotation. A minimum of 50 items at a concentration of over one item per litre of soil is necessary, so that samples of around 40 litres in size may be required. Remains are not always recovered fully by flotation so sorting and/or reflotation of the residues should be carried out for the samples to be analysed. Samples are needed from a range of datable contexts from sites to establish areas of activity. Larger samples may be needed to recover the range of remains on early sites where they are at low densities and samples of 50 litres are recommended for Neolithic sites in particular (de Moulins and Murphy 2001).

Animal bones

Evidence from animal bone is particularly important to establish which animals were exploited and the type of animal husbandry used; therefore large enough samples need to be excavated to recover sufficient bones for analysis (J. Rackham pers. comm.). Deposits with good potential to produce bone should be sampled and sieved to recover the bones of small mammals, amphibians, reptiles and birds, as well as eggshell and fish remains in order to provide evidence of environment or diet. Sampling appropriate deposits is also important for the consistent recovery of the small bones of the larger animals because these can reveal the keeping of young animals, butchery and trade waste (Payne 1992). Detailed study of animal bones can provide evidence of the use of animal products such as milk and wool, and show the introduction of improved breeds and husbandry methods (Albarella 1997a; Dobney *et al.* 1996; Gidney 2000).

Human bones

Skeletal analysis is a vast area of study which can reveal information such as age at death, stature, diet and pathology of groups of people, while analysis of DNA can reveal relationships. Such studies can provide direct evidence of culture, ritual and social conditions. A large number of burials have been excavated in the region, both published and unpublished, although the material is uneven between periods. The information is beyond the scope of this assessment and a regional review is recommended.

Sediments

Analysis of sediments by micromorphology and particle size analysis can reveal information about land use for cultivation or pasture, and phosphate analysis can be used to define burials and to provide evidence for the use of enclosures for animal keeping (Limbrey 2000; Macphail and Linderholm 2004). Study of soils can also provide information about site formation processes, for example whether sediments were deposited by water or other means. On the larger scale, geoarchaeology uses sediment analysis together with studies of organic remains and the evidence of the archaeological record of an area to study landscape change and the evolution of river systems and alluviation. Chemical analysis of heavy metals from sediments can be used to investigate and date mining activity as well as to study industrial pollution.

Molluscs

Sampling and analysis of deposits containing molluscs can provide evidence for land use from land snails, which are good environmental indicators. Rubbish deposits on occupation sites sometimes contain shells of marine molluscs including oysters, which contribute to evidence for diet. These can be compared by statistical analysis of size and shape together with their infestations to investigate their source and so provide evidence of trade.

Charcoal and wood

Charcoal can be identified to show the timber and wood used for fuel as well as contributing to the study of woodland management and exploitation and, for example, the use of wood in metalworking (J. Cowgill pers. comm.). Waterlogged wood can also provide such information and in addition provide evidence of wood working technology from tool marks on worked timbers.

Other types of preservation

Remains can be preserved by mineralisation (e.g. calcium phosphate replacement), for instance in the conditions that can obtain in cesspits, so that fruit stones and pips survive. Such samples can be analysed for parasite ova of parasites of the human gut, while remains of maggots and flies give evidence of conditions in the pits (c.f. Connor and Buckley 1999). Coprolites (semi-fossilized excrement) of humans and animals may also be found in these conditions; they can contain pollen

and other remains indicative of diet and environment. Pollen evidence can be preserved by corrosion products near ancient metalwork (Greig 2000). Plant remains are occasionally preserved by desiccation in daub and plaster, and smoke blackened thatch can preserve evidence of crops and weeds as well as construction (Letts 1999).

Biomolecules

Analysis methods for 'biomolecules' include residue analysis to investigate the use of pottery (cf. Evershed 1999), and techniques of investigating animal bone for signs of cooking are now being developed (Roberts *et al.* 2002). Exciting new techniques are becoming available for skeletal material, for example analysing human bones for heavy metals to investigate whether people are local or from other regions, and using stable isotopes to reveal diet and lifestyles of the people (Richards 2000). Appropriate specialists should be consulted on these and other techniques as they become available and applied to archaeological questions. More information can be found in *Guidelines for Environmental Archaeology* (English Heritage 2002b).

Scientific dating

Bayliss (1998) has discussed the problems of radiocarbon dating, together with new approaches. It is now recommended that waterlogged deposits are dated by AMS determinations on selected seeds of land plants. This avoids water plants, which take up dissolved ancient carbonates from limestone, and also avoids ancient carbon from coal in the sediments, both of which affect the results. Charred single pieces of well-stratified short-lived charcoal, hazelnut shell or cereal grains should be used rather than collections of material. This avoids dating old wood fragments and mixed material. Radiocarbon dates are quoted here as cal. BC and AD, and are given as the calibrated range at 95% confidence (Stuiver and Reimer 1993) unless stated; dates quoted as BP (before present) are uncalibrated radiocarbon years. The abbreviation ya is used for years ago.

Other dating methods include dendrochronology, thermoluminescence for pottery and fired clay, optical luminescence for sediments, and palaeomagnetic dating for kilns, hearths and furnaces. Specialist advice should be taken.

Sources of Information

In order to evaluate and analyse the resource for the study of environmental archaeology in the region, and establish gaps in the evidence, a catalogue of sites with evidence from plant and animal remains is being compiled (see Table E1 at http://www.le.ac.uk/ar/east_midlands_research_framework.htm). The sites described in the county and period summaries form the basis for this resource assessment. Apart from site reports other sources of information used are as follows:

1. The English Heritage Regional Reviews of Environmental Archaeology dealing with wood and charcoal (Murphy 2001a), plant macrofossils (de Moulins and Murphy 2001), and mollusca (Murphy 2001b). Other remains may be reviewed eventually. These reviews include selected published reports and Ancient Monuments Laboratory (AML) reports. However, they take little account of other unpublished archive reports.
2. The Environmental Archaeology Bibliography, maintained by Allan Hall of York University, is accessible from the English Heritage Website.
3. Archaeo-Botany Computer Database which maps and lists remains from some sites and is accessible as a link from the English Heritage website.
4. Published reviews and bibliographies for plant remains (e.g. Greig 1991; 1994–2001; 1996; Kroll 1992–2001), and for insect remains (Greenwood and Smith forthcoming).
5. Lists and copies of published work and unpublished archive reports kindly supplied by specialists who have worked in the region. Some unpublished work, particularly in developer reports, is unfortunately difficult to obtain.

Palaeolithic

The major changes in geology and climate during this long period are described in Chapter 2. For most of this period animal bone is an important source of evidence for the environment, and the region is fortunate to include the internationally important cave sites of Creswell Crags. Remains from the caves represent the last 70,000 years, with major evidence from the last glaciation and the early Holocene. Sites at Creswell have been excavated since 1862 and some of the finds and archives have been lost or dispersed over the years, but efforts are now being made to re-assemble, analyse and interpret the evidence by Sheffield University with the support of Derbyshire and Nottinghamshire County Councils. Other evidence in the region comes from the gravels such as at Allenton, Derbyshire, and from surviving deposits such as those at Wing and Glaston in Rutland. Palaeochannels found in the Trent, Soar, Nene and other river valleys preserve waterlogged evidence dating from the Lateglacial and Postglacial periods.

Deposits preserving early organic remains include the sediments at Brooksby, Leicestershire, which contained plant macrofossils (leaves, bud scales and seeds), and pollen and other remains which indicated relatively mild conditions (Rice 1991) and were dated to around 480,000 ya (Graf 2002). A lower deposit included evidence of pine, fir, birch, hazel and oak woodland, while on wetter ground alder and willow grew with bur-marigold, sedges and bulrush; water plants were

represented by stonewort, while open ground was represented by heather, grasses, plantain and saxifrages. The upper deposit contained the same trees but lacked evidence for oak and contained more herbaceous plants including violas and valerianella; and in addition heather, mountain sorrel and crowberry, the latter of a subspecies which now grows at higher altitudes (Connolly 1991). A recent investigation has suggested that the sediments are possibly from minor channels associated with the Bytham river (Challis and Howard 1999). Although these have yet to be analysed in detail, they show the potential of the area to provide environmental and other evidence.

Other early evidence in the region includes a pre-Ipswichian waterhole and animal pathway with associated mammal bones from Little Houghton, Northamptonshire (Smith 1995), whilst hippopotamus bones found at Tattershall, Lincolnshire, are thought to date from *c*. 120,000 ya (Brandon and Sumber 1988). Evidence from the Ipswichian interglacial before the start of the last glaciation *c*. 70,000 ya, includes that from Allenton, Derbyshire consisting of hippopotamus bones and remains of the flora of a warm phase (Jones and Stanley 1975). At Wing in Rutland a deposit from a deep drift-filled basin about 100 m wide and up to 18 m deep was studied by Hall (1980), who reported a pollen sequence through the greater part of an interglacial and early glaciation. The main deposit was 8 m in depth and consisted of silty clays, laminated clays and compressed peats. Plant macrofossils were also studied to show the local as well as regional vegetation. The profile showed the rise of mixed oak forest, the change to temperate hornbeam forest and deterioration to tundra-like vegetation, and was dated by comparison with European and other British sites to the last interglacial, the Ipswichian, and the beginning of the Devensian glaciation (*ibid*.), around 110,000 ya (Graf 2002).

Much of the evidence from Creswell Crags in Derbyshire is from the last glaciation. At Pin Hole Cave remains were recovered of lion, hyaena, wolf, red fox, brown bear, mammoth, woolly rhinoceros, horse, reindeer, and giant deer. Birds were also present including ducks and geese of open water and ptarmigan and red grouse of open ground (Jenkinson and Bramwell 1984). These are dated to the Upton Warren Interstadial *c.* 42,000 ya, which was a warm interlude within the glaciation. These remains were excavated by Armstrong in 1928 and were sufficiently well recorded to be quantified stratigraphically to show changes over time (*ibid*.). This provides information about the environment of the Middle Palaeolithic; further evidence of the same date has been found at Robin Hood's Cave and Mother Grundy's Parlour, Creswell.

A recently excavated deposit at Glaston in Rutland may date from *c*. 30,000 ya (Thomas and Jacobi 2001). Bones of hyaena, mammoth, glutton, woolly rhinoceros, reindeer, horse, mountain hare, lemming and voles were recovered, together with lithics including a 'leaf point', and the site is thought to date from the Early Upper Palaeolithic. Situated beside and beneath a sandstone raft in fault deposits or collapsed animal scrapes and burrows, the deposit was discovered during the excavation of medieval features. It may represent a hyaena den and coprolites will be tested for pollen and other evidence of diet and environment. Bulk sampling and sieving for flint and micro-faunal remains was carried out using 0.5 mm mesh sieves to recover diagnostic small mammal teeth because small mammals are good environmental indicators.

Numerous finds of mammal bones come from the river valleys. Peat at Pontylue pit, Syston, Leicestershire, contained mammal, insect and molluscan remains from a cold, treeless environment dated to *c*. 37,420 BP (Rice 1972; Graf 2002). Faunal remains recorded include mammoth and woolly rhinoceros at Barrow-on-Soar (Rice 1968; 1972) and a small species of mammoth of an early date at Birstall (Brandon 1999; Graf 2002). Stray finds of mammoth tusks and large bones are often made in the gravels and, if found *in situ*, they may provide useful dating evidence for the deposits. Such remains have been noted in Lincolnshire (Membery 2000a) and mammoth tusks have been found in quarries at Cossington and Syston in the Soar valley in Leicestershire during recent watching briefs (Sturgess and Ripper 2000; Higgins 2001).

Upper Palaeolithic evidence has been recovered from Robin Hood's Cave and Mother Grundy's Parlour at Creswell. Bones of hyaena, ibex and mountain hare have been found with pollen evidence for open country of sedges and grasses with some juniper, willow and birch trees present (Jenkinson and Gilbertson 1984). At Pin Hole Cave, Creswell, faunal remains dated to the end of the glaciation *c.* 13,000–10,000 BP were found. These included bones of many woodland bird species which are familiar today such as starling, rook, wren, robin, great tit, long tailed tit, tree sparrow, chaffinch, crossbill, corn bunting, owls, and many others. The presence of so many woodland birds before the end of the last cold phase was an unexpected and interesting discovery (Jenkinson and Bramwell 1984).

Evidence for the environment at the end of the last glaciation has been found in waterlogged deposits from palaeochannels. In the Idle valley the vegetation was found to be open with few trees and evidence of an Arctic Structure Soil was found, thermoluminescence dated to 13,700 ya (Howard, Bateman *et al.* 1999). Channel sections from Barrow-upon-Trent, Derbyshire and from Hemington Quarry, Leicestershire (channel A) have been AMS dated to around 11,700 BP and contain remains of caddis-fly larvae, which live in cold conditions; plants from the latter channel are of reedswamp (Greenwood 2002; Greenwood *et al.* 2003). Another palaeochannel section from Hemington Quarry extension also has cold phase insects including a species which lives on dwarf willow (Greenwood pers. comm.). At Croft, Leicestershire, a channel thought to date from the Loch Lomond stadial has been described (Smith *et al.*

2005). Other Lateglacial channels have been dated in the Soar and Nene valleys where they occur in a time cluster of palaeochannels as a result of the major changes in rivers at this date (Brown *et al.* 1994). Dating, mapping and analysis of these channels has shown the potential to provide evidence of the evolution of the river system and landscape (Knight and Howard 1994; Howard *et al.* 2001).

Creswell is now a Site of Special Scientific Interest (SSSI) and studies of the modern environment have been carried out, as well as excavation of remains from Palaeolithic to post-medieval date (Jenkinson and Gilbertson 1984). Of particular interest is the early evidence for the mammals and bird species present. Hence, Creswell Crags is an important resource for biological and ecological studies as well as archaeology. Other aspects of the site are the public interest generated by the visitor centre and the potential of study of the ancient environment in relation to the modern environment of the SSSI.

Potential research topics

- The region has great potential to build on an existing body of data from a variety of different areas and deposits.
- Creswell, Derbyshire, is important for research, in particular interdisciplinary studies, and has tremendous potential for creating public interest with its visitor centre and admission to the cave sites. It has SSSI status, which is vital to the conservation of the sites and their surroundings, as well as being of importance for the wider study of environmental change and human activity.
- Palaeochannels of the main rivers have great potential for the study of environmental change; co-ordination and publication are required.
- Potential for information about beginnings of modern river systems from palaeochannel studies.
- Investigation of unusual deposits of good potential, such as those at Glaston and Brooksby, must be a priority.
- Stray finds of mammoth bones and tusks should be mapped, curated and dated.
- Literature of other disciplines is important (e.g. botanical, zoological, geological); there is a need for references to be made known to archaeologists and environmental archaeologists.

Mesolithic

Information about the Mesolithic environment is comprehensively incorporated into Chapter 3, so little need be added here. The available evidence derives from waterlogged deposits in palaeochannels in the Trent valley such as at Aston and Staythorpe, and the other main river valleys, but particularly from headwaters and small catchments. The peats of the Peak District and cave sites at Creswell also preserve evidence. There is an absence of information from occupation deposits about food consumed, but these are rare nationally. At the start of the period the Early Postglacial environment is known from palaeochannels from the Nene and Soar (Brown *et al.* 1994), the Nene at Raunds (Brown 1999), Croft, Leicestershire (Smith *et al.* 2005), Birstall, Leicestershire (Ripper 2004), and at West Bridge, Leicester (Shackley and Hunt 1984). These show the reedswamp conditions of the valleys and generally open environment with evidence for some colonisation by trees. Recently Brayford Pool, Lincoln has produced peats with a sequence from Mesolithic to medieval date (M. Jones pers. comm.).

A cool temperate forest of birch and pine (41% tree pollen) has been identified at Ditchford, Northamptonshire, in a profile dominated by grasses and sedges at 9485 ± 125 BP (Brown *et al*. 1994), showing the development of woodland as the climate warmed. The same development was found at Apethorpe, Northamptonshire (Sparks and Lambert 1961) and Narborough Bog, Leicestershire (Brown 1999). Such early woodland is also known from Croft in Leicestershire, where pollen in the profile was dominated by sedges and grasses with a little birch and pine which persisted until at least 9840 BP. After an hiatus, this was succeeded by birch, hazel and willow woodland with some evidence of open ground. Traces of occupation features contained Late Mesolithic flints (Smith *et al.* 2005). In Nottinghamshire Misterton Carr has produced environmental evidence of this date (Buckland and Dolby 1973), as have Girton Quarry and Bole Ings, where insect evidence and other remains indicated dense woodland (Dinnin 1992; 1997). At Dog's Hole Fissure, Creswell, early woodland is attested by bones of wolf, beaver and woodland birds, together with a mollusc fauna dated to *c*. 8500 BP (Jenkinson and Gilbertson 1984).

Recent work at Staythorpe, Nottinghamshire has found oak elm lime woodland on the terraces with alder willow aspen carr in the floodplain from palaeochannels of the early to mid sixth millennium BC, one of which was possibly active for around a thousand years (Davies 2001). Stable isotope data from the femur of a human female 1.53–1.57 m tall suggests that she was living mainly on meat, with no evidence for consumption of coastal resources (*ibid.*). Evidence for similar woodland with elm has also been found at Aston on Trent recently dated to around 5000 cal. BC (C. Salisbury, M. Greenwood pers comm.). Lincolnshire currently provides little information for this period although coastal sites, river valleys and kettle-hole data have great potential to add to our understanding (Membery 2000a).

Human impact on the woodland including suggested clearing has been found in a dated sequence of pollen and ostracods from the East Moors, Derbyshire (Hicks 1971; 1972; Taylor *et al.* 1994). Evidence for burning has also been found in pollen profiles at Lismore Fields, Buxton (Wiltshire and Edwards 1993) while possible

clearance by humans was recently found at Burton Latimer, Northamptonshire (Phillips 2000).

Major environmental changes are seen in this period: the open cold conditions of the Early Postglacial were followed by colonisation by trees and the rise of cold temperate forest, and then by the development of climax temperate woodland which eventually shows signs of human exploitation. Changes in fauna occurred alongside the changes in habitat: from large mammals of cold conditions to woodland grazing animals and birds. These may correlate with changes in flint technology and lifestyle but dating evidence is needed to show how and when this may have occurred.

Potential research topics

- Changes in the environment and changes in technology should be correlated. Any opportunities to date organic remains found with lithics must not be missed.
- Analysis and dating of pollen profiles showing early clearings is needed for more of the region.
- Great potential of stable isotope analysis for any finds of human bone, or any already in archive, to obtain a more representative sample of results.
- Recovery of any charred material from in situ contexts is a priority, both for dating remains and as evidence of fire.
- Potential of palaeochannels for dated evidence of this period.
- Potential of headwaters and small catchments to provide evidence.

Neolithic to Early–Middle Bronze Age

The sites with environmental evidence have been discussed in Chapter 3, but are included here because the beginnings of farming are an important area of study. Much of the available data is from waterlogged remains, both from the peats of the Peak District and from palaeochannels in the river valleys. Charred plant remains have been recovered from over a dozen sites mostly in small numbers, while good groups of animal bones are present on only a few sites. Analysis of molluscs and soil micromorphology have provided some information; for example, at Raunds, land used as pasture and for stock herding has been indicated by soil micromorphology and phosphate analysis of pre-barrow soils of Neolithic to Bronze Age date (Macphail forthcoming). Few of these sites are mentioned in the English Heritage Regional Reviews of Environmental Archaeology as most were unpublished or in progress at the time.

Evidence of the early lime woodland comes from North Derbyshire (Hicks 1971; 1972), the Trent at Langford and Cottam, Nottinghamshire (Scaife and Allen 1999; Greenwood and Smith forthcoming), Croft and Narborough Bog, Leicestershire (Brown 1999; Smith *et al.* 2005), Butterbump, Lincolnshire (Greig 1982a), and the Nene valley, Northamptonshire (Brown 2000). Pre-elm decline disturbance has been found from North Derbyshire sites including Lismore Fields (Wiltshire and Edwards 1993), and clearings in the Soar and Nene valleys have been described and discussed by Brown (2000).

Neolithic

The early clearings in North Derbyshire lack cereal pollen and are interpreted as used by herders with their animals. The use of land for pasture can also be demonstrated through the presence of dung beetles, as in the Late Neolithic palaeochannel at Hemington (Brown and Hatton 2002; Smith 2002). Clearance has also been dated by radiocarbon analysis of charcoal or organics from tree-throws at Raunds, Northamptonshire, at *c*. 3000 BC, and at Sproxton, Leicestershire in pre-barrow contexts dated to 3990–3810 cal. BC, where evidence from snails and micromorphology of buried soils suggested cultivation followed by pasture (Clay 1981). Identification of charcoal from these and other sites, for example Irthlingborough (Parry forthcoming), has also contributed to the evidence for woodland and clearance. Few sites have produced many animal bones, although Skendleby Lincolnshire, Giants Hills 1, contained evidence of cattle, sheep, red and fallow deer (May 1976).

The earliest dated cereal pollen includes that from Lismore Fields from at least 6000 BP (Wiltshire and Edwards 1993), from Collingham, Nottinghamshire (Bishop 2000b), in pre-elm decline levels, and from immediately post-elm decline levels at Cottam (Scaife and Allen 1999). Recently cereal pollen has been found in a Late Neolithic partly cleared profile of *c*. 2800 BC from Hemington Quarry, channel C (Brown and Hatton 2002; Smith 2002). Evidence of Neolithic cereal pollen is lacking from much of the region, only appearing in Bronze Age profiles from the Soar and Nene valleys in a time cluster of silted palaeochannels, possibly formed as a result of clearance in the floodplains (Brown *et al.* 1994). Waterlogged deposits from headwaters and mires may have better potential to preserve evidence of early cereal pollen and other land use beyond the floodplains (Brown 1999). Pollen can also be used to investigate the duration and size of clearings and their possible ritual use (Brown 2000). More well-dated pollen profiles are needed to show dates for cereal cultivation and to provide evidence of human activities in the region.

Charred plant remains have been recovered mostly in small numbers from isolated pits. An exception is at Lismore Fields, Buxton, where numerous emmer grains with emmer chaff, flax and crab apple were found dated to 3990–3150 cal. BC. This is taken to be evidence of cultivation which may imply some sedentism earlier than previously thought (Jones 2000). These data also contribute to the debate about long fallow cultivation. Jones (*ibid.*) suggests other possibilities, such as a range

of garden-type cultivation methods, which can maintain productivity of the same area over a long period. Recent work at Sheffield University has drawn attention to the speed at which clearings become overgrown by brambles and other plants if not maintained, whilst a study in northern Europe has shown that weeds from small woodland clearings in a shifting cultivation regime are different from those found on Neolithic sites. This suggests that cultivation may have been more stable and settled than that associated with shifting cultivation (Bogaard 2002). Analysis of weeds may therefore help to establish the type of cultivation practised (M. van der Veen pers. comm.). However, good assemblages of plant remains are rare for this period so their recovery and study is a future priority.

Other sites which have produced charred cereal remains often show a greater abundance of nut shell and fruits than cereal remains. This is the case at Deeping St Nicholas, Lincolnshire, where more hazelnuts and sloes were found than barley, with remains at low concentration up to only 1.08 items/litre of soil (Murphy 1994a), at Briar Hill, Northamptonshire, where a little emmer was found with nut shell and sloe (Perry 1985), and at Willow Farm, Castle Donington, Leicestershire where a pit contained a cache of crab apples dated to 2200–1800 cal. BC (Wk-10074) with nut shell and few cereal grains (Coward and Ripper 1998; 1999). This type of assemblage has lead to the suggestion that there was more reliance on gathered than cultivated food. However, it has been pointed out (Moffett *et al.* 1989) that use of cereals, as well as the collection of wild food plants, were usual aspects of the Neolithic economy.

Reconsideration of the data by Robinson (2000) agreed with this conclusion and added that, although the proportions of wild and cultivated foods is uncertain, nut shell and fruits were more often part of the diet in Neolithic times than in later periods. The remains in pits may be related to their use for the storage of nuts which were consumed nearby, or inclusion of nut shell in pits might have been a common ceremony at the time (*ibid.*). Late Neolithic pits containing nut shell fragments have been found in Leicestershire at Braunstone and Syston (Albone 2000; Meek 1998). A burnt mound of Late Neolithic date at Birstall produced samples with charcoal mainly of alder and hazel; a small amount of hazelnut shell and sloe fruit stones were present although no cereals were found. There was some pollen evidence to suggest that this was in a riverside clearing with undisturbed wildwood in the vicinity. Butchered bones of aurochs recovered from a nearby palaeochannel were found to be of the same date range (Ripper 2004).

Another group of charred plant remains from Potlock Cursus, Derbyshire, contains few wheat and barley grains with numerous seeds of blackberry, some of which were immature, some sloe, elder and haws, with plants of grassy and disturbed land. Open grassy vegetation and nearby scrub or woodland margin was indicated. The remains were thought to represent food waste together with burnt vegetation possibly cleared from the ditches (Monckton and Moffett 1996). However, their interpretation as originating from a hedge or boundary may not be out of the question in the context of the monument (R. Loveday pers. comm.). Another unusual deposit consisting of numerous emmer grains with some chaff and few hazelnut shell fragments was found in the cursus at Aston on Trent and dated to *c*. 3500 BC (Alvey 1964; Loveday 2000). At Oakham, Rutland, small numbers of grains of wheat and barley were found to be more common than the few hazelnut shell fragments in the pits of the circle (Monckton 1998a). At Skendleby, Lincolnshire, the charred plant remains from Giants' Hills long barrow 1 included wheat grains and hazelnut shell (May 1976). More sampling of dated deposits is needed to investigate if there is a pattern of plant remains from monuments or other sites in the area, and whether there is a change over time. When deposits of this period are located a range of large samples (50 litres) is recommended.

Few settlements have been found in the region. Lismore Fields, Buxton, is thought to be an unusual survival of remains from a building where grain was stored, preserved because the building burnt down. Clearly recovering information from such unusual finds should be a priority; investigation of less obviously productive settlement sites is also, however, important if results are to be meaningful and representative. In the Thames floodplain in Oxfordshire, excavations at the large-scale settlement at Yarnton yielded remains similar to those reported by Moffett *et al.* (1989). A total of 201 cereal grains to 2728 nut shell fragments was found from over 7 tonnes of samples, which does not necessarily demonstrate a fully arable economy (Robinson 2000). The Trent valley has the potential for this type of investigation and initial results from the Neolithic site at Willington, Derbyshire, have shown only a trace of cereal remains but with more nut shell present, processing of more samples is required to investigate this (Beamish 2001a). Large samples are necessary but the importance of context has been emphasised, particularly middens and occupation deposits, where even if remains are at a low concentration they may be more revealing about the economy (Robinson 2000).

Early–Middle Bronze Age

The change in the character of the woodland during the Neolithic and Bronze Age is seen at sites such as Croft, Leicestershire, where the post-elm decline woodland of lime, oak and hazel dominated by alder, shows a drop in the proportion of lime in a profile dated from 1890–1500 BC containing traces of cereal pollen (Smith *et al.* 2005). Cereal pollen is present from the Early Bronze Age in diagrams from the East Moor, Derbyshire, and pre-barrow land use evidence of arable and pastoral is noted (Chapter 3). Recent work on a palaeochannel at Staythorpe, Nottinghamshire, has shown that the Trent valley was largely cleared by the

Early Bronze Age although some areas of woodland probably remained (ARCUS 2001; Davies 2001). Some half dozen palaeochannels provide snapshots of local land use, evidence of pasture with some cultivation and clearance of woodland. More evidence of the distribution of woodland and dates of clearance are needed to establish the picture for the whole region

More animal bone has been recovered from this period but little from settlements. At Billingborough Lincolnshire, dated *c.* 1700–1600 BC, there was evidence of cereal production and the presence of sheep/goats (Lane 1995), while bones of sheep, pig and cattle including an ox femur with a flint tool, possibly a marrow extractor, embedded in it were found at Stanton-on-the-Wolds, Nottinghamshire (Bird and Bird 1972; Chapter 3). Small groups of animal bones have been recovered from several palaeochannels and barrow sites. The complete recovery of good groups of animal bone is a future priority.

At Lockington, Leicestershire, emmer grains and chaff were recovered from a pit dated to 1875–1645 cal. BC while spelt wheat chaff was identified from a second pit, dated by charcoal from the pit to 1425–1260 cal. BC (Monckton 2000). The latter is an early date for spelt, and compares with the earliest date of 1671–1420 cal. BC quoted for spelt in eastern England, from Godmanchester, Cambridgeshire (Murphy 1998). However recent work at Langford, Nottinghamshire, has produced evidence of charred spelt and barley from possibly Late Neolithic/Early Bronze Age contexts which are yet to be dated (Snelling and Rackham 2001). At present spelt is absent from Bronze Age contexts in Lincolnshire (Murphy 1998).

Charred plant remains have been recovered from various barrows and cremation cemeteries. At the Early Bronze Age barrow at Deeping St Nicholas, Lincolnshire, grassland plants with roots and tubers were found, hazelnut shell and fruits including sloe and elder, with sparse cereal grains and chaff of emmer wheat (Murphy 1994a). This was thought to represent a mixture of plant material accidentally charred beneath the pyre, kindling material and perhaps intentional food offerings (Murphy 1998). Very similar remains were found at Eye Kettleby near Melton Mowbray, Leicestershire, from a Bronze Age cremation cemetery (Monckton forthcoming a). Round barrows have been sampled in Leicestershire and Rutland at Eaton, Oakham (Paradine 1981; 1998), Tixover and Cossington, and Lockington (Moffett and Monckton 2000) and have produced only very sparse charred seeds or cereal remains. Micromorphological analysis of a buried soil below the latter barrow found no indication that the soil had been cultivated, but evidence for grazing was found from calcite spherules as produced in the gut of grazing animals (Limbrey 2000).

In the Trent valley evidence is accumulating for the use of land as pasture although cereals have been found on some sites and more investigation is necessary. For example, a palaeochannel associated with a burnt mound at Willow Farm, Castle Donington, Leicestershire, was dated to 1390–910 cal. BC (Beta 119651; Coward and Ripper 1998; 1999; Smith *et al.* 2000), and insect remains have shown the use of the surrounding land as pasture, although some woodland was still present and cereal pollen may indicate cultivation on drier ground. No insects of domestic rubbish or occupation were found, suggesting short term use of the burnt mound. A few charred remains of emmer and barley with hazelnut shell fragments were found in samples from the burnt mound, although at a very low density (Smith *et al*. 2000). This together with a few animal bones from the palaeochannel suggested food consumption at the site.

More evidence is needed at the landscape scale on the balance between pasture, cultivated land and woodland in different parts of the region to investigate changes throughout the period. The large-scale pastoral economy of the fens in the Bronze Age has been elucidated by Pryor (1998a), who has proposed differences from the pastoral use of the Trent. This requires further investigation as well as comparison with developments in the rest of the region. Evidence may be forthcoming from future projects on the Trent, Nene, Welland and Witham, but is also required for the areas away from the main river valleys.

Potential research topics

Environment and land use

- Dated pollen evidence is urgently needed.
- Clearings – duration, size and use – should be investigated by detailed pollen analysis.
- Does the date of woodland clearance vary across the region?

Prehistoric farming: arable and pastoral

- Beginnings of cereal cultivation, dates of first cereal pollen – does this vary within the region or nationally?
- Spread of crops, dated charred crop remains, regional variation or comparison with other regions.
- Investigation of type of cultivation through information from weeds of crops.
- Importance of cereals in relation to gathered food: any change over time, differences in region or site types?
- Stable isotope analysis of human bone can be used to investigate the balance of meat and plant foods in the diet.
- Evidence for exploitation of domestic animals.
- Evidence for pasture.

Early Neolithic priorities

- Pollen evidence for clearings, cereal cultivation and land use needed from well-dated deposits.
- Analysis of insect remains needed from dated deposits to investigate the importance of grazing.

- Analysis of buried soils a priority.
- Recovery of animal bones a priority.
- Recovery of Neolithic cereals and weeds should be maximised by using large samples; crop remains to be studied in relation to research on weeds and cultivation methods.
- Recovery of dated charred plant remains of this period is a priority to answer questions about the spread of cereal crops and the use of gathered resources. A range of large samples is recommended (50 litres) to maximise recovery; more radiocarbon dates are required.
- Sampling of any settlements is a priority.

Bronze Age priorities

- Dated evidence of new crops needed over the region; in particular further investigation of regional variation in the date of introduction of spelt wheat.
- Analysis of any samples of charred plant remains needed as a baseline to compare with later samples in the study of arable expansion (see Late Bronze Age/Iron Age section).
- Recovery of evidence of hedges for control of animals.
- Evidence of volcanic events (Baillie 1995).
- Evidence for land use from the study of a range of remains is necessary: insects and plant macrofossils as well as pollen should be analysed.

Gaps in the evidence

- Evidence from settlements.
- Good groups of plant remains.
- Animal bone assemblages.
- Synthesis of dated landscape and land use information.
- Unpublished work a problem.

Late Bronze Age and Iron Age

To date over 40 Iron Age sites have been sampled and produced charred plant remains but only four of Late Bronze Age–Early Iron Age date. From Northamptonshire three extensive sites have been sampled: Covert Farm, Crick, Grange Park, Courteenhall and Stanwick. Charred remains have been recovered from a few others including Briar Hill, Twywell, Wilby Way, Wellingborough and Culworth. In Nottinghamshire, Gamston and Dunston's Clump (Jones 1987) have produced some good samples of charred plant remains, while Aslockton has fewer but more evidence of stock management. Recent excavations in the Trent valley by Trent and Peak Archaeological Unit at Hoveringham and Rampton Quarries, Nottinghamshire and Swarkestone, Derbyshire, have both revealed Iron Age and Roman occupation, but as yet Derbyshire has little evidence from charred plant remains (unless Carsington is Late Iron Age), although there is good evidence for arable activity from waterlogged remains from field boundaries at Gardom's Edge and the East Moors.

In Leicestershire, the 'agglomerated' settlement at Humberstone (Pelling 2000) and the farmstead at Wanlip (Monckton 1998c) produced good samples Other farmsteads and small occupation sites have been routinely sampled to provide comparable data, but most have low concentrations of remains. In Lincolnshire the large settlement of Dragonby and some of the fenland sites such as Deeping St James have produced charred and waterlogged remains, the latter from Bronze Age to Iron Age date. Evidence of the pastoral use of a field system has been found at Market Deeping in waterlogged field ditches. Sites at Fiskerton and Tattershall Thorpe have produced waterlogged evidence of Iron Age activity and environment. Recent excavations at Welland Bank, Lincolnshire, have employed a range of analytical methods to investigate enclosures, droveways and settlements and found evidence of a mainly pastoral economy.

Animal bone is rarely preserved on the sand and gravels of the region, but sites with good assemblages include Dragonby, Lincolnshire; Crick, Northamptonshire; and three Leicestershire sites: Humberstone, Enderby site I and Tixover, the last two also with molluscan evidence. Market Deeping and Cowbit, Lincolnshire, have produced animal bone assemblages which have been analysed. Significant evidence for landscape change and land use has been obtained by sampling palaeochannels exposed and destroyed during quarrying operations. They are an important resource and for this period they are mainly of Late Bronze Age date.

Late Bronze Age

Evidence for pastoral farming has been found from field systems, enclosures and droveways in Lincolnshire at West Deeping, Billingborough and Welland Bank which began in the Middle Bronze Age and were in use into the Early Iron Age (Pryor 1998a). These are interpreted as having been used for stock control from their form and from other evidence: soil analysis of an enclosure at Welland Bank suggested it was used as a stockyard (*ibid.*). Deeping St James and West Deeping have produced evidence of grassy vegetation and, at the latter, of hedges, probably for stock management (Murphy 1998; Hunn and Rackham forthcoming). Charred cereals are sparse at these sites to date. An enclosure at Welland Bank, contemporary with the stockyard enclosure, was filled with a layer of dark earth which contained a spread of charcoal, domestic rubbish and evidence of manuring and some cultivation, found from soil analysis; cultivation of cereals on the horticultural scale was suggested (Pryor 1998a). The main activity was stock rearing of cattle, and some sheep, for which the extensive enclosures and droveways were constructed (*ibid.*).

At Leash Fen, near Gardom's Edge, Derbyshire, there

is evidence of mixed arable and pastoral farming separated by areas of woodland, which begins in the second millennium BC and continues into the first millennium BC (see Chapter 5). Settlements in Lincolnshire appear to have lacked spelt; samples from Hagnaby Lock contained only emmer and nut shell while at Deeping St James waterlogged remains of plants of weedy grassland were found, with a few charred cereals including emmer, free threshing wheat and barley, flax, and with more abundant nut shell. Emphasis on pastoral farming was suggested, in contrast to the cultivation of spelt on drier sites in eastern England noted by Murphy (1997; 1998). As noted above, the earliest spelt from this region comes from Lockington, Leicestershire, revealing the early presence of this cereal in the Trent valley, but spelt is not found on many Late Bronze Age/Early Iron Age sites, Covert Farm, Crick, Northamptonshire, being one of the few examples (Monckton forthcoming b). Cereal pollen is found in some palaeochannels including those of the Trent, although cultivation was probably at some distance from these wet sites.

River valleys

Pollen, plant macrofossils and insect remains from waterlogged deposits in palaeochannels have been studied in the Trent valley and other rivers. In the former, sites of Late Bronze Age–Early Iron Age date, such as Girton, Nottinghamshire, have yielded evidence of local reedswamp with grassland in the floodplain, the presence of dung beetles showing the use of the grassland as pasture (Greenwood and Smith forthcoming; Greig 1994). Little evidence for local woodland is found at most of these sites and the landscape is thought to have been substantially cleared in this period. However, evidence for fen woodland is found at some sites such as at Repton, Derbyshire, in deposits after 2610 BP (Greenwood and Smith forthcoming) showing that local variation occurs.

Investigations in the Soar and Nene valleys also indicate clearance at this time together with alluviation of Iron Age to Roman date, following destabilisation of topsoils by cultivation (Brown 1992; Brown *et al.* 1994). This may be the case in the Trent valley where Iron Age boats were found in a silted channel at Holme Pierrepont and buried enclosures possibly of Iron Age date have also been found (Knight and Howard 1994, 16). The Iron Age causeway at Fiskerton, Lincolnshire, in the Witham valley, has also yielded evidence of wetland vegetation (Greig 1982b; 2003). In 2001, a log boat of Iron Age date was found there, along with another probably of Roman date (Pitts 2001); environmental investigations are part of an ongoing project.

Site environments

Headwater deposits at Croft (Fig. 69) and Kirby Muxloe in west Leicestershire show that by the Bronze Age the character of the woodland had changed from the mixed lime woodland of the Neolithic to less species-rich alder woods (Smith *et al.* 2005). At Kirby Muxloe, near the Bronze Age to Roman site (Cooper 1994), clearance begins around 1000–700 BC with a dramatic fall in oak pollen followed by deforestation of the valley bottom after 500 BC. Cultivation of cereals at some distance from the site is suggested by pollen and local use of grassland as pasture by the insect fauna (Brown *et al.* forthcoming). Evidence of hedgerows has been found in field ditches at Market Deeping, Lincolnshire (Hunn and Rackham forthcoming), while evidence from a palaeochannel indicates that it was freshwater with occasional marine influxes, in contrast to the saltmarsh vegetation found at Cowbit (Murphy 1998; 2001c). At Tattershall Thorpe, Lincolnshire, insect remains and pollen from the waterlogged enclosure ditch provided good evidence for food storage on site, and for a local environment dominated by grassland used as pasture (Chowne *et al*. 1986). More of this type of evidence from waterlogged deposits close to sites is needed to provide details of environment, land use and cereal cultivation.

Woodland resources

Exploitation of wood resources for timber and fuel is suggested by on-site finds of charcoal of oak, ash, hazel, alder, willow, and field maple. Scrub or hedge species such as hawthorn and blackthorn also occur (e.g. Morgan 1998). Together with work on waterlogged wood, this can provide information on woodland exploitation and management (Murphy 2001a). More data about the extent of surviving woodland in the Late Bronze Age and Iron Age landscape are needed.

Iron Age expansion of agriculture

An increased number of settlements indicates a growth in settled population dependent on farming. Evidence for agricultural expansion comes from field systems in

Fig. 69: ***Samples being taken from palaeochannel deposits at Croft, Leicestershire***

Nottinghamshire and in Derbyshire where investigations are dating the boundaries and producing evidence of cultivation (Long *et al.* 1998). De Moulins and Murphy (2001) note that there is little evidence from cereal remains to suggest intensification of agriculture in the Iron Age because of the lack of Late Bronze Age evidence for comparison in this region. However, recent work at Crick, Northamptonshire, has shown an increase in maximum density of charred cereal remains per litre of soil from 1.3 items/litre in the Late Bronze Age/Early Iron Age to 16 items/litre in the Middle Iron Age, and 171 items/litre in the Late Iron Age (Monckton forthcoming b). This agrees with evidence from waterlogged deposits from Wollaston, Northamptonshire, which shows Bronze Age woodland clearance followed by mixed agriculture in the Middle to Late Iron Age (Meadows 1995). More evidence from dated cereal pollen is needed to establish this trend.

Spelt cultivation is thought to be part of the strategy of agricultural expansion (van der Veen and O'Connor 1998). Present on a few Bronze Age sites, spelt becomes common in the Middle Iron Age, as at Crick, Wanlip and Humberstone (Monckton 1998b; 1998c; forthcoming b; Pelling 2000). A group of arable weeds characteristic of extensification (i.e. cultivation of larger areas) rather than intensive garden-type cultivation has been described for the north of England by van der Veen (1992). A similar group of weeds occurs with the cereals at Crick, but more detailed analysis is needed to study crop husbandry for this region. A future priority is to look for regional diversity in the expansion of agriculture, and in the relative importance of animals and crops, for example, to see if there differences on different soils.

Food, plant and animal products

From the Middle Iron Age onwards the main wheat crop appears to be spelt which occurs with a little emmer and very occasional grains of bread wheat type. Hulled barley, including six-row barley, is also found on most sites as another main crop. Rye has only so far been found at Dunston's Clump, Nottinghamshire (Jones 1987). Edible legumes have been found at a number of sites, with horse bean identified at Dragonby (van der Veen 1996). Hazelnut shell, sloe, haws and elder are often found in small amounts, while Dragonby also yielded woad, flax/linseed and apple. Many plants have a variety of uses and it is rare to find evidence for use, but the presence of woad at Dragonby shows this plant was available in the Late Iron Age for dyeing cloth, or perhaps even for body decoration (*ibid.*). Other charred plant remains often include arable weed seeds, plants of grassy vegetation and damp ground plants. Most of these latter two types could be weeds of the cultivated fields but could also represent plant material used as fodder, bedding, roofing or for other purposes.

Meat was an important part of the diet although the acid soils of the region do not often favour bone preservation. Where evidence survives, butchery is attested by cut marks on some of the bones. At Humberstone, Leicestershire, most cut marks were found on the larger bones and appear to represent disjointing cuts on both sheep and cattle, most often on cattle humerus bones, showing the inhabitants were enjoying legs of beef (Charles 2000). At Enderby, Leicestershire, the most common bones of domestic animals were of the head region suggesting local slaughter; beef, mutton or lamb, and pork were consumed as well as possibly red deer, roe deer, wood pigeon and hare (Gouldwell 1992). Domestic fowl was also present suggesting the possibility of eggs as well as poultry. At Market Deeping, Lincolnshire, sheep were most numerous, but cattle provided the most meat because of their larger size; wild resources were used occasionally and included swan, geese, duck and beaver (Albarella 1997b). At Cowbit Wash, Lincolnshire, neonatal cattle, sheep and pigs were all found showing that the animals were bred on the site. As calves were the most numerous the possibility of milk production was considered although this could represent seasonal mortality (Albarella 2001a).

Other animal products except antler and horn are rarely found; the famous hides, woollen cloaks and hunting dogs described in the classical literature show they were used and traded. In the absence of other evidence, production of leather and wool can be inferred from the quantity and age of the domestic animals represented by their bones.

Crop processing and storage

Crop processing waste interpreted as fine sievings (i.e. chaff and small seeds) cleaned from the grain after dehusking have been found at, for example, Gamston, Nottinghamshire (Moffett 1992), Humberstone, Leicestershire (Pelling 2000) and Crick, Northamptonshire (Monckton forthcoming b). Remains of waste from hand sorting grain (i.e. large weed seeds which remain with the grain after fine sieving) have also been found at Gamston, Wanlip, Leicestershire and other sites. At Dunston's Clump, Nottinghamshire, cleaned cereals and evidence of wheat in spikelet form (in the chaff) was found in pits, but is not thought to suggest pit storage since signs of *in situ* burning were lacking (Jones 1987). At Humberstone, Leicestershire, the presence of cleaned spelt grain in a post hole of a four-post structure of Middle Iron Age date has been interpreted as evidence of above-ground grain storage. It is possible that the grain was stored clean after dehusking, or that the grain was processed by parching near the granary after removal from storage as spikelets, some of the grain being charred in the process and accumulating in the postholes (Pelling 2000). Grain was also found in four-post structures of Late Iron Age date at Crick, Northamptonshire; in one case comprising cleaned barley grains in a post hole, in another a mixture of

barley and wheat, implying the use of the granary for different cereals (Monckton forthcoming b). Abundant grain has also been found in post holes of Late Iron Age four-posters at Stanwick, Northamptonshire (Campbell unpublished a).

Possible ritual activity

A large deposit of processed spelt grain was found in an isolated Late Iron Age pit at Rushey Mead, Leicester, which also contained a burial. No evidence of *in situ* burning was found and the charred grain appears to be part of the fill of the pit, possibly introduced with the burial (Monckton 2001). In a Late Iron Age ditch at Tixover, Rutland, the deposit with most cereal remains and bone from the site also contained the skeleton of a human infant (Beamish 1992; Monckton 1996a). At Wanlip, Leicestershire, an unusual assemblage of pottery and a saddle quern together with charred cereals remains was interpreted as a placed deposit (Beamish 1998). The recently discovered East Leicestershire hoard site (Priest *et al*. 2003) produced a mass of animal bone, mostly pig, but also including cattle and sheep, suggesting that ritual feasting took place on the site; many of the pig bones show butchery marks.

Animal husbandry

Midlands sites with good bone assemblages have been compared by Hammon (forthcoming). At Crick cattle are most abundant, followed by sheep and few pigs from the Middle to Late Iron Age (*ibid.*); cattle are also most abundant at Enderby I (Gouldwell 1992). It is suggested at Crick that this may be because cattle are more suited to lowland wetter environments because of their water requirements and the unsuitability of sheep to wet pasture (Hammon forthcoming; cf. Grant 1984). Cattle are considered important in agricultural expansion because of the need for traction and manure (van der Veen and O'Connor 1998). At the Late Iron Age farmsteads of Enderby I (Clay 1992) and Tixover (Beamish 1992) good assemblages of animal bone are dominated by cattle followed by sheep and pigs; domestic fowl bones were found at the former (Gouldwell 1992), while the small mammal fauna at Tixover indicated scrub or woodland in the vicinity (Baxter 1994). At both sites, snail fauna suggest the presence of grassland pasture. Humberstone, Leicestershire, differed in that sheep and cattle were about equal.

In Lincolnshire, sheep are the most abundant at Dragonby, Ancaster Quarry and Helpringham Fen (Chapter 5). This was also the case at Market Deeping, whereas at Cowbit Wash calves were the most numerous, the mortality of young animals at this site showing that they were bred on site and perhaps suggesting seasonal use of the site (Albarella 1997b; 2001a). Further investigation of the variations in animal husbandry in different parts of the region is needed.

A barley deposit at Dunston's Clump, Nottinghamshire, found in an enclosure thought to be an animal pen, has been interpreted as fodder. However, de Moulins cautions that barley can also be used as food for human consumption (de Moulins and Murphy 2001). In Leicestershire, the low-lying farmsteads at Enderby and Kirby Muxloe produced small numbers of cereal remains with very little chaff (Monckton 1995; 1998d). This may be because the chaff was used for fodder, as Pelling (2000) suggested for the settlement at Humberstone where more cereal grains were found. A mixed economy was suggested at these sites, although with more emphasis on pastoral farming (Clay 2002). Animal bone was not well preserved at Kirby Muxloe but evidence for pasture was found in a waterlogged palaeochannel (Brown *et al.* forthcoming). When such deposits of this period are encountered their study is a priority because this form of evidence is particularly valuable to the interpretation of the economy. Further studies are needed in order to consider plant and animal remains together and in the light of other archaeological evidence from sites, in order to understand how the people lived at the time.

Late Iron Age cereal cultivation

At Crick a higher density of plant remains was found in the Late Iron Age than earlier, suggesting that agricultural expansion continued with barley more abundant. Cereal remains are notably abundant from the extensive settlements of Northamptonshire, reaching a maximum density of 171 items/litre of soil at Covert Farm, Crick (see above); they are also abundant in numerous samples at Stanwick and Courteenhall (Campbell unpublished b; Ciaraldi 1999). In contrast, at Enderby I (Monckton 1992) and Kirby Muxloe (Cooper 1994) in Leicestershire, very low maximum densities of cereal remains with little chaff were recovered: 0.1 and 2.3 items/litre of soil respectively (Monckton 2004a). Poor survival was considered a possible explanation for the few cereals because the sites were truncated by ploughing. However, subsoil features survived well, the former site yielding a good assemblage of animal bone, the latter very abundant charcoal. In the light of subsequent investigations elsewhere, it can be suggested that the sites were more suitable to pastoral farming, and that the low number of cereal remains reflects this. However the level of survival of remains must be questioned on every site. While sites can be compared on the basis of the density of remains in the best sample from each site, quoted here as 'the maximum density of charred plant remains as the number of items per litre of soil' (cf. Murphy 1998), the quantity of samples and their composition must also be taken into account.

Recent investigations at Huncote, Desford and Ashby, Leicestershire have however shown higher maximum cereal densities in late Iron Age samples: 19,

187 and 32 items/litre of soil respectively (Ciaraldi 2001; Jarvis 2001; 2004a). This corresponds with the Northamptonshire picture. A grain-rich sample from Ashby contained about equal amounts of wheat and barley, the wheat including spelt grains and chaff with bread wheat type grains and some probable emmer with weed seeds (Ciaraldi 2001). Samples from the extensive settlement at Gamston, Nottinghamshire, included some with abundant chaff with a maximum density of 23 items/litre of soil (Moffett 1992). Carsington, Derbyshire, has a deposit of abundant cleaned barley grain, but this may be Roman. In Lincolnshire, Market Deeping had a fairly low maximum density of cereal remains of 9 items/litre of soil (Murphy 1998). Dragonby produced abundant charred and waterlogged plant remains, animal bones and other evidence illuminating food production and the varied diet of the inhabitants. Regional differences are emerging and warrant further investigation.

Despite the generally greater abundance of cereals, Pryor's observation that animal husbandry was the main activity in the lowlands during the Bronze Age, and cereal cultivation only became significant in the Iron Age still requires testing for the different parts of the region (Pryor 1998a). The plant data from the East Midlands suggests that the Iron Age saw the development and expansion of agriculture, although the timing of this in relation to different soil types requires investigation. The difference in economy on sites of different types, sizes and geologies is poorly understood so sampling is particularly important for sites of this period. Equally, radiocarbon dating is particularly problematic between 800–400 BC, so additional resources will be required to date the material.

There is a lack of evidence from large settlements outside Northamptonshire and, especially from hillforts, which would contribute to evidence about social organisation. Evidence from animal bone is particularly important to establish the type of animal husbandry from the proportions, ages and use of the species present. The information for land use, particularly for pasture, available from waterlogged deposits and other remains such as snails, phosphates and sediments should be analysed whenever encountered. Some variations in emphasis on arable and pastoral farming in different parts of the region are becoming apparent as more data is collected, but only by sampling more, well-dated sites will we begin to understand if the differences result from settlement type, size, date or geology. Integration of the evidence and the use of information from experimental archaeology to reconstruct life in the past should be extended in this period, as it has the potential to increase understanding and communicate results to the public.

Potential research topics

- Are there differences in dates of woodland clearance and what woodland remained?
- Landscape/land use: More information from dated palaeochannels and waterlogged deposits providing evidence of the general and more local environment is required. These deposits provide a snapshot at the sampling site which can build into a general picture. Single widely spaced sample sites are usually taken from palaeochannels; more complete information could be obtained with more sample sites. Dating more samples can give better resolution. Seeds of land plants should be selected for AMS dating.
- Information from river valleys needs co-ordination, more publishing and synthesis.
- Dating alluviation and mapping and dating river channels (cf. Trent valley project).
- Dating sites of this period is problematic in the Iron Age because they fall in a flat area of the radiocarbon calibration curve. Multiple samples with known stratigraphic relationships should be assayed and the results calibrated by statistical analysis (see Bayliss 1998). Other methods should be considered.
- Important to look for regional diversity in expansion of agriculture and in the relative importance of animals and crops. Are there differences on different soils? (M. van der Veen pers. comm.)
- The region includes the fens of Lincolnshire and the floodplain of the Trent, heavy clays and upland geologies to compare. Some differences are appearing already and there is great potential for further work particularly on charred cereal remains and arable weeds in relation to other evidence from sites.
- Study of the development of farming in different parts of the region.

Iron Age and Roman transition

- First evidence of introduction and/or production of new crops (spelt wheat, bread wheat, rye, oats, pulses) and the herbs and fruits which come with the Romans.
- Evidence for high status (slaughter of young pigs or other animals, hunting, fruits, exotics) or impoverishment of sites could provide important data on the Iron Age/Roman transition.

Gaps in the evidence

- Recovery of animal bone assemblages is a priority.
- Pollen and waterlogged remains of this date associated with sites are a priority.
- Large settlement sites outside Northamptonshire to be sampled for comparison.
- Analysis of remains and dating from boundary ditches of field systems needed.
- Evidence from hillforts lacking because of old excavations; any opportunities to sample or analyse old samples from archive would be useful.

Roman

The Regional Review of plant remains covers three settlement sites and two salterns in Lincolnshire, together with information from Lincoln, and the Leicester urban sites of the Shires, Causeway Lane and Bonners Lane (de Moulins and Murphy 2001). Dunston's Clump is the only site mentioned for Nottinghamshire, and no sites from Derbyshire or Northamptonshire are included. This survey draws on additional unpublished information from assessments of Stanwick villa, Courteenhall and Croughton in Northamptonshire, a few Leicestershire farmstead sites, and some corn driers and more urban data from Leicester, together with some data from Carsington in Derbyshire. Excavation of saltern sites in Lincolnshire has recovered a range of remains. A site at Chesterfield, Derbyshire, was sampled during excavation by Manchester University, as were Roman sites excavated recently by the Trent and Peak Archaeology Unit at Captains Pingle, Swarkestone, Derbyshire, and at Hoveringham Quarry and Rampton Quarry in Nottinghamshire. Animal bone has been recovered from many excavations but large assemblages have been studied only from Leicester and Lincoln (see below; Fig. 70).

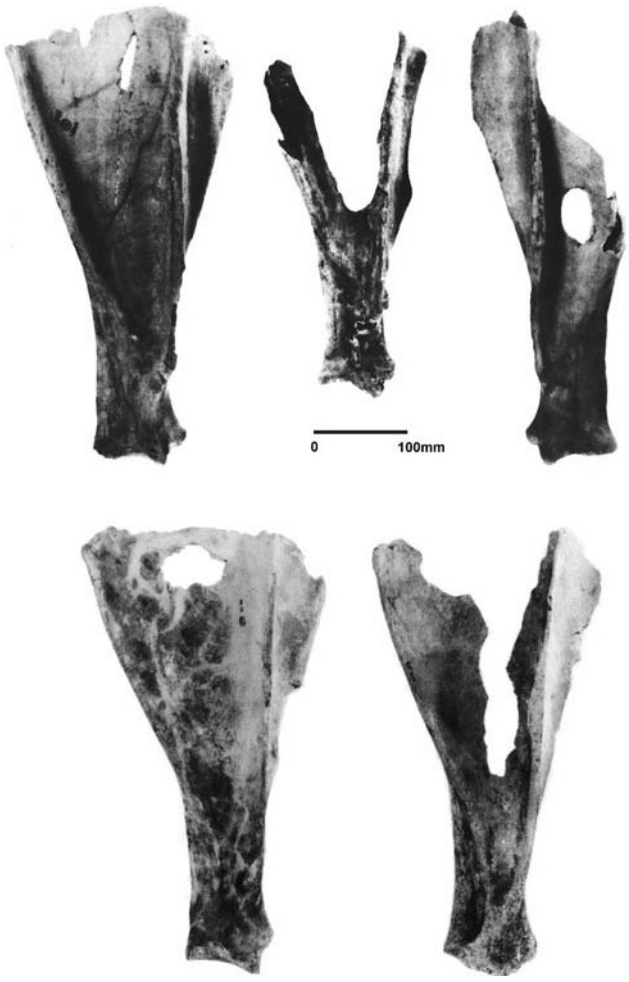

Fig. 70: ***Cattle scapulae from Lincoln***

Environment and land use

Evidence for an open environment in Roman times was found in waterlogged deposits at Croft, Leicestershire from the top of a deposit of Iron Age to Roman date (Smith *et al.* 2005). A nearby arable and pastoral landscape was indicated by the insect remains from a Roman well at Empingham, Rutland (Buckland 1986; Cooper 2000a) and by pollen from a mire deposit at Stamford Road, Oakham, which also had evidence of cereal cultivation (Greig *et al.* forthcoming). Pollen evidence for a cultivated landscape with hay meadow in a cleared environment following Iron Age woodland has been found at Birstall, Leicestershire (Greig 2004). A well at Piddington has insect remains indicating an open dry environment with some cultivation of brassicas and pulses and land used as pasture (Simpson 2001). At Carsington, Derbyshire a series of waterlogged samples have potential to provide evidence of the environment (D. Smith pers. comm.). There is an absence of long pollen profiles which extend into this period or of palaeochannels from the Trent valley at present, so it is necessary that sampling of these deposits continues in order to provide a picture of local variation in the environment. The exploitation of wooded areas is shown from charcoal analyses from many sites particularly those associated with metalworking. Lincolnshire has produced good evidence from sites with waterlogged remains: open grassland has been found at Dragonby, Hibaldstow, West Deeping and Denton Villa with additional evidence for salt tolerant vegetation from the saltern site at Morton Fen (Murphy 1998).

Sites with Late Iron Age and Roman evidence

It is only by comparing remains across periods that changes in agricultural practice can be identified. A few extensive sites have evidence for both periods. Dragonby, Lincolnshire has productive Iron Age but richer Roman samples, with more varied remains from when the site developed into a Roman small town. In Northamptonshire, Stanwick also has abundant remains of both Iron Age and Roman date from dry and waterlogged samples. Assessment showed great potential to produce evidence of both Iron Age and Roman agriculture but more limited potential for the transition period (Campbell unpublished a). The site at Grange Park, Courteenhall, also produced rich Iron Age and Roman samples including some from the transition period, which have the richest plant assemblages from the site. These may reveal changes in the site economy if the potential identified in the assessment is realised (Ciaraldi 1999). Samples of Roman date from Covert Farm, Crick, produced a low density of remains indicating only small-scale domestic activity (Monckton forthcoming b), perhaps because the focus of the Roman settlement was elsewhere. At Market Deeping, Lincolnshire, samples from Roman deposits contained

far more cereal remains than those from earlier periods (Murphy forthcoming b). Dunston's Clump, Nottinghamshire, produced both Iron Age and Roman material including evidence for animal enclosures and fodder in the later phases of the site (Jones 1987). At Dragonby and Stanwick evidence for the availability of more varied foods may suggest an increase in status. Increased cereal production may be reflected in the more abundant remains from some sites.

The site of a stone building and surrounding features at Carsington, Derbyshire, produced a deposit of cleaned barley consisting of prime grain product. The barley was of a hulled form and included the six-row variety. A sample of the grain was radiocarbon dated to cal. BC 92 to 236 cal. AD (Beta-68680), too wide a range to be helpful; however quite abundant late Roman plant remains were also found on the site. Leicestershire farmsteads (Monckton 2004a) include the small rural sites of Normanton le Heath site 1 and Gimbro Farm, which have a low density of remains in both periods (Monckton 1994; Jarvis 1999). Desford has a grain-rich sample of Late Iron Age date and a few remains in Roman samples (Jarvis 2001). Similarly the site at Ashby also produced a grain-rich Late Iron Age sample and a moderate amount of plant remains in Roman samples (Ciaraldi 2001). Some sites producing low densities of cereal remains continue to do so into the Roman period perhaps because they rely more on pastoral farming in both periods. Sites which produce less evidence in the Roman period may have undergone a change of use or be failing. Examination of plant remains from sites which continue, fail or are new settlements contributes to the picture of the developing economy; however a range of sites must be sampled to see the pattern of resources exploited.

Countryside

Agriculture

The main cereal cultivated during the period was wheat, mainly spelt with occasional emmer and bread wheat type grains; hulled barley, including six-row barley was a second important cereal. Wild or cultivated oat is found, possibly as a weed of the crops, and rye occurs occasionally as, for example, at Dunston's Clump, Nottinghamshire. The Roman period is characterised by finds of abundant burnt wheat chaff, as waste or spent fuel from cereal processing, dumped in features on many sites. The lack of cereals in primary contexts, such as from corn driers, in Lincolnshire has been noted by Murphy (1998), although the settlement at Market Deeping produced abundant cereal remains, identified as crop processing waste, in pits and ditches. Here, a maximum density of 178 items/litre of soil was found – compared to only 9 items/litre in Iron Age contexts – showing the much larger scale of cereal waste disposal in the Roman period (*ibid.*).

At Carsington, Derbyshire, samples from an extensive third- to fourth-century deposit contemporary with the building were dominated by chaff, mainly of spelt wheat, with a maximum density of 402 items/litre of soil. This was thought to indicate the dehusking of wheat on the site, possibly for consumption there (Monckton 1997). Other sites with similar remains include Dunston's Clump, Nottinghamshire, which has evidence of cereal processing from chaff dominated samples (Jones 1987); the later Roman site at Potterspury, Northamptonshire, which produced chaff dominated samples from ditches from a pipeline investigation which, by its nature, only traversed part of the site (Meek 1996–7); and Scalford Brook near Melton, Leicestershire, which yielded a chaff-rich deposit from a gully (Beamish 1991; Monckton 2004a).

Stinking mayweed is considered to be an indicator of more intense cultivation of clay soils and makes its first appearance in the Roman period, both in Lincolnshire in the West Deeping area (Murphy 1998), and in Leicestershire at Causeway Lane and Crown Hills, Leicester, and Ashby (Monckton 1999a; Jarvis 2000a; Ciaraldi 2001). This may be evidence for the extensification of agriculture on the claylands using better ploughing equipment in the Roman period. It has been suggested that larger breeds of cattle would be needed for ploughing clay soils so correlation of data with animal bones is needed (van der Veen and O'Connor 1998). A number of sites, such as Carsington, Derbyshire, have produced good assemblages of weeds with the cereal remains, which may be compared with other sites in the future to investigate cereal production. Weeds typical of extensive cultivation have been studied for the north of England by van der Veen (1992) and more detailed analysis of the weed assemblages would be required to study aspects of cereal production in this region.

Corn driers and malting kilns

Evidence from corn driers shows the increase in agricultural production and bulk processing of cereals. Corn driers are the most characteristic Roman agricultural feature, which, when found with cereal remains *in situ*, can provide evidence for the variety of parching and drying processes for which they were used (van der Veen 1989). However, the evidence for such processes as malting is not always clear cut. Abundant remains from a number of corn driers at Stanwick villa have the potential to elucidate the function of different types of structures and to provide evidence about the villa economy (Campbell unpublished a). At Courteenhall corn driers with evidence of malting have been found (M. Ciaraldi pers. comm.).

Other corn driers with cereal remains have been found at Empingham (Alvey and Monckton 2000) and Ridlington in Rutland (Monckton 2002); and at Appleby Magna (Jarvis 2000b), Ketton (Meadows and Holmes 2001) and Hamilton, Leicestershire (Jarvis 2004b). At Empingham, the use of chaff as fuel and the presence of mostly germinated spelt grain was thought to suggest

malting. Analysis of cereal remains from five corn driers at Ridlington showed their use for a variety of different functions, including processing spelt for dehusking; parching malted spelt; drying spelt for possible storage; and processing barley for drying or dehusking (Monckton 2002). These were all thought to be activities carried out on the site. At Appleby Magna samples were interpreted as parching of spikelets of spelt probably for dehusking. Corn driers at sites near Leicester include Norfolk Street villa which has evidence for spelt chaff used as fuel in a corn drier probably dehusking waste used for the processing of more cereals (Jones 1982; van der Veen 1989). At another possible villa site at Crown Hills, similar remains were found of chaff-rich samples with more seeds present including stinking mayweed (Jarvis 2000a). Charred cereals have been reported from corn driers at Wood Burcote villa near the small town of Towcester (Turland 1977), but it is unclear whether analysis was undertaken. Hence evidence for Roman agricultural production is accumulating, although corn driers with cereal evidence have yet to be found in Derbyshire, Nottinghamshire or Lincolnshire.

Pastoral farming

A great deal of evidence from animal bone assemblages found in towns demonstrates the supply of meat and animal products to these settlements (see below); however, there are fewer rural bone assemblages for comparison, although Stanwick is one exception (Campbell forthcoming). Remains of fodder show the resources used to feed animals, and evidence for pasture from this and previous periods has been obtained from waterlogged deposits. At Dunston's Clump, Nottinghamshire, barley interpreted as fodder was found in later phases of an enclosure ditch (Jones 1987). Recent work at Ashby has recovered a sample containing rye with cultivated or wild oat and barley, which was thought to represent fodder, although the date is still to be confirmed (M. Ciaraldi pers. comm.). Evidence for hay was found from a charred sample containing abundant seeds of grasses and tall grassland plants at Causeway Lane, Leicester (Monckton 1996b; 1999a), while waterlogged remains from wells at Stanwick contained evidence of hay as part of the agricultural economy (Campbell forthcoming).

Field systems

Field systems can provide important evidence for agricultural expansion and pastoral farming. Waterlogged deposits from a field system at West Deeping produced pollen indicating grassland and damp ground (Murphy 1998; Hunn and Rackham forthcoming). Dunston's Clump, Nottinghamshire, is set in an extensive field system of brickwork plan which warrants further investigation. If waterlogged, field ditches have considerable potential to provide dating evidence from organic remains, together with pollen which may provide evidence for the use of the fields for cultivation or pasture. Investigation of field ditches is a priority in order to obtain dated evidence of land use (*ibid*.).

Viticulture

Other unusual evidence comes from Wollaston, Northamptonshire, where trenches were discovered associated with grape vine pollen, providing evidence for vineyards (Brown and Meadows 2000; Meadows 1996).

Salterns

Excavations on saltern sites in Lincolnshire have produced charred plant remains as well as waterlogged material. Samples from Morton Fen differed from all other Roman sites investigated so far in eastern England, having barley as the most abundant cereal rather than spelt. Grains and chaff of six-row hulled barley were found with some wheat including bread wheat type, spelt and emmer. Salt tolerant plants were also found, and the predominance of barley was thought to be because it is the most salt tolerant of the cereals. This site provides the only example at present of expansion of Roman agriculture onto saline soils (Murphy 1998; 2001c). The animal bones suggested that cattle were reared on the site; horse and cat bones were also found (Albarella 2001a).

Plant and animal products

Plants and animals were a source of other important products apart from food. Cereal waste chaff may have been used as fodder (van der Veen 1999) and was used as fuel for cereal processing and probably for other purposes. Chaff is more likely to have been used in places near to where cereals were produced and processed, although spelt can be transported in spikelet form and cleaned where it is required, but this is less efficient because of the bulk. Straw could be used for animal bedding and for thatch on lower status buildings. Plant remains should be examined for such uses. Animal products other than meat included dairy products and eggs. The former leave little evidence, except perhaps when pottery residues are analysed, the latter can be found as shell which can be identified from its microstructure (Boyer 1999a). Other animal products such as horn cores and antler off-cuts provide evidence of the working of these materials. Production of wool can be inferred from the age of the sheep at slaughter, but is rarely found as fibres or textiles. Leather is occasionally found in waterlogged deposits but must have been very important and in common use, when the quantity of animals slaughtered is considered.

Villas and small towns

Cereal processing

Corn driers found at a number of villa sites have provided evidence of crop processing as at Stanwick,

Northamptonshire and Empingham, Rutland (see above). The provision of cereals to Roman Leicester may be implied by the presence of corn driers with evidence for dehusking spelt at Norfolk Street villa and Crown Hills in the hinterland of the town (Jones 1982; van der Veen 1989). At Crown Hills the seeds included stinking mayweed (Jarvis 2000a); seeds of this plant were also found with cereals in Leicester at Causeway Lane. Together with the lack of abundant chaff in samples within the town, this suggests that processing was carried out elsewhere for supply to the town, possibly at surrounding villas (Monckton 1999a). No comparable evidence is available to date for the small towns and retrieval and analysis of plant remains from these sites is a priority.

Storage

An interesting deposit of cleaned spelt grain with holes and traces of insect attack was found at Croughton villa (de Rouffignac 1996). If spelt is stored in the chaff (as spikelets) it is protected from insect attack. The grain would only become infested in this way if cleaned before storage and stored above ground. Bulk storage of cleaned grain is only known from major Roman centres such as London and Colchester and some of the forts of northern England; this is the first find of its type from a rural site, with consequent implications for status and supply of produce. No large deposits of cleaned cereals are known from any of the Roman towns in the region, with the exception of a deposit of malt from Derby (see below).

Food

Apart from the range of cereals and hedgerow fruits and nuts commonly found on rural sites the settlement at Dragonby yielded remains of beans, coriander, summer savory, opium poppy and celery as indicators of Romano-British diet (van der Veen 1996). Waterlogged remains from wells at Stanwick villa produced evidence for a wide range of foods in the diet, including a variety of fruit remains (Campbell forthcoming). The villa at Denton has plant remains including beet (Connolly and Biek 1971), which has also been found in Leicester and Lincoln. Such remains compare with the variety of foods found in the towns of Lincoln and Leicester described below; they imply the higher status of these sites, or perhaps that they were the source of produce for the towns.

Small towns

Although small town sites have been excavated over the years, few have been sampled for environmental remains. In Lincolnshire, Dragonby produced a wide range of charred and waterlogged remains, while at Hibaldstow a few charred plant remains including bean have been identified (Greig 1979). In Northamptonshire recent work at Irchester recovered waterlogged samples with pollen evidence (A. Brown pers. comm.). Unfortunately test pitting at Medbourne, Leicestershire, to uncover the extent of the Roman small town, did not produce well-sealed dated deposits to sample (Pollard 1988). More evidence is needed from the small towns to investigate their status and economy further.

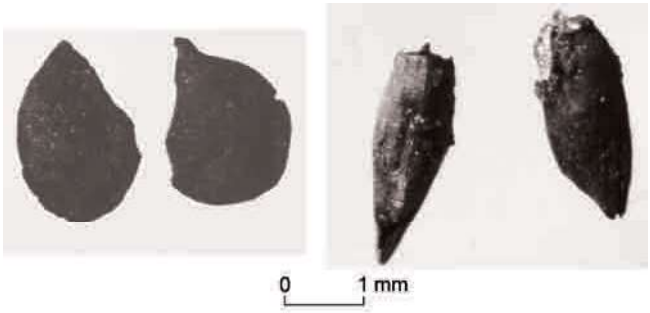

Fig. 71: ***Charred seeds from burnt hay from Roman Causeway Lane, Leicester. Left: Yellow-rattle. Right: Knapweed***

Roman towns

In Leicester major urban excavations have provided the opportunity for environmental sampling both inside and outside the town walls. Inside the town, samples from excavations in the north-east quarter at the Shires sites, Little Lane and St Peters Lane (Lucas and Buckley 1989; forthcoming) and at Causeway Lane (Connor and Buckley 1999) can be compared with sites from the southern suburb around Bonner's Lane (Finn 2004). There is abundant evidence for the foods consumed in the town (Fig. 71), including cereals, mainly spelt wheat and barley; vegetables such as legumes and leaf beet; and fruits such as sloe, wild plum and apple. Additionally, coriander, fig and lentil may represent introductions or imports; opium poppy, columbine and possible sweet violet may have been garden plants (Moffett 1993; Monckton 1999a).

Other food remains include a variety of freshwater fish, as well as herrings and eels (Nicholson 1992; 1999) and abundant oyster shells which, from their size, shape and infestations, appear to have been brought from the Essex coast. These were from a second-century cellar at Little Lane (Monckton 1993) and later deposits at Causeway Lane (Monckton 1999b). Roman cesspits at Causeway Lane were identified from the presence of mineralised seeds, gut parasites and fly puparia (Boyer 1999b; Skidmore 1999). Apart from the evidence for domestic occupation, a sample interpreted as the remains of charred hay possibly suggests the stabling of horses.

Outside the walls, at Newarke Street, a cesspit predating a Roman cemetery contained mineralised remains of legumes and other seeds, suggesting some external occupation and rubbish disposal (Cooper 1996). In the southern suburb, only a scatter of burnt cereal grains was found in Roman samples, too little to suggest much domestic or cereal related activity. In

addition, a kiln or oven was found at Bonner's Lane but the associated features contained no evidence to suggest use connected with cereals (Finn 2004).

Large animal bone assemblages from the Shires sites and Causeway Lane in Leicester (Gidney 1991–3; 1999) have shown the use of more sheep for meat in the early phases; the use of celtic shorthorn cattle of mature age, probably after having been used to produce milk; and the use of young pigs for meat. The bone provided evidence of butchery practices and also of horn working from the abundant horn cores on Causeway Lane. Domestic fowl were consumed, as were their eggs, and wild resources included wild duck, wild goose, red and roe deer and hare. Other large groups of animal bones include those from Great Holme Street where a deposit including cattle skulls was interpreted as primary butchery waste; raven bones were also present as an urban scavenger (A. Gouldwell pers. comm.). A Roman pit from the High Street cellars excavation produced the unusual find of a white tailed eagle, perhaps indicating that the environs of Roman Leicester may have provided a suitable habitat (Baxter 1993a; 1993b). Few rural bone assemblages are available to suggest the areas where the domestic animals were raised and their recovery is a priority.

Lincoln has good environmental evidence from waterlogged deposits including three urban sites which preserved seeds of dill, celery, hemp, chestnut, strawberry and rose as well as the plants mentioned above from Leicester (Moffett 1995a; 1995b; Greig 1989). However, because of the type of deposit, less evidence of charred cereals was preserved, although the same cereals were represented. Animal bone from a number of sites in Lincoln has been synthesised by Dobney *et al.* (1996). Food supply and status are discussed; an interesting deposit of sand-eel bones from the Waterfront area raised the possibility of local fish-sauce production or their use as bait for fishing. Information about water quality, flow rates and flood events was also obtained (*ibid.*; Steane *et al*. 2001).

The recent publication of the 1971–2 excavation of the extramural site at Little Chester, Derby, includes an analysis of the charred plant remains undertaken by R.C. Alvey in the 1970s (Alvey and Smith 2002). One of the largest assemblages of germinated spelt grains from Roman Britain was discovered, comprising some 12,500 grains with 87% germination; the deposit was interpreted as pure malt. Although the malt had been dumped and could have been produced elsewhere, it is likely that brewing was carried out on the site. Two other samples were identified as the remains of burnt thatch. Animal bones from the site (Harman and Weinstock 2002) were mainly domestic, with sheep most abundant in the early phases and cattle in the later phases, followed by sheep and pigs. The bones were mainly waste from slaughtering and butchery, and the absence of the better joints suggested that they were exported off the site. Bird bones included domestic fowl and probably domesticated goose and duck. Wild birds included woodcock, raven, blackbird and possibly starling. Part of a dog skeleton was found in a disused well. Soil samples from the ditch fills were compared with ones from the ramparts and natural substratum (Sparey-Green and Morgan 2002). They were found to be most similar to the cutting of the wall trench rather than the rampart. This work shows the value of re-examining and publishing sites and data in archive and should be commended.

The towns have great potential to provide detailed evidence from plant and animal remains of diet, living conditions, trade, and the introduction of new foodstuffs from abroad. Bulk sampling and analysis of materials is essential on any urban excavations both to augment evidence already obtained from well-studied areas but particularly to recover evidence from other towns in the region.

Potential research topics

- Evidence of arable farming methods from charred plant remains needed. There is an increase in disposal of spelt wheat chaff and introduction of corn driers, both of which indicate changes in cereal production and bulk processing. Analysis can provide evidence of function of corn driers which can have a number of purposes.
- Evidence of arable expansion is required from pollen-bearing deposits to add to the evidence of more abundant cereal remains from sites.
- The evidence for the use of fodder should be examined, e.g. hay from Causeway Lane, Leicester, and Stanwick, Northamptonshire.
- Analysis of weed floras and study of weed ecology may produce evidence of extensification of agriculture and may help to indicate the source of cereals.
- Investigate the timing of the increase in the variety of foods available, including imports and introduced plant foods and flavourings found mainly in the towns and some of the larger settlements.
- Supply of crops and meat to the towns could be investigated by comparison with rural sites.
- Villa estates have potential to provide evidence of economy, perhaps to supply other places.
- All the environmental evidence from a site must be considered together and in relation to other evidence from the site to make any conclusions about site economy.

Gaps in the evidence

- Lack of environmental evidence from small towns.
- Lack of sampled sites in Derbyshire.
- Studies of the villa and rural economy needed.
- Trade routes for fish and oysters to be investigated.
- Evidence of the Iron Age/Roman transition.
- Evidence of the Roman to Saxon transition.

Anglo-Saxon

Plant remains have been recovered and studied from sites at Raunds, West Cotton, and Higham Ferrers in Northamptonshire, while sites from Lincolnshire include settlements at Nettleton, Boston, Riby, Gosberton, and Flixborough, as well as a tenth- to twelfth-century waterlogged deposit at Waterside in Lincoln. In Leicestershire an extensive settlement has been excavated at Eye Kettleby near Melton Mowbray. Animal bone has been collected from most excavations on suitable soils, with good assemblages from the Northamptonshire sites mentioned above, from Lincoln, Flixborough, Riby and Quarrington in Lincolnshire and from Eye Kettleby. Waterlogged deposits include palaeochannels at Birstall, Leicestershire, Raunds and West Cotton, and mires at Eye Kettleby and Stamford Road, Oakham.

Early Saxon evidence at West Cotton (Northamptonshire) was sparse, consisting of a few grains of free-threshing wheat and barley with a few weed seeds of calcareous loam and clay soils suggesting continued exploitation of this terrain from the Roman period. Early/middle Saxon samples at Langham Road, Raunds, yielded a single seed of flax, with a little barley and quite abundant free-threshing wheat grains. The presence of a few fragments of wheat chaff of both bread and rivet wheat may indicate the introduction of rivet wheat by AD 850 (Campbell 1994); this has now been confirmed at Higham Ferrers (see below). At this site sparse evidence of early/middle Saxon date nonetheless showed hulled barley to have been cultivated with oats present either as a weed or a crop, while few weed seeds were found. There was no convincing evidence of the continued cultivation of spelt at this site (Moffett 2001), as was also the case at Eye Kettleby, Leicestershire (Monckton forthcoming a). Early Saxon evidence from Nettleton Top, Lincolnshire, include the presence of flax and barley (Carruthers 1993). Although absent from this region, there is evidence for some continuity of spelt cultivation into the post-Roman period in the eastern counties (Murphy 1994b). This remains a topic for future investigation.

In Leicestershire the excavation of the extensive Saxon site of six- to seventh-century date at Eye Kettleby has provided evidence for the crops cultivated. Free-threshing wheat was the only type found, most probably bread wheat from the form of the scarce rachis material. Barley of a hulled form, including the six-row variety, was the commonest and most abundant cereal. Although sometimes thought to be used mainly for animal food, it can be used for human consumption when the papery hulls are removed by parching and pounding, and may have been accidentally burnt and preserved by charring. Barley is the cereal most tolerant of damp conditions and the presence of buried mire deposits near the site may suggest this was a wet area in the past. Cultivation of the clay soils continues from the Roman period and is shown from the evidence of the arable weed, stinking mayweed, found at Eye Kettleby (Monckton forthcoming a).

At another mire at Stamford Road, Oakham, with pollen evidence from Roman to medieval date showed less sign of cultivation in the middle of the profile (Greig *et al.* forthcoming). This may suggest more emphasis on pastoral farming at this time in the area or perhaps reflects some more general change which requires further investigation. Evidence for traditional hay meadow and flood meadow has been found at Birstall, Leicestershire, from seeds and pollen in a waterlogged deposit near to a Saxon bridge or causeway (Greig 2004). This suggests the exploitation and management of seasonal pasture in the floodplain of the River Soar which was a vital part of the farming economy at the time. There are also pollen records of rye and hemp – typical early medieval crops – being grown in the area. The insect remains included numerous dung beetles as further evidence of the land being used as pasture, and there were some indications of trampled muddy ground, perhaps from the use of the crossing point (Smith and Tetlow 2004).

In Leicester deposits associated with a Saxon building at Bonner's Lane produced only small quantities of plant remains including free-threshing wheat and barley (Monckton 2004b). This supports the evidence above that the type of wheat grown changes from spelt in the Roman period to free-threshing wheat, perhaps as a cultural change or a change in the method of cultivation.

Samples from middle Saxon rural sites at Boston and Riby in Lincolnshire were dominated by six-row barley with free-threshing wheat, rye and oats (Giorgi and Rackham 1996; Hall 1994). On the Lincolnshire silt fens, barley, oats and horse bean were common at Gosberton and cereal processing waste indicated local production. This assemblage was thought to represent an agricultural system based on salt tolerant crops similar to that found on the coasts of Holland and Germany (Murphy 1993). Charred cereal grains and pulses were also found at the high status site of Flixborough (Loveluck and Dobney 1998). In middle to late Saxon contexts at Higham Ferrers the free-threshing wheat recovered included bread wheat and rivet wheat identified from rachises (Moffett 2001). Rivet wheat has been found in the Midlands and the south of England in contexts from the eleventh century onwards, suggesting that the crop may have been introduced from Europe after the Norman Conquest. Here, however, it was radiocarbon dated to AD 770–1000 indicating that this crop was present in pre Conquest levels (L. Moffett pers. comm.); this is the earliest occurrence known at present. Hulled barley, rye and legumes (probably peas or beans), were also cultivated. Leguminous seeds of vetches were quite abundant and may have included cultivated vetches, although the identification could not be confirmed. At this time there was a change in the weed flora to include corncockle, thorow-wax and stinking mayweed which are typical medieval weeds, while there were also fewer plants of damp ground. This

may represent changes in cultivation methods or processing practices by this time (Moffett 2001).

Late Saxon to early medieval evidence was abundant at West Cotton (Campbell 1994; forthcoming), although the precise dating is under revision. Remains of both bread wheat and rivet wheat, rye, six-row barley and oats were found. A deposit of barley and oats with weeds of spring sown crops was thought to be remains of 'dredge', a mixture of oats and barley grown together. This mixture contains many sprouted grains, interpreted as malted grains for brewing, and was found in an oven of tenth-century date. Waterlogged deposits contained evidence of flax retting showing the cultivation and processing of this crop for fibre on the site. Remains of hay were recovered, in the form of typical tall grassland plants, and its use for fodder, perhaps with cereal waste, was part of the agricultural economy of the site. The waterlogged deposits also indicate the presence of pasture and the large weed flora has allowed some conclusions to be drawn about arable practices. It was suggested that a two or three field system of crop rotation was in place in West Cotton by the Late Saxon period with fallow or grazing alternating with the crops (Campbell 1994). Campbell concluded that there was a well-developed agricultural economy involving all the major cereal crops, the production of hay from traditionally managed meadows, as well as the production and processing of flax and brewing.

Animal bone assemblages from the Lincolnshire sites of Riby and Quarrington indicate that stock rearing was the main activity (Albone 2000). At Riby, cattle were the main species and were possibly over-wintered there in the middle Saxon period (Steedman 1995). Quarrington shows a shift in emphasis from cattle to sheep later in the period, with most sheep at both sites killed relatively young for meat rather than kept for wool or dairy produce (Walker and Lane 1996). At Flixborough cattle, sheep/goats, pigs, geese and chickens were identified (Loveluck and Dobney 1998) showing the more varied diet of the higher status site.

At Higham Ferrers, Northamptonshire, sheep/goats were found to be more frequent than pigs which were probably fed on woodland products. Pigs were common, however, particularly in the middle Saxon period. From their age, cattle were used mainly for traction, while sheep/goat and pigs were used for meat, with animals probably reared and butchered locally. The animal bone suggested no evidence for a high status diet and wild species were rare throughout the period. Fish bones, mainly of fresh water fish, were found with a few fragments of marine species suggesting trade with the coast (Albarella and Johnstone 2000).

A large assemblage of early to late Saxon bones from Burysteads and Langham Road, Raunds, has been studied by Davis (1992) and the full report is to follow. Animal bone has also been studied at Lincoln as part of the sequence from the Roman to the medieval period (Dobney *et al.* 1996); and it was noted that there was a trend for the increasing consumption of lamb and mutton and for the farming of sheep for wool from the Anglo-Saxon period onwards (Chapter 7), reflecting the changes in farming practices in the countryside.

Other resources

There is a need to investigate wild food resources such as freshwater fish and wild fowl, their production, management and collection. Marine fish and shellfish and wild fowl are known to have been exploited in the Roman and medieval periods. Fish weirs and fish traps are known from rivers such as the Trent (e.g. Cooper 2003), but there is little evidence for the consumption of fish or eels, and more investigation of deposits by sieving to recover the small bones is required.

Woodland

Woodland, parks and wood pasture were an important resource supplying timber, fuel (as wood or charcoal), pasture, and wild resources, as well as for hunting. Investigation through documentary sources as well as archaeology has provided information about their importance and exploitation (Foard 2001a) and environmental archaeology has the potential to contribute significantly to such studies.

Potential research topics

- Timing of the change from spelt to free-threshing wheat.
- Evidence for hiatus in cultivation or not? Any evidence of frost ring-event of 540 AD (Baillie 1995) detailed pollen diagrams are showing this as a significant environmental event.
- Introduction of crop rotation.
- Agricultural expansion.
- Timing of the introduction of rivet wheat, dating evidence needed.
- Animal husbandry, changes and development.
- Exploitation of woodland.
- All classes of evidence under-represented for the period.

Medieval

Major urban excavations in Leicester have produced abundant evidence of a wide range of plant and animal remains providing evidence for diet and living conditions from a number of sites such as Causeway Lane (Connor and Buckley 1999). Urban deposits in Lincoln have produced particularly good animal bone assemblages (Dobney *et al.* 1996), in addition to charred and waterlogged plant remains (Moffett 1995b; 1995c; 1996). Some evidence has been recovered from St Peters Street, Northampton (Williams 1979) and Nottingham castle ditch (Connor and Gnanaratnam

2000). In Derbyshire a few remains have been recovered at Chesterfield, although little has been recovered in Derby until recent excavations at the Magistrates' Courts (A. Boucher pers. comm.).

Evidence from rural sites is most abundant in Northamptonshire, particularly from the Raunds and West Cotton Projects. An interim report on the plant remains has been published (Campbell 1994); and animal bones from West Cotton have been analysed. In Leicestershire samples of plant remains have been analysed from several village sites and from the town of Oakham (Monckton 2004a), while a good assemblage of animal bones has been recovered from Market Harborough (Baxter 1996). In Derbyshire a site with a field system has been sampled at Thurvaston (Moffett 1999). Some evidence has been recovered from the town of Chesterfield.

Few castles, monasteries or moated sites have been sampled, apart from the Augustinian Friary, Leicester (Mellor and Pearce 1981), and fishponds at Owston Abbey, Leicestershire (Hayne *et al.* 1988). Evidence for the environment from waterlogged remains has been recovered from palaeochannels associated with medieval bridges at Hemington Leicestershire (Greig and Smith forthcoming) and with the settlements at Raunds, Northamptonshire (Campbell forthcoming; Robinson forthcoming b).

Countryside

Evidence for an open pastoral and cultivated environment was found in waterlogged deposits in silted channels at Hemington Bridges, Castle Donington, Leicestershire (Cooper 2003; Cooper and Ripper forthcoming; Smith 2000). The presence of some woodland with oak trees was also indicated in pollen samples (Greig and Smith forthcoming). Waterlogged deposits from Northamptonshire have provided evidence for the farming landscape which is to be published soon (Campbell forthcoming; Robinson forthcoming b). A fishpond at Owston Abbey (Leicestershire) contained the remains of water plants and marginal plants of the surrounding vegetation, together with remains of fish, showing the species present to be rudd, bream, chub, roach, pike and perch (Hayne *et al.* 1988).

Woodland was an important resource in this period and studies have been carried out on Rockingham Forest (Foard 2001a). Changes in land used as arable, pasture, meadow and different types of woodland over the period may be detected in documentary records and through study of the present landscape (Foard 2000). Other studies of woodland have been carried out in Leicestershire by Squires (1995; 2004; Squires and Jeeves 1994). In Nottinghamshire dendrochronology results have been published for Sherwood Forest (Laxton 1997).

Charred cereal remains from West Cotton (Northamptonshire) show the presence of rivet wheat as a new crop by early medieval times (Campbell 1994; forthcoming). This also occurs with bread wheat and they may have been used for different purposes because they have different qualities, bread wheat being favoured for milling for bread flour, while rivet wheat is more suitable for biscuits and pottage. The straw also has different uses: bread wheat straw being more suitable for fodder as it lacks long awns which may choke some animals, while rivet wheat has very long straw which is useful for thatching (Campbell 1994). Barley of both two-row and six-row types was cultivated as well as oats and rye. The major cereals were all cultivated and evidence for crop rotation, first found in the late Saxon period, continued. In twelfth-century deposits the occurrence of cultivated vetch was confirmed as an additional crop, probably for fodder, as part of a crop rotation system. In an oven of twelfth-century date barley and oats also occurred as a mixed crop used for malting to brew beer. Rye chaff was found in the oven and rye straw is known to be favoured to line malting ovens to support the grains during roasting of the germinated grains before extraction of the malt. Flax cultivation and processing also continued on the site (Campbell 1994; forthcoming).

Analysis of the animal bone provides evidence for animal husbandry at West Cotton (Albarella and Davis 1994) and from Burysteads and Langham Road at Raunds (Davis 1992) adds to the picture of a developing agricultural economy in the region. At West Cotton animal bone of early to late medieval date included cattle, sheep, pig and equids; dogs and cats were common and wild animals were rare. Sheep were kept for wool, but meat and probably milk were used. Cattle were for traction, meat and dairy produce; fewer cattle were found later as horses became more frequent and were used for traction. Pigs decreased later as sheep increased, possibly because woodland used to feed pigs was reduced in favour of pasture for sheep. Cattle, equids and dogs were used for skins, while domestic fowl, geese, duck and pigeon were used for eggs and feathers as well as meat. The cattle and sheep compared in size to those from Leicestershire and Yorkshire but were larger than those from Cornwall and Northumberland. These larger animals in central England were possibly products of improved husbandry methods and 'improved' sheep and cattle were perhaps kept in medieval Northamptonshire (Albarella and Davis 1994).

In Derbyshire at Hemp Croft, Thurvaston, samples of charred plant remains consisted mainly of free-threshing wheat grains with rachis, identified as probably bread wheat (Moffett 1999). A few grains of barley were present, with legumes including pea and field bean representing additional crops. Smaller legumes were also present, and may have included cultivated vetch as a fodder crop, possibly used as part of crop rotation, although it was suggested that the remains may have been derived from thatch (*ibid.*). Seeds and grains can fall from weedy straw used as thatch and be burnt in the domestic hearth and it has been shown that legumes, cereals and weeds all occur in thatch (Letts 1999); this

would therefore explain the mixture of vetch and food legumes. An unusual find was possible evidence for falconry at Little Chester, Derby where a late Saxon or medieval cesspit contained the remains of two female sparrowhawks. Female sparrowhawks are larger than males and are known to have been used in falconry (Harman and Weinstock 2002).

In Leicestershire, Cropston Road, Anstey is a site with a known field system (Browning and Higgins 2003) and evidence for crops and diet of the twelfth- to thirteenth-century inhabitants was obtained from charred refuse in a boundary ditch. Foods included bread wheat with some rye, oats and barley; hazelnuts as gathered food; and legumes. The wheat included grains with chaff and, as bread wheat threshes free from the chaff easily, the abundant chaff suggested that it was grown nearby. The weeds included cleavers and corn cockle which are typical of autumn sown crops such as wheat and rye, while stinking mayweed indicates the cultivation of heavy clay soils. The increase in the latter weed in medieval times is thought to be related to the use of the mould board plough (Greig 1991), because this enabled more efficient cultivation of clay soils. The deposit may represent waste from agricultural activity, possibly processing a bread wheat crop. These remains give a glimpse of what was growing in the village field system. At Saxby (Monckton 2004a) a sample from the thirteenth- to fourteenth-century ditch contained quite abundant grains of free threshing wheat and chaff (rachis), which included bread wheat and also rivet wheat as the first from a rural site in Leicestershire and Rutland. South Street, Oakham, like Anstey, produced only bread wheat chaff, while Freeby and Barrowden had no chaff at all (*ibid.*). Hence the site at Saxby provides evidence for the cultivation of rivet wheat in the county, where it seems less common than in Northamptonshire, although both types of wheat have been found in medieval Leicester (Moffett 1993; Monckton 1999a). Rivet wheat is now known from an increasing number of sites in the Midlands from the Early Medieval period onwards (Moffett 1991); more evidence from rural sites is needed to study of the introduction and spread of this cereal.

Medieval towns

Cesspits used for the disposal of latrine waste or sewage are often a rich source of evidence because the minerals in the sewage cause the remains to become mineralised. These pits may also contain coprolites (mineralised excrement) and tests can reveal the presence of the eggs of gut parasites as evidence of public health, these together with the preserved maggots of latrine flies confirm the presence of sewage and provide evidence of conditions in the pit. Cesspits often contain fruit stones, fruit pips and chewed fish bones as evidence of foods which were certainly consumed (Fig. 72). Although also found in the Roman period, cesspits become much more common in the medieval and post-medieval periods. Rubbish pits are also a good source of evidence because they often contain burnt cereal grains and seeds preserved through charring. This type of deposit may contain accidentally spilled grains burnt in the cooking hearth and then cleaned away into a pit with other rubbish such as meat bones, which can provide evidence for diet. Pottery fragments give a date range to such pits and these two different types of evidence can assist in the interpretation of features and provide much evidence about occupation in the past.

Leicester

As in the Roman period sites from inside and outside the town walls have been sampled. Inside the town excavations in the north-east quarter at the Shires (Lucas and Buckley 1989; forthcoming) and Causeway Lane (Connor and Buckley 1999) can be compared with the sites in the southern suburb in the Bonner's Lane area (Finn 2004). In the twelfth to thirteenth centuries at Causeway Lane abundant remains from numerous cesspits and rubbish pits show that there was intense occupation at this time. The range of fruits increased from those found in Roman samples to include grape, blackberry, damson, plum, apple and pear, and vegetables included pea, bean and leek (Moffett 1993;

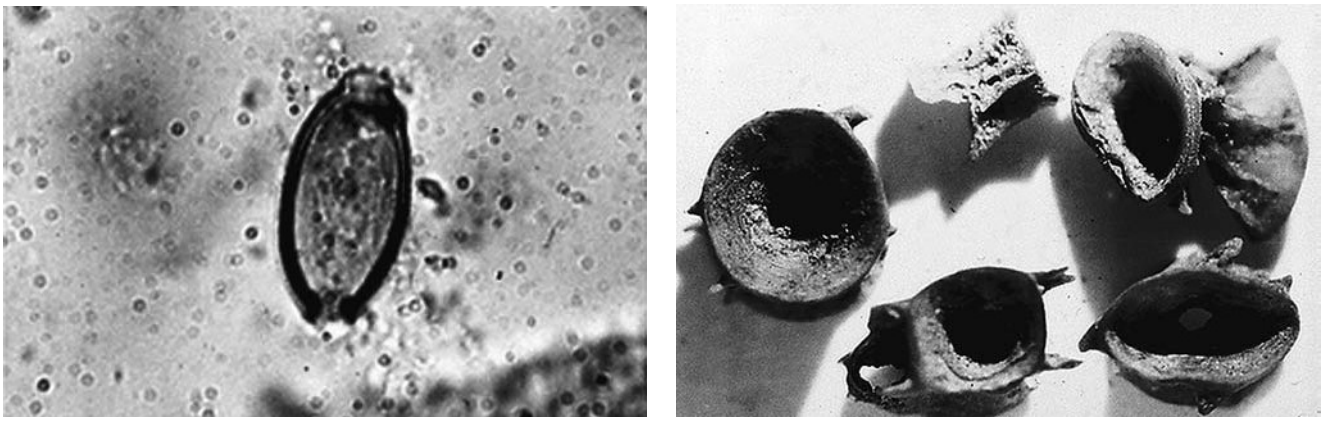

Fig. 72: ***Remains from sewage from medieval cesspits at the Shires, Leicester. Left: egg of a parasite of the human gut, whip worm (size about 0.005mm). Right: fish bones, including some distorted by chewing (diameter c. 4mm)***

Monckton 1999a). The cereals changed from the hulled wheat of Roman times to free-threshing wheat which included not only bread wheat which is used today, but rivet wheat.

Meat was from the domestic animals which were butchered more uniformly during the period (Gidney 1991–3; 1999), while fowl were also consumed, as were their eggs identified from eggshell (Boyer 1999a). Other foods included abundant fish, with more large sea fish than in the Roman period demonstrating the fishing of deeper waters with improved technology (Nicholson 1992; 1999). Oysters medieval date from the Shires of were fewer and smaller, from deeper waters and more managed populations than in the Roman period (Monckton 1993). Analysis of pottery residues from Causeway Lane showed that ruminant fat was used in lamps, dripping dishes contained pig or boar fat, while jugs had little residue suggesting they were used for aqueous liquids (Evershed 1999). At the sites in the suburb at this time charred cereals from domestic rubbish were also found, although at Oxford Street germinated barley was probably malted barley for brewing. A waterlogged deposit from a well there contained leather off-cuts and seeds of weld, which is a dye plant, suggesting the trades being carried out in the area (Monckton 1999c).

In the late medieval period there is less domestic evidence from Causeway Lane in the north-east of the town. Rubbish pits at the Shires show larger sheep being kept for wool before being used for meat, and calves used as veal. Early slaughter of calves is used in managing cows to produce milk and this suggests the development of dairy production (Gidney 2000; Albarella 1997b). In contrast, the suburb at Bonners Lane yielded abundant domestic rubbish including numerous cereal grains and legumes which may be the remains of food for animals as well as people. Pig keeping was inferred at Oxford Street from the find of neonatal piglets (Browning 1997); a sample with charred cereal grains included numerous seeds of stinking mayweed, again indicating cultivation of claylands (Greig 1991). Samples from York Road also recovered abundant domestic evidence, with the cereals wheat, barley, rye and oats, some legumes and abundant fruit remains coming from a cesspit (Monckton 2004b).

The best preserved waterlogged evidence for the environment in medieval Leicester was found during excavations at an Augustinian Friary, near the west gate of the town (Mellor and Pearce 1981). Here, ditches contained remains of waterside vegetation from a wide range of plants with evidence of flooding from the water snails in the deposits (O'Connor 1988). The relative cleanliness of the site was shown by the type of insect remains found. Insect evidence also showed the cultivation of legumes and possibly the storage of cereal grain on the site (Girling 1981). A wide range of food remains included meat, oysters and some large fish (Mellor and Pearce 1981), providing a comparison with the secular areas of the town investigated more recently.

Nottingham

Charred plant remains found at Nottingham Castle in a burnt deposit from a twelfth- to thirteenth-century ditch at the Hospital site, included free-threshing wheat with rachis material of both bread wheat and rivet wheat. The deposit contained quite abundant grains, chaff and weed seeds possibly as cereal cleaning waste, but possibly derived from burnt thatch (Connor and Gnanaratnam 2000).

Derby and Chesterfield

An excavation at Full Street, Derby, recovered seeds of medieval date (R. Hall 1975). Excavations at the Magistrates' Court by Archaeological Investigations Ltd., have produced evidence of cereal processing, and animal bones typical of tanning waste with tanning pits in the medieval suburb. Pits at Chesterfield contained some cereal remains including free-threshing wheat with weed seeds (Monckton 1999c).

Northampton

Excavations at St Peters Street Northampton recovered charred plant remains from a drying oven, with cereals including two-row barley and oats, together with weed seeds; and a pit from house 10 contained fruit remains – sloe, bramble and elder – with wheat grains and stinking mayweed seeds. Animal bone, fish bones, and shellfish were found and evidence from snails and insects was investigated. Pits on the site included some used for tanning (Williams 1979).

Lincoln

Three sites in Lincoln are noted as producing plant remains (Murphy 1998). Charred plant remains from eleventh- to thirteenth-century deposits at Flaxengate included free-threshing wheat of both bread wheat and rivet wheat types, while both six-row and two-row hulled barley were identified. Two-row barley is preferred for malting, since its grains are of uniform size. Germinated grains of both barley and oats were noted and it is possible that malting residues were represented; the oats included both common oat and sand oat with rye and vetch as crops (Moffett 1996). Two other Lincoln sites included preserved waterlogged plant remains, Dane's Terrace and Waterside, where cultivated plants included celery, columbine, fig, strawberry, flax/linseed, apple, sweet gale (used for flavouring ale), cherry, plum/bullace, raspberry and grape (Moffett 1995b; Greig 1989). Using information from the animal bones from the town and its hinterland, approaches to the study of provisioning the town were suggested by O'Connor (1983). A detailed programme of analysis of animal bone from Lincoln has since been carried out (Dobney *et al.* 1996). The trends noted include the killing of older sheep, which were kept for wool before being used as meat and the use of calves for veal as part of increased dairy production from the late medieval period onwards, as noted at Leicester (Albarella 1997a).

A wide range of evidence for foods, living conditions and activities has been recovered from the towns of Leicester and Lincoln, although more data is required to expand the picture already obtained to other parts of these towns. Comparable data is needed from other towns and small towns in the region. Evidence is lacking from monastic sites, castles, and high status sites. Northamptonshire has produced good evidence for the rural economy, and evidence from villages and rural sites is now being collected in the rest of the region as a future priority because the exploitation of the different landscapes of the region requires investigation. Data is needed from towns and their hinterlands to study the provisioning of the towns and trading relationships with their surroundings and further afield. Information from economic history studies (Dyer 1989) provides the background for data from rural and urban sites, and comparisons are needed to integrate the information on farming, crops, produce and diet. Consideration of the archaeological and palaeoenvironmental evidence in conjunction with documentary records is an important area of study for this period.

Potential research topics

- One of the main objectives for the period is to study the relationship of towns to the countryside in order to establish how towns were provisioned.
- Development of farming and the introduction and spread of new crops such as rivet wheat. Rye and oats also increased in occurrence in this period. Weed seeds found with cereals can demonstrate the more intense cultivation of clay soils and some leguminous seeds may suggest that crop rotation was being practiced. Samples which may represent mixed crops like maslin and dredge should be investigated as they are recorded in documentary records.
- The increase in size of some domesticated animals by the late medieval period as well as changes in animal husbandry to include dairy products (Albarella 1997a).
- Diet and living conditions: a wide range of foods and other evidence recovered from the towns has provided such information for Leicester and Lincoln, although more data is required to expand the picture already obtained to other parts of these towns. Evidence is needed from small towns, monastic sites, castles, and most particularly from rural sites across most of the region.

Gaps in the evidence

- The introduction and spread of rivet wheat.
- Crop rotation and field systems.
- Changes in animal husbandry (meat, wool, dairy).
- Butchery and trades using animal products (horn, bone, hides, tanning).
- Evidence from plant remains for brewing, retting fibres and dyeing
- Supply to towns, food and other products.
- Sea fish technology and trade.
- Freshwater fish production and supply.
- Urban diet and living conditions.
- Woodland management.
- Environmental evidence of land use.

Post-Medieval and Modern

Post medieval

Information from this period derives mainly from Lincoln and Leicester where animal bones from urban excavations show changes and improvements to animal husbandry. There is more evidence for trades using animal products and the use of horses for transport and traction becomes more evident. Some samples of plant remains show more variety of useful garden plants. The use of cesspits for the disposal of sewage, as found in Leicester and Nottingham, continues. Silted channels with mills and fish weirs are a source of environmental evidence for this period.

Areas of future research include documenting the introduction of new world crops and studying deposits from garden sites, which can produce data for authentic replanting (Murphy and Scaife 1991; Murphy 1998). A recent project carried out for the National Trust at Lyveden New Bield, Northamptonshire sampled the Tudor moat. The sediments contained pollen including that of roses and pinks, providing evidence of the plants growing before the abandonment of the garden.

Animal bone has been studied from Lincoln for the late medieval to post medieval period (Dobney *et al.* 1996); evidence for improvement of breeds has been found in the larger sheep in sixteenth-century Lincoln. The trend towards killing older sheep after they had been kept for wool continued from the late medieval period in Lincoln and in Leicester, as did the use of calves for veal (Albarella 1997a). There is evidence from Lincoln that there had been some changes in pig breeds and pig husbandry by the seventeenth century and that pigs were killed for meat at an earlier age (Dobney *et al*. 1996). This was thought to be due to improved stock of faster-growing, larger sized animals which achieved a higher weight when younger, so the animals could be slaughtered earlier (Albarella 1997a). This was the main improvement in pig husbandry until the introduction of new breeds in the eighteenth century.

In Nottingham a cesspit was excavated at High Pavement (Alvey 1973) and a well at Castle Gate (Alvey and McCormick 1978). In Northampton tanning pits have been investigated by chemical analysis to provide evidence for the leather industry there (Shaw 1996). Activity in the south suburb in Leicester increases during the post-medieval period, including the continued use of cesspits for sewage disposal at Bonner's Lane and the Bowling Green Yard. Numerous fruit pips from these include figs and blackberry

together with sloe, apple and grape. At Bonners Lane, rubbish pits contained such abundant charred cereal grains that they must have been waste or accidental loss from some commercial use, either for sale as grain or in other products (Monckton 2004b). Bones from the site show the processing of animal skins adding to the tanning pit evidence for tanners' or tawyers' trading activity in the suburb (Baxter 1998). Pigs were being kept in back yards, which was apparently not always successful, as several whole pig skeletons were found in a pit and they are thought to have died of disease (*ibid*.). Abundant burnt cereal grains and legumes may be the remains of food for animals as well as people.

In the north-eastern quarter of the town evidence from a rubbish pit at Causeway Lane showed that an improved breed of pig with a dished profile of the skull frontal was being introduced (Gidney 1999; 2000). This possibly represents a cross with a pig of Asian origin and is probably of eighteenth-century date. A few large rubbish pits and a well at the Shires contained charred grains of cereals from domestic rubbish and seeds of additional plants such as dill, hops, asparagus and marigold possibly grown as garden plants (Moffett 1993). The fewer, larger pits and a stone-lined well may suggest fewer, larger properties with large gardens in the area at this time, and at least one such residence is known on High Street from the sixteenth century (Courtney 2000). After this, the north-east quarter was recorded as an area of trees on maps of the eighteenth century and did not become populated again until Victorian times.

Other Leicestershire sites include the town of Mountsorrel where a deposit of sheep foot bones, similar to those from Bonners Lane, was found at a site where leather working and saddlery are known to have been carried out (Lucas 1987). Evidence for the post-medieval horse trade was found at Market Harborough where a pit containing horse bones included bones with the pathology of draught animals, slaughtered and skinned for hides; cattle horn cores were found as waste from the horner's trade (Baxter 1996).

Modern

Investigation of modern deposits is rarely carried out as part of archaeological projects but is sometimes carried out as ecological research. One example is a study of sediments from Groby Pool, Leicestershire to compare evidence for woodland and land use with documentary evidence. This shows that the pollen record mirrors the history of the mixed oak woodland of the area over the last 200 years (David and Roberts 1990). This type of work provides a firm basis for recording less well-documented areas in earlier times as well as more recently. It also has great potential to reveal the history of land use and record changes in the landscape. Another study of lake deposits at Creswell, Derbyshire (Jenkinson and Gilbertson 1984) recorded vegetation up to recent times and also includes a study of the present ecology of the site. This is a useful comparison with the very early deposits from the area and is an important contribution to the preservation and management of the site.

Sampling for plant remains and animal bones from post-medieval to more recent deposits has the potential to reveal the introduction and use of foods and other traded material, particularly New World introductions, imported into the country and their spread through the region. Studies of animal bones can show the changes in animal husbandry and the introduction of improved breeds of animals; it can also show the animals used for traction and transport, as horses replaced the large cattle of earlier times. There is also the potential to reveal diet, living conditions and status of historically recorded households or settlements of both rich and poorer people. Study of skeletal material has great potential to reveal history of disease and social conditions of groups of people. Another important area of study is the history of pollution by metals and other materials which may be deposited in sediments.

Potential post-medieval and modern period research topics

- Changes in animal husbandry.
- Introduction of improved breeds of animals.
- Trades in animal products.
- Animals used for traction and transport, change from use of large cattle to horses.
- Introduction of new plants as crops or garden plants (particularly New World introductions).
- Possible changes in diet and living conditions.
- Recovery of evidence from rural sites, which is currently lacking.
- Evidence from higher status sites is needed to compare with those in other regions.
- Living conditions and diet of workers in trades and industries.

A Cross-Period Research Agenda for Environmental Archaeology

Introduction

The function of this concluding section is to summarise the research potential of the period-based environmental agendas above, highlight the major barriers to advancing the subject in the region, and suggest ways of overcoming them. Charred remains of crop plants and domestic animal bones are as much an artefact of material culture as pottery and, therefore, should be recovered and recorded as part of the 'preservation by record' of sites which are to be destroyed. Information about the ancient environment is crucial to the study of archaeology and therefore the recovery of information from natural deposits which are to be destroyed is also essential and should form an integral part of the Sites

and Monuments Record. Lack of access to unpublished data is clearly a major barrier to advancing the agenda and it is vital that, when published, reports include sufficient primary data to support the conclusions drawn. Table 8 summarises the current resource.

The potential of the region and cross-period themes

The wide range of geologies across the region permits the investigation of different types of economic exploitation, farming and settlement history. The Peak District has unique evidence of Palaeolithic activity and environment from the cave sites at Creswell, while palaeochannels and peats have provided evidence of the early wooded environment with clearings and the beginnings of cereal cultivation in the Neolithic. All the main river valleys in the region and their many tributaries have been found to produce a wealth of evidence from waterlogged deposits from palaeochannels discovered during quarrying, development and surveys usually connected with threats of development. These deposits have great potential to provide evidence of the general and more local environment, each sampling site providing a snapshot of the environment which can be dated and which can be built up into a more general picture of landscape and land use. Mapping and dating river channels contributes to the evolution of the river systems and landscape, and dating alluviation often relates to human activities such as woodland clearance and cultivation. This information is being used to investigate the different types of woodland and clearing dates; evidence for land used as pasture and cereal cultivation contributes to information about the environment of the occupied landscape and human activity.

The claylands in the south of the region have an increasing amount of evidence for settlement on the drift geology from prehistoric times onwards and the study of a range of settlement types is possible to compare with both other parts of the region and places beyond. This will elucidate aspects of the development of farming and the rural economy. In Roman and later times, Leicester and Lincoln have provided good urban evidence, both with the potential for further investigation; more evidence from the other towns is needed. If this could be related to rural data, sources of supply of food and other materials to the towns may be suggested. Northamptonshire has good rural data with waterlogged remains, and offers the potential to study the Roman villa environment and economy, while there is also abundant evidence of the medieval rural economy which has the potential to be related to documentary evidence in some places. Derbyshire has particular potential for information about early as well as later mineral exploitation, with evidence from sediments to add to that from the sites themselves. The Lincolnshire fens and river valleys have good waterlogged remains, with great potential to study the relative importance of pastoral and arable from prehistoric to more recent times, particularly for methods of animal husbandry.

Table 8: ***Numbers of sites with each type of environmental remains***

Period	*Total Sites*	*Mammal bone*	*Bird bone*	*Fish*	*Molluscs*	*Charred plants*	*WL plants*	*Pollen*	*Insects*
Palaeo	10	8 (5*)	1	–	–	–	2	5	1
LG	11	2 (1*)	1	–	1 Sn	–	6	6	6
Meso	23	2 (2*)	2	–	1 Sn	–	8	17	8
Neo–EBA	39	8	–	–	2 Sn	16 (3*)	9	15	6
BA	31	8	–	–	1 Sn	15 (4*)	12	18	11
LBA–EIA	16	5	1	1	–	4	5	5	5
IA	42	15 (6*)	1	1	2 Sn	27 (14*)	10	12	9
LIA–RB	17	4	–	–	–	16 (5*)	5	5	2
Roman	33	11	1	–	–	22 (16*)	12	8	6
Roman urban	12	12 (7*)	4	4*	2 Oyst	10 (2*)	5 (3*)	2	2 (m)
E. Saxon	6	3	–	–	–	6 (3*)	1	1	1
L. Saxon	16	5 (3*)	1	–	–	12 (7*)	4	4	3
Med	21	9 (5*)	–	2	–	17 (9*)	4	4	2
Med urban	17	12 (7*)	6	6*	1 Oyst	11 (9*)	8 (3*)	4	4 (m)
Post-med	12	8 (5*)	1	2	1 Oyst	4 (3*)	1	1	1

Key:
Sn = snails, Oyst = oysters
m = mineralised
LG = Lateglacial palaeochannels
Meso = Mesolithic, and includes Mesolithic–Neolithic waterlogged deposits.
* Numbers in brackets are sites included with particularly good assemblages.
Sites are listed up to November 2001 (see EMARF website Table E1). NB only selected sites with animal bone are included here.

Future work should be directed to filling gaps in the evidence and building on the existing body of data in order to preserve the evidence by record. Integration of the information from different studies is needed to maximize the evidence from sites which will be destroyed by development, and to inform the preservation of sites in the ground. The potential for research in the region can be encapsulated within the following cross-period themes.

- *Environment:* change, human impact and land use.
- *Farming:* pastoral: evidence for domestic animals, pasture and fodder.
  arable: beginnings, development and expansion of agriculture, crops grown.
  economy: the relative importance of arable, pastoral, woodland and wild resources.
  countryside: change in land use, economy, resources (mainly Roman–Post Medieval).
- *Urban and rural life:* diet, living conditions, crafts, trade, evidence for the supply of food and other resources and the relationships of towns with their hinterlands.

Major gaps in the evidence

Table 8 demonstrates that whilst data are accumulating well in the region, there are still very significant gaps in the record which can be summarised as follows.

- Lack of published early prehistoric pollen profiles as noted by Greig (1996).
- Evidence for early clearings and their use from pollen analysis and insect remains.
- Evidence for Neolithic settlements, evidence of crops, wild resources and animal husbandry.
- Lack of extensive dated evidence for agricultural land use; pasture, cultivation and woodland.
- Bronze Age crop remains, for comparison with later periods, as evidence for development of agriculture.
- Evidence from Iron Age hillforts and extensive settlements.
- Evidence for the Iron Age to Roman transition.
- For Roman small towns, evidence of status, economy and function are lacking.
- Anglo-Saxon evidence of crops and animal husbandry.
- Medieval rural evidence of agricultural production and the use of fields.
- Evidence from medieval towns.
- Post-medieval plant remains, introduced plants and improved animal husbandry and breeds.

Principal barriers and how to overcome them

These can be summarised under two headings:

Improving and standardising methodologies

- Standardisation of methodologies and the provision of clear guidelines will ensure comparability of information.
- Sampling requirements should be specified in site briefs so that sample size and quantity is less of a commercial consideration.
- Waterlogged deposits should be sampled for pollen, plant macrofossils, and insect remains; AMS dating of the seeds of land plants should be standard.
- Bulk sampling for charred plant remains as routine; a range of samples is needed.
- Recovery of animal bone assemblages by appropriate sampling.
- Investigation of buried soils by sediment analysis, micromorphology (Limbrey 2000; Macphail and Linderholm 2004).
- Boundary and field ditches can be investigated for dating evidence and land use from waterlogged remains (Hunn and Rackham forthcoming).
- Stable isotope analysis of human bone to investigate diet and lifestyle, as at Staythorpe (Davies 2001).

Improving the dissemination, review and synthesis of results

- Environmental data to be recorded on SMRs.
- Improved access to unpublished 'grey literature'.
- Publication of sufficient primary data to back up conclusions drawn.
- A review of the evidence from animal bone is urgently required.
- The environmental evidence from Lincolnshire needs to be reviewed.
- Co-ordination and synthesis of information from the region's river valleys is urgently needed.

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