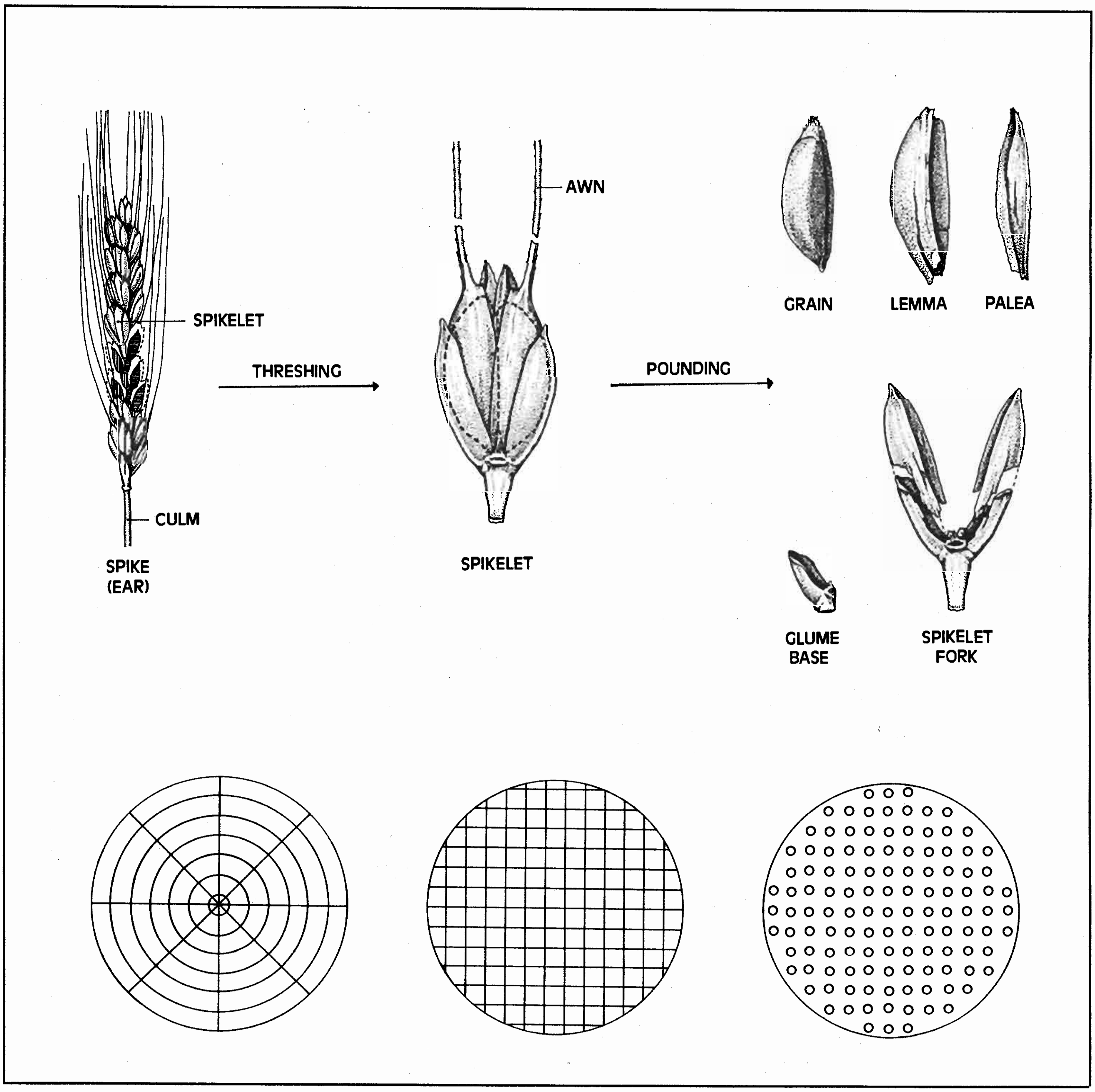
Volume 12 Number 2 (1996 for 1995) ISSN 0268-425X

Circaea



The Journal of the Association for Environmental Archaeology

Circaea

This is the last issue of *Circaea*, the Journal (formerly Bulletin) of the Association for Environmental Archaeology (AEA). It will be continued as *Environmental Archaeology & Human Palaeoecology* (EA&HP).

This issue of *Circaea* was edited and assembled by Allan Hall and Harry Kenward at the University of York, England. It is distributed free to members of the AEA. Annual subscriptions to the Association are currently £16 for ordinary individual members, £8 for students and unwaged, and £24 for institutions.

Circaea is published by the Association for Environmental Archaeology, c/o Environmental Archaeology Unit, University of York, Heslington, York YO1 5DD, U.K. Enquiries concerning membership of the AEA should be sent to Dr Rebecca Nicholson, Membership Secretary, Association for Environmental Archaeology, c/o Department of Archaeological Sciences, University of Bradford, Bradford BD7 1DP, U.K.

Notes for contributors to *Environmental Archaeology & Human Palaeoecology* may be found on the inside back page of this issue.

The *Newsletter* of the Association, produced four times a year, carries lists of recent publications, and news about conferences and the business of the Association. It is edited by Wendy Carruthers (Sawmills House, Castellau, Pontyclun, Llantrisant, Mid Glamorgan CF7 8LP, U.K.) and Vanessa Straker (Department of Geography, University of Bristol, Bristol BS8 1SS, U.K.), to whom copy should be sent (on 5.25- or 3.5-inch floppy disk in IBM-PC format as WordPerfect, Word or ASCII files to Wendy, or by e-mail or as hard copy, to Vanessa).

Front cover: Cereal grains and sieves—borrowed from Jones (p. 177) and Nesbitt et al. *(p. 195).*

Circaea, The Journal of the Association for Environmental Archaeology **12** (2) (1996 for 1995), 157-175 ISSN 0268-425X

Insects and plants from a late medieval and early post-medieval tenement in Stone, Staffordshire, U.K.

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Summary

The insect and plant remains from four samples from a late medieval and early post-medieval tenement at Stone, Staffordshire, are discussed. Evidence from the earliest sample suggests that the medieval buildings in this part of Stone were built on the silted remains of a fresh water swamp, perhaps the remains of the Scotch Brook, which may have been pooled or dammed. The late medieval layers were a mixture of plant materials used in the settlement and which had been derived from a number of sources. It is possible that this material may represent the decomposed remains of a house floor, or alternatively, a spread of discarded domestic rubbish in an external yard. The post-medieval deposit appears to have been in a relatively dry state at the time of its deposition. There is a some circumstantial evidence from the plant remains, and even more marginally from the insect remains, to suggest that the post-medieval deposit might represent the remains of thatch.

Introduction

The small market town of Stone is located approximately 10 km to the south of Stoke-on-Trent (Fig. 42). In 1993 the installation of a town centre by-pass necessitated the excavation of No. 9 High Street (Fig. 43), a tenement of the former Falcon Inn. The excavation was carried out by the Birmingham University Field Archaeology Unit on behalf of Staffordshire County Council. This excavation gave the archaeologists the opportunity to examine a medieval tenement structure from this small town. For the environmental archaeologists involved, this work presented an opportunity to examine the nature of housing, living conditions and utilisation of economic crops for a previously unexamined period in this part of the English Midlands. In addition, did the environment of this tenement structure echo that seen in other larger scale urban settlements from the same period?

Methods

Four 'general biological samples' of about 10-15 litres were collected from the site by the authors on two separate occasions during the period of excavation.

For the plant remains, a subsample of 1 litre was sieved from each context. Each subsample was sieved by washing it through a series of three sieves (of mesh sizes 4 mm, 1 mm and 0.3 mm) to separate the size fractions and make the samples easier to sort. The large fraction (4 mm sieve) was dried and sorted by eye for large items such as hazel nutshell fragments. Only a few identifiable items were found in the large fraction, though the presence of other material, such as wood and coal, was noted. The 1 mm sieve fraction was sorted in its entirety under a binocular microscope. A subsample of the fine fraction (0.3 mm sieve) from each residue was examined for small seeds. Only a few fragments of seeds were found in any of the fine fraction subsamples, and none of the seed fragments represented species not found in the 1 mm fraction. The fine fractions were not further sorted, therefore, and virtually all of the results are for remains from the 1 mm sieve fraction.

The material was identified by comparison with modern specimens in the reference collection at the University of Birmingham. Results are presented in Table 78 in taxonomic order within approximate habitat groups. Taxonomy follows Stace (1991). Since time was limited, no attempt was made to count every seed. Instead items were scored according to their approximate abundance in the sample as given by the scale in Table 78. It is considered unlikely that much information of importance has been lost by this method as the exact numbers of seeds are

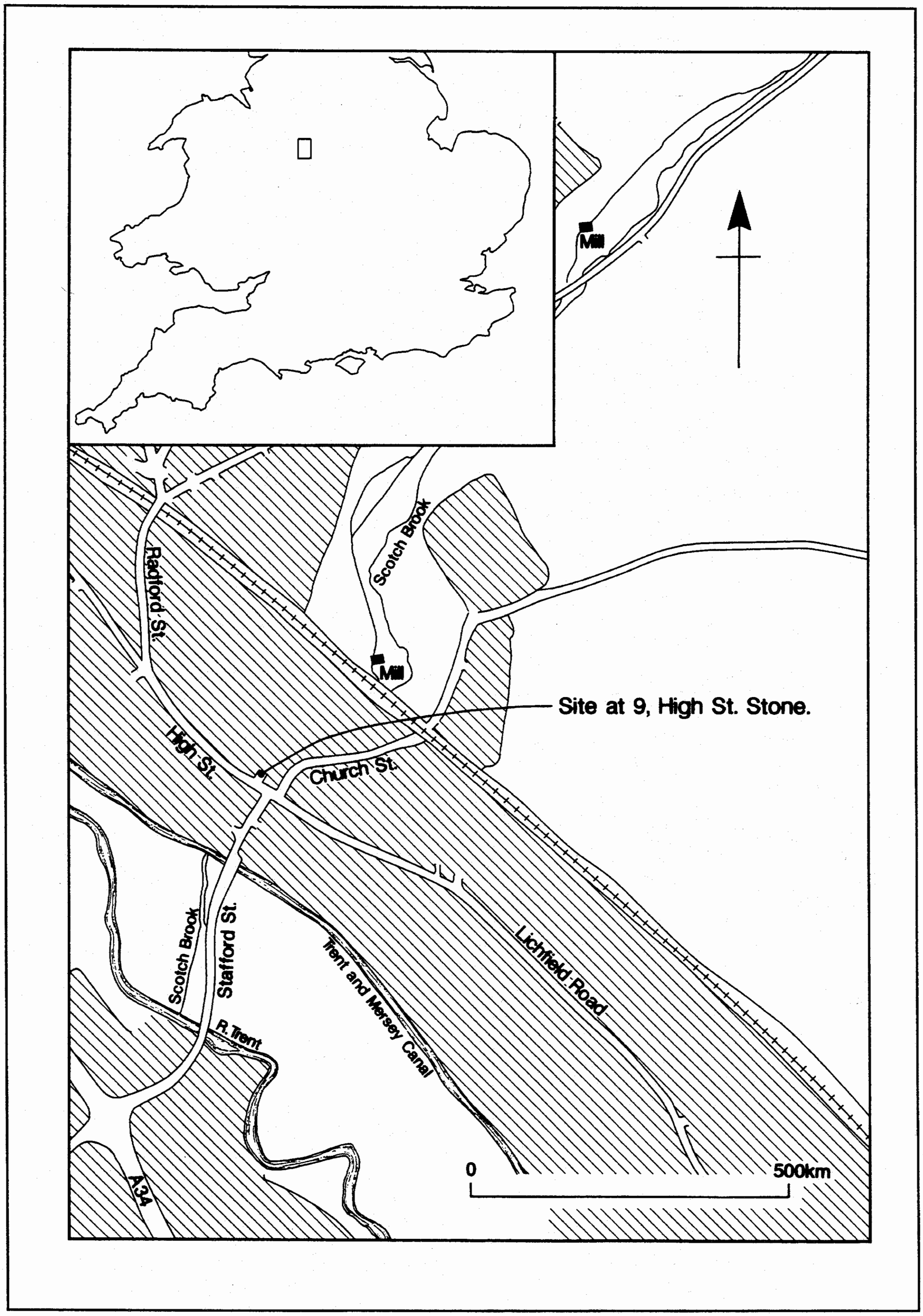

Figure 42. Location of the site at Stone.

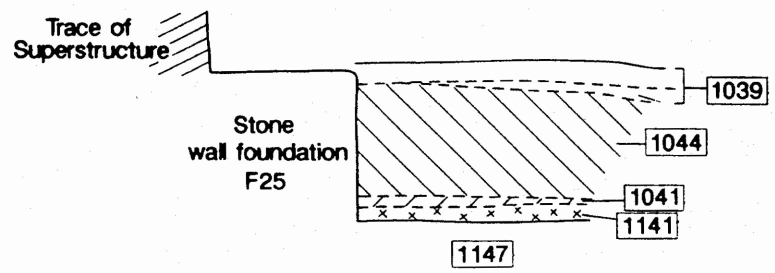

Figure 43. Relationship of archaeological deposits discussed in the text. Numbered layers: 1039—floor surfaces associated with early post-medieval building (the lower part, shown by a dashed line, is the equivalent of 1059 but not distinguished in the area represented by this section); 1044—mixed dump deposit; 1041 and 1141—medieval occupation deposits associated with timber building. 1147—pre-occupation deposit.

probably less important than their relative abundance. Even relative abundance of seeds is difficult to interpret since different species produce different amounts of seeds. Local factors, such as the proximity of where a plant grew to the particular spot where the deposit formed (and the sample was taken) can also influence the number of seeds in a sample. For these reasons, only presence or absence of a species is used in calculating the percentage abundance of ecological groups given in Figure 44. These statistics are clearly crude, but they provide a basis for a broad comparison between the samples.

Assigning the plants to broad habitat groups is intended only as one interpretation of probable groups. Many plants grow in a variety of different habitats and many of the species listed here could well be placed in other habitat groups. This caution should be borne in mind when looking at Table 78 and Figure 44.

The insect remains were extracted from subsamples of approximately 7-10 litres using the standard method of paraffin flotation as first outlined by Coope and Osborne (1968) and subsequently improved upon by Kenward *et al.* (1980). The resultant flots were sorted under a low-power binocular microscope. The insect fragments were identified using a number of entomological keys and by direct comparison with the Gorham Collection of British Coleoptera housed at Birmingham. The coleopterous species recovered from this material are presented in Table 79. The taxonomy follows Lucht (1987). In addition, because of the complexity of these faunas, a number of different forms of statistical analysis have been carried out. These analyses follow some of the methods outlined by Kenward (1978). The ecological groups to which species have been assigned follow those given by Hall *et al.* (1983) and Hall and Kenward (1990). The grouping to which each species has been assigned is presented on the right-hand side of Table 79. The percentages of these groupings in each sample are presented in Table 80 and in Figures 45 and 46. A list of the first 10 ranks of abundance for the species present in each of the samples is presented in Table 81.

The pre-structural phase

The earliest deposit sampled on site (1147, Fig. 43) consisted of a thick layer of dark grey or brown silt containing abundant plant remains. It was later sealed by a layer of gravel, on top of which lay the earliest occupation layers.

Both the plant and insect remains recovered from 1147 clearly attest to the natural origin of this deposit. The only indication of human activity is a few grains of cereal pollen (Greig, unpub.). Most of the plant and insect species present come from aquatic or waterside environments. There is a wide range of water beetles which favour the slow-moving or stagnant water around the base of aquatic plants. Typical of this environment are *Hygrotus inaequalis* (Balfour-Browne 1940), *Ochthebius minimus*(Hansen 1987), and the *Bagous* species among the Curculionidae. However, other species present, such as *Agabus bipustulatus*, *Colymbetes fuscus*, and the *Dytiscus* species, suggest that less heavily vegetated areas of still, open water were also present. In addition, the

Taxon	1147	1041	1141	1059	Common name
Solanum nigrum L.	-	-	-	+	black nightshade
Stachys arvensis (L.) L.	-	+	+	-	field woundwort
Lamium sp.	-	++	+	++	dead-nettle
Galeopsis angustifolia Ehrh. ex Hoffm.	-	+	-	-	red hemp-nettle
Galeopsis speciosa/tetrahit	-	-	-	++	hemp-nettle
Galeopsis sp.	-	-	+	-	hemp-nettle
Valerianella dentata (L.) Pollich	-	+	-	-	cornsalad
Centaurea cyanus L.	-	++	+	+	cornflower
Carduus/Cirsium	++	+	-	+	thistle
Carduus/Cirsium/Centaurea	-	-	+	-	thistle/cornflower
Lapsana communis L.	-	++	++	+	nipplewort
Sonchus arvensis L.	-	+	+	-	perennial sow-thistle
Sonchus asper (L.) Hill	-	+++	+	++	prickly sow-thistle
Anthemis cotula L.	+	++	+	++	stinking mayweed
Chrysanthemum segetum L.	-	++	+++	++	corn marigold
Asteraceae mayweed type flower head	-	-	-	+	daisy family
Asteraceae thistle type flower head	-	-	-	+	daisy family
Bromus hordeaceus/secalinus	-	+	+	-	soft-brome/rye brome
Grassland species					
Ranunculus acris/repens/bulbosus	+	++++	++++	+	buttercups
Filipendula ulmaria (L.) Maxim.	-	-	+	-	meadow-sweet
Potentilla erecta (L.) Raeusch.	-	+	++	+	tormentil
Sanguisorba minor Scop.	-	-	+	-	salad burnet
Anthriscus sylvestris (L.) Hoffm.	-	+	-	-	cow parsley
Torilis sp.	-	-	+	+	hedge-parsley
Daucus carota L.	-	-	+	-	(wild?) carrot
Prunella vulgaris L	-	+	+	-	selfheal
Odontites verna (Bellardi) Dumort.	-	+	-	-	red bartsia
Rhinanthus minor L.	-	+	-	+	yellow rattle
Leontodon sp.	-	-	+	-	hawkbit
Taraxacum sp.	-	+	-	-	dandelion
Poa annua L.	-	-	-	+	annual meadow-grass
Poa sp.	-	+	-	+	meadow-grass
Wet ground and aquatic species					
Ranunculus flammula/reptans	-	+	-	+	lesser/creeping spearwort
Persicaria hydropiper (L.) Spach	-	-	-	++	water-pepper
Salix sp. buds	-	+	+	-	willow
Oenanthe fistulosa L.	-	+	-	-	tubular water-dropwort
Apium nodiflorum (L.) Lag.	+	-	-	-	fool's water-cress
Menyanthes trifoliata L.	-	+	-	-	bogbean
Lycopus europaeus L.	+	-	-	-	gypsywort
Pedicularis palustris L.	-	+	+	+	marsh lousewort
Sonchus palustris L.	-	+	-	-	marsh sow-thistle
Senecio aquaticus Hill	-	+	-	-	marsh ragwort
Bidens cernua/tripartita	++++	-	-	-	bur-marigold
Potamogeton sp.	++++	-	-	-	pondweed
Lemna sp.	+	-	-	-	duckweed
Eleocharis palustris/uniglumis	-	++	++	+	spikerush
Blysmus compressus (L.) Panzer ex Link	-	+	-	-	flat-sedge
Carex spp.	++	+++	+++	++	sedges
Glyceria cf. *fluitans* (L.) R. Br.	++++	-	-	+	?floating sweet-grass
Sparganium erectum L.	+++	-	-	-	branched bur-reed
Sparganium sp.	-	-	-	+	bur-reed

Taxon	1147	1041	1141	1059	Common name
Hedgerow/woodland edge species					
Corylus avellana L.	+	+	+	+	hazel
Rubus cf. *fruticosus* L. agg.	+	+	-	-	?bramble
Rubus sp.	+	+	-	+	bramble/raspberry
Rosa sp. thorns	-	+	+	-	rose
Prunus spinosa/domestica	-	+	-	+	sloe/bullace/ damson/plum
Prunus/Crataegus thorns	-	+	+	+	sloe/hawthorn
Ilex aquifolium L. leaf spines	-	-	+	-	holly
Sambucus nigra L.	+	++	++	++	elder
Heathland species					
Pteridium aquilinum (L.) Kuhn leaf frags.	+	++	+++++	+++	bracken
Calluna vulgaris (L.) Hull stems/leaves	-	-	-	++	heather
Ulex sp. stems/leaves	-	-	+	+	gorse
Unclassified					
Moss fragments	-	++	+++	+++++	mosses
Ranunculus sp.	-	-	-	+	buttercup/spearwort
Stellaria palustris/graminea	-	-	-	+	marsh/lesser stitchwort
Rumex crispus/conglomeratus/obtusifolius	-	+	-	-	docks
Rumex sp.	-	++	+++	++	dock
Viola sp.	-	-	-	+	violet/pansy
Fabaceae pod fragments	-	-	-	+	pea family
Senecio cf. *vulgaris* L.	-	-	-	+	?groundsel
Poaceae panicle nodes	-	-	+	-	grass
Poaceae	-	+	+	++	grass
Tree buds		-	++	++	++

small numbers of elmid or 'riffle' beetles suggest that there may have been an area of silt-free and possibly fast-flowing water nearby.

Other species of beetle present indicate that there were detritus-filled muddy areas at the water's edge. Most of the species of the families Carabidae and Hydrophilidae present favour this form of environment. In particular, both *Bembidion guttula* and *Chlaenius nigricornis* occur on clay soils by fresh water, often under heaps of reeds and sedges (Lindroth 1985; 1986). In addition, areas of open mud are suggested by *Platystethus cornutus* and the *Dryops* and *Heterocerus* species.

The vegetation locally consisted of aquatic plants which grow in still or slow-moving water and is represented by large numbers of seeds of relatively few species. These included bur-marigold (*Bidens cernua/tripartita*), pondweed (*Potamogeton* sp.) ?floating sweet-grass (*Glyceria* cf. *fluitans*) and branched bur-reed (*Sparganium erectum*). The last of these is the sole food plant of *Donacia marginata* and one of those favoured by *D. simplex* (both recorded, the latter in large numbers). Sedge (*Carex* spp.) seeds were also present. These are difficult to identify to species but it is highly probable that these were aquatic, rather than dry-ground, species. This is borne out by the insect remains, since *Plateumaris sericea* and, to some extent, *Donacia simplex* feed on waterside species of *Carex*.

Other plants which may have formed part of this stream-edge community, but which are represented poorly or not at all by botanical evidence, are indicated by a number of species of beetles. *Prasocuris phellandrii* feeds as an adult on a range of aquatic Apiaceae. Both the larvae of this species and the adult of *Leiosoma deflexum* will feed on *Caltha palustris*, the marsh marigold. *L. deflexum* and *Hydrothassa glabra* also feed on various waterside *Ranunculus* species. Willows (*Salix* spp.) are a common food plant for *Dorytomus* weevils. The botanical evidence for willow, however, consists of a very small amount of pollen, which does not suggest it was growing in the immediate vicinity (Greig, unpub.).

Taxon	1147	1041	1141	1059	Ecological code
Carabidae					
Nebria brevicollis (F.)	4	-	-	1	oa
Notiophilus sp.	-	-	-	1	oa
Dyschirius sp.	1	-	-	-	oa
Clivina fossor (L.)	-	-	1	-	oa
C. contracta (Four.) (*C. collaris* (Hbst.))	-	-	-	1	oa
Trechus spp.	2	-	1	-	oa
Bembidion guttula (F.)	3	-	-	-	oa
B. spp.	1	1	-	1	oa
Patrobus sp.	1	-	-	-	oa
Pterostichus strenuus (Panz.)	2	-	-	-	oa
P. nigrita (Payk.)	2	-	-	-	oa-d
P. sp.	-	-	1	-	ob
Agonum spp.	2	-	-	-	oa
Amara spp.	1	1	2	-	oa
Chlaenius nigricornis (F.)	1	-	-	-	oa-d
Halipidae					
Halipus sp.	1	-	-	-	oa-w
Dytiscidae					
Hygrotus inaequalis (F.)	1	-	-	-	oa-w
Hydroporus spp.	8	-	-	-	oa-w
Agabus bipustulatus (L.)	4	-	-	-	oa-w
A. spp.	2	-	-	-	oa-w
Colymbetes fuscus (L.)	-	1	-	-	oa-w
Dytiscus spp.	1	-	-	-	oa-w
Hydraenidae					
Hydraena spp.	8	-	-	1	oa-w
Ochthebius minimus (F.)	2	-	-	-	oa-w
O. spp.	7	3	1	-	oa-w
Limnebius spp.	4	-	-	-	oa-w
Helophorus grandis Ill.	6	1	-	-	oa-w
H. grandis Ill. or *aquaticus* (L.)	8	-	-	-	oa-w
H. spp.	50	2	1	1	oa-w
Hydrophilidae					
Colelostoma orbiculare (F.)	6	-	-	-	oa-w
Sphaeridium sp.	1	-	-	-	rf
Cercyon impressus (Sturm.) (*C. atomarius* (F.))	3	-	4	-	rf
C. haemorrhoidalis (F.)	-	2	-	4	rf
C. melanocephalus (L.)	1	1	1	-	rt
C. unipunctatus (L.)	-	-	1	-	rf
C. atricapillus (Marsh.)	-	3	-	-	rf
C. pygmaeus (Ill.)	1	-	-	-	rf
C. tristis (Ill.)	1	1	-	-	oa-d

Table 79 (this page and four following). The Coleoptera from Stone. Taxonomy after Lucht (1987) with synonymy where differing from Kloet and Hincks (1977). Key to ecological coding (Hall and Kenward 1990): oa (& ob)—species which will not breed in human housing; w—aquatic species; d—species associated with damp watersides and river banks; rd—species primarily associated with drier organic matter; rf—species primarily associated with foul organic matter often dung; rt—insects associated with decaying organic matter but not belonging to either the rd or rf groups; l—species associated with timber; p—plant feeding species; m—species from moorland/heathland; h—members of the 'house fauna' (this is a very arbitrary group based on archaeological associations, cf. Hall and Kenward 1990).

Taxon	1147	1041	1141	1059	Ecological code
Othius sp.	1	-	-	-	
Neobisnius spp.	-	20	3	-	
Philonthus spp.	3	-	3	-	
Ocypus sp.	-	-	1	-	
Quedius spp.	-	2	1	3	
Tachyporus spp.	-	1	1	-	
Tachinus rufipes (Geer)	2	-	-	-	
T. spp.	1	1	-	2	
Aleocharinae gen. & spp. indet.	9	40	5	4	
Pselaphidae					
Brachygluta sp.	-	-	-	1	
Trissemus impressus (Panz.)	-	1	-	-	
Cantharidae					
Cantharis spp.	1	1	-	-	ob
Rhagonycha spp.	3	-	-	-	ob
Elateridae					
Adelocera murina (L.) (*Agrypnus murinus* (L.))	-	2	-	1	oa-p
Athous sp.	-	-	-	1	oa-p
Helodidae					
?*Cyphon* sp.	-	1	-	-	oa-d
Scirtes hemisphaericus (L.)	7	-	-	-	oa-d
Dryopidae					
Dryops sp.	1	-	-	-	oa-d
Elmis aenea (Mull.)	3	-	-	-	oa-w
Oulimniius spp.	1	-	1	-	oa-w
Limnius volckmari (Panz.)	1	-	-	-	oa-w
Heteroceridae					
Heterocerus spp.	1	-	-	-	oa-d
Dermestidae					
Dermestes sp.	-	1	-	-	h
Nitidulidae					
Brachypterus urticae (F.)	1	-	-	-	oa-p
B. glaber (Steph.)	-	-	-	1	oa-p
Meligethes spp.	3	1	1	2	oa-p
Rhizophagidae					
Rhizophagus sp.	-	-	-	1	
Cucujidae					
Monotoma spinicollis Aubé	-	1	-	-	rt
M. brevicollis Aubé	-	1	-	-	rt
M. bicolor Villa	-	2	-	-	rt
M. spp.	-	7	-	-	rt
Cryptophagidae					
Cryptophagus acutangulus Gyll.	-	8	-	-	rd-h
C. ? dentatus (Hbst.)	-	2	1	-	rd-h
C. distinguendus Sturm.	-	1	-	5	rd-h

Taxon	1147	1041	1141	1059	Ecological code
C. scanicus (L.)	-	4	1	1	rd-h
C. ? cellaris (Scop.)	-	1	-	-	rd-h
C. spp.	3	43	6	19	rd-h
Atomaria spp.	2	8	3	1	rd-h
Lathridiidae					
Enicmus minutus group	1	45	9	7	rd-h
E. transversus (Ol.) or *histrio* Joy	1	-	-	-	rt
Cartodere filiformis (Gyll.) (*Dienerella*)	-	5	-	6	rt
Corticaria or *Corticarina* spp.	4	60	18	85	rt
Mycetophagidae					
Typhaea stercorea (L.)	-	-	1	-	rd-h
Colydiidae					
Aglenus brunneus (Gyll.)	-	12	3	1	rt-h
Endomychidae					
Mycetaea hirta (Marsh.)	-	18	8	23	rd-h
Lyctidae					
Lyctus brunneus (Steph.)	-	1	-	-	l
Anobiidae					
Anobium punctatum (Geer)	-	11	1	28	l-h
Ptinidae					
Tipnus unicolor (Pill. Mitt.)	-	6	6	6	rd-h
Ptinus fur (L.)	-	35	6	40	rd-h
Anthicidae					
Anthicus floralis (L.)	-	2	-	-	rf
Scarabaeidae					
Geotrupes sp.	-	-	-	1	oa-rf
Oxyomus silvestris (Scop.)	2	-	-	2	oa-rf
Aphodius sphacelatus (Panz.)	4	1	-	-	oa-rf
A. prodromus (Brahm)	4	1	-	-	oa-rf
A. sphacelatus or *A. prodromus*	8	5	-	-	oa-rf
A. fimetarius (L.)	4	1	-	-	oa-rf
A. ater (Geer)	2	1	-	-	oa-rf
A. granarius (L.)	-	1	-	-	oa-rf
A. spp.	-	-	2	-	oa-rf
Cerambycidae					
Leiopus nebulosus (L.)	-	-	-	1	l
Chrysomelidae					
Donacia marginata Hoppe	4	-	-	-	oa-w-p
D. simplex F.	20	-	-	-	oa-w-p
Plateumaris sericea (L.)	2	-	-	-	oa-w-p
Hydrothassa glabra (Hbst.)	2	-	-	-	oa-w-p
Prasocuris phellandrii (L.)	1	-	-	-	oa-w-p
Phyllotreta spp.	2	4	-	1	oa-p
Haltica spp.	2	-	-	-	oa-p
Chaetocnema spp.	2	-	-	1	oa-p

Taxon	1147	1041	1141	1059	Ecological code
Scolytidae					
Phloeophthorus rhododactylus (Marsh.)	1	-	-	-	l
Curculionidae					
Apion spp.	3	1	-	2	oa-p
Strophosoma faber (Hbst.) (*Strophosomus*)	-	-	1	-	oa-p
Barynotus spp.	1	-	-	-	oa-p
Sitona tibialis (Hbst.)	-	1	-	-	oa-p
Phloeophagus lignarius (Marsh.) (*Rhyncolus*)	-	-	-	1	l
Bagous sp.	1	-	-	-	oa-d
Dorytomus spp.	3	-	-	-	oa-d
Leiosoma deflexum (Panz.)	1	-	-	-	oa
Hypera sp.	-	-	-	1	oa-p
Sitophagus granarius (L.)	-	4	2	1	g
Micrelus ericae (Gyll.)	1	-	-	-	oa-m
Ceutorhychus spp.	1	1	-	1	oa-p

The few plants of disturbed ground are represented by a very small number of seeds; they include ?fat-hen (*Chenopodium* cf. *album*), knotgrass, (*Polygonum aviculare*), one of the thistles (*Carduus/Cirsium* sp.), and stinking mayweed (*Anthemis cotula*). All of these plants will grow in most disturbed habitats but they are also known to have been crop weeds. The beetle *Brachypterus urticae* lives on stinging nettle (*Urtica dioica*), which was not represented by seeds, although *Urtica* pollen was present. These plants could have grown on drier ground above the stream edge, as stream banks are often disturbed by channel recutting, or the seeds could have been carried downstream from habitats some distance away, possibly including arable fields. The presence of heathland, though probably not immediately nearby, is suggested by a small amount of pollen of Ericales (Greig, unpub.) and the presence of the insect *Micrelus ericae* which feeds on heather, *Calluna vulgaris* (Kock 1992). *Phloeophthorus rhododactylus*, which feeds on gorse and broom (Duffy 1952), was also present, but there was no indication of these plants from the botanical evidence. Other species such as hazel (*Corylus avellana*), bramble (*Rubus fruticosus* agg.) and elder (*Sambucus nigra*) are indicated by only a small number of seed remains. It is possible that all of these remains were washed down from further upstream.

The late medieval deposits

Although given two different context numbers (1041 and 1141) during excavation, the late medieval deposit at this site are essentially one archaeological layer. It consisted of a thin but extensive spread of a black organic sediment which was the earliest evidence for activity on the site and was dated to the 15th century. This layer may have been associated with a timber building. Other material in the deposit which was not further identified included fragments of charcoal, uncharred wood, and small lumps of coal.

The biological remains present in this material suggest that this deposit has a far different origin from that of 1147. Of the beetle fauna present, 32.8% are species which appear to be commonly associated with human housing (Table 80 and Fig. 45). Most of the 'house fauna' beetles present breed in relatively dry mouldering plant and animal materials. Among these species are the Cryptophagidae, Lathridiidae, *Mycetaea hirta*, and two species of Ptinidae, the spider beetles *Tipnus unicolor* and *Ptinus fur*. It is thought that all these species are able to exploit the environment in damp timber and wattle buildings or amongst the plant debris on floor surfaces which would result from either deliberate or accidental scattering of plant materials (Hall and Kenward 1990). The presence of timber buildings on site is also suggested by the occurrence of both *Anobium punctatum*, the furniture beetle, and *Lyctus brunneus*, the powder-post beetle, which frequently live in domestic timbers.

In addition to the above species, there are others that are part of a decomposer community which is associated with rather wet and foul plant materials. Species which inhabit this type of material are many of the recorded

	1147	1041	1141	1059
Subsample weight (kg)	8	14	13	13.5
Subsample volume (l)	10	7	8	10
N	311	636	167	304
S	95	79	58	60
% (oa+ob)	76.5	5.3	8.4	5.9
% (w+d)	59.5	2.5	2.8	3.3
RT (rd + rt + rf)	52	477	122	237
% rd	1.9	20.4	24.5	33.5
% rt	9.3	36.3	34.1	40.1
% rf	10.6	3.7	9.5	2.3
% l	0.3	1.9	1.2	9.5
% g	0.0	0.6	1.2	0.3
% 'h'	2.2	32.8	29.3	44.0

Table 80. Proportions of the coleopteran faunas from Stone. For key to ecological codes, see Table 79.

	1147		1041		1141		1059
1	*Helophorus* spp. 50	1	*Corticaria/Corticarina* spp. 60	1	*Corticaria/Corticarina* spp. 18	1	*Corticaria/Corticarina* spp. 85
2	*Donacia simplex* 20	2	*Enicmus minutus* 45	2	*Trogophloeus* spp. 12	2	*Ptinus fur* 40
3	*Stenus* spp. 11	3	*Trogophloeus* spp. 43	3	*Enicmus minutus* 9	3	*Anobium punctatum* 28
4	Aleocharinae 9		*Cryptophagus spp.* 43	4	*Oxytelus sculptus* 8	4	*Mycetaea hirta* 23
5	*Hydroporus* spp. 8	5	Aleocharinae 40		*Mycetaea hirta* 8	5	*Cryptophagus* spp. 19
	Hydraena spp. 8	6	*Ptinus fur* 35	6	*Cryptophagus* spp. 6	6	*Omalium* spp. 7
	Helophorus grandis/ aquaticus 8	7	*Cercyon analis* 21		*Tipnus unicolor* 6		*Enicmus minutus* 7
			Cercyon spp. 21		*Ptinus fur* 6	8	*Cercyon* spp. 6
	Laccobius spp. 8	9	*Neobisnius* sp. 20	9	*Cercyon* spp. 5		*Cartodere filiformis* 6
9	*Scirtes hemisphaericus* 7	10	*Omalium* spp. 18		Aleocharinae 5		*Tipnus unicolor* 6
10	*Enochrus* spp. 6						

Table 81. Beetle species falling in the first ten ranks of abundance for the four assemblages from Stone, with numbers of individuals recorded given after each name.

Hydrophilidae, particularly *Megasternum boletophagum* (Marsh.) and *Cryptopleurum minutum* (Hansen 1987). Many of the species of Orthoperidae, Ptiliidae and Staphylinidae also inhabit this type of material, as do the *Monotoma* and *Corticaria* or *Corticarina* species. A modern analogue for this kind of material is the wet and blackened material around the base of hay ricks and compost heaps. Similarly, the presence of squalid plant matter or animal dung is also indicated by *Platystethus arenarius* (Fourcr.) and the *Aphodius* and *Cercyon* species. The *Aphodius* species mainly feed in animal dung although they are also found infrequently in very rotten plant materials (Jessop 1986).

Cereal remains identified included rachises of rye (*Secale cereale*), rivet or macaroni wheat (*Triticum turgidum/durum*), bread wheat (*Triticum aestivum*) and barley (*Hordeum vulgare*). The single fragment of oat chaff (*Avena* sp.) could represent either a crop or a weed. Barley and bread wheat were represented in small amounts, though this does not necessarily reflect their relative importance as crops. It is not possible to distinguish rivet from macaroni wheat on the basis of a few rachises, but it is generally assumed that such rachis material represents rivet wheat, as this wheat is more suited to the British climate and there is historical evidence for its cultivation. Rivet wheat has been grown in southern Britain at least since the 11th century (Moffett 1991) though it is no longer a commercial crop. No cereal bran was seen, either as whole grains or as fragments, nor was cereal bran seen among

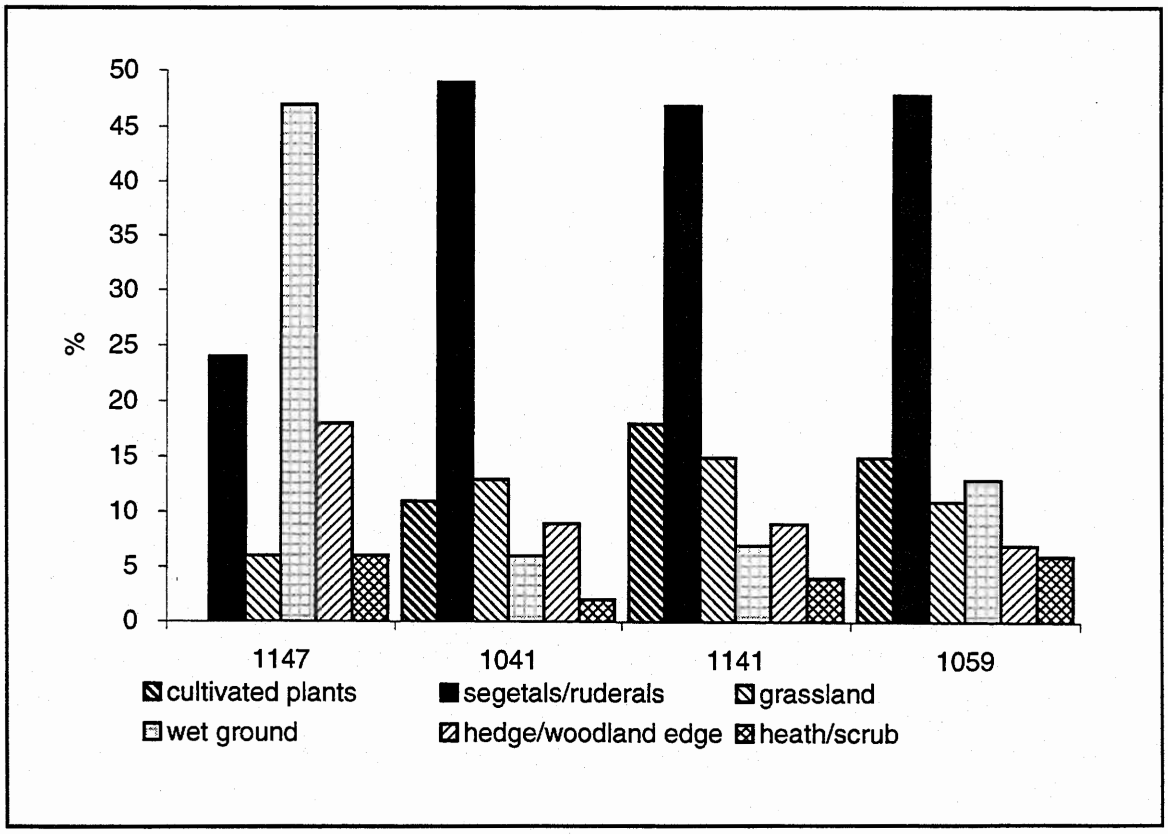

Figure 44. Percentages of numbers of species of plants recorded from Stone, by habitat groups.

the pollen material (Greig, unpub.). Since the granary weevil *Sitophilus granarius* is strictly a pest of stored grain products, its presence may indicate that there was some grain present even though its remains did not survive, or the weevil may have been introduced by chance from grain stored elsewhere.

Other crops included hemp (*Cannabis sativa*) and flax (*Linum usitatissimum*), both probably cultivated for their fibres, and beet (*Beta vulgaris*), an apparently popular vegetable at least since the Roman period (Moffett 1988). It is not yet clear at what stage the plant began to be cultivated for its roots as well as its 'greens'. A single charred bean or vetch seed (*Vicia faba/sativa*) was the only macrofossil evidence for legume crops, though legumes often do not survive particularly well in waterlogged deposits.

Grape (*Vitis vinifera*) and fig (*Ficus carica*) are more likely to have been imported. Dried figs and raisins were imported in large quantities in the later Middle Ages (Gras 1918), Wine, an essential item on the tables of the rich, was also imported in very large quantities. Vines were sometimes cultivated in England, occasionally in vineyards for wine, but probably more often on a small scale for verjuice, the medieval equivalent of vinegar. Verjuice was made from unripe grapes and thus considerably easier to produce than wine.

The largest group of plants from this period were those which grow in disturbed open habitats, generally with well-drained soils, such as crop fields, waysides, active stream banks, waste ground and gardens. Most of these plants either grow on neutral to somewhat acid soils, or are indifferent to soil pH. The great majority of plants in this group are annuals but some perennials are also well adapted to a disturbed environment. Sheep's sorrel (*Rumex acetosella)* and perennial sow-thistle (*Sonchus arvensis*) can reproduce from adventitious buds on thickened horizontal or oblique roots and thus can survive and even flourish more strongly if their root systems are broken by ploughing (Håkansson 1982).

Although many weed ecologists make a distinction, in theory, between weeds of crops (segetals) and weeds of waste and disturbed ground (ruderals), in practice this distinction

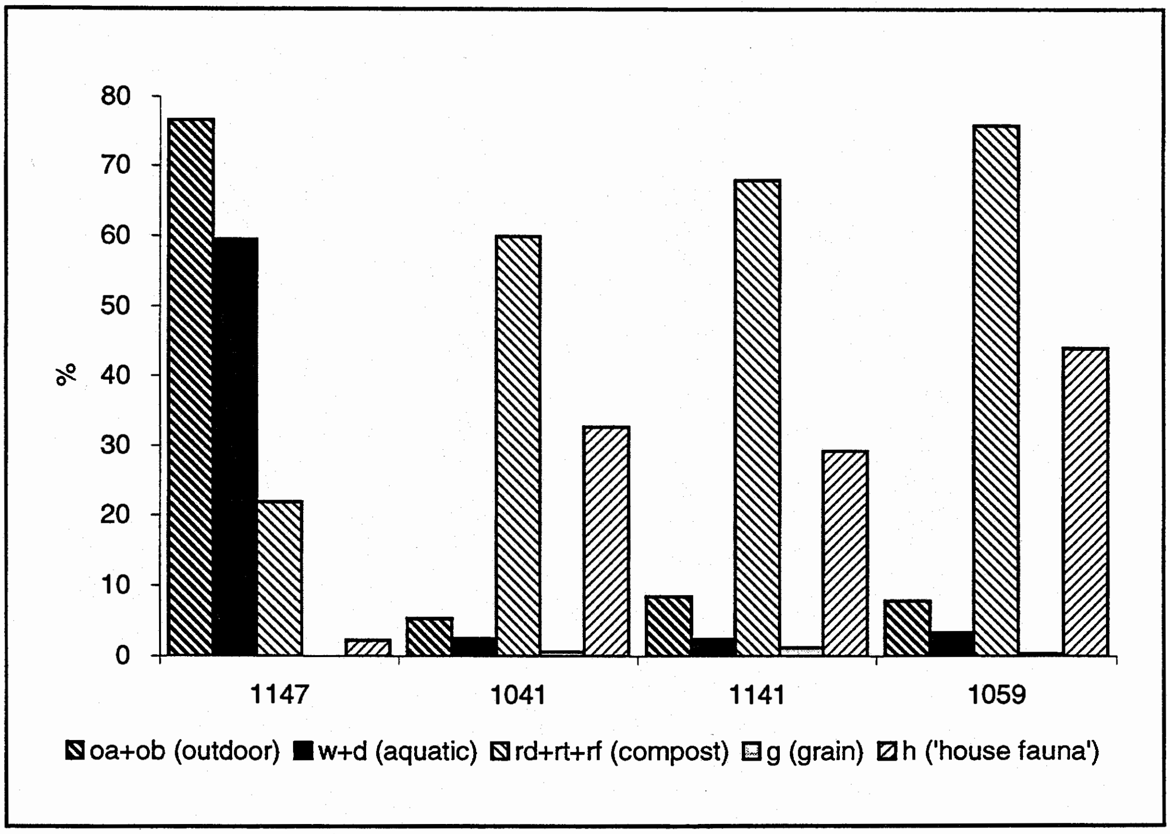

Figure 45. Percentages of beetles from Stone for selected ecological groups.

depends on specific ecological circumstances, including farming methods (Holzner 1982). Some plants are likely to have been more closely associated with arable habitats, but all of the plants in this group could have grown in crop fields and many of them also wherever human disturbance afforded suitable habitats. Association with cereal crop processing waste may have been one means by which weed seeds became included in the deposit. Others could include dumping of garden waste or clearing of disturbed areas for another use.

Plants characteristic of arable habitats include corncockle (*Agrostemma githago*), field pennycress (*Thlaspi arvense*), sun spurge (*Euphorbia helioscopia*), shepherd's needle (*Scandix pecten-veneris*), cornsalad (*Valerianella dentata*), cornflower (*Centaurea cyanus*), nipplewort (*Lapsana communis*), stinking mayweed (*Anthemis cotula*), corn marigold (*Chrysanthemum segetum*) and brome (*Bromus hordeaceus/secalinus*). A number of these plants would not be seen in a modern British cornfield because of modern seed cleaning techniques and herbicides. Corncockle, shepherd's needle, cornflower and stinking mayweed are all very rare plants in Britain today. Others, such as nipplewort, are still common but more likely to be seen today along waysides and on waste ground. The bladder campion (perhaps represented by seeds identified as *Silene* cf. *vulgaris*) was said to have been common as a weed of barley on light soils in the late 18th century (Pitt 1794, 95).

Some of the plants which today are usually associated with grassland may also have grown in crop fields. Buttercups (*Ranunculus acris/repens/bulbosus*), wild carrot (*Daucus carota*) and yellow-rattle (*Rhinanthus minor*) can grow in arable habitats. Red bartsia (*Odontites verna*), although not regarded as an arable weed today, seems to appear not infrequently in archaeobotanical assemblages in association with cereal remains. It is also mentioned by Dickenson (1976, 104) as appearing in cornfields in Staffordshire in the late 18th century. All of these plants, however, are also characteristic grassland plants, and the presence of other grassland plants in the assemblage which are unlikely to have invaded the crop fields suggests that there is a genuine presence of grassland material.

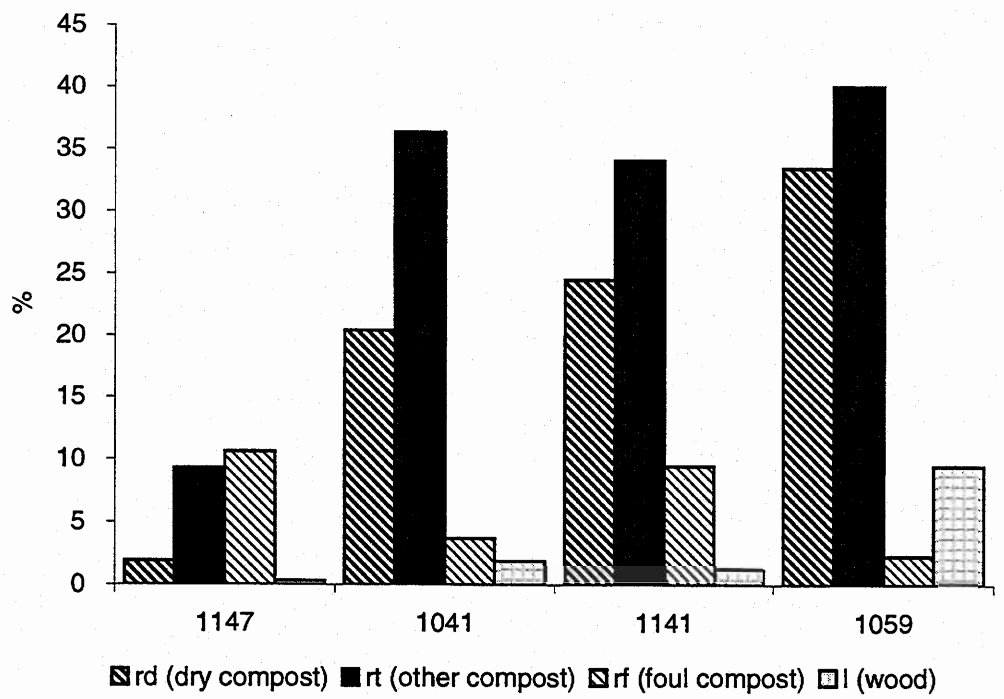

Figure 46. Percentages of beetles from Stone in compost and wood groups.

Meadow-sweet (*Filipendula ulmaria*) is a common plant of wet grassland. Yellow-rattle (*Rhinanthus minor*) and self-heal (*Prunella vulgaris*) grow in both wet and damp grassland, while cow parsley (*Anthriscus sylvestris*) is an important species of damp grassland. Other plants of damp grassland include meadow-grass (*Poa annua*) and tormentil (*Potentilla erecta*), the latter generally on acid soils. Wild carrot and salad burnet (*Sanguisorba minor*) are found in damp grassland but also commonly in chalk grassland which tends to be dry. Hawkbit (*Leontondon* sp.) and dandelion (*Taraxacum* sp.) can be found in almost any type of grassland.

Salad burnet is mainly found in limestone areas in modern Staffordshire (Edees 1972, 86) and this was apparently where it was also recorded in the late 18th century (Dickenson 1976, 111). Stone is some distance from the nearest limestone (in the north-eastern part of the county), but it need not follow that the plant was growing far afield. Liming to improve soil fertility was a common practice in the medieval period and could well have created favourable conditions for salad burnet, and perhaps also for wild carrot, another plant often found on calcareous soils.

Unfortunately the various species of beetle, lice and fleas which have been used on other archaeological sites to suggest that plant species such as these were bought onto site as hay for stabling and bedding (see, for example, Hall and Kenward 1990; Kenward and Allison 1994) were not present in these deposits at Stone.

There was a group of wet ground plants which inhabit places such as wet ditches, marshes and the edges of streams, lakes and rivers. Except for the sedges (*Carex* spp.), wet ground plants were generally represented by small numbers of seeds. Floor coverings often consisted of plant material strewn loose on the floor and sedges were well suited for this purpose, as well as for thatch. Other plants found that might have been collected, perhaps inadvertently, with the sedges are lesser or creeping spearwort (*Ranunculus flammula/reptans*) tubular water-dropwort (*Oenanthe fistulosa*), marsh lousewort (*Pedicularis palustris*), marsh sow-thistle (*Sonchus palustris*), marsh ragwort (*Senecio aquaticus*) and spikerush (*Eleocharis palustris/uniglumis*). Spikerush could possibly also have been a crop weed. It is thought to have sometimes invaded poorlydrained areas of crop fields in the past, possibly from wet boundary ditches. Although not today regarded as a weed, it has frequently been found in archaeobotanical assemblages in association with cereal remains (Jones 1988).

Hazel (*Corylus avellana*), ?bramble (*Rubus* cf. *fruticosus*), a fragment of a fruitstone similar to sloe or a primitive plum (*Prunus spinosa/domestica*) and possibly elder (*Sambucus nigra*), could all represent plants collected for food from hedgerows and woodland edges much as people still do today. Evidence of hedges is slight in terms of amount of material, but suggestive. Thorns of rose (*Rosa* sp.), sloe or hawthorn (*Prunus spinosa/Crataegus* sp.) and the spiny tips of holly leaves (*Ilex aquifolium*) could all have come from hedgerow trimmings.

Fragments of bracken frond (*Pteridium aquilinum*) were very abundant, mainly in the subsample from 1141. Bracken could have been collected from heaths, rough grassland and woodland and brought into the town, possibly for a number of purposes. Bracken could have served as bedding both for animals and people and there is evidence that it was sometimes incorporated in thatch (Letts 1994). Bracken was noted as a first layer of roofing material tied to turves with heather ropes in a study of old buildings in the Hebrides (Smith 1996).

A few leaf and stem fragments of gorse (*Ulex* sp.) suggest that it was also brought into the town, perhaps also for roofing or for fuel.

It would seem that this deposit consisted of a mixture of plant remains which built up as a result of a number of different activities. Judging from the mixed domestic character of the plant remains, the relatively low numbers of beetles of outdoor species and the dominance of 'house fauna', this may have been an internal floor surface. This point cannot be proved, however, either by the environmental evidence or by the archaeology (which was inconclusive). It is also difficult to tell if this material reached the squalid state suggested by the beetles whilst the supposed floor was occupied or if this is a decaying dump of domestic refuse cleared away from occupied buildings.

Post-medieval deposit

The medieval organic layer was cut by a sandstone wall and covered by a layer of dark silty clay. Similar dark silty deposits at the same level were excavated slightly further from the wall, and one of these (1059) was sufficiently undisturbed to sample. It is likely that the sandstone wall represents the remains of a building, but it is not clear whether the dark silty layers lay inside or outside the building. Ceramics date the deposit to the late 15th or early 16th century.

The most striking feature of the post-medieval sample was the predominance of cereal straw. Manually pulling apart unprocessed lumps of material showed fragments of cereal culms compressed together in an organic matrix. There were also some fragments of unidentified wood and a few lumps of coal.

The cereal straw itself is not at present identifiable to species but large numbers of rachis nodes of rye were found, suggesting that some or most of the cereal straw may have been rye. Rivet/macaroni wheat and bread wheat rachis fragments were also identified, but in much smaller amounts. Six-row barley and oat were present as a mere couple of fragments. Many rachis nodes were too poorly preserved to identify to species and could have been either rye or barley, but given the accompanying assemblage are far more likely to be the former.

Rye and rivet wheat are tall cereals, and old varieties of bread wheat were much taller than modern varieties. The long straw of these cereals makes them very suitable for use in thatching. Letts (1994), in a study of thatch preserved in medieval and post-medieval buildings in southern England found that rye, rivet wheat, and bread wheat were the three most common cereals used for thatching. The presence of these three cereals with a large amount of cereal straw is very suggestive of thatch, although the evidence is highly circumstantial. Straw could also have had a number of other uses including flooring and bedding. Bracken, heather and gorse were sometimes used in thatched roofs as base coats (Letts 1994), though these too could have had other uses.

The possibility that the remains could represent thatch does also receive some tentative support from the beetle remains. This fauna, similar to that from 1041, is also dominated by species which are characterised as 'house fauna' (46%). However, unlike that from 1041, the list of species which fell into the top 10 ranks of abundance (Table 81) clearly shows a dominance by the dry compost group. In particular, *Ptinus fur*, *Mycetaea hirta* and various species of Lathridiidae and Cryptophagidae are more numerous than they were in 1041. These species, and to some extent the proportions in which they are seen here, are similar to those found in thatch from abandoned Hebridean blackhouses (Smith 1996). This may suggest that roofing thatch represents an optimal environment for these species. However, the occurrence of this community and the suggestion that it represents thatch at Stone should be considered carefully. This microhabitat present in thatch and exploited by these species, could also occur in other materials and circumstances around human habitation.

The assemblage of arable/disturbed ground plants is very similar to that from the late medieval layers but the numbers of seeds of grassland species is small. Sedges and water-pepper (*Persicaria hydropiper*) were the most common seeds of wet ground plants. Hedgerow/woodland edge species were also still present, including a couple of thorns of sloe or hawthorn, although there was no sign of holly. Moss fragments were very abundant but unfortunately resources were not available for identifying them. The mosses could be of interest as it might be possible to determine whether they were collected from outside the town, and if so from what type of environment, or whether they were growing on the post-medieval structure itself.

There are a number of Coleoptera species present throughout these samples that have a historical interest. Amongst, these are the staphylinids *Trogophloeus bilineatus*, *Oxytelus nitidulus*, and the blind and flightless beetle *Aglenus brunneus*. These are species which appear to have been more common in the urban environment in the past than they are today (Hall *et al.* 1983; Hall and Kenward 1990). Although they are not as numerically dominant as in some of the Anglo-Scandinavian deposits from York (Hall *et al.* 1983) and medieval Beverly (Hall and Kenward 1980) their presence here may still suggest a continuation of this urban environment into this period at Stone. It has been suggested that a combination of climatic change and, more probably, the loss of spreads of warm decaying plant and animal matter in towns are responsible for the decline of these species (Kenward 1975).

Conclusion

Despite the relatively small size of the medieval settlement of Stone this particular area of it at least seems to have had a similar living environment to, and imported the same range of plant resources as, that seen in the larger and earlier urban centres such as Anglo-Scandinavian York (Hall *et al.* 1983). Similar environments and similar deposits have found in a range of smaller medieval towns such Anglo-Norman Durham (Kenward 1979), early medieval Beverly (Hall and Kenward 1980) and at the Early Christian rath site of Deer Park Farms, Northern Ireland (Kenward and Allison 1994). There is little previous evidence of what the environment was like in medieval towns in the English Midlands, however, since waterlogged deposits of this type have rarely been excavated and sampled. It may be significant that at Stone this 'medieval urban' type environment seems to have been present in a later period, well into the 15th century.

Acknowledgements

We are grateful to James Greig and John Letts for permission to use their unpublished material, to Gwilym Hughes for archaeological information, and to the Staffordshire County Council Highways Department and to the Severn-Trent Water Authority for funding this project. Figures 42 and 43 were prepared by Mark Breedon.

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Disk copy received: March 1995

Circaea, The Journal of the Association for Environmental Archaeology **12** (2) (1996 for 1995), 177-182 ISSN 0268-425X

An ethnoarchaeological investigation of the effects of cereal grain sieving

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Summary

Results from an ethnographic study on the Greek island of Amorgos has demonstrated that it is not easy to detect sieving on the basis of grain measurements in individual samples. The results also have implications for the identification of barley, as a sieved sample of six-row barley has a grain composition expected for a mixture of the two- and six-row species.

Introduction

When discussing the archaeobotanical recognition and consequences of crop processing, several authors have considered the effects of grain sieving on the composition of cereal samples. For example, Dennell (1972) has experimentally investigated the effect of sieving on species composition in a mixed wheat sample, while the use of grain dimensions to identify sieving or to determine sieve mesh size in archaeobotanical material has been advocated by Dennell (1972; 1974; 1978) and criticised by Hubbard (1976). More recently, Hillman (1984) described the likely effect of sieving on grain size.

This paper, based on an ethnographic study of crop processing on the Greek island of Amorgos (Jones 1984; 1987; 1988; Halstead and Jones 1989), presents evidence for the effect of sieving on grain dimensions and, more particularly, on the composition of barley samples. Cereal grain was collected from both the product and by-product of sieving crops of wheat (*Triticum aestivum* L. and *T. durum* Desf.), barley (*Hordeum vulgare* L.) and a wheat/barley maslin. The term sieving refers here to the use of a fine sieve which retains most of the cereal grain but allows smaller particles to fall through. The opposite process, whereby large particles are removed from grain which passes through a coarse sieve, is not considered here. The subsequent effects of charring on grain dimensions are also not considered in this paper.

The sieves used on Amorgos had a mesh of concentric wire rings supported by 'spokes' radiating from the centre (Fig. 47a). This allowed grains to pass through the sieve both vertically (with the long axis of the seed perpendicular to the mesh) and horizontally. It is unlikely that sieves would have been constructed in this way before metal wire came into common use. More likely forms for early prehistoric sieves are a mesh of gut, leather or wicker (Fig. 47b) or skin pierced with holes (Fig. 47c). Both these types of sieve allow grain to pass through them vertically, but not usually horizontally (unless the grains are very small).

The effect on grain dimensions

The type of sieve used has bearing on which dimension of the grain is most relevant to the effects of sieving. For the circular type of mesh, through which grains can pass horizontally, the minimum diameter is probably most relevant, but for the other types of sieve, through which grains can only pass vertically, the maximum diameter is most important. Some small grains lying horizontally might be retained by sieves which only allow grain to pass through vertically, but otherwise length should be of indirect relevance only.

For two reasons, sieving by-products might be expected to exhibit a relatively marked cut-off (corresponding to sieve mesh size) at their upper limit of maximum grain diameter, while sieving products would show no noticeable cut-off at their lower limit of maximum grain diameter (Fig. 48). First, since only a small proportion of crop seeds are removed by cleaning, grain cleaning by-products are more likely to show unusual metrical properties than are cleaned products, which should be little different to the uncleaned crops (Hubbard 1976, 263). Secondly, while large 'prime' grains are relatively unlikely to pass through to the

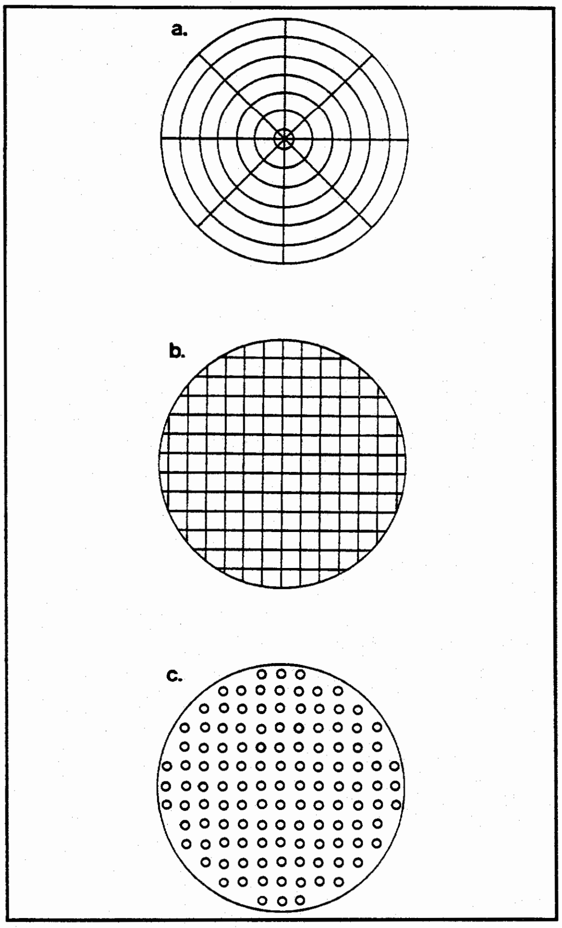

Figure 47. Types of sieve. (a) concentric; (b) checkered; (c) pierced.

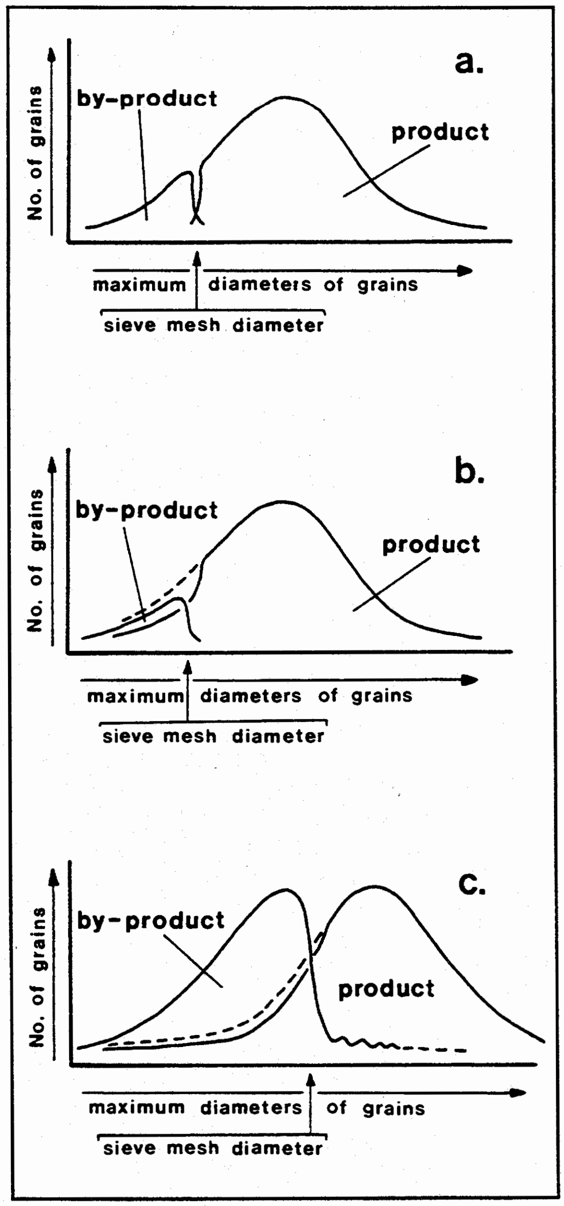

Figure 48. Predicted effects of sieving on maximum grain diameter (after Hillman 1984, 23). (a) theoretical effect; (b) more realistic effect; (c) effect when equal numbers of grains measured from product and by-product.

sieving by-product, small 'tail' grain may well be retained with the sieving product (Hillman 1984, 23).

Samples collected on Amorgos can be used to explore the metrical differences which are detectable in practice (but with reference to minimum grain diameter because of the type of sieve used on Amorgos). A mixed wheat and barley maslin from Amorgos was sieved, and the length, breadth and thickness of grains from the product and by-product were measured (Fig. 49). In each case, fifty grains of wheat and fifty of barley were measured, the sort of number routinely measured in archaeological samples.

As expected, for both wheat and barley, there is relatively little difference in grain length between the sieving product and by-product. There is much greater difference between the product and by-product in breadth and thickness. In the case of wheat, the difference is particularly marked (i.e. there is little overlap) for breadth, because this was usually the minimum diameter of the grains. Conversely, in the case of barley, the difference was most marked for thickness, as this was usually the minimum 'diameter'.

As predicted (Hubbard 1976; Hillman 1984), there was no noticeable cut-off towards the lower limits of minimum diameter (i.e. the

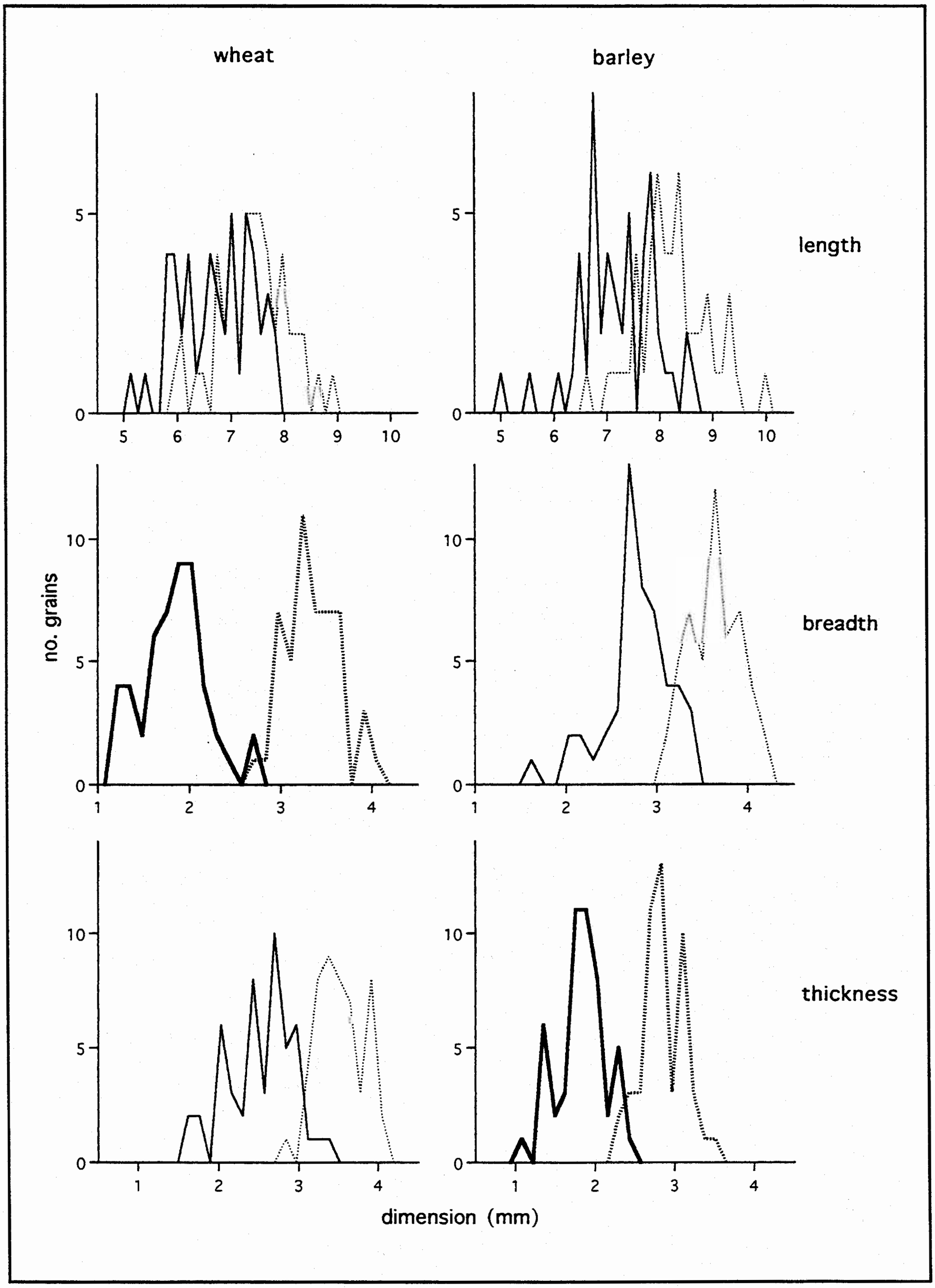

Figure 49. Effects of sieving on grain dimensions in a sample of wheat and barley maslin from Amorgos (50 grains measured from each of the product and by-product, for each cereal). Solid line—by-product; broken line—product. Bold lines indicate minimum diameter (and clearest separation of product and by-product).

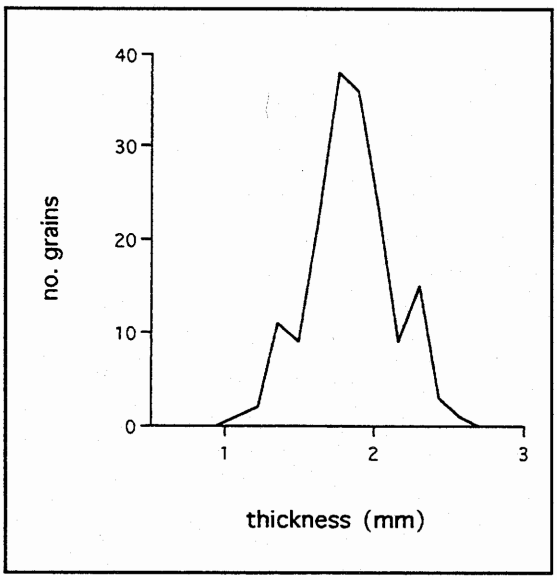

Figure 50. Effect of sieving on barley thickness in the by-product for a larger number of grains (n = 170).

breadth of wheat grains or the thickness of barley grains) in the sieving product. There was also no detectable cut-off, however, towards the upper limits of minimum diameter in the by-product. This could be because of variations in the size of the mesh in different parts of the sieve (which is likely to be even more of a problem for early prehistoric sieves). So, at least on the basis of 50 measurements, it may not always be possible to detect sieving from either the product or by-product. Indeed, measurement of thickness for a larger number of barley grains from the sieving by-product (170 grains, representing all the measurable barley grains in the by-product from that batch of sieving) also failed to reveal any detectable cut-off in the distribution (Fig. 50).

On the other hand, the predicted trough between the two distributions (for product and by-product) of minimum diameter (Hillman 1984 and Fig. 48c) is clear for both wheat and barley (Fig. 51) and corresponds closely to the known mesh size (2-2.5 mm) of the sieve used on Amorgos. Where both products and by-products are suspected to be present, on the basis of botanical composition or archaeological context, therefore, it may be possible to detect sieving by looking for bimodality in their combined grain size distribution, even when the individual distributions are near normal.

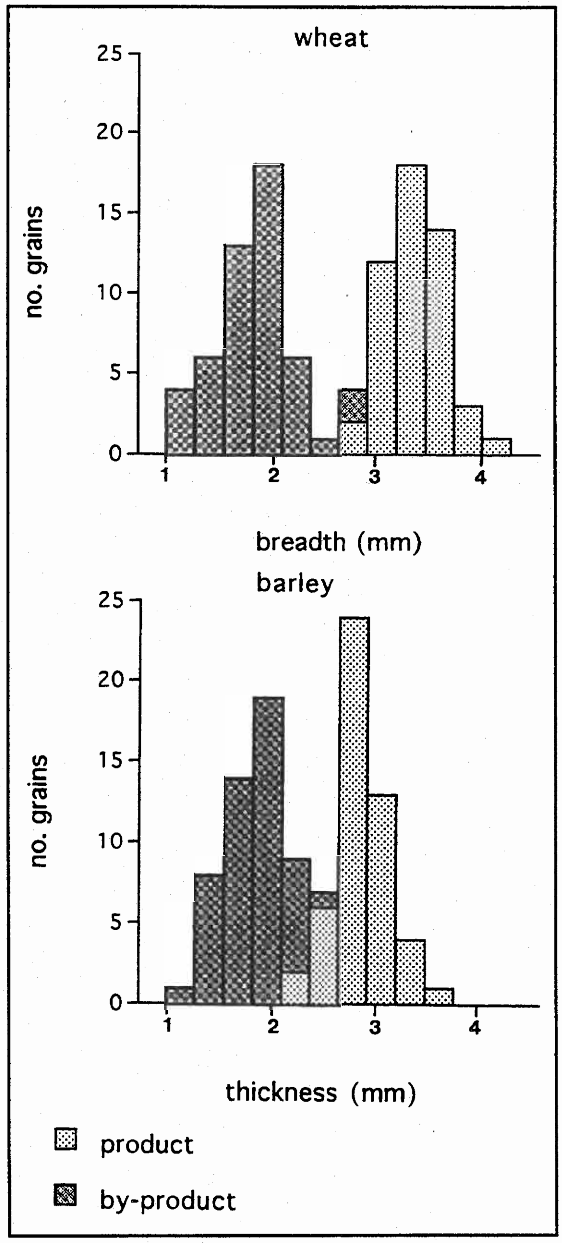

Figure 51. Histograms showing the bimodal distribution of minimum grain diameter in the combined sieving product and by-product (50 grains of each).

The effect on crop composition

Dennell (1972) has demonstrated experimentally that sieving affects crop composition as well as grain size distribution, with the smaller-grained einkorn (*T.*

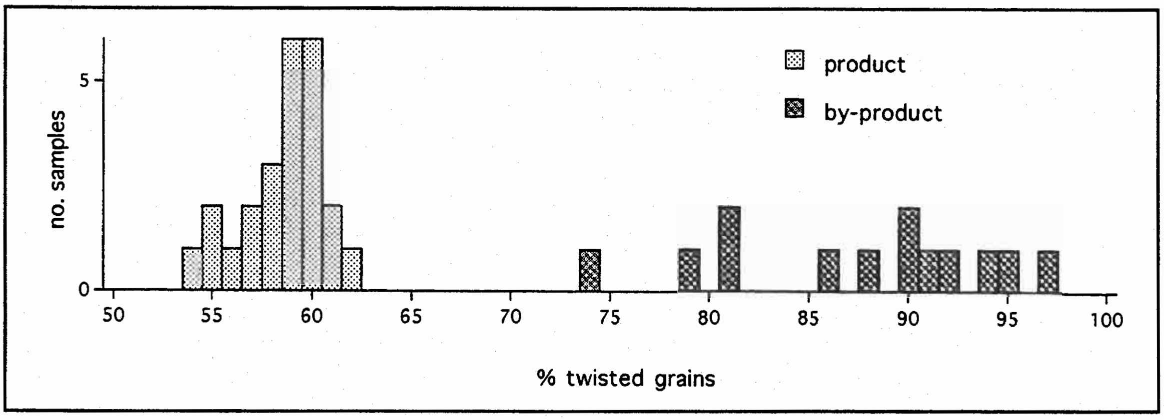

Figure 52. Histogram showing the proportion of twisted barley grains in sieving products and by-products.

monococcum L.) being selectively removed from a mixed einkorn and emmer (*T. dicoccum* Schübl.) crop by sieving. A similar effect was suggested by Gordon Hillman (pers. comm., in Milles 1986, 119) with regard to barley, as the lateral twisted grains of six-row barley tend to be smaller than the central straight grains.

This effect can be demonstrated empirically for six-row barley on Amorgos. The relative proportions of straight and twisted barley grains were calculated for samples of sieving products and by-products from barley and maslin crops. For samples with fifty or more barley grains, the percentages of twisted grains amongst total barley grains are plotted in Fig. 52. It is apparent that the proportion of twisted grains is greater in sieving by-products than in products. The percentage of twisted grains in the products is always slightly less than the 66.7% expected for six-row barley (mean 58.6%), while the percentage in sieving by-products is always greater than 66.7% (mean 87.5%).

This observation has significance for the archaeological identification of barley species. Since all the grains of two-row barley are straight, a percentage of less than 66.7% twisted grains might be taken to indicate a mixture of two- and six-row barley (e.g. Halstead and Jones 1980). In fact, a reduced proportion of twisted barley grains may indicate sieved (but pure) six-row barley (e.g. Milles 1986). This interpretation would be strengthened by other indications of sieving, such as the absence of small weed seeds (Hillman 1981; 1984; Jones 1984; 1987) or the existence of complementary samples with enriched proportions of twisted grains.

Conclusion

This study has demonstrated that sieving does not always result in a noticeable cut-off in the distribution of seed dimensions (in either the product or by-product) although, if a clear cut-off was detected, it might indicate particularly rigorous sieving. It may, nevertheless, be possible to detect sieving in quite small samples of grain by comparing the dimensions in different samples. Sieving also has implications for the identification of barley: because the proportion of straight barley grains is increased by sieving, a sieved sample of six-row barley could be mistakenly interpreted as a mixture of two- and six-row barley.

Acknowledgments

I would like to thank Drs N. J. Fieller and P. Halstead for comments on an earlier draft of this paper; neither should be held responsible for any remaining flaws. I am also grateful to Colin Merrony for drawing Figures 47 and 48.

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Disk copy received: February 1995

Circaea, The Journal of the Association for Environmental Archaeology 12 (2) (1996 for 1995), 183-189 ISSN 0268-425X

An insect fauna of Roman date from Stourport, Worcestershire, U.K., and its environmental implications

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Summary

An extensive insect fauna comprising chiefly beetles and caddis flies from a rural deposit of Roman age close to the River Severn at Stourport, Worcestershire is described. The terrestrial environment depicted is very similar to that of present day Worcestershire, consisting primarily of open grazing land with scattered trees and bushes. The aquatic insects appear, however, to show a River Severn running over a clean stony or sandy bed, rather than the silt- and mud-covered bottom we see today.

Introduction

Although insect-bearing deposits of Roman age are fairly common, most are associated with human occupation and reflect a rather stereotyped synanthropic environment. When the present site was discovered, having no apparent connection with human occupation, it was welcomed for the opportunity it provided to see what the insects could show of the rural environment of the time.

The deposit came to light in late 1982 when excavations were in progress for a marina to be constructed alongside the River Severn at Stourport, Worcestershire (National Grid Ref. SO 818 698). The attention of the late Professor Shotton was drawn to these excavations when Mr Ivor Gough, the man in charge of building operations, reported the discovery of an antler protruding from the gravel face. In consequence of this discovery Professor Shotton, accompanied by the present author, paid a visit to the site to see the situation at first hand. The antler, and a scapula which had also been found, were seen and identified as red deer (*Cervus elaphus* (L.)). Of more interest, however, was the discovery, above the gravel from which the antler came, of a bed of organic silt rich in fragments of stick and many hazel (*Corylus avellana* L.) nuts, which looked as if it might contain contemporaneous insect remains. A trial sample was taken which, suitably processed in the laboratory, did indeed show the presence of a large insect fauna, so a second visit was paid to the pit to collect samples and stratigraphic data more precisely.

The lithology of the sampled face is shown in Fig. 53. Samples were taken at approximately 5 cm intervals through the brown organic silt to detect any environmental changes which might have occurred during the period of deposition. No significant differences between the layers were detected so that finally the silt was regarded as a single entity, possibly all laid down in one flooding episode. The insects listed below, therefore, were all obtained from a bulk sample traversing the entire deposit. However, although each 5 cm sample contained essentially the same fauna, a few species were noted which were not recorded from the bulk sample. These appear at the end of the main list (Table 82) for, although they do not alter the environmental picture, some are interesting occurrences. Plant macrofossils noticed during sorting for insect remains are also recorded, although this list claims neither to be complete nor expertly compiled.

Some of the larger pieces of wood were submitted to Mr. R. E. G. Williams of the School of Earth Sciences, University of Birmingham, for radiocarbon dating and the result was a date of 1770 ± 60 years BP (Birm 1167), roughly 200 A.D.—about the middle of the Roman period in England. This date applies to the entire thickness of the organic silt (see Fig. 53) so if, as is suspected, the deposit was laid down by a single flood it would have been around this time. If, however, the material was laid down over a period of time, clearly the base and top might be considerably older and younger respectively.

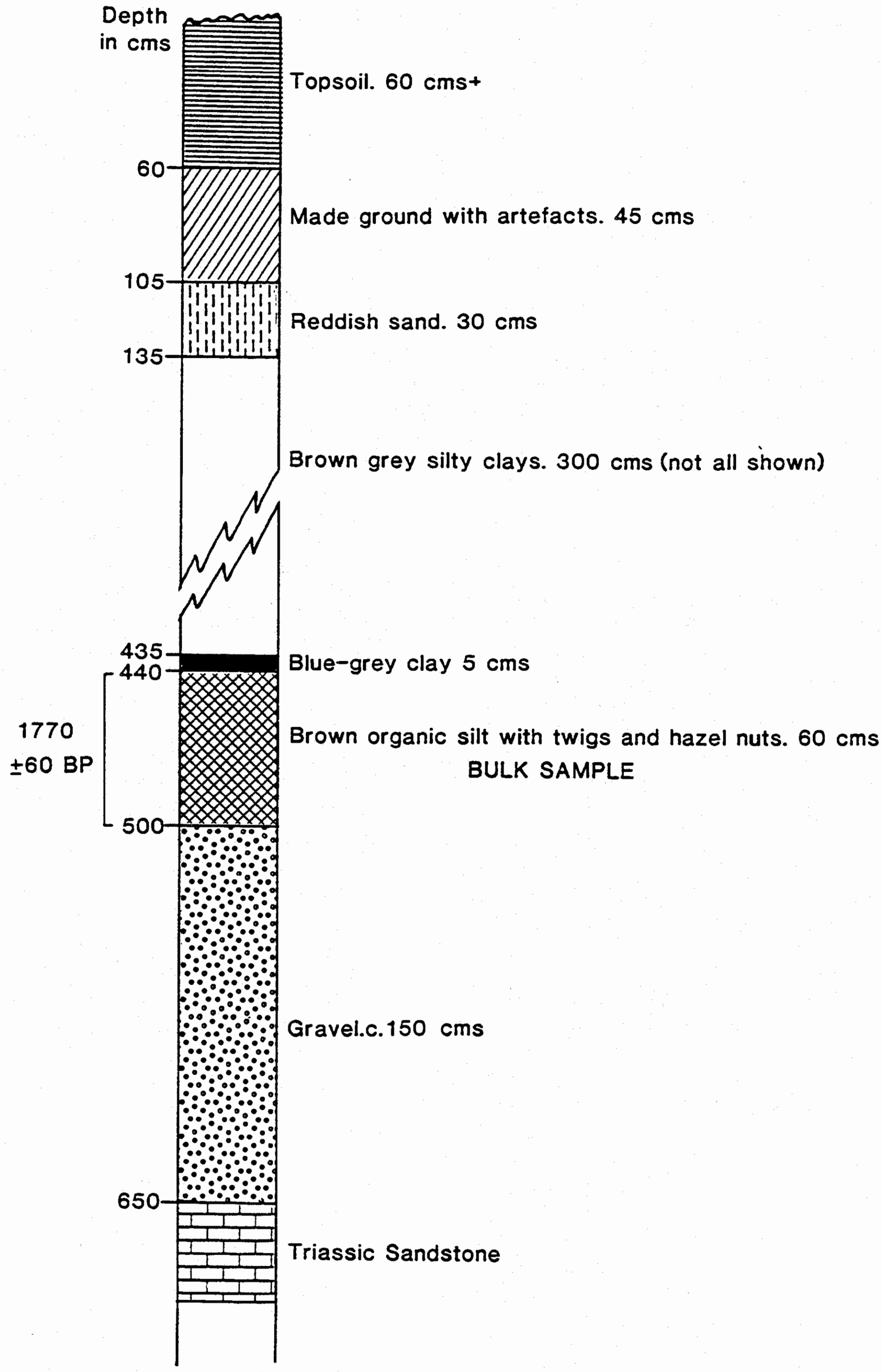

Figure 53. Lithology of the section at Stourport with sampled horizon marked. Since the material was collected some years ago, before the use of metric measurements was de rigueur, *all the measurements were taken in imperial units. To comply with today's usage these have been converted to metric but rather than introduce a spurious impression of impossibly accurate measuring by taking one inch to equal 2.54 centimetres, the less precise one foot to thirty centimetres has been used as pinpoint accuracy was unnecessary here and in practice impossible to achieve.*

Methods

The matrix was a coarse silt containing a mixture of twigs, fragments of wood, and complete hazel nuts. It broke down readily in warm water and, after washing over a 300 micron sieve to dispose of the fine mineral portion, the residue was subjected to paraffin flotation to concentrate any insect remains present. All insect fragments which appeared to be identifiable were picked out, together with any plant macrofossils which were noticed (see above).

The caddis fly larvae (Trichoptera) in the list in Table 82 were kindly named by Miss Bridget Wilkinson. Since these records are based on larval sclerites which may be repeated at each instar, numbers of individuals are difficult to estimate so they are entered as present only. The list follows the classification of Hickin (1967). In the list of beetles the minimum number of individuals needed to produce the skeletal parts identified is provided and the classification used is that of Lucht (1987).

The local environment depicted by the insects

For the purposes of this discussion the fauna may be conveniently looked at in two parts, the terrestrial and the aquatic.

The terrestrial environment

A cursory glance through the list suggests a mixture of habitats making up a landscape very similar to that of rural Worcestershire today. The carabid ground beetles illustrate this well. Such species as *Patrobus atrorufus, Pterostichus oblongopunctatus, Platynus affinis* and *P. obscurus* all live in damp, shady places, woodland for preference, while *Trechus quadristriatus/obtusus* and *Bembidion quadrimaculatum* inhabit dry, open country with short vegetation. Between these two extremes *Bembidion lunatum* and *B. harpaloides* live on damp, clayey soil, *Trechus rivularis* prefers swampy ground with *Sphagnum* and sedges (*Carex* spp.) and *Stomis pumicatus* lives in gardens and meadowland. Most of the remaining Carabidae are eurytopic and will live happily in a range of habitats. Other sections of the terrestrial fauna tend to follow a similar pattern. Thus, of the Elateridae identified, *Agriotes pallidulus* and *Adelocera murina* both live in grassland where their larvae live at the roots of grass, while *Denticollis linearis* develops in rotten wood. *Cerylon histeroides* is found beneath the bark of dead logs and *Grynobius planus* lives in dead branches. Both species of *Scolytus* named attack trees and *Acalles parvulus* is found in dead sticks on the ground in woodland. *Rhynchaenus quercus* is a leaf miner on oak (*Quercus*) and *Rhyncolus lignarius* inhabits dead wood of various sorts. In contrast to these, as well as the elaterids mentioned above, the dung beetles *Aphodius* and *Geotrupes* suggest pastureland with grazing animals, while the two chafers, *Phyllopertha horticola* and *Hoplia philanthus* both live in meadowland where their larvae attack grass roots. Amongst the phytophagous Chrysomelidae and Curculionidae many are polyphagous but the few with specific host plants e.g. *Galeruca tanaceti* (tansy, *Tanacetum vulgare* L.), *Chaetocnema concinna* (knotgrasses, etc., *Polygonum*) and *Notaris acridulus* (sweet-grass, *Glyceria*), suggest the presence of open ground. The scolytid *Phloeophthorus rhododactylus* lives in the stems of broom (*Cytisus (Sarothamnus) scoparius* (L.) Link) and related plants, all inhabitants of open country.

In addition to these two groups which represent woodland and open grassland there are a number of species present, chiefly amongst the Staphylinidae and Pselaphidae, which inhabit moss, leaf litter, grass tussocks or other accumulations of vegetable material.

It is felt that a collection of beetles from flood refuse scoured from the banks of a few kilometres of the present day River Severn would be very similar in make-up to this list of nearly two thousand years ago.

Two species not recorded from the bulk sample, but noticed in some of the smaller serial samples, are worthy of note. The first, *Ernoporus caucasicus* lives on lime (*Tilia* spp.) and, although apparently widespread in England during the latter half of the Flandrian, is now known as British from only a single locality which was not discovered until the late 1940s (Allen 1969). The Stourport record is the most recent known occurrence of the species in Britain until its rediscovery around 1948, but it adds little to our knowledge of the beetle's distribution as the modern record is from Herefordshire, only a few kilometres from Stourport. The other species, *Bembidion stomoides*, is rather more widespread in Britain today although still a rare beetle. It is a river-bank species with a predominantly northern distribution in England at present.

INSECTA	
ODONATA	
Zygoptera	
Agrion sp.	1
MEGALOPTERA	
Sialis sp. (larval mandibles)	16
HEMIPTERA	
Gerridae	
Gerris sp.	3
TRICHOPTERA (det. B. Wilkinson)	
Glossosomatidae	
Glossosoma sp.	
Agapetus sp.	
Philopotamidae	
Philopotamus montanus (Don.)	
Polycentropidae	
Polycentropus flavomaculatus (Pictet)	
Psychomiidae	
Tinodes sp.	
Lype reducta (Hagen)	
Psychomyia pusilla (F.)	
Hydropsychidae	
Hydropsyche contubernalis McL.	
H. instabilis (Curtis)	
H. pellucidula (Curtis)	
H. siltalai Döhler	
Cheumatopsyche lepida (Pictet)	
Odontoceridae	
Odontocerum albicorne (Scop.)	
Limnephilidae	
Drusus annulata Steph.	
Limnephilus sp.	
Anabolia nervosa (Curtis)	
Potamophylax latipennis (Curtis)	
Halesus sp.	
Chaetopteryx villosa (F.)	
Micropterna sequax (McL.)	
Sericostomatidae	
Sericostoma personatum (Spence)	
Goera pilosa (F.)	
Silo pallipes (F.)	
Brachycentrus subnubilus Curtis	
Lepidostoma hirtum F.	
Lasiocephala basalis (Kol.)	
COLEOPTERA	
Carabidae	
Nebria brevicollis (F.)	1
Loricera pilicornis (F.)	1
Clivina ?fossor (L.)	1
Dyschirius globosus (Hbst.)	1
Trechus secalis (Payk.)	3
T. rivularis (Gyll.)	1
T. quadristriatus (Schr.) or *obtusus* Er.	3
Bembidion lunatum (Dufts.)	3
B. quadrimaculatum (L.)	1
B. harpaloides Serv.	2
B. unicolor Chaud. or *guttula* (F.)	2
Patrobus atrorufus (Strom.)	1
Stomis pumicatus (Pz.)	1
Pterostichus oblongopunctatus (F.)	1
Platynus assimilis (Payk.)	2
P. obscurus (Hbst.)	2
Gyrinidae	
Orectochilus villosus (Mull.)	2
Hydraenidae	
Hydraena riparia Kug.	12
H. rufipes Curt.	4
H. gracilis Germ.	1
H. minutissima Steph.	1
Ochthebius bicolon Germ.	9
O. minimus (F.)	3
Limnebius truncatellus (Thunb.)	5
Helophorus cf. *brevipalpis* Bedel	6
Hydrophilidae	
Megasternum boletophagum (Marsh.)	7
Hydrobius fuscipes (L.)	1
Chaetarthria seminulum (Hbst.)	1
Silphidae	
Phosphuga atrata (L.)	1
Ptiliidae	
Acrotrichis sp.	3
Staphylinidae	
Micropeplus sp.	1
Metopsia clypeata (Mull.)	1
Olophrum piceum (Gyll.)	2
Acidota cruentata (Mannh.)	1
Lesteva punctata Er.	1
Trogophloeus arcuatus (Steph.)	3
Trogophloeus sp.	4
Oxytelus rugosus (F.)	4
Bledius sp.	2
Stenus sp.	4

*Table 82. (above and opposite). Insect taxa recorded from deposits at Stourport. *indicates a species not on present day British List. Plant remains noticed during sorting:* Ranunculus *Subgenus* Batrachium*;* Rubus *sp.;* Betula *sp.;* Alnus glutinosa *(L.) Gaertner;* Corylus avellana *L.;* Sambucus *sp.; and* Zannichellia *sp.*

Lathrobium sp.	2
Xantholinus linearis (Ol.) or *longiventris* Heer	4
Philonthus sp.	1
Tachinus rufipes (Degeer)	1
Drusilla canaliculata (F.)	1
Aleocharinae indet.	8
Pselaphidae	
Bythinus sp.	5
Tychus niger (Payk.)	1
Rybaxis sp.	1
Brachygluta sp.	3
Cantharidae	
Podabrus alpinus (Payk.)	1
Elateridae	
Agriotes pallidulus (Ill.)	1
Adelocera murina (L.)	1
Denticollis linearis (L.)	1
Throscidae	
Throscus dermestoides (L.)	2
Buprestidae	
Trachys pumilus Ill.	1
Helodidae	
gen. et sp. indet.	2
Dryopidae	
Helichus substriatus (Mull.)	2
Dryops sp.	3
Elmis aenea (Mull.)	18
Esolus parallelepipedus (Mull.)	30
Oulimnius tuberculatus (Mull.)	16
O. troglodytes (Gyll.)	13
Limnius volckmarii (Panz.)	23
Normandia nitens (Mull.)	20
Macronychus quadrituberculatus (Mull.)	10
Heteroceridae	
Heterocerus sp.	1
Byrrhidae	
Simplocaria semistriata (F.)	2
Rhizophagidae	
Rhizophagus sp.	1
Cucujidae	
**Airaphilus elongatus* (Gyll.)	1
Colydiidae	
Cerylon histeroides (F.)	1
Coccinellidae	
Exochomus quadripustulatus (L.)	1

Anobiidae	
Grynobius planus (F.)	1
Scarabaeidae	
Geotrupes sp.	1
Aphodius spp.	6
Phyllopertha horticola (L.)	1
Hoplia philanthus (Fuess.)	1
Chrysomelidae	
Timarcha tenebricosa (F.)	1
Galeruca tanaceti (L.)	1
Haltica sp.	1
Chaetocnema concinna (Marsh.)	1
Scolytidae	
Scolytus ?mali (Bechst.)	1
S. scolytus (F.)	1
Phloeophthorus rhododactylus (Marsh.)	4
Curculionidae	
Rhynchites sp.	2
Apion spp.	5
Otiorhynchus ovatus (L.)	1
Phyllobius parvulus (Ol.) or *viridaearis* (Laitch.)	2
P. calcaratus (F.)	5
Polydrusus pterygomalis Boh.	2
Sciaphilus asperatus (Bonsd.)	3
Brachysomus echinatus (Bonsd.)	3
Barypeithes araneiformis (Schr.)	3
Strophosomus sp.	6
Barynotus obscurus (F.)	1
Rhyncholus lignarius (Marsh.)	1
Bagous sp.	4
Notaris acridulus (L.)	1
Thryogenes sp.	1
Anthonomus pomorum (L.)	2
Curculio villosus F.	1
C. pyrrhoceras Marsh.	1
Curculio sp.	2
Magdalis armigera (Fourc.)	1
Acalles parvulus Boh.	1
Micrelus ericae (Gyll.)	1
Rhynchaenus quercus (L.)	1

Coleoptera recorded from other samples but not from bulk sample:

Bembidion stomoides Dej.
Dianous coerulescens (Gyll.)
Serica brunnea (L.)
Hylesinus crenatus (F.)
Ernoporus caucasicus Lind.

The aquatic environment

If, as seems reasonable from its very close proximity, the water beetles in this fauna inhabited the contemporaneous River Severn, conditions in the aquatic environment seem to have changed more noticeably than those indicated by the terrestrial fauna. Aquatic insects are represented by members of several orders including the alder fly, *Sialis*, a damsel fly, *Agrion* and *Gerris*, the pond skater. More profusely represented are the caddis flies (Trichoptera), identified by Miss Bridget Wilkinson, and the beetles, some of which were recovered in large numbers.

The first three of these, *Sialis*, *Agrion* and *Gerris*, all tend to live in or on slowly moving or still water and all could be found in the Worcestershire Severn today. The Trichoptera, however, suggest a different facies for, apart from *Brachycentropus nubilus*, whose larvae tend to live mostly in rivers with only a slow current, most of the caddis recognised by Miss Wilkinson spend their larval lives in small, running streams with clean stony, gravelly or sandy bottoms. In addition, of those species which construct portable larval cases, the great majority make them of sand grains. The remainder utilise silk to make tunnels, tubes or traps attached to stones (Hickin 1967, Lepneva 1964; 1966).

Amongst the beetles there is a substantial group whose members are today found in slowly moving or still water. These include *Hydraena riparia*, *H. rufipes*, *H. minutissima*, *Ochthebius bicolon*, *O. minimus*, and members of the genera *Limnebius*, *Helophorus*, *Hydrobius* and *Chaetarthria*, totalling just over 40 individuals. In addition, however, a number of species were found which today live principally in running streams with clean, stony beds. These species, mostly Dryopidae and Helmidae were represented by more than 130 individuals. Most of these beetles would be difficult to find in the Worcestershire Severn today and in fact some, e.g. *Helichus substriatus* and *Macronychus quadrituberculatus*, have very restricted distributions in Britain This phenomenon, of aquatic insect remains typical of, on the one hand, slowly moving or stagnant water and on the other of rapidly flowing streams, occurring together has been noted in a number of sites of pre-Roman age (Osborne 1988), Stourport being the most recent described to date. The cause of this phenomenon has been tentatively interpreted as the deposition in recent times of a layer of mud or silt on the bottoms of our larger rivers as a result of tree-felling and deep ploughing with consequent massive outwash of topsoil into the rivers (Osborne, *op. cit.*) Furthermore, evidence is accruing to suggest that this effect, of species such as *Macronychus quadrituberculatus* and *Stenelmis canaliculatus* occurring in slowly flowing Midlands rivers well away from their present day known localities, may be seen up till industrial revolution times (Osborne, in prep.).

Evidence supplied by the caddis flies (above) reinforces that of the beetles in this supposition. Most of those recorded build larval cases of sand grains or spend their larval existence in tubes constructed on the surface of submerged stones. Neither of these habitat requirements would be satisfied by a substantial deposit of mud on the river bottom.

Climate

There is little in this fauna to suggest a thermal environment differing significantly from that of today. Virtually all the species recognised are still on the British List and most would be at home in Worcestershire now. The only species not known to be living in Britain at present is the cucujid *Airaphilus elongatus*, a species apparently found in marshy meadowland. It has been found in a number of Late Glacial and Flandrian sites in Britain, with Stourport as its last known occurrence here to date. There are several possible reasons for its absence today (though it may still be living here unnoticed). Precedents for this situation include *Ernoporus caucasicus*, first noted as 'British' during the 1940s (Allen, *op. cit.*) but subsequently found to have been widespread during Neolithic and Bronze Age (and now Roman) times and *Stenelmis canaliculata*, discovered in Lake Windermere in 1956 (Claridge and Staddon 1961), which again has proved to have been quite generally distributed until fairly recently. On the other hand *Airaphilus* may have become extinct with the disappearance of some unrecognised but vital part of its habitat as a result of man's activities. An analogous situation is provided by beetles dependent on dead wood. Many species are known to have disappeared from this country over the last few thousand years as the forests have declined because of the growth of agriculture, and the pitiful remnants have been cleaned up, first by such agencies as firewood collecting and rooting by pigs and (more lately) in the interests of forestry (e.g. Osborne 1972).

The other possibility is that *A. elongatus* was a victim of the so called 'Little Ice Age'. Precedents for this are very few, probably because little research has been carried out on faunas which lived close either side of this event. The most likely candidates, hitherto, were *Gyrinus colymbus* (Girling 1984) a whirligig beetle found in medieval Leicestershire but now found no nearer than the eastern seaboard of France or southern Norway, *Aphodius quadrimaculatus*, a French species recorded here from a Bronze Age deposit (Osborne, 1969) and the widespread European ladybird *Coccinula quattuordecimpustulata*. It is possible that a number of species were eliminated from Britain by this cold spell but the effect may be to some extent hidden by the existence of exotic beetles imported from the continent to 'improve' the cabinets of collectors in Victorian times (see Allan 1943). Many specimens now reside in old British collections which are no longer found here but which still find a place in the British List, but it is noticeable that many of these are large or brightly coloured or otherwise collectable, whereas those which are now very rare or extinct but which can be proved from fossil evidence to have been living in this country prior to the rise of the Victorian collector, such as *Ernoporus*, *Stenelmis*, *Gyrinus colymbus* and now possibly *Airaphilus*, are small, dowdy and obscure.

Further research will probably clarify the status of *Airaphilus* in Britain. Its presence, however, in a fauna otherwise notable for its ordinariness is not enough to justify any conclusions about the contemporaneous climate. The overwhelming majority of those insects identified suggest climatic conditions very like those of today.

Conclusions

The environmental picture presented by the Stourport insect fauna of rural midland Britain is one of mixed open and wooded country, much like present day Worcestershire but probably with a much cleaner River Severn running over a bed of sand, gravel and stones rather than the mud and silt seen today.

Acknowledgments

My thanks are chiefly due to Mr Ivor Gough who brought the site to our notice and allowed sampling to go on despite the work on the marina. I would also like to thank Miss Bridget Wilkinson for her great contribution in identifying the caddis fly remains, without which any conclusions reached would have been much diminished in value.

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Typescript received: January 1995

Circaea, The Journal of the Association for Environmental Archaeology **12** (2) (1996 for 1995), 191-194 ISSN 0268-425X

Southerly-derived fluvioglacial deposits near Scrooby, Nottinghamshire, U.K., containing a coleopteran fauna

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Summary

Sand and gravel deposits near Scrooby, in northern Nottinghamshire, and similar deposits elsewhere in southern Yorkshire and the eastern midlands, are interpreted as southerly-derived meltwater sediments formed during an early deglacial phase of the last pre-Devensian ice cover in the region. A lens of peaty silt in the deposits near Scrooby yielded beetle remains which indicate a cold continental climate and a sparse low vegetation on damp ground and around localised pools, probably existing during a pause in meltwater flow.

Introduction

In 1972 Mr P. Scholey, the owner of Scrooby Top Gravel Pit, between Scrooby and Ranskill in north Nottinghamshire, reported to Doncaster Museum that a thin lens of fibrous peaty silt was exposed (at SK 6575 8930) within the sand and gravel worked there. Dr Paul Buckland, then at the museum, collected a small sample (0.25 kg) of the peaty silt, processed it and passed it to one of the authors (M.G.) for examination. Despite subsequent visits to the pit, no further traces of organic deposits were found. A paper essentially similar to this one was prepared later in the 1970s but publication at that time was not possible. Tragically, Maureen Girling died on Christmas Eve 1985, but the original paper survived amongst the other author's unpublished work and is now presented, with suitable amendments. Grateful acknowledgment is made to Dr Terry O'Connor, a colleague at Bradford, for the encouragement that resulted in publication, and to Dr Buckland for similar encouragement and also for advice on the coleopteran content.

The sand and gravel deposits

The deposits at Scrooby Top Pit vary from pebble-free sand to gravel with a sand matrix. Most of the contained pebbles are of 'Bunter-quartzite' type, derived from pebble-rich varieties of the Triassic Sherwood (formerly Bunter) Sandstone; the other pebbles in the gravel are of flint or more rarely of Carboniferous sandstone. The deposits rest on Sherwood Sandstone, which this far north consists of red sandstone containing only a few small pebbles, and the top of the deposits is cryoturbated and strewn with ventifacts.

Similar deposits form scattered outcrops on locally elevated ground within a belt of country stretching south-south-westwards from the southern side of Doncaster Race Course to the Mansfield-Hucknall area, and rising in this direction from about 12 m OD to slightly over 180 m OD (Gaunt 1976, fig. 16). Their pebble composition is similar to that given above for Scrooby Top except for those gravels situated on or close to outcrops of Permian rocks, which in places contain small proportions of pebbles of Permian limestone. Local details of these deposits are included in several Geological Survey memoirs (Gaunt 1994; Eden *et al.* 1957; Smith *et al.* 1967; Smith *et al.* 1973; Edwards 1967; Frost and Smart 1979), and their depositional environment has been described elsewhere (Gaunt 1976, chapter 12; 1981, 87-8; 1994, 104-6), so only a summary is given here.

Several factors imply a southerly derivation. The 'Bunter-quartzite' pebbles, in the more northerly deposits especially, must have come from the south because in central and northern Nottinghamshire the Sherwood Sandstone becomes increasingly poor in pebbles in a northerly direction, and it contains virtually no pebbles from Bawtry northwards. Moreover, even in the more southerly deposits an appreciable proportion of these pebbles can be matched in size only by those in the Sherwood Sandstone of the upper Trent Valley.

It is highly unlikely that the small but persistent amount of flint pebbles in the deposits came directly from the Chalk to the east because there are no accompanying pebbles of durable Jurassic rocks, which crop out widely in that direction also; the only other source of flint pebbles is to the south, from the 'chalky' glacial deposits, or directly from the pre-Devensian 'chalky' ice itself, in the middle Trent Valley. The sand in the deposits is reddish-brown and 'clean', which implies a Sherwood Sandstone source; because the pebbles preclude a northerly derivation this source must lie to the south. Their 'clean' condition contrasts with other sands in the region derived from Carboniferous rocks to the west and north-west, which are yellow-brown, 'dirty' (because of the presence of finely fragmented coal and mudstone) and commonly clayey. Cross-bedded directions measured in the more northerly deposits dip predominantly to the north.

Stratigraphic evidence implies a pre-Ipswichian age (*sensu* Mitchell *et al.* 1973) for the deposits. In places, notably in the Doncaster-Bawtry area, the deposits rest on tills and other glacial sediments formed during the last complete ice cover of the area, which is demonstrably pre-Ipswichian. There also, the cryoturbation and ventifact-strewn periglacial surface coincident with the top of the deposits can be traced under late Devensian 'Lake Humber' sediments and, farther north-east, under coeval glacial sediments. Finally, it is apparent that after formation of the sand and gravel deposits there was a phase of valley incision and general denudation prior to formation of the older river (sand and) gravel of the area, which is demonstrably Ipswichian in age.

The deposits cannot be marine or lacustrine because of their wide range of elevations, and formation directly from ice in *situ* is precluded by their pebble composition, which is utterly different from the north-westerly derived erratic suites in adjacent tills. The sedimentary features suggest a torrential fluvial or fluvioglacial origin. However, the former would require a degree of topographic inversion since the last pre-Devensian ice cover that is unacceptable on geomorphological grounds elsewhere in the region.

In addition, 'chalky' glacial deposits are absent north of the middle Trent Valley, so it seems likely that at least the flint pebbles and the larger of the 'Bunter-quartzite' pebbles were transported over the watershed along the northern side of this part of the valley. Only fluvioglacial transport provides a feasible explanation of these various points. It is concluded, therefore, that the deposits formed during an early deglacial phase of the last pre-Devensian ice cover in the region when, probably because of the enormous isostatic depression of northern Britain, meltwater from the middle-upper Trent Valley escaped in a north-north-easterly direction along routes running approximately between Hucknall and Doncaster. These routes were presumably to some extent still confined by large masses of ice, especially to the south-east and east, because such an early meltwater phase must have occurred prior to the cutting, also by meltwater from the middle-upper Trent Valley, of the 'trench' between Nottingham and Newark, and deposition of the Eagle Moor (formerly part of the Hilton) terrace deposits between Newark and Lincoln (Straw 1963; Brandon and Sumbler 1988).

The coleopteran fauna

The sample of peaty silt from Scrooby Top Pit yielded 11 beetle taxa. Several of the species are now limited to more northerly regions and two are no longer living in Britain. In the following faunal list the nomenclature of the British species follows Kloet and Hincks (1977), and the non-British species are indicated by an asterisk. The fragments are expressed as a minimum number of individuals (MNI).

Carabidae	
Patrobus septentrionis Dej.	1
Dytiscidae	
Hydroporus sp.	1
Hydrophilidae	
Ochthebius sp.	1
Helophorus aquaticus (L.) type	2
**H. jacuticus* Popp.	2
Hydrobius fuscipes (L.)	1
Staphylinidae	
**Acidota quadrata* Zett.	1
Tachyporinae indet.	1
Curculionidae	
Otiorhynchus nodosus (Müll.)	3
Notaris aethiops (F.)	2
Rhinoncus castor (F.)	1

The ecological requirements of the fauna as a whole suggest a largely barren, treeless landscape, with sparse, low vegetation growing damp ground and around small pools. *Patrobus septentrionis* is generally found on damp soils, although Lindroth (1974) states that the species is less hygrophilous farther north. The typical habitat of *Helophorus jacuticus* (*H. praenanus* of Angus 1973) is small grassy pools, and *Hydrobius fuscipes* lives in well-vegetated small pools. Damp ground or accumulations of plant debris around pools would also provide suitable habitats for the Staphylinidae. The three weevils are herbaceous plant feeders. *Notaris aethiops* has been recorded on *Sparganium ramosum* Huds., *Otiorrhynchus nodosus* is recorded on a wide range of plants, including *Rumex* species, *Dryas octopetala* L. and *Trifolium repens* L., and *Rhinoncus castor* occurs on *Polygonum aviculare* L. and *Rumex* species (Hoffman 1950-8).

The present distributions of most of the species indicate a colder, more continental climatic regime than that occurring in the southern Yorkshire-eastern Midlands region at present. *Helophorus jacuticus*, one of the non-British species, is now restricted to Siberia. It has previously been recorded from the pre-Ipswichian deposits at Balderton, near Lincoln (Coope and Taylor 1991), and from the 'Wolstonian channel' deposits at Brandon, Warwickshire (Osborne and Shotton 1968); it appears also to have been widespread in Britain during the colder phases of the Devensian glacial Stage. The other non-British species, *Acidota quadrata*, has a high arctic distribution at present, extending southwards in Scandinavia and Canada only at high altitudes. Three of the remaining species, *P. septentrionis*, *O. nodosus*, and *N. aethiops*, are now limited to northern regions of Britain. *Rhinocus castor* has the most northerly range of this genus in Europe; it is of interest to note that the very small size of the specimen from Scrooby lies outside the typical size range of this species found in Britain, but closely resembles examples in the Natural History Museum, London, which were collected from Newfoundland.

Despite the small size of the faunal list, the ecological requirements and climatic implications of most of the eight named species are sufficiently distinct to give a fairly clear picture of the extremely cold, almost barren, depositional environment of the peaty silt containing the Coleoptera. The implications of the fauna are, therefore, compatible with the southerly-derived meltwater hypothesis advanced above, and the fauna possibly lived around transient pools or abandoned channels during a local pause in the meltwater flow of sufficient duration to allow the establishment of a sparse low vegetation close to the water's edge.

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Typescript received: May 1995

biological species all wheat taxa that readily interbreed (for further discussion of the definition of species see Cronquist 1978; Gupta and Baum 1986; Mayr 1992; Miller 1987). For example, wild emmer and domesticated emmer are interfertile, and are thus considered subspecies of the one species. In the tetraploid free-threshing wheats, virtually all the traditional species with the genomic complement AABB are accorded only subspecies or varietal status within one species: in MacKey's (1966) system *Triticum turgidum* (L.) Thell. Thus under MacKey's system domesticated emmer is known as *Triticum turgidum* (L.) Thell. ssp. *dicoccum* (Schrank) Thell. and macaroni wheat as *Triticum turgidum* (L.) Thell. ssp. *turgidum* conv. *durum* Desf. Mk.

Overall there was agreement on the following:

(a) Both systems offer advantages in that they emphasize different characteristics which are useful in different roles. The biological species system better reflects the genetic and evolutionary relationships, and thence patterns of variation in morphology. The traditional binomial system is much more conveniently expressed in writing, and continues to be the system most familiar to most archaeobotanists.

(b) Whichever system is chosen, it should be used consistently and accurately, with reference to a specified published checklist. Miller (1987) offers a convenient synopsis of a range of nomenclatural systems; Zohary and Hopf (1993) present a streamlined version of the biological species system.

(c) Most participants noted that, for most of their publications, they used the traditional species system and would probably continue to do so.

(d) It was also agreed that in publications in which it is important to stress the nature of evolutionary relationships or the pattern of manifestation of specific features within single biological species, the biological species system could be an appropriate format (e.g. Hillman and Davies 1990; 1992; Zohary and Hopf 1993).

For the purposes of the present paper we are using the version of the traditional binomial system outlined by Miller (1987, 18).

2. *Applicability of modern taxonomies to ancient specimens*

The question next arose of whether there was any justification for applying the names of present-day wheat taxa to ancient forms. In some cases this is satisfactory: there *is* a clear similarity between, for example, modern emmer wheat spikelet and grain morphology, and that of many ancient tetraploid glume-wheat remains, so these can be justifiably named as emmer. Further, the use of familiar Latin names means that we are using nomenclature easily understood in different languages, and allows ancient plant remains to be linked to the wider agronomic and botanical literature.

Nevertheless, concern was expressed on two grounds:

(a) Our view of the range of taxa in ancient assemblages could be overly narrowed by the limited number of taxa surviving today. Obviously archaeobotanists have to start with known modern taxa and work back to identifying ancient unknowns, but we should consider the possibility that taxa which are no longer extant were present in the past. Furthermore, assemblages are likely to have derived from far more complex mixtures of landraces and species than are known today.

(b) Use of modern names for ancient wheats might appear to indicate that they share not just morphological but also ecological characteristics with their modern counterparts. It was agreed that any such assumptions should be discouraged for several reasons.

(i) Any one species (even the narrower classical species of the traditional system) embraces a broad spectrum of ecological tolerances which overlap massively between the different species. Although the modes and medians of the frequency-distributions of values for any one aspect of their ecology are doubtless different in each of the species, the overlap of the respective distributions is so great that archaeological remains assignable to a named species on the basis of morphology cannot be assumed to exhibit a known set of ecological tolerances (Davies and Hillman 1988, 603).

(ii) All ancient wheat populations, like their present-day progeny, are likely to have experienced intense selection pressure on those features of physiology which determine their ecological tolerances. The range of ecological tolerances represented in each population will have changed through time, and these changes will have accelerated when seed-stocks were sown in new areas. See, for example, the classic experiment of Harlan and Martini (1938).

(iii) Our knowledge of the ecology of archaic wheats is based on such a narrow range of surviving populations as to be hardly representative of the galaxy of forms which existed in the past. For example, emmer was (and is) basically a winter wheat (Miller 1992, 251), but once it ceased to be the principle wheat of arable farmers, atypical, spring-sown forms were particularly advantaged. These could be sown at the last minute as an optional extra if farmers found they had spare land and time after planting more important spring crops such as legumes (Hillman 1981, 146-8). The samples of emmer obtained by Percival for his classic monograph (1921, 188) came from just such areas where emmer had become a marginal crop, and it is hardly surprising that these are listed as spring-sown.

There was general agreement that we should be extremely careful about extrapolating ecological characteristics from a limited range of modern examples to ancient populations.

3. Systematic application of botanical names

In concluding discussion of this point, consensus was reached that applying a name to ancient assemblages of wheat should follow three steps:

(a) The separation of clearly defined morphological groups in the material.

(b) Referral of the groups to (i) ploidy level and (ii) free-threshing or glume wheat status.

(c) Application of a botanical (Latin) name to each group, or the indication of an intermediate status between two or more known taxa.

However, it was particularly emphasized that botanical (Latin) names should be used only as shorthand for specified groups of character combinations (i.e. ploidy level and glume wheat/free-threshing status), *except in those rare cases where a more specific identification is possible.* It was generally felt that identification tables should contain both groupings (as in (b)) and Latin names. For the most common domesticated wheats, following the binomial system suggested by Miller (1987), the referral of names would be as in Table 83.

Thus the term '*T. durum/turgidum* group' would be applied to all tetraploid, free-threshing wheat remains, except for *T. carthlicum*. It would not imply (or rule out) any more specific identification to, say, *T. durum*, *T. turgidum*, *T. turanicum* or *T. polonicum*. As stressed further on, any more detailed level of identification would require explicit justification. Such more detailed identifications are in practice rarely possible in ancient specimens.

Where we are unable to determine either of the key characters—ploidy level and free-threshing/glume wheat status—we should make this clear. For example, if we can say that some grain is free-threshing, but its ploidy level cannot be determined, it should be named simply as 'free-threshing wheat'. The custom in older publications of naming all free-threshing wheat as '*T. aestivum*' or 'bread wheat' should obviously be avoided. Most identifications to ploidy level of free-threshing wheats prior to the early 1980s are highly suspect.

With regard to the use of terms relating to free-threshing and glume wheats, we have yet to confront fully the problems caused by the existence of intermediates between glume wheats and free-threshing wheats in both the tetraploid and hexaploid series. These include forms of *T. durum* collected in Turkey by GCH in which the top half of the ear shatters like emmer, and the speltiform *T. aestivum* collected by Kuckuck (1964) in Iran and by GCH in east Anatolia, in which parts of many of the ears shatter on threshing, as in *T. spelta*.

4. Use of geographical and ecological distributions in identification

Identification of wheat remains on geographical or ecological grounds has long been made by archaeobotanists: for example, the long-held assumption that prehistoric free-threshing wheats in central Europe must be hexaploid—now overturned by Stefanie Jacomet's work on the mainly tetraploid Swiss Lake Village material (Jacomet *et al.* 1989, 327; Jacomet and Schlichtherle 1984), and the automatic identification by some archaeobotanists of free-threshing wheats from the Indian subcontinent as *T. sphaerococcum*, rather than simply to the *T. aestivum* group.

Another common example of this practice is the automatic identification of free-threshing wheats from the Mediterranean area as tetraploid, even though hexaploid wheats are cultivated widely in the area today. In view of the wide ecological ranges of wheat both within the traditional species, and within ploidy level, this kind of assumption is inappropriate. Wheats of *all* ploidy levels will grow in virtually all parts of the world in which wheat grows.

Ploidy level	Free-threshing/ glume wheat	English name	Botanical name and authority
Diploid	Glume	Domestic einkorn	*T. monococcum* L.
Tetraploid	Glume	Domestic emmer	*T. dicoccum* (Schrank) Schübl.
Tetraploid	Free-threshing	Macaroni/ Rivet wheat	*T. durum* Desf./ *T. turgidum* L. group
Hexaploid	Glume	Spelt wheat	*T. spelta* L.
Hexaploid	Free-threshing	Bread wheat	*T. aestivum* L. group

Table 83. Naming system for archaeological remains of domesticated wheats.

The ploidy levels of wheats growing in a particular area must always be demonstrated by application of rigorous identification criteria. Even where wheats of one period are generally found to be of only one ploidy level, it cannot be assumed that other finds of this period are the same.

Similarly, identifications are sometimes made *within* ploidy level on regional/ecological grounds. For example, rachis remains that are otherwise similar are often identified to *T. durum* in Mediterranean areas, and to *T. turgidum* in northern Europe (see Moffett 1991 for a useful discussion of tetraploid wheats). Identifications made in such a way are generally insecure unless it is clear they are made in a wide inclusive sense meaning 'free-threshing tetraploid wheat', as recommended in this paper. We recommend that the botanical name applied to such rachis remains is '*T. durum/turgidum* group'.

Some cultivated wheats that today have very local distributions—for example *T. macha* and *T. carthlicum*—may have been more widespread in the past; in the case of taxa such as *T. carthlicum*, distinguished by small genetic differences, they may have arisen by mutation more than once. For the wild wheats our knowledge of distribution is still highly uncertain, and again may not in any case reflect past distribution. For example, *Aegilops squarrosa* L. (also known as *Ae. tauschii* Coss.), a wild ancestor of *Triticum aestivum*, has recently been found in China, where it was previously unknown (Yen *et al.* 1983, 55-6). The ecology and distribution of remaining populations is likely to have changed over the millennia, as many of the areas in which wild wheats may have grown are now under intensive cultivation. The consensus of the meeting was that assumptions about the presence of species based on assumed past geography and ecology are potentially misleading.

5. Conclusions: wheat taxonomy and nomenclature

(a) Application of modern wheat taxonomy to ancient material should be undertaken with care, and should be accompanied by full morphological characterization and justification. The possibility that plant remains may include other, less widely-distributed taxa, or those for which there are no modern analogues, must be allowed for.

(b) Both the traditional binomial system and biological species system of naming have advantages. The binomial system has the advantage of being well known and simple. The biological species system is appropriate when the emphasis is on the study of the evolution and genetics of wheats or precise patterns of morphological variation. Whichever is chosen, explicit reference should be made to the system of nomenclature used, as well as to the identity of accessions of modern reference specimens used for comparison.

(c) Latin names of modern wheat taxa can usually be applied to ancient remains only in a broad sense; identifications to a more specific level must be fully justified. Tables of identifications should include both descriptive characters (glume wheat/free-threshing status; ploidy level) and any botanical names used.

(d) Use of geographical and ecological distributions to identify plant remains is inappropriate; equally, identifications of wheat remains should be used to infer past growing conditions only with extreme caution.

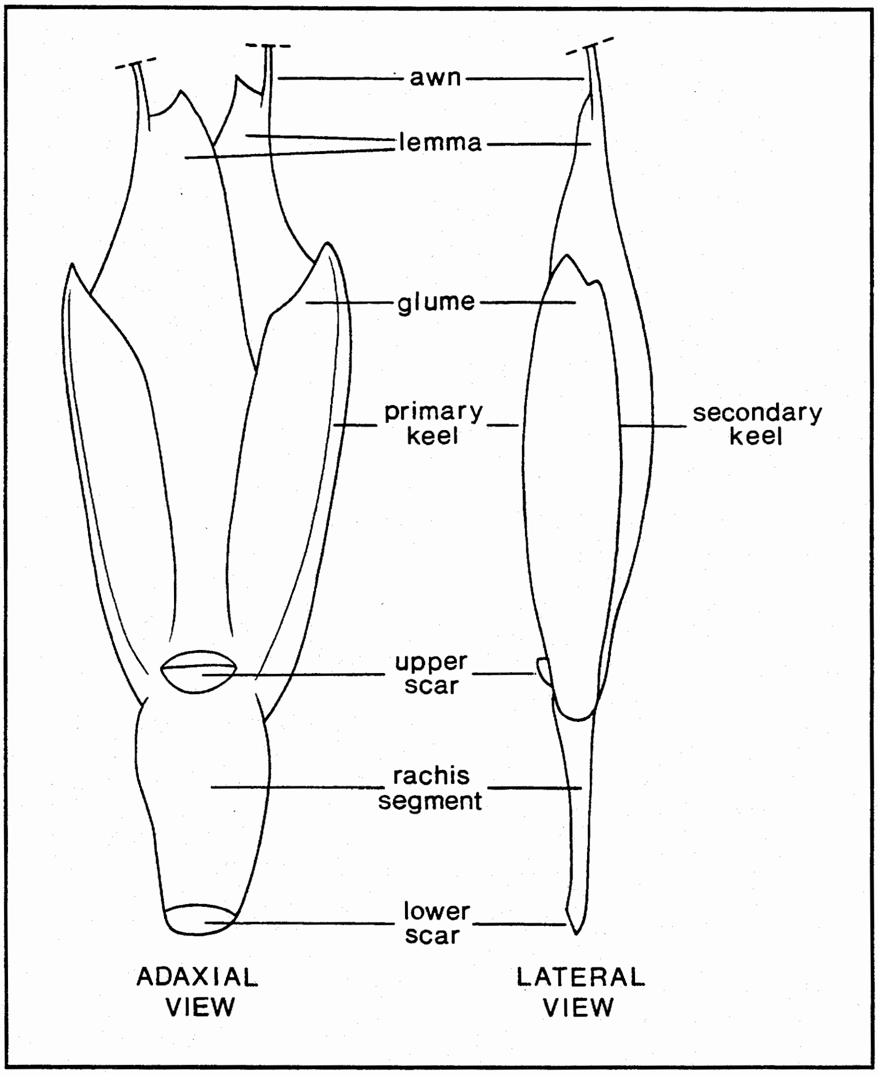

Figure 55. The principal diagnostic features of a stylized spikelet of a glume wheat. (From Nesbitt 1993).

(e) This session ended by discussing our incomplete state of knowledge of the taxonomy of present-day wheats. Work on morphological characterization has not progressed in the same way as that on genetics, particularly with regard to the rarer taxa. Reference material is often incorrectly identified and, when grown on to increase stocks, has often hybridized with other taxa.

Glume wheat chaff

(Convenor: Stefanie Jacomet, Botanical Institute, University of Basel)

This primary concern of this session was the separation of spikelet forks and glume bases of einkorn, emmer and spelt. Terminology of spikelet parts is shown in Fig. 55. Stefanie Jacomet first presented a synopsis of the characters (particularly the prominence of veins on the glumes and the shape of the glume shoulder and apex) which have proved diagnostic in investigations of Swiss waterlogged assemblages where material such as whole ears (including parts that often do not survive in charred material) have been preserved (Jacomet 1987; 1989, table 13; Jacomet *et al.* 1989, 325). Gordon Hillman then summarized additional criteria that he had isolated from studies of modern wheats which can be used with more fragmentary remains, as outlined in his 1978 student guides. These include the relative width of the rachis scar (expressed as a percentage of spikelet width at the level of the scar); features of the rachis internode (see next section); the prominence of (and angle at) the secondary nerve (secondary keel) of the glume; the pattern of tertiary venation on all glume surfaces, and the angle and prominence of the primary keel (Jacomet's '*Hauptkiel*'). After warning of the variation within single ears which occurs in several of his chaff characteristics, he went on to outline features (commonly surviving in charred chaff) which provide clues to the part of the ear from which the spikelet derived, and which thereby permit more exact use of the species-diagnostic criteria.

Of Hans Helbæk's criteria (1970, 204-5), the absolute width of the glume base has been found useful (for example, Nesbitt 1993, 83-6), but *relative* width of the upper rachis disarticulation scar is more reliable than the absolute width. The third of Helbæk's features (absolute spikelet width) was usually unreliable. In addition, when confronted with fragmentary remains of glume bases, most agreed that as primary determinants, they used the features of glume venation and the angle at primary and secondary nerves (keels), as outlined by Hillman in his student guides.

However, it was also agreed that most of these features varied between the different populations of any one species as represented by the assemblages from different sites, and that we should not expect them to have universal validity through time and space. These criteria are most effectively used in the analysis of large assemblages to isolate internal groupings which might then be seen to have affinities with modern species. It was agreed that these criteria cannot always reliably identify individual specimens.

Other features which were agreed to be of some value were the robustness of the lower part of the glume in transverse section (although this varies between populations within species); the glossiness or otherwise of the surface of the glumes, which can clearly distinguish well-preserved einkorn and emmer; and the hollowness of the culm two centimetres below the spike as a distinguishing feature between hexaploids and tetraploids, although this part of the plant rarely survives. Participants were reminded that if they find remains of terminal spikelets (rotated through 90°) these cannot derive from einkorn, as the terminal spikelet in the diploid taxa is a tiny sterile appendage, as noted by Schiemann (1948, 8).

There was incomplete unanimity on the utility of the prominence of primary keels of glumes, although it had sometimes proved useful in separating keeled domestic einkorns from unkeeled domestic emmers in continental Europe (Knörzer 1971, 14-6). Terry Miller stressed that both the wild emmers and wild einkorns have strong primary keels, so prominent keels are likely to have characterized many of the domestic derivatives of both species, particularly the more primitive forms. In support of this, Leonor Peña-Chocarro was able to confirm that all the cultivated emmers she has recently collected in Spain are strongly keeled. This point was reinforced when ancient European and Near Eastern spikelet forks were compared under the microscope in the practical session. On Central European forks the primary nerve is very strong in einkorn and weak in emmer; in Near Eastern and Spanish forks it is strong in both taxa. As is often the case, a character that is useful in one region does not work in another. Another variation is the exceptionally heavily-veined glumes of what appear to be a distinct group of glume wheats (tentatively assigned to the tetraploids) from Neolithic and Chalcolithic sites in the Near East and southeast Europe. The past distribution of this form remains uncertain.

A further character which was rejected for general use is the angle between the glumes as viewed from the abaxial or adaxial side. This feature can be radically affected by charring and is therefore more likely to be useful on desiccated or waterlogged material. It also overlaps between diploid and tetraploid wheats, and thus has been found more useful for separating emmer from spelt. Even in this case its usefulness varies between assemblages.

It was agreed that the breakage pattern of the rachis ('barrel break' in spelt; 'wedge break' in emmer) as a character for distinguishing spelt should be used with circumspection and only in combination with more reliable criteria. Modern-day spelt often breaks up into both barrel- and wedge-shaped spikelets (e.g. Percival 1921, fig. 207). In southwest Asia care is also needed to ensure that chaff remains of *Aegilops crassa* Boiss. are not confused with the more heavily indurated forms of spelt (*Aegilops crassa* chaff is illustrated by Bor 1968, 181).

Quantification

A brief discussion on how best to present numerical data relating to glume wheat chaff followed. It was agreed that scoring the number of glume bases present in a sample (with one spikelet fork scored as two glume

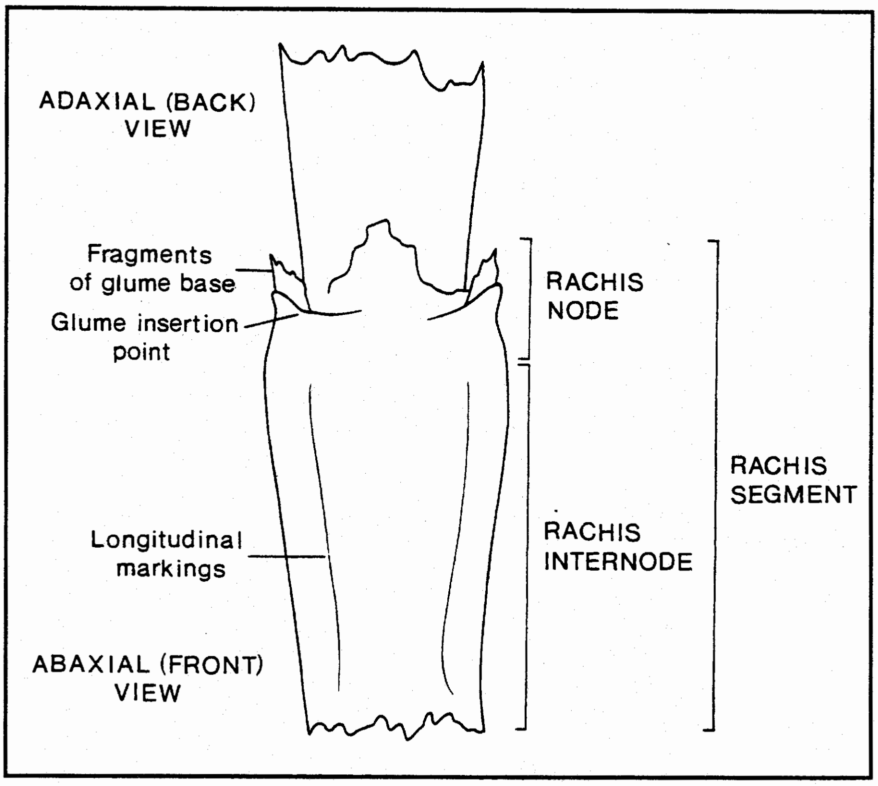

Figure 56. The principal diagnostic features of a portion of rachis of a free-threshing wheat. Note the distinction between 'rachis segment' and 'internode'.

bases) was preferred as, with the exception of one-grained einkorn, the figures are then readily comparable with the number of grains present. Spikelet forks are easily recognized and scored in archaeological material. Glume bases are more difficult as they can be confused with sturdier pieces of glume. Glume bases should only be scored if pieces of rachis node still adhere, as in the glume base illustrated in Fig. 54(a). It is important that simple pieces of glume are not scored as glume bases, as this will leave to overestimation of spikelet remains.

Conclusions: glume wheat chaff

Identification of spikelet forks and glume bases is fairly straightforward in well-preserved specimens which offer a range of independent criteria. While some characters are relatively secure, it was emphasized that a combination of characters should always be used, and that in different assemblages different combinations might prove useful. In using measurements of any kind relative size differences within any one assemblage are often useful, but absolute measurements should not be relied upon. Where sufficiently large numbers of measurements can be made, width of glume bases is often a highly effective tool for checking identifications made on the basis of qualitative characters (Nesbitt 1993, 83-6).

Introgression between taxa of different ploidy levels means that even criteria which are generally regarded as ploidy-specific may sometimes be insecure. Marked regional variation suggests each site should be approached afresh; as ever, identification criteria that work in one place should not be applied uncritically to others.

Free-threshing wheat chaff

(Convenor: Gordon Hillman, Institute of Archaeology, University College London)

Until recently it was believed that rachis fragments of tetraploid and hexaploid free-threshing wheats could not be separated. Since the mid-1970s unpublished, but widely circulated, criteria from Gordon Hillman (also outlined in an unpublished paper given at the 1983 International Workgroup for Palaeo-ethnobotany meeting in Groningen, in the

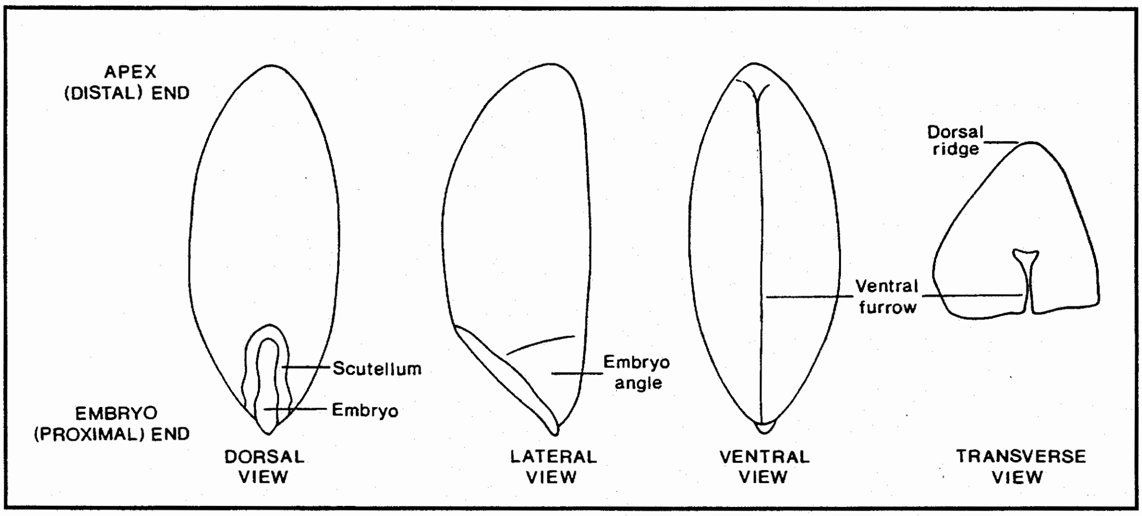

Figure 57. The principal diagnostic features of a stylized wheat grain.

Netherlands) have been tested and found effective by a wide range of users on diverse modern and ancient internodes. The testing has involved independent identifications using chemical criteria applied by Frances McLaren which, so far, have affirmed Hillman's criteria in both modern and ancient specimens (Hillman *et al.* 1993; McLaren *et al.* 1991). These criteria have been successfully applied by, amongst others, Jacomet (1987; 1989), Jacomet *et al.* (1989, 327-9), Jacomet and Schlichtherle (1984, 174), Maier (1995, 202-11; 1996), Moffett (1991) and Nesbitt (1993, 80-3). All these references include illustrations, but we would, as usual, stress the necessity for study of authenticated modern reference material prior to any work on ancient material.

Characters which serve to distinguish chaff at the level of ploidy include the presence of striations or lines of dots running down the abaxial ('front') surface of the rachis. These are often clearest on the lower internodes of an ear, which are more heavily built and thus more likely to survive charring (the absence of such striations is not a reliable character); the shape of the rachis in abaxial view, in all but short internodes; the robustness of the fragments of glume bases remaining at the node together with the presence or absence of a heavily thickened keel at the base of the glumes; the presence or absence of a fold at right-angles to the primary vein around the base of the glume and across the primary nerve itself (the *'am Grunde faltig eingezogen'* glumes described by Schiemann 1948, 17); the degree of swelling ('lumps') on the rachis node immediately below the point of glume insertion, and the shape of the rachis internode in transverse section (for terminology see Fig. 56). Delwen Samuel pointed out that the degree of swelling below the point of glume insertion can also be seen clearly from the adaxial ('back') side of the node. The swellings below the point of glume insertion appear to be the same as the *'Wulst'* identified in early German literature (Schröder 1931; Zimmerman 1934). The glumes themselves also offer other characters of potential value, but rarely survive intact.

Discussion also centered on those genetic or environmental factors that complicate the use of diagnostic characters. The problems introduced by the study of some of the less well-known taxa, and in the identification of compact forms of wheat were also raised. In the latter case Terry Miller emphasized the difference between truly compact wheats and forms which were merely dense-eared. The morphological distinction between these is difficult. The truly compact forms bear the C allele and have a zigzag rachis. Thus *T. compactum*, which carries the C allele, is a true compact wheat, as is *T. paleocolchicum*. Unlike *T. compactum* which has a very short ear, *T. paleocolchicum* has a long ear. *T. macha* also carries the C gene and is thus compact. However, because it is a glume wheat with a semi-brittle rachis, multiple-joined rachis segments are unlikely to appear as archaeological specimens and the zigzag character will be less clear than with *T. compactum*. The same is only partly true for *T. paleocolchicum*, in which part of the rachis is often tough, especially at the base of the spike.

The situation regarding *T. sphaerococcum* is unclear. Percival claims that all the forms of this species have dense ears, but this was queried by Terry Miller, who pointed out that some undoubtedly have zigzag rachises. These are clearly shown in Percival's illustrations (1921, figs. 205, 206). Terry Miller stressed that single characters could not be relied on to identify archaeological specimens. For example, a zigzag rachis could derive from *T. compactum*, *T. sphaerococcum* or even from less fragile *T. paleocolchicum* or *T. macha*.

It is clear that more work on the compact wheats is needed. Any claim that truly compact wheats have been found in archaeological remains would need to be backed by full explanations, and clear illustration of true zigzag rachises. Where wheat remains can be demonstrated to have unusually short internodes, but there is no evidence for zigzag rachis, the term 'dense-eared' is appropriate. However, given the variability in length of rachis segments within the ear, and the ability of charring to greatly shrink rachis segments (Villaret-von Rochow 1967, 33-7), any claim for a 'dense-eared' wheat would need to be supported by measurements and illustrations.

Most past identifications of ancient material as *T. sphaerococcum* have been made on geographical grounds rather than on clearly defined morphological criteria, and are therefore highly suspect. The morphological characters that distinguish this species from *T. compactum* are poorly defined (Percival 1921, 321-4) and it is unclear to what extent these will be visible in archaeological plant remains.

It was agreed that, at present, awn remains could be identified only at the generic level or above, for example wheat/rye as against barley. Identification below genus level needs further work.

Quantification

On scoresheets, rachis segments should be scored by the number of nodes present (see Fig. 56 for the terminology): for example, an intact length of four nodes and internodes would be scored as four rachis segments. Presence of intact lengths of more than one rachis segment should, of course, also be separately scored. As with rachises of glume wheat chaff, rachis fragments should generally only be scored if they bear a rachis node.

It was agreed that Jacomet's (1987; 1989, fig. 5; see also Nesbitt 1993, 80) system of measurements for free-threshing wheat chaff should be used as standard, consistently taking measurements from one side (e.g. the left) of internodes.

Conclusions: free-threshing wheat chaff

(a) Useful criteria do exist for separating tetraploid and hexaploid wheats. However, these characters should only be used when strongly-developed and, like those for the glume wheats, should always be used in combination. In many modern and ancient specimens the critical characters are poorly developed. As with many spikelet forks of glume wheats, a proportion of free-threshing internodes cannot be identified using morphological criteria.

(b) Measurements of certain rachis features may offer some potential in separating free-threshing species such as *T. durum*, *T. turgidum*, *T. turanicum* and *T. polonicum*, but the pattern of continuous variation in rachis and other criteria between such taxa suggests that investment of a great deal of effort in this area is probably pointless, except where material is exceptionally well preserved. However, with genetically disjunct taxa such as *T. carthlicum* in the tetraploids and *T. sphaerococcum* in the hexaploids, useful criteria do exist, and in the case of *T. carthlicum* have already been applied (but not yet published) by Hillman. However, any identification beyond the basic level of tetraploid or hexaploid requires full justification in publication, and most such identifications extant in the literature have little value.

(c) The biases introduced by charring, resulting in dramatic shrinkage of rachises (Villaret-von Rochow 1967, 33-4), the preferential preservation of internodes from the lower part of the ear, and the variation in spike features induced by climate, mean that attempts at identifying dense, compact or pyramidal forms should be treated with caution.

Wheat grains

(Convenor: Glynis Jones, Department of Archaeology and Prehistory, University of Sheffield)

Identification of grains was agreed to be the most difficult area. In part this is because

Dorsal view	Ventral view	Lateral view	Transverse section
Apex (distal) bluntness/attenuation	Flatness of ventral face	Apex bluntness/ attenuation	Presence of a ridge
			Curved *vs* angular
Asymmetry of the grain	Compression lines	cross-section	
Presence of a ridge		Embryo angle	Depth and shape of the ventral furrow
Parallel-sidedness		Presence of a hump above the embryo	
Attenuation or roundness of the embryo (proximal) end			
Position of greatest width of the grain			

Table 84. Grain characters of potential value for identification of archaeological wheat remains.

charring affects the morphology of grains more than that of chaff; in part because of wide intra- and inter-specific variation in grain characters today; and in part because characters tend to be more subjective, unlike the present/absent characters used for chaff. The potentially useful characters are listed in Table 84; terminology is shown in Fig. 57.

Grains present some of the clearest cases of different characters being effective in different geographical regions. For example, Mark Nesbitt found distinguishing between grains of glume wheats and free-threshing wheats to be a straightforward matter on most of the archaeological Turkish material he had examined. In contrast, Gordon Hillman and others found that making this distinction presented great difficulties in the case of Romano-British spelt and bread wheat. Similarly, Stefanie Jacomet pointed out that in the case of Swiss Lake Dwelling wheats, grain extracted from intact emmer and spelt spikelets proved to be identical in appearance, while others found that it was possible to distinguish at least some of the more extreme forms of spelt from emmer in Wales and northern England.

Because of this great variability there was no general agreement on the usefulness of different characters; it is suggested here that grain has to be considered on a site-by-site basis, and that any linkage between internal groups and modern taxa would require justification in each case. Where the much more diagnostic chaff remains are present, and indicate that there is only one taxon present, this can obviously be extremely helpful in suggesting possible identities of the grain. However, it is far more common for taxa to be mixed, or for the amounts of chaff present in grain samples to be too small to permit any inferences.

Some specific cases were discussed. It was agreed that a high back or hump above the embryo, a character used by earlier archaeobotanists to indicate tetraploidy, was not a universally reliable character as it can also occur in some forms of *T. spelta* and *T. macha*. Gordon Hillman suggested that hexaploid wheats could often be reliably distinguished from diploid and tetraploid wheats (with the exception of *T. carthlicum*) by the degree of attenuation or roundness of the embryo end and from the depth of the ventral furrow relative to the height of the grain at the same point. It was agreed that applying the term 'compact' to grains could be misleading, as it suggests an automatic link with compact-eared wheats; it would be better simply to use neutral terms such as 'short and round-grained'.

Within the glume wheats, difficulties still exist in separating grain of one-grained einkorn from grain in one-grained spikelets of emmer: although most emmer spikelets are two-grained, the terminal spikelets are almost always one-grained, and there are both modern and ancient populations of emmer in which the spike contains a mixture of one- and two-grained lateral spikelets. The same is true of spelt. It was also agreed that distinguishing grains from two-grained spikelets of emmer and einkorn presents difficulties that we are equally far from resolving, although there are several characters useful for separating extreme forms of either type.

Quantification

There are two approaches to counting grains. One is to select a number of grains and embryo-end bearing grain fragments, and to attempt identification of all, irrespective of preservation or size. The other is to select a number of whole grains and to identify these, and then to assume the relative quantities in these reflect those in the fragments. Checks are needed to ensure that this is in fact true. Naturally, in the case of very small samples all surviving material must be identified. In the case of larger samples, the method used is a matter of choice that must be recorded in the publication.

Conclusions: grain identification

Overall there was agreement on the kind of characters that could be used in separating taxa, but little agreement on what combinations of characters were consistently successful in separating specific taxa. Grain morphology seems to vary greatly between different regions and periods. Although it is usually possible to distinguish groups of grain and tentatively refer some of them to modern taxa, problems are much greater than with chaff. Often identification will only be possible for a proportion of grains, and identification may be possible only to ploidy level or free-threshing/glume wheat status. Regional variations in the degree to which grains can be identified may as much reflect our degree of self-certainty in making identifications as any real patterns of morphological variation. Adequate explanation of how specimens have been identified, and suitable illustrations should be a routine part of publication.

Overall conclusions

Our conclusions were encouraging: broadly similar approaches are used by all present at the meeting; in part this reflects the widespread adoption during the last two decades of Gordon Hillman's criteria, which in turn, owe much to his early training with Maria Hopf.

It was agreed that both the traditional system of nomenclature and the biological species system have advantages in different situations, but that it is most important that whichever system is used is applied accurately, consistently, and with reference to a published checklist.

Consistent, repeatable identifications are only possible when a combination of characters is preserved; such character combinations have proved more elusive for grains than for chaff, and their identification is often difficult to confirm. Grains require greater caution in identification, and urgently need further comparative studies.

In the case of glume wheat chaff, separation of einkorn, emmer and spelt is often straightforward for well-preserved material, especially if enough spikelet forks are present at the site to allow metrical criteria to be applied in addition. However, the criteria we use at present take little account of the possible admixture of rarer taxa such as *T. paleocolchicum*, *T. timopheevi* and *T. macha*, although combinations of more cryptic criteria have now been isolated by Mason and Hillman which offer the possibility of distinguishing the more extreme forms of *T. paleocolchicum* and *T. macha*. Rachis internodes from free-threshing wheat can usually be divided into tetraploid and hexaploid groups, but intermediate specimens do exist even in modern populations. In both areas, further work is badly needed to achieve reliable identification at the classical species level.

All criteria would benefit greatly from studies of a wider range of modern populations. This raises a constant theme of the meeting: our poor knowledge of even the modern wheats, particularly those taxa that are relatively rare today. Equally worrying is our lack of familiarity with a sufficiently broad range of the forms that can exist within any one classical species, or even within one landrace. This frequently reflects inadequate reference collections which often have very few accessions of each species. Such deficiencies have doubtless been the cause of several cases where widely used criteria have wrongly been assumed to have diagnostic potential. This problem is exacerbated by the fact that wheats in many reference collections are commonly either misidentified at source, and/or are the products of hybridization in botanical gardens. Even specimens obtained directly from genebanks have often been misidentified at source. Our incomplete knowledge of morphological variability is compounded by our lack of familiarity with recent advances in studies of wheat origins, hybridization, introgression and phenotypic plasticity, and by the fact that such studies are still far from resolving some of the major issues.

Another constant theme of the meeting was that different identification criteria or groups of criteria are effective in different areas, often to a radical extent. For wheat identifications to be fully intelligible to those working in other areas—or even other sites—it is essential that we provide the reasoning by which each morphological group has been named. We must be sure to describe both 'normal' types and also unusual or unreferrable types. Descriptions should be supported by illustrations (the publications of Willem van Zeist in *Palaeohistoria* set the standard for this), and where identifications include a quantifiable element—for example, 'short and rounded' grains or 'dense' internodes—these must be supported by measurements.

New techniques

An encouraging development is the growth of new techniques that offer independent criteria for identification. Of these, infra-red spectroscopy is already giving good results for both grain and chaff (McLaren *et al.* 1991; Hillman *et al.* 1993), while ancient DNA holds promise for the future (Allaby *et al.* 1994; Brown *et al.* 1993; 1994).

Acknowledgments

We are very grateful to the convenor of each session for guiding the discussions and commenting on the draft of this paper, and to the following participants in the meeting, some of whom also commented on this paper: Gill Campbell, Alan Clapham, Richard Hubbard, Helmut Kroll, John Letts, Frances McLaren, Lisa Moffett, Peter Murphy, Rainer Pasternak, Mark Robinson, Delwen Samuel, Marijke van der Veen, and George Willcox. Successive drafts of this paper were prepared by Mark Nesbitt, incorporating comments from the convenors and organizers. We also thank Laura Morrison for useful suggestions.

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Revised disk copy received: April 1996

Circaea, The Journal of the Association for Environmental Archaeology 12 (2) (1996 for 1995), 211-47 ISSN 0268-425X

Archaeobotanical and historical records compared—a new look at the taphonomy of edible and other useful plants from the 11th to the 18th centuries A.D.

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Summary

An increasing number of first-time archaeobotanical records have recently been made of edible and other useful plants from deposits of medieval and post-medieval date, which prompts the questions: 1. Why are some plants found more frequently than others? 2. Why have some plants not yet been recorded? 3. How many more are awaiting discovery? and 4. How do the data from the British Isles differ from those from the European mainland? This paper addresses these questions.

Introduction

The archaeobotanical and documentary evidence for useful plants in the British Isles were last reviewed more than a decade ago (Green 1984; Greig 1983). Since then, progress has been rapid in the widening geographical range of the sites investigated, the numbers of results which have been published, and the detail of the identifications. The writer's own work on medieval and post-medieval material from Shrewsbury Abbey (Greig, in prep.) prompted him to wonder how many plants have been recorded as having been in use according to historical documents, yet have apparently not yet been found as archaeobotanical remains. It naturally follows from this to wonder which research strategies, with regard to both recovery and identification, would be most effective in making good the disparities.

Methods: the data

The commoner plants which may have been in use in northern Europe between the 11th and the 18th centuries are listed in Table 85. The taxa have been carefully selected so that the list is not too long. Three kinds of evidence are given for each taxon: first, the main British archaeobotanical evidence, second, the historical evidence, and thirdly, archaeobotanical finds from mainland Europe are given; this last category includes those from central, western and northern Europe including Scandinavia. The limited coverage of the data is only meant to provide an example of whether a plant is known from the main sources, rather than being a comprehensive database (which is completely beyond the scope of this article). The taxa are discussed more less in the order in which they are listed, or alphabetically under the following headings: cereals and legumes; fruit, nuts and oil plants; vegetables; herbs and seed flavourings; medicinal or decorative plants; industrial, fibre, brewing and other plants.

Archaeobotanical data

The British archaeobotanical data presented here are taken mainly from Greig (1991) with some more recent data having been added from particularly rich sites such as Eastgate, Beverley (McKenna 1992), Windsor and Reading (Carruthers 1993 and unpublished), and Shrewsbury (Greig, in prep.).

Historical data

The British documentary evidence comes from several distinct subject areas, in which historians have compiled and interpreted the scattered fragments comprising the original evidence. The main sources are some very detailed records of gardening (Harvey 1981; McLean 1981) and of fruit (Roach 1985). Much of this evidence comes from the surviving accounts of medieval gardeners such as Alexander Neckham (b. 1157), Bartholomew de Glanville (*c.* 1200 - *c.* 1260), Henry Daniel (*c.* 1375) and 'John the gardener' (*c.* 1400), as

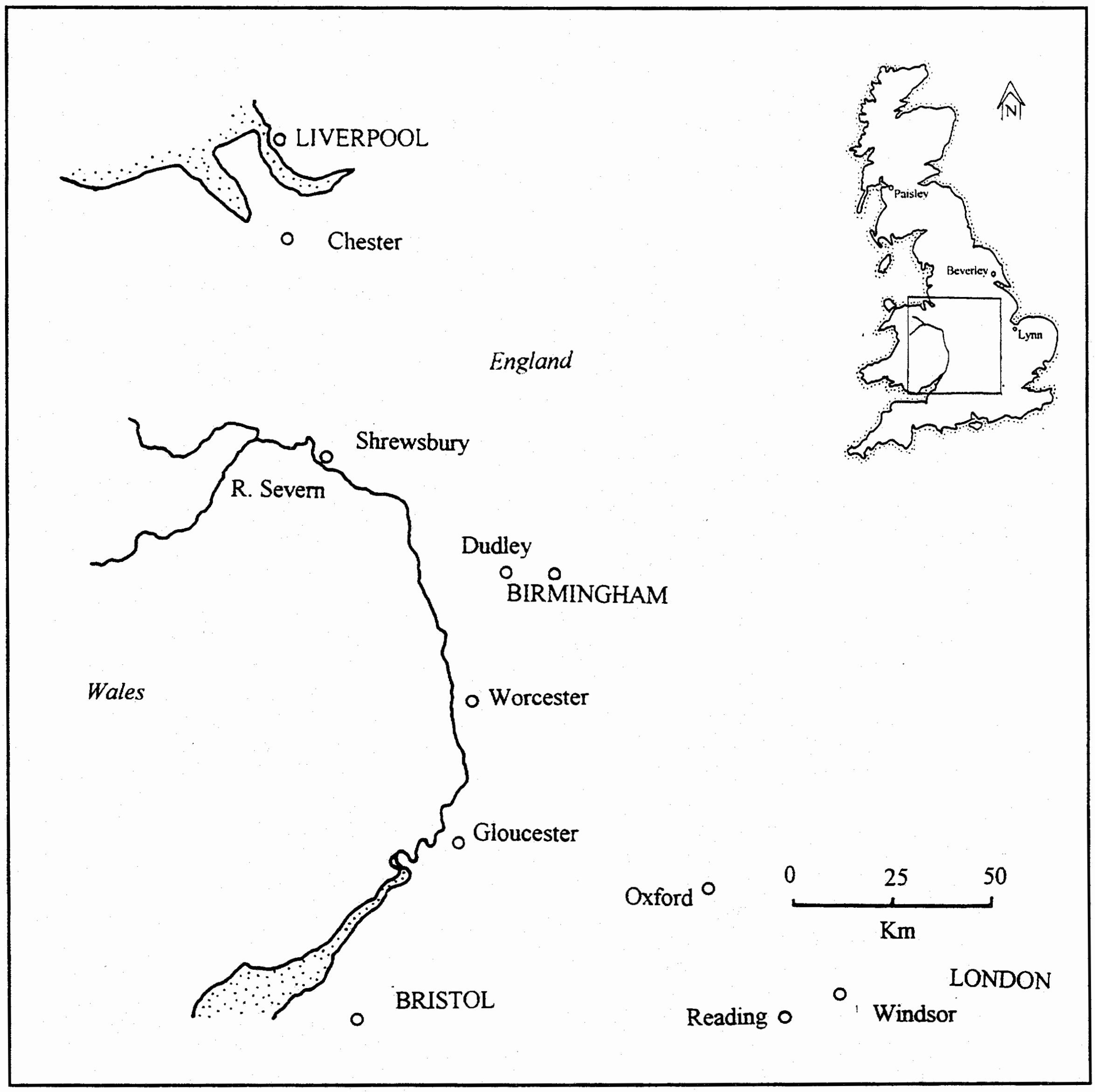

Figure 58. Location map showing some of the sites and other places mentioned in the text.

described by Harvey (1981). Further lines of evidence come from works on food and cookery (Wilson 1973), compilations of economic history (Dyer 1989; Oschinsky 1971; Titow 1972) and from customs records. Only one of the latter has been used here (Gras 1918), in the hope that it is a representative example, since it covers many southern and eastern ports over a long period.

Some of these data need interpretation before they can be compared with archaeobotanical results. Confusion can arise since much of the original source material was written in medieval Latin, French or Middle English, or a mixture of these, as in some of the customs records. It can be hard to understand exactly which plants are meant, as demonstrated by the elegant example of historical detective work proving that *Theuthorne* was really gooseberry (*Ribes uva-crispa*) and not a species of *Rhamnus* (Harvey 1981, 122-3). In some cases the historian may have been uncertain and did not attempt a translation, as for example *Quibebes* (Gras 1918, assumed here to be *Piper cubeba* (cubebs), although *sede for worms* or *setewal* is still a mystery. The data are, of course, biased because there are so few records from before AD 1300, and so many more from after AD 1550.

The archaeobotanical data from the European mainland used here have been drawn from the reviews in van Zeist *et al.* (1991), with additional data from Hellwig (1990), Kroll (1995), papers in Kroll and Pasternak (1995), Paap (1984), Ruas (1992), Schultze-Motel (1992; 1993), van Zeist (1992), Wiethold and Schulz (1991), and Hjelmqvist (1991; 1995).

Results

Cereals and legumes

The staple foodcorns

The main staple foods (barley, beans, oats, peas, rye and wheat) are present throughout the period in question, both in the historical and the archaeobotanical records (Table 85).

The main question here is whether there is any archaeobotanical evidence of the relative proportions of the various staple foodstuffs grown and used in particular regions or at particular periods, which can be compared with the historical records. Leading on from this is the question of change in place and time of these relative proportions. These apparently simple questions are very difficult to answer, and require separate and exhaustive study. It is possible to obtain some rough quantification of the proportions of cereals represented by bran in latrine deposits (Robinson *et al.* 1992). Another approach is to compare finds of chaff and grain: Rösch *et al.* (1992) have attempted this for sites in southern Germany and Switzerland, and suggest that the data from scattered finds (rather than concentrated ones such as granaries) may provide some evidence of this kind.

The documentary evidence from Britain, gathered from surviving information on crop yields and food allowances in lowland England, records variable amounts of wheat, rye, oats and barley without any obvious trends (Dyer 1989). Likewise, records of yields (e.g. Titow 1972) seem to show little discernible pattern. Even if one obtained an archaeobotanical record that was perfectly representative of the crops actually grown, it would probably also show continuous and unpatterned variation. Various factors might have caused different proportions of crops to be grown. For example, there would have been differences between what individuals decided (or were told) to do. Secondly, different circumstances would also have caused variation: if factors such as bad weather made it difficult to prepare and sow the fields with wheat and rye in the autumn, or if a severe winter destroyed the seedlings, a larger area would need to be sown with oats, barley and peas in the spring. Finally, economic factors, such as the market values of various crops, the reliability of obtaining a good yield, and uses of various by-products such as straw probably determined what was grown.

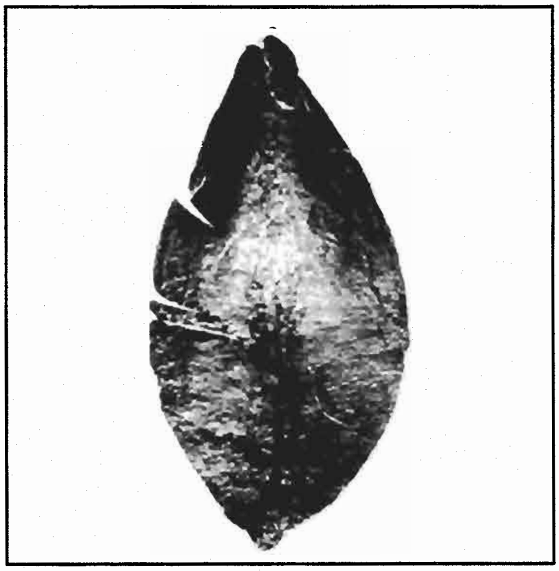

Figure 59. Fagopyrum esculentum *(buckwheat, fruit valve), x10, Shrewsbury, 18th C.*

Nevertheless, it would be very valuable to compare more archaeobotanical results with historical records, as Green (1984) and Rösch *et al.* (1992) have already done, to elucidate the relative importance of cereals in the past.

Some comments on particular cereals and legumes

Comparison of the records from the British Isles with those from the European mainland reveals a number of differences:

Fagopyrum esculentum (buckwheat) is a relatively late arrival in England. The finds of the distinctive pollen are not accurately dated, but are probably post-medieval, and the macrofossil find from Shrewsbury (Fig. 59) is probably 18th century. The earliest historical record of buckwheat in England seems to be in Thomas Tusser's treatise of the 1580s (Grigson 1985), so the lack of earlier archaeobotanical buckwheat finds may not be a result of taphonomic factors alone. This late arrival (or acceptance) of buckwheat in Britain is somewhat surprising, especially since there were, according to the customs records (Gras 1918), fairly good contacts between the Low Countries and England via ports such as Dordrecht. On the European mainland, although there is a Viking Age find (Schultze-Motel 1993), buckwheat first appears regularly at sites of the 12th century and later, especially in the Netherlands.

Oryza sativa (rice) is another crop with a far more extensive archaeobotanical record across the Channel. There seems to be only one published macrofossil find from Britain, from Southampton (Green 1984), despite there being a substantial historical record from household accounts, cooking recipes and customs records going back to the 13th century. It is hard to understand why rice is not found in British material, as the macrofossil remains are distinctive. *Oryza* has been found at a number of mainland European sites from the 13th century onwards (e.g. Wiethold 1995, 137-8), although this may in part be a reflection of the large amount of archaeobotanical work undertaken. It is harder to obtain parallel evidence from the pollen record because the pollen of rice cannot readily be distinguished from that of other cereals.

Panicum miliaceum (millet) is not known from documentary records in England, so its absence from the archaeobotanical record is not surprising. Indeed it may never have been grown in the British Isles or used as more than bird-seed. According to the archaeobotanical records, millet was certainly present on the European mainland, although it seems to have been a minor crop (Rösch *et al.* 1992).

Triticum turgidum tp. (rivet wheat) is an example of a crop whose history has only recently emerged, and Moffett (1991) has now demonstrated its presence throughout the medieval period in England. The first documentary record of rivet wheat is much later, dating from the 16th century, when farming came to be written about. There do not appear to be any medieval finds of rivet wheat from the European mainland, but then it does not seem to have been popular in Germany, for example, for it is hardly mentioned by Schiemann (1948, 41-2), and not at all by Körber-Grohne (1987). It seems to have been more popular in France, judging by the French names given to many varieties, and perhaps archaeobotanical finds can be expected here.

Vicia faba (bean), *Pisum sativum* (pea) and other members of the Fabaceae (Leguminosae) such as *Lens culinaris* (lentil) and *Vicia sativa* (vetch) are rather poorly represented in the archaeobotanical record because their seeds and pods are preserved less readily than the remains of cereals; charred remains are few perhaps because pea and bean straw was apparently less used for fuel than cereal straw and chaff. The pollen is distinctive, but relatively little is produced and dispersed, so only occasional grains of *Vicia faba* and *Pisum* are found. British archaeobotanical records of charred *Lens culinaris* are very few, even though lentils are mentioned in a number of historical accounts. However, there is a far more consistent record of *Lens* from the European mainland; this may show that lentils were more widely grown there—it does, of course, require warm summer temperatures for seed production.

Finally, *Zea mays* (sweetcorn, maize), introduced from the Americas, has only one reported macrofossil find, from 16th/17th century deposits at Hall in Germany (Rösch *et al.* 1994) and a pollen find from Maaseik in Belgium (van den Brink 1989). Maybe regional preference can explain the lack of finds, since Gerard (1597) wrote 'The barbarous Indians, which know no better, thinke it a good food; whereas we may easily judge that it nourisheth but little...., a more convenient food for swine than for man'. If more post-medieval material is examined thoroughly, it may be possible to learn more about the history of maize in Europe.

Fruit

Archaeobotanical finds of fruit remains are biased by taphonomy, since many fruitstones and pips are robust and are therefore readily preserved. They are numerous in deposits such as latrine fills, particularly in 15th/16th century urban deposits; records from other sites and periods consist mostly of rather scattered finds. Archaeobotanical finds of fruit can be considered under four main headings:

(1) Common fruit, probably home-grown, or wild-gathered: e.g. *Fragaria vesca* (wild strawberry), *Prunus cerasus* and *P. avium* (sweet and sour cherries), *Malus domestica* (apple) *Pyrus communis* (pear), *Prunus domestica* (plum, in the widest sense), *Rubus fruticosus* (bramble), *R. idaeus* (raspberry), *Vaccinium myrtillus* (bilberry).

(2) Common imported fruits: *Ficus carica* (fig), *Vitis vinifera* (grape), *Phoenix dactylifera* (date).

(3) Less common fruit: *Cydonia oblonga* (quince), *Mespilus germanica* (medlar), *Morus* spp. (mulberries), *Cornus mas* (cornelian cherry), *Prunus persica* (peach), *Ribes uva-crispa* (gooseberry), *R. rubra* and *R. nigra* (red- and blackcurrant), *Sorbus domestica* (service).

(4) Absent or very rare fruit: *Berberis vulgaris* (barberry), *Citrus* spp. (oranges, lemons), *Fragaria* x *ananassa* (hybrid strawberry), *Physalis alkekengi* (Japanese lantern), *Prunus armeniaca* (apricot), *Punica granatum* (pomegranate).

Common fruit

These are represented in both archaeobotanical as well as historical records throughout the period in question. Most of the fruit listed above seems to have been cultivated to some extent, with the exception of brambles and bilberries, which are scarcely mentioned in the historical literature on gardening. These were probably gathered from the wild, as were *Crataegus* spp. (haws) and *Sambucus nigra* (elderberries). *Rubus idaeus* (raspberry) may well also have been initially gathered wild. The historical record from the 16th century onwards suggests that it was taken into cultivation at about that time.

Malus domestica (apple) and *Pyrus communis* (pear) (Figs 60 and 61) are frequently found among the remains of food and other rubbish as apple pips and fragments, pear pips, and stone cells probably also from pears. The historical record is also extensive. The archaeobotanical records from mainland Europe also indicate that these fruits, the apple especially, were common.

Some of the largest and commonest fruit remains are fruitstones of *Prunus*. This is because they are readily preserved, tend to be concentrated in latrine deposits, and plums (in the broad sense) were evidently popular. Since the variation in *Prunus* fruitstone morphology is almost continuous, identification methods have concentrated on putting the fruitstones of various primitive plums into groups according to size and shape rather than attempting a more detailed identification in terms of present-day plum varieties. However, many archaeobotanists do not always attempt identification as far as they might, and '*Prunus* sp.' is all that is given in many reports.

On present evidence, the plumstones found at medieval sites in England such as early medieval Norwich (Ayers and Murphy 1983) are generally of rather primitive forms such as the more or less wild *Prunus spinosa* (sloe), here illustrated by examples from Shrewsbury (Fig. 62a). *Prunus domestica* ssp. *insititia*, which includes the bullace, a primitive cultivated form (Fig. 62b), and damson-type fruits (Fig. 62c), while *P. domestica* ssp. *domestica* (plums in the modern sense) seem to be a relatively recent development, and are something the writer has not encountered as archaeobotanical finds. They have mainly been found at post-medieval sites such as Dudley Castle, West Midlands (Moffett

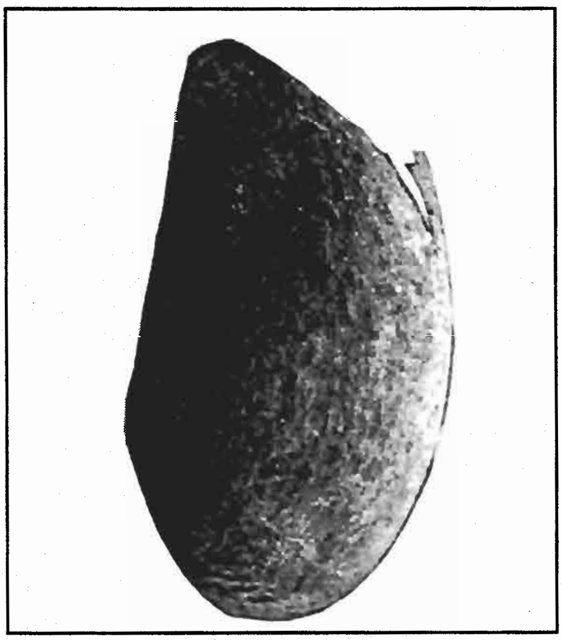

Figure 60. Malus domestica *(apple, pip), x10, Shrewsbury, late 15th -16th C.*

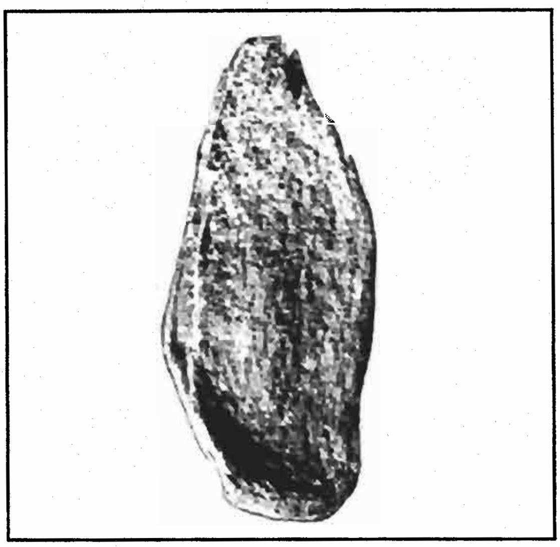

Figure 61. ?Pyrus communis *(?pear, pip), x10, Shrewsbury late 15th -16th C.*

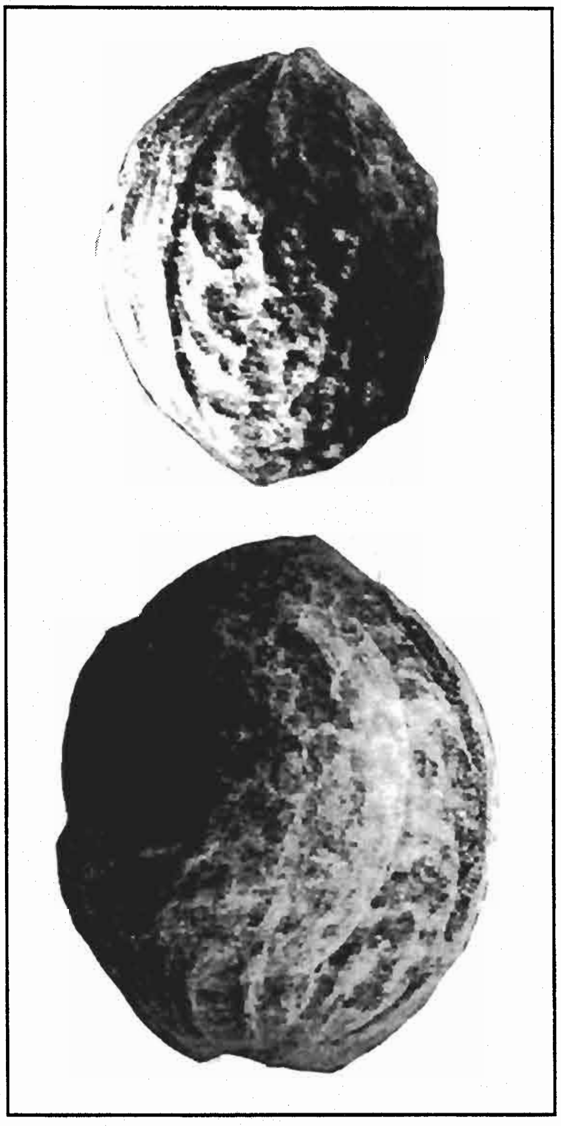

Figure 62. Prunus *fruitstones. (a, above).* Prunus spinosa *var.* macrocarpa *(large-fruited sloe), x5, Shrewsbury, late 15th-16th C; (b, below)* Prunus insititia *(bullace-type), x5, Shrewsbury, late 15th-16th C.*

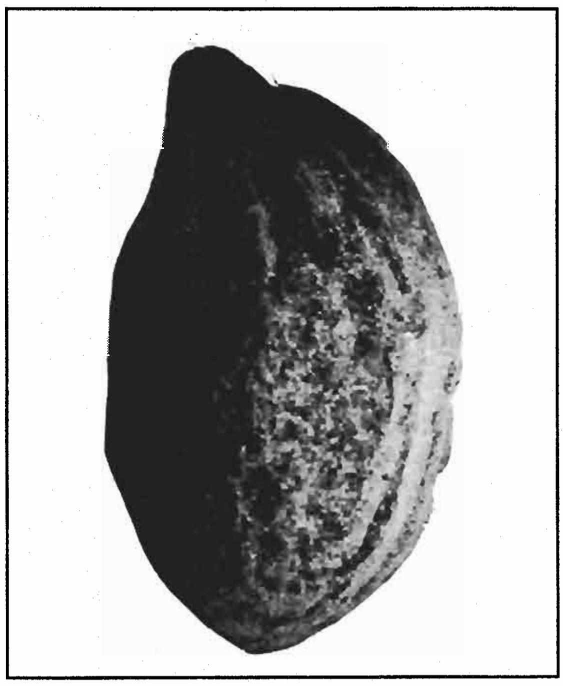

Figure 62, continued, (c) Prunus insititia *(damson-type), x5, Shrewsbury, late C15th-16th.*

1992) and Shrewsbury Abbey, Shropshire (Greig, in prep.; and see Fig. 58). In the post-medieval period, fruit-growing became an active interest among people with the necessary resources (Roach 1985), but archaeobotanical research has not as yet provided much parallel evidence for this. Exploring the development of fully domesticated modern plums is an interesting area for future investigation, should suitable material be recovered.

A further aspect of the use of *Prunus* is the making of prunes (dried plums). This may be done on the tree, even in England (M. Robinson, pers. comm.) and prunes were also imported from warmer climates (see below, under 'imported fruit'). Prunes can also be kiln- or oven-dried, a process which has the added advantage of making acid fruit, even sloes and crab apples, palatable (Wiltshire 1995). This may explain how large quantities of sloes, the stones of which are often found in faecal deposits, were made edible.

Evidence from mainland Europe shows a similar story to that from the British Isles, with large numbers of primitive *Prunus* fruitstones being found, particularly in medieval towns. At German sites such as Haithabu (Behre 1983) and Braunschweig (Hellwig 1990), a typology has been worked out, based on fruitstone morphology and dimensions. The question of how far *Prunus* fruitstones can be identified, and on the basis of what criteria, is also being studied in Germany by Körber-Grohne (1995). Eventually it may be possible to provide better answers than at present.

Cherry stones have been found at many medieval sites in Britain, although they have not always been identified to species, separating the tetraploid *Prunus cerasus* (sour, dwarf, or Morello cherry, Fig. 63) from the diploid *P. avium* (wild, or sweet cherry). The historical

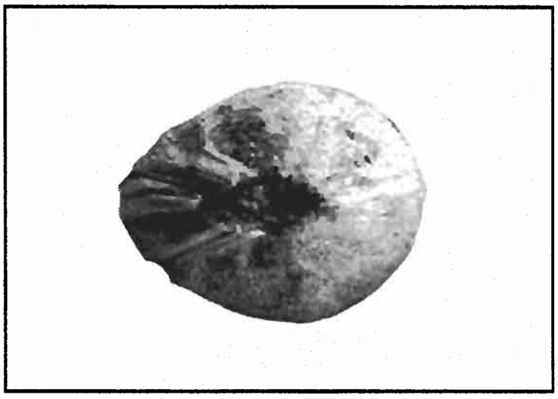

Figure 63. Prunus cerasus *(Morello cherry, fruitstone), x5, Shrewsbury, late 15th-16th C.*

evidence for sweet cherry in England, collected by Harvey (1981), suggests that it was grown throughout the medieval period, but sour cherry is not mentioned. The archaeobotanical record from mainland Europe shows that *P. avium* (sweet cherry) is present earliest at some sites, *P. cerasus* (sour cherry) at others (Hellwig 1990).

Imported fruit

Ficus carica (fig) pips are fairly common and sometimes abundant in medieval deposits, especially latrine pit fills, throughout the period in question. This abundance is partly the result of the large numbers (about 800 per fruit) of tough, easily preserved, seeds. Figs can just be grown in warmest parts of England now, and were also cultivated in the past (Roach 1985). However there is also evidence from customs records that dried figs were imported by the shipload (see below), and this seems a more likely source of the archaeological remains.

Vitis vinifera (grape, Fig. 64) pips are also often found among other food remains. There is historical evidence for viticulture in England, mainly for wine production, especially in the 11th and 12th centuries, followed by a decline in the 14th and 15th centuries, with little cultivation thereafter (Roach 1985). There is a small amount of possible archaeobotanical evidence such as 14th/16th century *Vitis* wood from Reading Abbey (Carruthers, unpub.), and a few finds of *Vitis* pollen from deposits where it was thought to have arrived by natural dispersal rather than by human agency. Such records may not give a true idea of vineyards since the representation of *Vitis* in pollen diagrams seems to be rather poor, even in

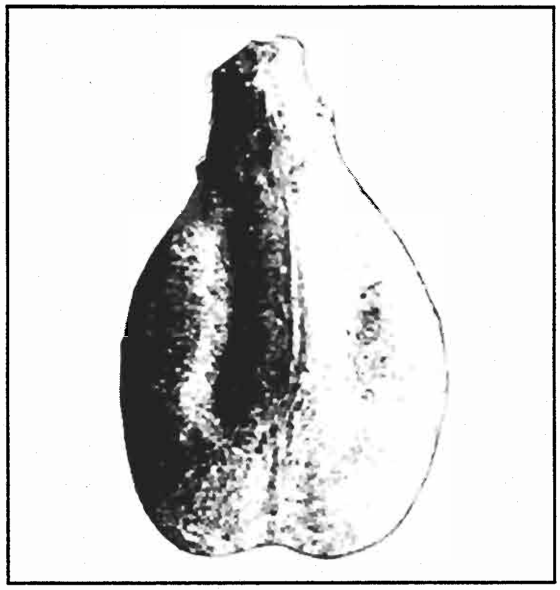

Figure 64. Vitis vinifera *(grape, pip), x10, Shrewsbury, late 15th-16th C.*

wine-producing parts of France where clear pollen evidence might be expected (Diot and Laborie 1989). On the other hand, there is plenty of evidence that raisins and currants were imported from Spain and Portugal (Gras 1918), and that they were cheap enough to be fairly widely consumed (Dyer 1989). As for figs, therefore, abundant imports therefore seem likely to be the source of most of the grape finds in England.

Phoenix dactylifera (date) stones have only been found at one medieval site in England, in Hull, dated to the 14th century (McKenna 1987). Dates could not have been grown in England, and they were certainly imported from the Mediterranean region: the Sandwich customs of 1303 list five cargoes with dates, London 1420-1 six, Lynn 1466-7 one, and dates are also given in the list of customs rates of 1507 (Gras 1918). Considering the robustness of date stones, these might be expected to have been found more often.

Beyond the British Isles, fig and grape pips are also found in suitable archaeological deposits in the Netherlands and Germany, and to a lesser extent in Scandinavia. Date stones have also occasionally been found in mainland Europe from the 15th century onwards, for example at 's-Hertogenbosch and at Amsterdam in the Netherlands (Paap 1984). Prunes were also imported as shown by entries in the Petty Custom of 1396, and also in the 1507 book of rates (Gras 1918, 504, 701).

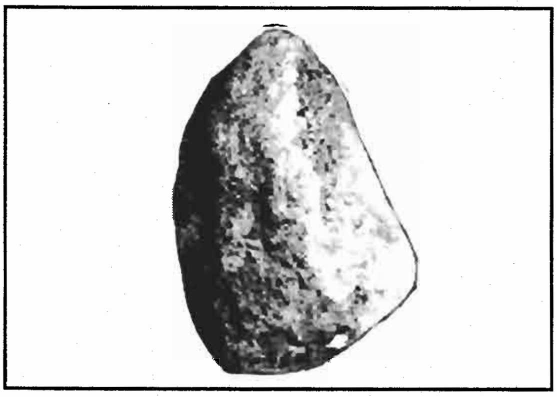

Figure 65. Mespilus germanica *(medlar, fruitstone), x5, Shrewsbury, late 15th-16th C.*

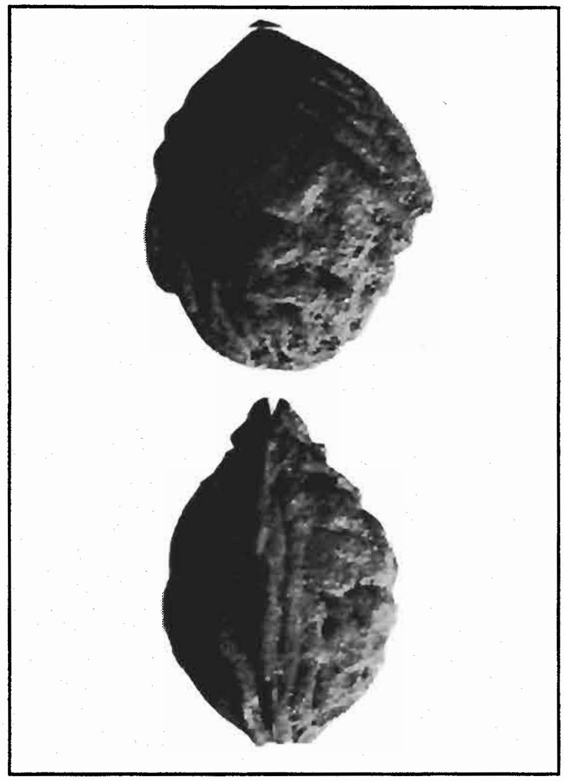

Figure 66. Prunus persica *(peach, fruitstone, two lateral views), x2, Shrewsbury 18th C.*

Rare fruit

Citrus sinensis and *C. limon* (oranges and lemons), together with other citrus fruit such as limes and tangerines, scarcely need any introduction today. Citrus trees do not survive the British winter (except when given protection from frost), as noted by John Parkinson (1640), yet the fruit was imported in the medieval period according to household records (Wilson 1973). The customs records cited here, however, list few records of oranges and none of lemons: one record for London from 1420-1 lists three cargoes containing oranges, and another, from 1509, lists one cargo of oranges and cork (Gras 1918). Of course, other collections of customs records may contain further information. The generally scarce historical references to citrus fruit suggest that it remained something of a rarity. There are apparently no published archaeobotanical records of *Citrus* from northern Europe, but a mineralised example has been reported (C. de Rouffignac, pers. comm.). This rarity is somewhat surprising, for the fruit contains a number of seeds which appear to be robust enough to become preserved.

Cornus mas (cornelian cherry) is not native to Britain and, although it can grow successfully here, the fruits rarely ripen (Stace 1991). The occasional finds of *Cornus mas* fruitstones in Britain (e.g. Hall 1992a) might therefore represent imported fruit.

Mespilus germanica (medlar, Fig. 65) had not been found by the time of the last survey (Greig 1983), but has since been found at a number of medieval and post-medieval sites. Medlar is mentioned in many gardening records although the tree may never have been universally popular, or was grown perhaps more as an ornamental (Harvey 1981). Medlar is also found in material from mainland Europe over roughly the same time span, mostly from the 13th century onwards.

Morus alba (white mulberry) and *M. nigra* (black mulberry) cannot be distinguished from their pips. *Morus* sp. has been found at a few English sites including Eastgate, Beverley, E. Yorkshire (McKenna 1992). There are gardening records but these are also few in number, suggesting that mulberry trees were uncommon (Harvey 1981). Mulberry was not apparently imported, and the fruit seems to have been of rather minor importance in Britain. It is found from the 15th century onwards in mainland Europe.

Prunus persica (peach, Fig. 66) is something of a rarity, having been found only recently at a number of British sites from the 12th century onwards, often as a result of bulk-sieving programmes during excavation. Documentary evidence of peaches comes mainly from gardening records throughout the period, although this may demonstrate only that peaches were known rather than grown. Another documentary record records the death of King John in 1216 from dysentery aggravated

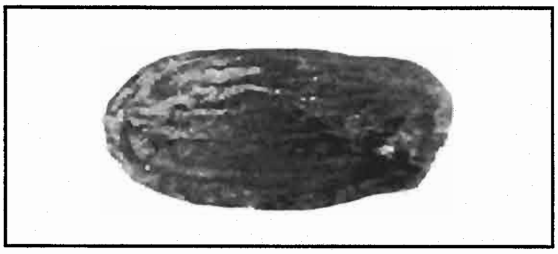

Figure 67. Ribes uva-crispa *(gooseberry, pip), x10, Shrewsbury, 18th C.*

by lampreys and green peaches (Roach 1985, 180). By comparison, peach stone finds in mainland Europe up to now only extend back to the 13th/15th century (Čuliková 1995a).

Ribes uva-crispa (gooseberry) has been found at a few sites from the 13th century onwards, and a number of *Ribes* sp. identifications (Fig. 67) may also be of gooseberry. The historical record also goes back to the 13th century (Harvey 1981). There is a scatter of records from mainland Europe, with a number of finds from the 14th century onwards reported from the Netherlands (Bakels 1991) but none at all from Braunschweig in Germany (Hellwig 1990). Other *Ribes* finds are discussed below.

Sorbus species have been cultivated for their fruit, or it has been gathered from the wild. *Sorbus domestica* (service) has not yet been identified with certainty from British material, although the historical record in Harvey (1981) and the number of finds from mainland Europe suggests that it was probably present. *Sorbus torminalis* (wild service, or chequers) has been found at a few British sites but apparently not yet in mainland Europe. *Sorbus aucuparia* (rowan), is sometimes found together with other food remains, suggesting that the fruit of this species was also used.

Absent fruit?

This section deals with fruit apparently not yet found fossil in Britain, but which perhaps may be found if attention is drawn to them. A 'forgotten fruit' is *Berberis vulgaris* (barberry), which is still grown in gardens, although the fruit is not eaten now. The berries were used in fish dishes in the past (Wilson 1973) and there are several gardening references (Harvey 1981). No archaeobotanical remains of *Berberis* have been found, although the seeds look as though they are readily identifiable and would be preserved. Since barberry is not a very well-known plant, remains could however easily pass unnoticed.

Cydonia oblonga (quince) is what would be regarded today as another minor fruit. There are no certain British archaeobotanical records of quince, partly because quince remains are difficult to identify: the seeds are very similar to those of apples and pears and they do not ripen fully in Britain. Stone cells, such as those found at Shrewsbury (Greig, in prep.) could have come either from quinces or from pears. Historical research has gathered a certain amount of gardening evidence for quince (Harvey 1981). Quince was also imported in the form of 'marmelardo' recorded in the list of customs rates of 1507 (Gras 1918, 700). This is a confection which was (and still is) made from quince pulp and given the Portuguese name of the fruit *Marmelo*, from which the English word 'marmalade' is derived. In mainland Europe, possible *Cydonia oblonga* seeds have now been discovered and identified (Hellwig 1990; Rösch 1993; Wiethold and Schulz 1991; Wiethold 1995), so further progress in this field may be expected.

Fragaria x *ananassa* (cultivated strawberry) is the product of hybridisation between the wild (and cultivated) European *Fragaria vesca* and either of the two American strawberries *F. virginiana* or *F. chiloensis*, giving rise to the ancestors of the modern hybrid cultivated strawberries (Wilhelm and Sagan 1974). This development occurred in the 18th century, according to Roach (1985). There is a single find of strawberry seeds distinctively of the hybrid kind, from Germany (Knörzer 1987).

Physalis alkekengi (Japanese-lantern) is grown more as a decorative plant than for food nowadays. The edible fruit are like small yellow tomatoes, but enclosed within papery bracts (the 'lantern'). Seeds have been found among other food remains in mainland Europe but from Britain there appear to be neither documentary nor macrofossil records. Attention is drawn here to Japanese-lantern so that if it is present among British plant remains, perhaps it might be recognized.

Prunus armeniaca (apricot) was first introduced to Britain in 1542 according to Harvey (1981), although there seems to be no reason why the fruit, fresh or dried, should not have been imported earlier than that. In the 16th-18th centuries the cultivation of apricot seems to have greatly interested English gardeners (Roach 1985). A British archaeobotanical find of apricot fruitstones in material from Lincoln has finally been made (L. Moffett, pers. comm.). In mainland Europe, however, apricot has already been recorded from 17th century Amsterdam (Paap 1984), and from 14th/15th century France (Ruas 1992).

Punica granatum (pomegranate) is recorded as a garden plant by a number of writers, although it is at its climatic limit in Britain and one wonders if it would have fruited even during the early medieval warm period. Pomegranates were also imported, according to a record from London in 1420-1 and two from London in 1508 (Gras 1918). Archaeobotanical remains of pomegranate have not been found in England; the seeds, though not very robust, can be preserved, as shown by at least two archaeobotanical pomegranate finds from Bavaria (Küster 1988).

Ribes rubrum and *R. nigrum* (red- and blackcurrants) have not yet been reported in the literature from British material, although there are unpublished records of *R. rubrum* from medieval to post-medieval latrine deposits from St John's Hospital, Canterbury (A. Hall, pers. comm.). They are thought to have been introduced much later than *R. uva-crispa* (gooseberry), the first historical records being those of Turner (1538) and Parkinson (1629) cited by Roach (1985). The distinctive flavour of blackcurrants was not, however, to everyone's taste, according to Parkinson (1640). These fruits seem to have arrived from mainland Europe, where *R. rubrum* and *R. nigrum* finds date from the 16th/17th century (Wiethold 1995).

Nuts and oil plants

Hazel nuts are present at most sites during the period in question. These are assumed to be from *Corylus avellana* (hazelnut), although several other *Corylus* species might be concerned, such as *C. maxima* (filbert) and possibly *C. colurna*. The subject deserves more attention.

Castanea sativa (sweet chestnut) macrofossils have not yet been found in Britain. This is a little surprising since chestnut trees were certainly present from Roman times in England, at least, according to Rackham (1980), and there are documentary records from Neckham, Bartholomew and Daniel, quoted by Harvey (1981).Chestnuts do not usually produce a crop of fully-formed nuts except in S.E. England. They may have been imported, but chestnuts are thin-walled and the remains may not be preserved or be difficult to identify. There is,

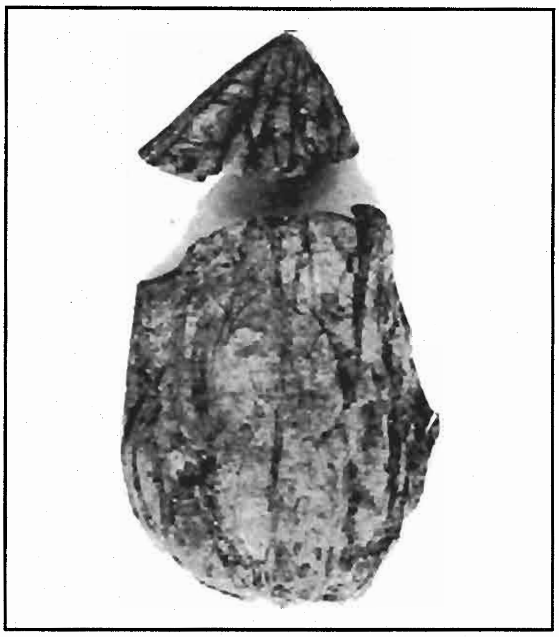

Figure 68. Juglans regia *(walnut, shell), x2, Shrewsbury, late 15th-16th C.*

however, some slight pollen evidence (Waton 1982).

In mainland Europe, by contrast, finds of *Castanea sativa* are now emerging from sites such as 17th century Amsterdam (Paap 1984) and from a range of sites in France (Ruas 1992).

Juglans regia (walnut, Fig. 68) records are accumulating steadily; finds of both macrofossils and pollen grains at British sites now cover virtually the whole period, although the documentary records of walnuts grown in gardens are scattered. Walter of Henley mentions them as great nuts (Oschinsky 1971); customs records usually just list 'nuts'.

Olea europaea (olive), of which there are both historical and archaeobotanical records from the Roman period, fails to re-appear in the medieval and post-medieval period. There is a documentary record of cooking with olive (Wilson 1973) although the customs records surveyed here make no mention of it (Gras 1918).

Pinus pinea (stone pine/pine nut, Fig. 69) was traded in Roman times for the religious significance of its cones (and probably also as food), and Roman remains have been found both in Britain and in mainland Europe (Kislev 1988). Medieval finds are much rarer, however, and one find from England (Shrewsbury, Greig,

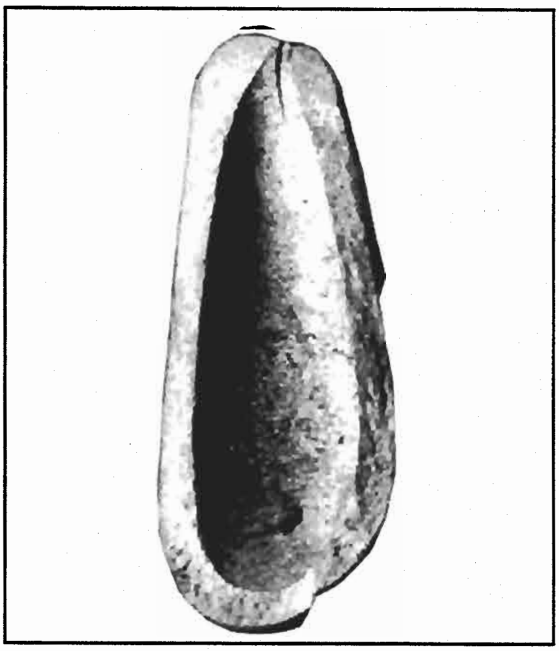

Figure 69. Pinus pinea *(stone pine, nutshell), x3.5, Shrewsbury, A.D. 1268-1310.*

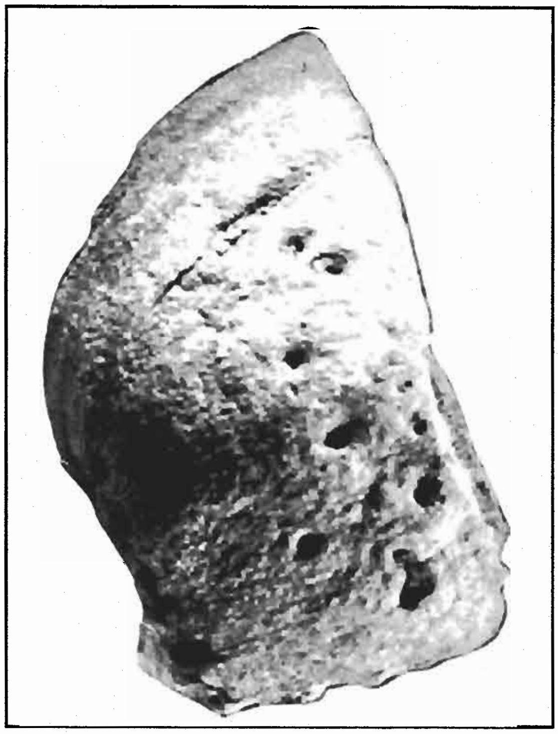

Figure 70. Prunus dulcis *(almond, nutshell fragment), x5, Shrewsbury A.D. 1268-1310.*

in prep.) and one early medieval find together with a later one from Dublin (S. Geraghty, in prep. and pers. comm.) are the only ones known to the writer. Occasional documentary records mention that pine nuts were imported during the medieval period (Wilson 1973, 298), although there is little specific evidence from the customs records, which usually simply mention 'nuts' (Gras 1918), probably because this was the category for assessing the tax payable. There do not appear to be any medieval finds of pine nut from mainland Europe.

Prunus dulcis (almond, Fig. 70) was known to the medieval gardeners Neckham, Bartholomew, and Daniel (Harvey 1981). It seems to survive the British climate well, and today almond trees are not uncommon in England. Almonds do ripen, although home-grown almonds are not often eaten, the trees being mainly grown for their vivid blossom. Almonds were imported, as shown by the customs records of *Amygdali* having had tax paid on them (Gras 1918), and some royal households imported almonds by the ton (Wilson 1973). Archaeobotanical remains have been rare in Britain to date, although almond shell was present in medieval material from Shrewsbury (Greig, in prep.). One would expect the robust almond nutshell remains to provide fairly good evidence of their presence, so the scarcity of finds is surprising. The best chance of obtaining a more representative record of the presence or absence of almond may be offered by the bulk-sieving of excavated material. The finds from the European mainland are more numerous; they date from the 13th-18th centuries.

Vegetables

Since the edible parts of vegetables are soft, it was thought unlikely that they would survive in the archaeobotanical record, yet this is an area where a surprising and unexpected amount of evidence has appeared in the last decade.

A further problem with vegetables is that so many are derived from native wild plants that it is hard to tell whether an archaeobotanical record, especially for a propagule, is more likely to represent a cultivated plant, or its wild relatives.

The staple vegetables

Archaeobotanical evidence of the Allioideae (onions, leeks, garlic, etc.) has been found, in the form of seeds and leaf fragments of *Allium porrum* (leek; e.g. Tomlinson 1991) and bulbs of *porrum* (leek; e.g. Tomlinson 1991) and bulbs of *A. sativum* (garlic) from Britain (McKenna 1992). Leeks, garlic and onions were apparently very widely grown and used (McLean 1981, 202-5; Harvey 1984). They were also traded, as shown by customs records (Gras 1918), which could either show that these were the only vegetables traded, or rather that these were the only traded vegetables that were *taxed*. In mainland Europe *A. sativum* has been found at Laufen in Switzerland (Karg 1991), and at Schwäbisch Hall in Germany (Rösch *et al.* 1994), where *Allium cepa* (onion) was also found.

The brassicas (Brassiceae) are also difficult to investigate; the edible parts have not yet been identified in northern European material. Seeds of *Brassica* species are not uncommon among other food remains, but it is not easy to separate the seeds of cultivated vegetables *Brassica oleracea* (cabbage, etc.) or *B. napus* (turnip) from those of *B. nigra* (black mustard). Although cabbage is known from the historical records to have been a staple vegetable during the period in question (Harvey 1984), its archaeobotanical record is uncertain. In mainland Europe, the Brassiceae are usually divided into groups such as *B. rapa*, *B. nigra/rapa* and *B. oleracea/napus*, which do not separate leaf, root or oilseed crops, but are nonetheless practical (Wiethold 1995). A 16th century find of *B. napus* has been reported from Germany (Kroll 1994).

Daucus carota (carrot) and *Pastinaca sativa* (parsnip) seeds are often found in archaeological material but, as mentioned above, the problem with these and some of the other Apiaceae (Umbelliferae) is in deciding whether the remains represent wild or cultivated plants; the wild plants are common in semi-natural grassland vegetation. As there is usually a grassland element in urban organic remains, such finds could just as easily have come from wild plants rather than cultivated vegetables. Also, the cultivated carrot seems to have reached Britain only in the 15th century according to McLean (1981) so earlier *Daucus* finds are almost certainly wild in origin. Parsnip seems to have a longer history of cultivation (McLean 1981). *Apium graveolens* (celery) grows wild on salt-marshes and is therefore less likely to have been part of the local flora in the surroundings of most archaeological sites. Its use as a vegetable rather than the seed being employed as flavouring was also a late development, and would be difficult to prove from the fossil record (celery seed used as a flavouring is further discussed below).

Figure 71. Cichorium intybus *(chicory, fruit), x 20, Shrewsbury, 14th C.*

Less common vegetables

Asparagus officinalis (asparagus) seeds have been found in post-medieval deposits at Leicester (L. Moffett, pers. comm.). Asparagus is mentioned by Turner in what seems to be the only clear historical record from Britain (Turner 1538), although there are scattered records from elsewhere (Harvey 1981). There are apparently no archaeobotanical records of asparagus from mainland Europe, apart from a Bronze Age find from Thy, northwest Jutland (Kelertas, unpub. *via* D. Robinson, pers. comm.)

Beta vulgaris (beet, beetroot) finds are now accumulating from deposits dated to the 15th and 16th centuries in Britain. Finds from inland sites, far away from the coastal habitat of the wild plant, provide fairly good evidence that beet was being deliberately grown at this time. The historical records of Neckham, Bartholomew and Daniel are earlier, dating from the 13th and 14th centuries. So also are the mainland European records, which start in the 13th century (Wiethold 1995). One can confidently expect further information on the early history of garden beet to emerge.

Cichorium intybus (chicory) seed, of which there is a 14th century find from Shrewsbury (Greig, in prep. and Fig. 71) and an unpublished record from a 15th/16th century well in Grimsby (A. Hall, pers. comm.), is hard to distinguish from the wild plant, which grows in perennial weed communities. There does seem to be some difference in seed morphology between cultivated endive and the wild chicory

Figure 72. Cucumis *sp. (cucumber or melon, seed fragment), x10, Shrewsbury, 18th C.*

noticeable in the reference material, which might possibly permit the identification of cultivated forms among archaeobotanical seed remains. Chicory has a historical record in Britain (Harvey 1981; McLean 1981, 212). *Cichorium intybus* seeds, though not necessarily the cultivated variety, have also been found at a few mainland European sites such as Lüneburg (Wiethold 1995).

Cucumis sativus (cucumber, gherkin) and *Cucumis melo* (melon) are some further taxa for which an archaeobotanical record has emerged fairly recently in Britain. *Cucumis* sp. (cucumber/melon, Fig. 72) has been found at two 18th century British sites now, although the documentary evidence of cucumber and possibly of melon goes back to the works of Alexander Neckham, who was born in 1157 (Harvey 1981). In mainland Europe, *C. sativus* is found from the 12th century, and earlier still at sites closer to its Slavonic homeland (in van Zeist *et al.* 1991). *C. melo* finds have dated from the 17th and 18th centuries. *Cucumis* can difficult to grow successfully out of doors in Britain now, so the find of subfossil seeds is perhaps surprising.

Valerianella (lamb's lettuce, cornsalad) seeds, including those of *V. locusta* (corn salad), of which the leaves were eaten, are quite often found archaeologically. It is only in the last decade or so that cornsalad has re-appeared—in English supermarkets. Seeds of various species of *Valerianella* are not uncommon in medieval urban organic deposits. It is difficult to say whether these represent garden plants, or cornfield weeds—*Valerianella* species grow wild as cornfield weeds as well as being cultivated. The seeds of cornfield weeds are often abundant in latrines and rubbish pits together with food remains, perhaps having been introduced with grain or straw or as food contaminants. However, it is likely that *Valerianella* species, including *V. locusta*, were used as salad vegetables even if this cannot be proven in the case of specific finds.

There are many other plants which have occasionally been grown as vegetables, such as *Scorzonera* and *Tragopogon* species (scorzonera, salsify) and *Sium sisarum* (skirret). These are only mentioned in passing here to illustrate how wide the range is of plants that have been used for food at one time or another. Any of these plants might be found in archaeological deposits and be identified if archaeobotanists are aware of their existence. Others are listed by Harvey (1981).

New vegetables from the Americas

An area of particular interest is evidence for the introduction of plants brought from the New World. Many of these were only slowly selected to accommodate European growing conditions and were not immediately accepted as more than curiosities for wealthy gardeners. In archaeobotanical terms they are distinctive, having few very close European relatives. So far there have been few such finds: there is one find of *Lycopersicon esculentum* (tomato) from Britain (Carruthers, unpub.). Moffett (1992; 1995) lists the few finds of *Cucurbita pepo* (pumpkin, etc.) from Britain and elsewhere in Europe, and discusses the introduction of *Cucurbita* (squashes). No evidence of *Solanum tuberosum* (potato), that commonest of New World discoveries, has yet been reported. However, *Phaseolus vulgaris* (French or kidney bean) has been found in Germany at Schwäbisch Hall (Rösch *et al.* 1994), together with *Helianthus annuus* (sunflower). *Helianthus tuberosus* (Jerusalem artichoke) has not been found. Post-medieval material holds the potential for some very interesting finds. For a discussion of *Capsicum* (sweet pepper, chili), see below.

Not found in Britain yet

Amaranthus lividus (love-lies-bleeding, amaranth) is a member of the Chenopodiaceae with red shoots and flowers. It can be grown as an ornamental as well as a vegetable. Amaranth is not apparently represented in Britain either by archaeobotanical or by historical records, perhaps because it was never popular. By contrast, in mainland Europe there is a fairly consistent record from Germany for the 11th-15th centuries arising from Knörzer's extensive work in the Rhineland (summarised in van Zeist *et al.* 1991), and also from Braunschweig (Hellwig 1990) and further east at Cottbus (Lange 1993), for example, although apparently not much from elsewhere. The reason for this patchy distribution might be a quirk of regional

Figure 73. Apium graveolens *(celery, 'seed'), x20, Shrewsbury, late 15th-16th* C.

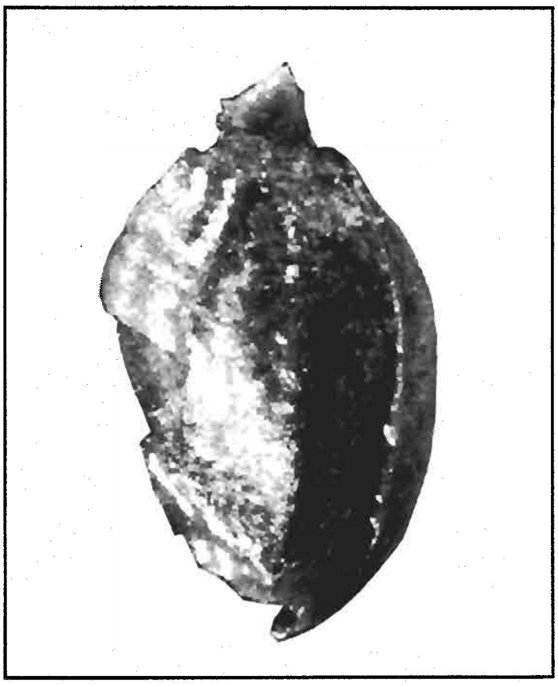

Figure 74. Coriandrum sativum *(coriander, 'seed'), x20, Shrewsbury, late 15th-16th* C.

preference, as is the largely British taste for parsnips (Körber-Grohne 1987).

Brassica napus (turnip) has long been a staple vegetable (Harvey 1981). As outlined above, it is difficult to identify Brassiceae exactly from the usual fossil remains—seeds. Recently, however, turnip has been identified from remains of the roots found in Greece (Byzantine Sparta, Hather *et al.* 1992). This demonstrates the possibility, at least, that further vegetable remains may yet be identified from northern Europe, to match the long historical record.

Lactuca sativa (lettuce) is mentioned by many of the gardening writers (quoted in Harvey 1981, McLean 1981), although 'healthy' foods (in the modern sense) such as salads and fruit do not seem to have been very popular according to the medieval cookery records, where stewing food all day long was more the norm. Lettuce was originally grown, incidentally, as a pot herb rather than for salad (Wilson 1973). There have been no archaeobotanical finds from Britain so far, and it can be difficult to distinguish *L. sativa* seeds from those of other (wild) lettuces. *Lactuca sativa* seed has been found in Scandinavia (Hjelmqvist 1991; van Zeist *et al.* 1991) and *L.* cf. *sativa* at Hall (Rösch *et al.* 1994), which demonstrates the possibility that a more detailed archaeobotanical record of lettuce will eventually emerge.

Lepidium sativum (cress) has a long historical record (Harvey 1981). There are also some historical records of *L. latifolium* (dittander), which seems to have disappeared from the garden in more recent times. There are a number of archaeobotanical records of *Lepidium* species from mainland Europe, with *L.* cf. *latifolium* being identified at Heidelberg (Rösch 1993), for example. For Britain, there are tentative records from 10th century Coppergate, York (Kenward and Hall 1995: one record, cf. *L. sativum*) and from late 13th/early 14th century deposits at Sewer Lane, Hull (Williams 1977; two records, *L.* cf. *sativum*).

Portulaca oleracea (purslane) has not been identified from British archaeobotanical remains although there is a documentary record for it from the 13th century. It has been found at many sites in mainland Europe from the 12th century onwards.

Raphanus sativus (radish) is included in most of the gardening records (Harvey 1981), although archaeobotanical evidence of radish does not appear to have been found in Britain. Records are now appearing from mainland Europe (Rösch *et al.* 1994), where many more kinds of radishes have traditionally been used than in Britain.

Spinacia oleracea (spinach) seems only to have been recorded by Daniel in 1375 among the gardening writers, and there are no British finds. *S. oleracea* has been found from the 13th and 14th centuries at some mainland European sites (e.g. Rösch *et al.*), showing that spinach seed may be preserved, recovered and identified. Another member of the Chenopodiaceae, *Atriplex hortensis* (orache), has been grown as a leaf vegetable, and there are a few scattered records from mainland Europe.

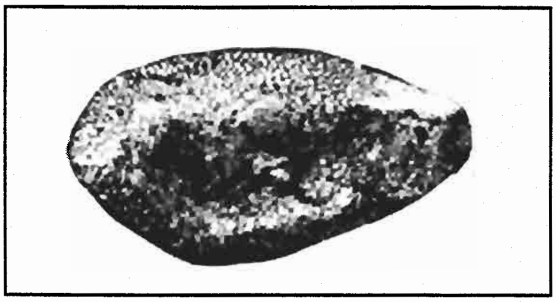

Figure 75. Hyssopus officinalis *(hyssop, 'seed'), x10, Shrewsbury, late 15th-16th C.*

Figure 76. Anethum graveolens *(dill, 'seed'), x10, Shrewsbury, late 15th-16th C.*

Common indigenous or long-established exotic flavourings

The commonest north European food flavourings of the past, according to the archaeobotanical finds, were three umbellifers with edible seeds: *Foeniculum vulgare* (fennel), *Apium graveolens* (celery, Fig. 73) and *Coriandrum sativum* (coriander, Fig. 74). *Brassica nigra* (black mustard) and *Papaver somniferum* (opium poppy) were also popular. There are historical records of these plants as well as archaeobotanical finds both from Britain and mainland Europe from most centuries, showing that they were both common and widespread.

Less common herbs and flavourings

There is a large selection of herbs and spices which have been found less often, either in Britain or in mainland Europe. *Hyssopus officinalis* (hyssop, Fig. 75) and *Satureja hortensis* (summer savory) have been found at a number of sites in Britain and on the European mainland. *Sinapis alba* (white mustard) finds are surprisingly rare, as is *Juniperus communis* (juniper; for example Rösch 1993) although the latter was perhaps always an unusual flavouring until it became used in gin.

Mainly mainland European finds

Relatively common in mainland Europe, but apparently less so in Britain, are finds of *Anethum graveolens* (dill, Fig. 76), *Nepeta cataria* (catmint), *Petroselinum crispum* (parsley) and *Satureja montana* (winter savory).

Mainland European finds only

Carum carvi (caraway) and *Anthriscus cerefolium* (chervil) seeds and pollen (van den Brink 1988; 1989) have been found only in mainland Europe despite there being a British historical record of each and a British tradition of using caraway in 'seed cake'. Caraway and chervil are both now perhaps mainly 'continental' tastes, and may also have been in the past. *Salvia* has only been found in mainland Europe (see below, under medicinal plants), and there is a possible *Origanum* sp. (marjoram) find from Paris (Ruas 1992). *Nigella sativa* (gith, black cumin, Roman coriander, 'onion seed') is another 'forgotten flavour'; it has been found at Cottbus in south-eastern Germany (Lange 1993). Possible worm-wood (*Artemisia* cf. *absinthium*) has been identified from Germany (Hellwig and Kuprat 1991). Sometimes even the leaves of plants used for flavouring have been found and identified, such as *Thymus* (thyme) leaves from Cologne (Knörzer 1987). The strong mainland European record may partly reflect the intensity of work carried out (and published) on city sites there, mainly in the Netherlands and Germany.

British finds only

The find of cf. *Mentha pulegium* (pennyroyal) calyces at Shrewsbury, and *Rosmarinus officinalis* (rosemary) seeds at Windsor (Carruthers 1993, Fig. 77) may be unusual 'lucky chance' finds. These herbs were probably widely cultivated elsewhere, but are not readily discovered because pennyroyal seeds cannot be distinguished from those of other mints, and because rosemary does not usually set seed. *Calendula officinalis* (pot marigold) has been found at several sites in England dating to the 15th century and later, and there are records of it in gardens even earlier. Curiously, however, pot marigold does not seem to be found in mainland Europe.

No finds so far?

There is a documentary record for *Cuminum cyminum* (cumin) in British gardens in the 11th,

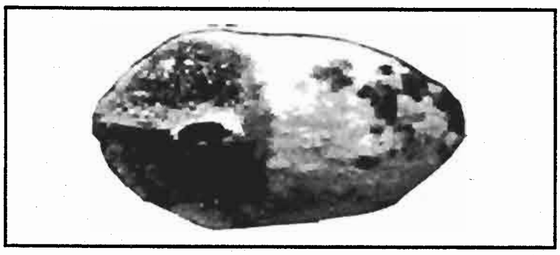

Figure 77. Rosmarinus officinalis *(rosemary, 'seed') from Jennings Yard, Windsor (Carruthers 1993), x20, 13th/14th C.*

13th 14th and 15th centuries, although its native habitat is the eastern Mediterranean (Rosengarten 1981) and one may wonder how successfully it, and indeed many of the other herbs and spices of southern European origin, could be cultivated in England. Cumin was also imported, as shown by a customs record from 1303 (Gras 1918, 166), but there does not appear to be an archaeobotanical record so far. *Pimpinella anisum* (aniseed) was also recorded by the gardeners and was imported as 'anys'. There is a single mainland European archaeo-botanical record. It should be noted that 'star anise' is something completely different, the fruits of *Illicium verum*, which is a member of the Magnoliaceae that grows in China. It may have reached Europe comparatively recently, and it has not yet been recorded archaeobotanically.

Two herbs with an historical, but not yet an archaeobotanical record, from medieval northern Europe are *Melissa officinalis* (balm) (there is a Roman find from East Yorkshire, A. Hall, pers. comm), and *Ocimum basilicum* (basil).

Taphonomy—leaves versus *seeds in plant flavourings*

When seeds were the useful part of a plant (as in the case of fennel), one can expect to find seed remains among archaeological material from rubbish pits and latrines. When the green parts of a plant were used (parsley, for example), one might not expect a corresponding archaeobotanical record, yet seeds are found surprisingly often, although they may under-represent the amount of the plant that was used. Another example of a green leaf herb with a seed record is lovage (*Levisticum officinale*), found by Rösch (1993). Some herbs such as celery can be used as seed or leaf, which may account for the more numerous celery finds. Also, herbs may have been stored and used when they contained seed, or the seeds were kept for re-sowing, having been discarded with domestic rubbish. This may be the reason why seeds of taxa such as *Hyssopus officinalis* (hyssop) are so rarely found. A final possible route by which seeds could arrive in rubbish deposits is from the strewing of floors with strong-smelling plants, which were eventually discarded with rubbish.

Exotic flavourings

Capsicum annuum (sweet pepper, paprika) has been recorded from one mainland European site, at 15th/16th century Ladenburg L2, in south-west Germany (Maier 1983). The pepper could equally have been used as a vegetable. Recently, *Capsicum* cf. *frutescens* dated to the 13th/14th century was found at Lund, Sweden; this must be an Old World cayenne pepper (Hjelmqvist 1995).

Tropical imports

A particularly interesting area concerns the tropical products which cannot be grown outdoors in the temperate world, and which have necessarily been traded a long way. It is worth remembering the potential for confusion in the historical records that mention such things. The spices were imported by traders, not plant taxonomists, and a range of related taxa may have been imported as one spice. For instance, the name 'pepper' has been widely applied, to the genera *Piper*, *Aframomum*, *Capsicum*, and *Pimenta*, as well as to *Persicaria*, *Vitex* and maybe others as well. Even so, the spice merchants must have had an extensive working knowledge of spices on the basis of appearance and flavour.

Finds of *Aframomum melegueta* (Melegueta pepper) from 16th century deposits in Kiel, Lübeck, Lüneburg and Göttingen have already been published (Wiethold and Schulz 1991; Wiethold 1995; Hellwig 1995). *Aframomum* finds from various sites in Britain have now been identified thanks to Julian Wiethold's demonstration of his find of *Aframomum* from Kiel together with modern reference material, at the International Workgroup for Palaeoethnobotany conference at Kiel in 1992. The present writer wondered whether the *Aframomum* seeds might be familiar, and on returning to the laboratory in Birmingham, he therefore looked through some old finds, and quickly discovered that some seeds identified as cf. *Borago officinalis* from a 15th century barrel latrine at Worcester (illustrated by Greig 1982,

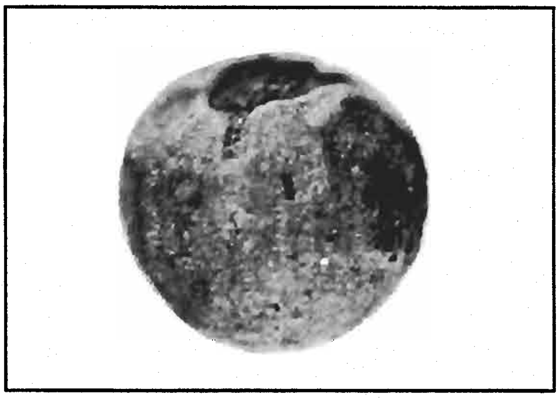

Figure 78. Piper nigrum *(peppercorn), x10, Shrewsbury, 18th C.*

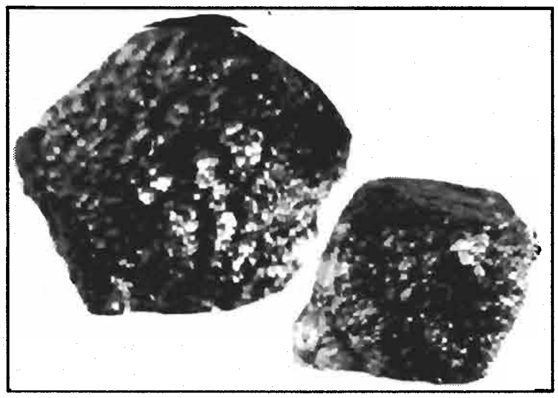

Figure 23. Aframomum *('grain of paradise'), (a), above, fossil specimen, x10, Shrewsbury, 18th C; (b), below, modern grain of paradise seed which is presumed to be* Aframomum melegueta.

50, and 1983, 202) were in fact those of *Aframomum*. More *Aframomum* seeds were found in material from 16th century Taunton as well (post-dating data published by Greig 1990). Then, quite by chance, the second dish of 18th century Shrewsbury material to be sorted after the Kiel conference revealed both the first *Piper* (Fig. 78) and *Aframomum* (Fig. 79) seeds from this site.

The somewhat complex botanical background to *Aframomum* is briefly that there are two species whose seeds seem to have been used: *A. melegueta* (Rosc.) K. Schum. (Melegueta pepper), and *A. Granum Paradisi* (L.) K. Schum. (Grains of Paradise), which have been much confused with each other (van Harten 1970), and also with other taxa such as *Elettaria* and *Cardamomum*. The writer obtained 'grains of paradise' from a spice wholesaler which are smaller and redder in colour than the archaeological material so far recovered, so the latter has only been identified as *Aframomum* sp. The use of various names for a range of related spices caused confusion in the past, as recorded by John Parkinson (1640).

Grains of paradise have been recorded historically in Britain from the 13th century onwards, but seem to have gone out of use in the 17th century, so that they are scarcely mentioned by many of the more recent 'complete (*sic*) herbals' (e.g. Grieve 1984; Rosengarten 1981), nor in the *Oxford Book of Food Plants* (Nicholson *et al.* 1969). *Aframomum* seeds were used as a form of pepper, for flavouring drinks, and finally as cattle medicine.

Other tropical taxa the seeds of which were used as spices include some Asian members of the Zingiberaceae (ginger family) such as *Elettaria cardamomum* and *E. major* (cardamom) which have only been found in Braunschweig, in 13th century and 12th-13th century contexts respectively (Hellwig 1990), and at Hildesheim (cited in Wiethold 1995), both in Germany.

Myristica fragrans (nutmeg—the 'nut', and mace—the surrounding aril) were likewise also imported in the medieval period, and being a robust nut, might be expected to have been preserved somewhere. Recently, mace has been found at Paisley Abbey in Scotland (Dickson 1996). From mainland Europe, nutmeg has been reported from the Czech Republic by Čuliková (1994).

Piper sp. (pepper) has recently been found at 15th century Worcester, 16th century rubbish pits at Taunton (the site was originally reported by Greig 1990), a 17th/18th century latrine pit of the Provost of Oriel College Oxford (M. Robinson, pers. comm.), and 18th century Shrewsbury, and there is a further unpublished record from medieval/post-medieval Canterbury (A. Hall, pers. comm.). There are doubtless yet more finds awaiting publication. Pepper has been recorded historically since Roman times, although there is only a single Roman archaeobotanical find, from Oberaden in Germany (Kučan 1992). There are a number of medieval references to pepper, which one can assume to refer mostly to *Piper* (Wilson 1973). On the mainland of Europe, medieval and later pepper finds have recently appeared from a number of sites such as Bremen at about 1200 (Behre 1991), 16th century Kiel, Lübeck and Mölln (Wiethold and Schulz 1991), 17th/18th century Köln (Knörzer

1987) and 18th century Groningen (van Zeist 1992).

The taphonomy of the pepper deserves mention, since the remains found up to now have been whole peppercorns. In the past, pepper was ground into powder before use as it is now, and there are of course references to powdered spices (Wilson 1973, 255). Examination of modern pepper which had been ground in a pepper mill seems to suggest that the resulting small fragments would be hard to distinguish among the usual range of unidentifiable plant debris seen during sorting, although coarser fragments resulting from a rough crushing or pounding might be recognizable, with experience. One might also wonder whether the sudden appearance of whole peppercorns represents their having been eaten whole, or whether they were then cheap enough to be allowed to spoil and be discarded, since they no longer needed always to be kept under lock and key (Wilson 1973, 256 and 263).

All the sites analysed by the writer which contained *Piper* (from Worcester, Taunton, Oxford and Shrewsbury), also contained *Aframomum*. Three were urban latrines/rubbish pits, the fourth, in Shrewsbury, being a rubbish deposit.

Probable *Syzygium aromaticum* (cloves) have been detected from their pollen both in mainland Europe (van den Brink 1988; 1989) and in Britain (Greig 1994). This should not be surprising, for cloves are flower buds. Maybe the cloves themselves are too fragile to be preserved, or the fragments have not yet been recognized. There is a considerable historical record of cloves, which were apparently just as widely used in the past as they are today.

Flavourings without an archaeobotanical record

There is a fairly long list of tropical spices which are often recorded in various documents such as accounts and customs records, for which there appears to be no archaeobotanical record at present. It is worthwhile to consider the possibility of identifying archaeobotanical remains of some of these.

There are several lesser-known species *of Piper* including *P. cubeba* (cubebs), which has seeds similar in appearance to those of *P. nigrum* and which were used in much the same way, although their flavour is inferior according to the present writer's taste. Seeds of *Piper longum* (long pepper) have not yet been obtained by the writer to see how identifiable they might be. Other species of *Piper* could also have been imported.

Zingiberaceae, the ginger family, includes many useful plants in addition to *Elettaria* and *Aframomum* mentioned above. Various tropical members of the Zingiberaceae were grown for their roots, such as the well-known *Zingiber officinalis* (ginger). Related taxa include *Curcurma longa* (turmeric), *C. zedoaria* (zedoary) and *Alpinia galangal* (galangal).

Other roots which were used include a member of the Cyperaceae, *Cyperus longus* (galingale), and a member of the Fabaceae, *Glycyrrhiza glabra* (liquorice; Nicholson *et al.* 1969, 134-5; Heywood *et al.* 1978, 298). All of these, and chiefly ginger, were imported, although liquorice was grown in England, traditionally around Pontefract in Yorkshire. One would suppose that the useful part, the root, would have no chance of becoming preserved and identified in archaeological material. But then, the same would have been said of *Allium sativum* (garlic) cloves and *A. porrum* (leek) leaf epidermis a few years ago.

Cinnamonum verum (cinnamon), for which there is a consistent documentary record, is the bark of a tree, which would be difficult to identify. The only archaeobotanical record is a find of a cinnamon flower from Greece dating from the 7th century B.C. (Kučan 1995).

Boswellia dalzielii and *Commiphora molmol* are the plants from which the aromatic resins frankincense and myrrh are obtained. These were used as perfumes rather than in food (Thulin and Claeson 1991). They are included here so that they should not be overlooked. The resin might contain pollen, and indeed possible *Commiphora* pollen has been found in archaeological material in Arabia (Levkovskaya and Filatenko 1992).

Crocus sativus (saffron) is often mentioned in cookery books (Wilson 1973), and modern saffron bears distinctive pollen which analyses of archaeological material such as latrine and rubbish pit fills could well be expected to reveal.

Sugar (from *Saccharum officinarum*) presents a problem because it is a substance which one would not expect to leave very clear pollen or macrofossil evidence, and being water-soluble is unlikely to be preserved in other ways, although the fibres from raw sugar might possibly be identified.

Finally, there is a group of relative latecomers, for example *Pimenta dioica* (pimento, allspice) from the West Indies. Drinks obtained from the fermented leaves of *Camellia sinensis* (tea), from the berries of *Coffea arabica* and *C. robusta* (coffee), and from the fruits of *Theobroma cacao* (cocoa, chocolate), are mentioned in documents from the 17th century onwards (Wilson 1973). Archaeobotanical remains of coffee and cocoa have been found, the former in the sea off Padstow, Cornwall, and the latter in Dublin (cited in Greig 1991, 329-30). It remains to be seen whether tea leaves have any distinguishing morphological features or a characteristic pollen content which permits their identification.

Medicinal and decorative plants

Medicinal/decorative plants recorded

Seeds of the possible medicinal plants *Atropa bella-donna* (deadly nightshade) and *Hyoscyamus niger* (henbane) are often found in urban archaeological deposits. The difficulty is that both of these could easily have grown wild on waste ground in towns, and it is almost impossible to find any real evidence that either was actually used as medicine.

Aquilegia vulgaris (columbine) has been found in deposits of faecal material and rubbish at a number of sites in Britain and in mainland Europe. The wild (or naturalised) plant grows in partly shaded calcareous habitats, and such habitats did, of course, exist in towns. However the frequent finds of columbine seeds make it likely that columbine was actually being used for medicine or was grown in gardens as it still is today.

Borago officinalis (borage) is a garden plant with an archaeobotanical record, mainly in the form of pollen evidence from latrines (Greig 1994). Borage flowers were eaten in salads as shown by an early recipe of about 1393, which included borage, primroses, roses and marigolds, or they were sugared (Wilson 1973, 303 and 307). This might explain the appearance of the pollen in latrine material; residues of honey containing borage pollen is another possibility.

Euphorbia lathyris (caper spurge) and some other spurge species have been found at a number of British sites, although many also grow as weeds. The irritant poison content of *Euphorbia* gave it the purgative qualities, mentioned in Chaucer's *Canterbury Tales* (Coghill 1960, 234). *Leonurus cardiaca* (motherwort) is another medicinal plant known from documentary sources and which has now been identified from a site in Sweden (Hjelmqvist 1991). *Ruta graveolens* (rue) is yet another medicinal plant with a limited archaeobotanical record; it has been recorded from 13th century Braunschweig (Hellwig 1990), whilst *Salvia officinalis* (sage) has been found in the Czech Republic (Čulíková 1995a). *Verbena officinalis* (vervain) is occasionally recorded as a macrofossil, but as this is a fairly common wild plant, it is hard to prove or suggest actual use. It has been used for tea (Grieve 1984), but its pollen has so far not been reported.

Medicinal/decorative plants not yet found

A number of medicinal plants are well known from historical references, but archaeobotanical remains have not, apparently, yet been found. Various *Artemisia* species are mentioned such as *Artemisia abrotanum* (southernwood) which may also be the wormseed *setewal* mentioned in some records (Gras 1918). Although *Artemisia* seeds are occasionally found (P. Tomlinson, pers. comm.), they are not usually well preserved or identifiable beyond genus. *A. absinthium* (wormwood) has, however been identified from Northeim in Germany (Hellwig and Kuprat 1991). The more plentiful pollen records of *Artemisia* show that the scarcity of seed records is probably because of low seed production or poor preservation. *A. abrotanum* does not appear to flower in Britain (Stace 1991).

Citrullus colocynthis (colocynth) is often mentioned in the literature, and it has been found elsewhere (cited in Schultze-Motel 1993), while *Paeonia mascula* (paeony) seed was used, but it has not been found.

Various species of *Rheum* (rhubarb) were also grown; originally the roots of *R. officinale* were imported from China for use as a laxative. When live rhubarb first arrived in Britain in the 16th century, it was a different species to the medicinal rhubarb *R. officinale* owing to confusion between the many *Rheum* species (Simmonds 1978, 319-20). *Rheum* does not appear to have been found archaeobotanically.

There are many more official medicinal plants which are listed and described in various herbals and pharmacopoeias, most of which are included by Grieve (1984), and it is a very large list from which only the commonest have been presented here.

Industrial, fibre, brewing and other plants

Seeds of the main fibre plants, such as *Cannabis sativa* (hemp), are often found in small numbers in archaeological deposits. Large concentrations of hemp seeds and pollen are also found in wetland retting sites. *Linum usitatissimum* (flax) seeds and capsule fragments are also found in archaeological deposits, but pollen grains are rare as flax produces very little pollen. *Gossypium hirsutum* (cotton) is known from the documentary records only.

Dyestuffs represent a very large subject area, discussed in connection with the pre-Conquest finds from Coppergate, York (Kenward and Hall 1995). There are now archaeobotanical records of *Rubia tinctorum* (madder) root, *Genista tinctoria* (dyer's greenweed) stem and *Isatis tinctoria* (woad) leaf (Hall 1992a) to compare with the historical record (Gras 1918, for example), even though the chance of finding identifiable remains of these had previously seemed unlikely. A further plant from Coppergate (and some other sites in York) which seems likely to have been used in dyeing is a clubmoss, *Diphasiastrum complanatum*; it was almost certainly imported from Scandinavia as a source of aluminium for mordanting. Cloth processing involved the use of *Dipsacus sativus* (fuller's teasel) flower heads for which an archaeobotanical record has recently emerged (Hall 1992b). At Aachen in Germany, *Dipsacus sativus* and *Isatis tinctoria* were found together in a 14th century context with *Reseda luteola* (a dyestuff), hemp and flax (Knörzer 1984). For a summary of the British and Irish archaeobotanical evidence for plants used in dyeing, see Hall (1996).

There are several more plants which were useful in various ways, such as *Carthamus tinctorius* (safflower), which was used as a dyeplant, as a substitute for saffron, and as an oil seed. Finds have not yet been reported from northern Europe. Another such plant is tobacco (*Nicotiana tabacum*) which has been found at Smeerenburg, Spitsbergen (quoted in Bakels 1991), and *N. rustica*, found in the Czech Republic (Čuliková 1995b).

Finally, *Humulus lupulus* (hop) has been found in small amounts at many British and mainland European sites. In Britain, the transition from unhopped ale to hopped beer is supposed to have taken place in the late 15th century according to documentary sources (Corran 1975). In mainland Europe, hopped beer was brewed throughout the medieval period, and consistent *Humulus* finds at sites such as 14th century Most in the Czech Republic suggest that hops were being used in this heartland of beer brewing then (Čulikova 1995a, 98).

Discussion

Documents versus *archaeobotany*

The documentary record is scattered in place and time (with very little early medieval evidence), as well as being selective in what is recorded. Some things in particular are recorded, such as certain imports, food bought for noble households, and what was supposed to have been grown in some gardens. Other things such as the diet, gardens and medicines of ordinary people are virtually unrecorded.

The archaeobotanical records are also very scattered in place and time, and vary in the amount that has been preserved and which can be identified. The evidence is biased this time towards plants whose remains are easily preserved and then identified, with very little or no information about some important foodplants such as cabbages. There is also a bias towards the times and places where latrine pits were used, especially monastic establishments, castles and later medieval and post-medieval towns.

The fact that documentary and archaeobotanical records show such different and fragmentary aspects of medieval and post-medieval life makes the comparison interesting and worthwhile. The earliest records of many plants come from documentary sources, probably because rare or exotic plants were more noteworthy than everyday ones. It seems to have taken some time before new imports or introductions became accepted and widespread. Only then did they have a good chance of being deposited and subsequently found in archaeobotanical material. However, the increase in detailed archaeobotanical research is narrowing the time gap between first documentary and earliest archaeobotanical record.

In the decade since the last reviews (Green 1984; Greig 1983) a surprising number of the plants for which there were then only historical records have been found and identified. These include some, such as *Allium* epidermis and *Cinnamonum* flowers, which would have been considered unlikely ever to be preserved and recognised. Also, pollen analysis can demonstrate the presence of some herbs used whilst they were flowering, as in the case of *Anthriscus cerefolium* (chervil, van den Brink 1988; 1989). Most of this progress is simply the result of careful and thorough work on large assemblages of suitable material, with a good reference collection available.

A number of vegetable taxa have been recorded from mainland sites, but have not been found in British material. There a number of possible reasons for this. Taste may have played a part, for the British attitude to potentially edible plants has not been as adventurous as that of our mainland European neighbours. Thus, for instance, a single mushroom species is generally eaten in Britain compared with a great variety in mainland Europe. Further north, in Scandinavia, an even smaller range of edible plants seems to have been used. Another reason for lack of British finds may be connected with identification, particularly for the more unusual taxa, which are often absent from the reference collection. In some plant groups such as the Apiaceae, the seeds may partly degrade, making exact identifications difficult.

Geographical evidence from documents

There is a wealth of evidence from customs records about the cargoes that were landed. These even give the names of the people concerned, and more importantly, where they came from and even the time of year, which was important for seasonal trade such as in figs and raisins, and the collection cited here (Gras 1918) is only one of many such. There is plenty of evidence of trade from France, Portugal and Spain bringing a great range of food, drink and a great range of other materials to England during the medieval period from the 13th century onwards, which were traded far and wide by merchants to consumers in distant parts, as at Paisley Abbey in Scotland (Dickson 1996).

Gardening records (Harvey 1981; 1984; McLean 1985; Roach 1985) show a somewhat different set of influences. There was much contact between England and various parts of France (which were at times ruled by the English) in the Middle Ages. Much of the knowledge of gardening seems to have come from this direction, and gardeners attempted to grow plants in England which were already well established in the warmer regions across the Channel.

Geographical differences from archaeobotany

There are enough results from some regions to show an emerging pattern of geographical differences. *Triticum turgidum*, for example, seems to be restricted to England, although there is not enough medieval evidence from France to show whether it was also grown there (as might be expected). Some other plants which seem only to have been grown in particular places include *Anthriscus cerefolium* in the Netherlands, and *Amaranthus lividus* in Germany. In contrast to the relatively rich floras of mainland Europe and to a lesser extent of England, the few finds of exotic plants in Scandinavia suggests that there was less contact with the southern lands, although there are fewer detailed results (Robinson *et al.* 1992). It appears that exotic plants arrived in England readily because of the connections with France during the medieval period, and because England was a ready market for produce on the sea route round the coasts of Spain and France from the Mediterranean.

Recovery strategies

The chance of finding new taxa can be increased in various ways. The examination of a large amount of material is particularly important in finding rare but significant taxa. A way of examining a large flora without an excessive time penalty is to examine a fairly small sub-sample for the identification and counting of all taxa, in order to obtain quantitative information, and to scan a large sample for additional taxa which can be recorded on a presence or absence basis. Such a strategy avoids the laborious counting of thousands of weed seeds, for example.

Another useful strategy is the bulk-sieving of large amounts of archaeological material on a fairly coarse mesh (in addition to the detailed examination of material mentioned above). The scanning of bulk-sieved material can lead to good recovery of larger seeds such as fruitstones, as well as other material such as bones and artefacts.

Identification strategies

The philosophy of identification can follow various pathways. One is to study and try to identify material as and when it is found, on the basis of already having a knowledge of much of the native flora. This obviously works well with a standard range of taxa. Unknown remains tend to languish awaiting the moment when there is time for another look, and in a busy working laboratory such opportunities are rare.

An additional strategy is to study a range of modern material so that it will more easily be recognised if it should occur among archaeological material. This can be a valuable technique, especially with rarer useful plants and also wild plants that are now rare, for example certain cornfield weeds. The potential flora that could be encountered increases steadily through the Middle Ages, and rises sharply in the post-medieval period. It is naturally important for anyone studying medieval material to know the (large) range of potential finds, especially when studying rich urban floras. The study of post-medieval floras needs an even larger reference collection, including plants from the Americas. This study of the potential macrofossil flora complements the regular revision which any good reference collection needs, and the memory-refreshing study of particular groups needed by archaeobotanists.

There are a number of taxa that need special attention, especially in the British Isles. Some have been found at various sites already, but rarely, such as *Asparagus*, *Cydonia*, *Elettaria*, *Fagopyrum*, *Fragaria* x *ananassa*, *Lactuca*, *Lepidium*, *Lycopersicon*, *Oryza*, *Punica*, *Sorbus*, *Spinacia*, *Szygium* and *Zea*. Finally, there are some other taxa such as *Colocynthis*, *Cuminum*, *Berberis* and *Pimenta*, which feature in several historical records, but the writer does not know of finds from northern Europe. If these are in reference collections and known, more finds and a better idea of their past histories will surely emerge.

A number of taxa need to be identified beyond genus level, which is usually possible given reference material and the help of colleagues at workgroups. Such taxa include *Cucumis*, *Prunus*, *Sorbus* and *Ribes*. All that will then remain will be to actually publish the results!

Conclusion

The author began compiling this article in 1993. It was intended to draw attention to some of the perhaps lesser-known economic plants so that they could be more readily recognised and identified if they should occur. Archaeobotanical progress has been so rapid in the intervening time that several thorough revisions of the text have been necessary to include new results, with first finds of taxa such as *Capsicum frutescens* type, *Citrus*, *Myristica*, *Phaseolus*, and a number of others. Further finds of a large range of taxa have increased our knowledge of their archaeology. This review will, it is hoped, provide a useful English synthesis of these recent results in the European literature. It is also to be hoped that future results will continue to make such progress in furthering our knowledge of the archaeobotany of useful plants to give a truer and more detailed picture of the changing use of plants in different places and at various periods of time.

Acknowledgements

I would like to offer thanks to W. J. Carruthers for permission to publish her photograph of rosemary seed, to J. Wiethold, A. Parker and R. McFadden for help in obtaining *Aframomum melegueta* material, to M. Robinson for rosaceous reference material, to Lisa Moffett and R. N. Lester for help with historical references, to N. Baker for archaeological data, to Allan Hall for some additional records and many useful comments and, finally, to colleagues who have sent me reprints quoted here. The analyses of the Shrewsbury material have been funded by English Heritage, to whom thanks are due for permission to quote the results here.

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Century A.D.	11	12	13	14	15	16	17	18	
CEREALS AND PULSES									
Avena spp.	+	+	+	+	+	+	+	+	Arch BI
oats	+	+	+	+	+	+	+	+	Hist BI
	+	+	+	+	+	+	+	-	Arch EU
Fagopyrum esculentum L.	-	-	-	-	-	x	x	+	Arch BI
buckwheat	-	-	-	-	-	+	+	?	Hist BI
	-	+	+	+	+	+x	+x	+	Arch EU
Hordeum spp.	+	+	+	+	+	+	+	+	Arch BI
barley	+	+	+	+	+	+	+	+	Hist BI
	-	+	+	+	+	+	+	-	Arch EU
Lens culinaris L.	-	+	-	-	-	-	-	-	Arch BI
lentil	-	-	N, B	W	M?	W	-	W	Hist BI
	+	+	+	+	+	-	+	+	Arch EU
Oryza sativa L.	-	-	-	+	-	-	-	-	Arch BI
rice	-	-	W	-	W	W	W	W	Hist BI
	-	-	+	-	+	+	+	+	Arch EU
Panicum miliaceum L.	-	-	-	-	-	-	-	-	Arch BI
common millet	-	-	-	-	-	-	-	-	Hist BI
	-	+	+	+	+	+	+	+	Arch EU
Pisum sativum L.	+	-	+	-	+	-	+	-	Arch BI
pea	+	+	N	D	+	A	+	+	Hist BI
	-	+	+	-	+	+	-	+	Arch EU
Secale cereale L.	+	+	+	+	-	-	+	-	Arch BI
rye	+	+	+	+	+	+	+	+	Hist BI
	-	+	+	+	+	+	+	+	Arch EU
Triticum aestivum s.l.	+	+	+	-	-	+	-	-	Arch BI
wheat	-	-	+	+	+	+	+	+	Hist BI
	-	+	+	+	+	+	+	-	Arch EU
Triticum turgidum L.	+	+	+	+	-	+	+	-	Arch BI
rivet wheat	-	-	-	-	-	+	+	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Vicia faba L.	+	+	+	-	+	x	x	-	Arch BI
broad bean	-	-	N, B	D	-	-	-	-	Hist BI
	-	+	+	-	+	+	+	-	Arch EU
Zea mays L.	-	-	-	-	-	-	-	-	Arch BI
maize	-	-	-	-	-	+	-	-	Hist BI
	-	-	-	-	-	+	+	-	Arch EU

Table 85 (above and following pages). Cultivated and other useful plants known from (i) British archaeobotanical finds, (ii) historical references from Britain, and (iii) archaeobotanical finds from the European mainland.

Arch BI = archaeobotanical record from British Isles, + = macrofossil, x = pollen; Hist BI = historical record from British Isles; Arch EU =archaeobotanical record from European mainland, symbols as before. Further explanations of the table are given at the end.

Century A.D.	11	12	13	14	15	16	17	18	
FRUIT									
Berberis vulgaris L.	-	-	-	-	-	-	-	-	Arch BI
barberry	-	-	-	D	-	A, W	W	R	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Citrus spp.	-	-	-	-	-	-	-	-	Arch BI
orange, lemon	-	-	W	W	W	W	-	W	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Cornus mas L.	-	-	+	+	-	-	-	-	Arch BI
cornelian cherry	-	-	W	+	-	-	-	-	Hist BI
	-	-	+	+	+	+	+	-	Arch EU
Cydonia oblonga L.	-	-	-	-	-	-	-	-	Arch BI
quince	-	-	N	D	+	T	-	-	Hist BI
	-	-	?	+	+	+	?	-	Arch EU
Ficus carica L.	-	+	+	+	+	+	+	+	Arch BI
fig	Æ	-	N, B	-	+	-	-	-	Hist BI
	-	+	+	+	+	+	+	+	Arch EU
Fragaria cf *ananassa* Duch.	-	-	-	-	-	-	-	-	Arch BI
hybrid strawberry	-	-	-	-	-	-	-	R	Hist BI
	-	-	-	-	-	-	-	+	Arch EU
Fragaria vesca L. s.l.	+	-	+	+	+	+	+	+	Arch BI
wild strawberry	Æ	-	-	D	J	A, T	-	-	Hist BI
	-	+	+	-	+	+	+	+	Arch EU
Malus domestica Borkh.	+	+	+	+	+	+	+	+	Arch BI
apple	Æ	-	N, B	D	J	A	-	-	Hist BI
	-	+	+	+	+	+	+	+	Arch EU
Mespilus germanica L.	+	-	+	-	-	+	+	-	Arch BI
medlar	Æ	-	N	D	M	T	-	-	Hist BI
	-	-	+	-	+	+	+	+	Arch EU
Morus nigra L.	-	-	+	+	+	-	-	-	Arch BI
mulberry	Æ	-	N, B	D	-	A, T	-	-	Hist BI
	-	-	+	+	+	+	+	+	Arch EU
Phoenix dactylifera L.	-	-	-	-	-	-	-	-	Arch BI
date	-	-	-	-	+	W	-	-	Hist BI
	-	-	-	-	+	+	+	+	Arch EU
Physalis alkekengi L.	-	-	-	-	-	-	-	-	Arch BI
Japanese-lantern	-	-	-	-	-	-	-	-	Hist BI
	-	-	+	-	-	+	-	-	Arch EU
Prunus armeniaca L.	-	-	-	-	-	-	+	-	Arch BI
apricot	-	-	-	-	-	R	R	R	Hist BI
	-	-	-	-	+	-	+	-	Arch EU
Prunus avium (L.) L.	Æ	-	N	-	D	M	A	-	Hist BI
sweet cherry	+	+	+	+	+	+	+	+	Arch EU

Century A.D.	11	12	13	14	15	16	17	18	
Prunus cerasus L.	-	-	-	-	+	-	-	-	Arch BI
dwarf cherry	-	+	-	+	+	+	+	+	Arch EU
Prunus avium/cerasus	-	-	-	-	-	-	-	-	Arch BI
cherry	R	R	R	R	-	R	R	R	Hist BI
Prunus domestica	+	-	+	+	+	-	-	-	Arch BI
ssp. *domestica*	Æ	-	N, B	D	M	A	-	-	Hist BI
damson, plum, etc.	-	+	+	+	+	+	+	+	Arch EU
Prunus domestica ssp. *insititia*	+	+	+	-	+	-	-	+	Arch BI
(L.) Bonnier & Layens	-	-	-	D	-	-	-	-	Hist BI
bullace	-	-	+	+	+	+	+	+	Arch EU
Prunus persica (L.) Batsch	-	+	+	+	-	-	-	+	Arch BI
peach	Æ	-	N	D	-	A, T	R	R	Hist BI
	-	-	+	+	+	+	-	+	Arch EU
Prunus spinosa L.	+	+	+	+	+	+	-	+	Arch BI
sloe	-	-	W	-	-	-	-	-	Hist BI
	-	+	+	+	+	+	+	+	Arch EU
Punica granatum L.	-	-	-	-	-	-	-	-	Arch BI
pomegranate	-	-	W, B	D	-	A, T	-	-	Hist BI
	-	-	-	-	+	-	+	+	Arch EU
Pyrus communis L.	-	+	-	-	+	+	+	+	Arch BI
pear	Æ	-	N, B	D	J	-	-	-	Hist BI
	-	+	+	+	+	+	+	+	Arch EU
Pyrus/Cydonia	-	+	+	-	+	+	+	-	Arch BI
pear or quince (stone cells)	-	-	+	-	-	-	-	-	Arch EU
Ribes uva-crispa L.	-	-	+	-	+	-	-	+	Arch BI
gooseberry	Æ?	-	H	D	M	-	-	-	Hist BI
	-	-	-	-	-	-	+	+	Arch EU
Ribes sp.	-	-	-	-	+	+x	+	+	Arch BI
gooseberry, blackcurrant, redcurrant									
Ribes rubrum L.	-	-	-	-	-	-	-	-	Arch BI
redcurrant	-	-	-	-	-	T	P	+	Hist BI
	-	-	-	-	-	+x	+	+	Arch EU
Ribes nigrum L.	-	-	-	-	-	-	-	-	Arch BI
blackcurrant	-	-	-	-	-	-	+	+	Hist BI
	-	-	-	-	-	x	+	+	Arch EU
Rubus caesius L.	+	-	+	-	-	-	-	-	Arch BI
dewberry	-	-	-	-	-	-	-	-	Hist BI
	-	-	+	+	+	+	-	+	Arch EU

Century A.D.	11	12	13	14	15	16	17	18	
Rubus sect. *Glandulosus*	+	+	+	-	+	-	-	-	Arch BI
Wimmer & Grab.	-	-	-	-	-	T	-	-	Hist BI
bramble	+	+	+	+	+	+	+	+	Arch EU
Rubus idaeus L.	-	-	+	-	+	-	-	+	Arch BI
raspberry	-	-	-	-	-	T	P	+	Hist BI
	-	-	+	-	+	-	+	+	Arch EU
Sorbus aucuparia L.	-	-	-	+	-	-	-	-	Arch BI
rowan	Æ	-	-	D	-	-	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Sorbus domestica L.	-	-	-	-	?	-	-	?	Arch BI
service-tree	-	-	-	D	-	A	-	-	Hist BI
	+	-	+	+	+	-	-	-	Arch EU
Sorbus torminalis	-	-	+	-	-	-	?	-	Arch BI
(L.) Crantz	-	-	-	-	-	-	-	-	Hist BI
wild service-tree	-	-	-	-	-	-	+	-	Arch EU
Vaccinium myrtillus L.	+	+	+	+	+	+	+	+	Arch BI
bilberry	-	-	-	-	-	-	-	-	Hist BI
	-	+	+	-	+	+	+	+	Arch EU
Vitis vinifera L.	+	+	+	+	+	+	+	+	Arch BI
grape	Æ	+	N, B	D	J	A	P!	+!	Hist BI
	+	+	+	+	+	+	+	+	Arch EU
NUTS AND OIL PLANTS									
Castanea sativa L.	-	-	-	-	-	-	-	x	Arch BI
sweet chestnut	-	-	N, B	D	-	-	-	-	Hist BI
	+	-	-	+	+	+x	+	+	Arch EU
Cocos nucifera L.	-	-	-	-	-	-	-	-	Arch BI
coconut	-	-	-	-	-	-	-	-	Hist BI
	-	-	-	-	-	+	+	+	Arch EU
Corylus spp.	+	+	+	+	+	+	+	+	Arch BI
hazel, filbert	-	-	B	D	J	-	-	-	Hist BI
	-	-	+	+	+	+	+	+	Arch EU
Juglans regia L.	+	+	+	+	+	-	+	+	Arch BI
walnut	-	-	B	D	+	A, T	-	-	Hist BI
	-	+	+	+	+	+	+	+	Arch EU
Olea europaea L.	-	-	-	-	-	-	-	-	Arch BI
olive	-	-	-	-	+	-	-	-	Hist BI
	-	-	-	+	-	-	+	+	Arch EU
Pinus pinea L.	+	+	-	-	-	-	-	-	Arch BI
pine nut	-	-	-	W	+	-	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Prunus dulcis Miller	-	+	+	-	-	-	-	-	Arch BI
(D. Webb)	-	-	N, B	W, D	+	A	-	-	Hist BI
almond	-	-	+	+	+	-	+	+	Arch EU

Century A.D.	11	12	13	14	15	16	17	18	
VEGETABLES									
Allium porrum L.	+	+	+	-	-	-	-	-	Arch BI
leek	-	-	N, B	D	J	-	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Allium sativum L.	-	-	+	-	-	+	-	-	Arch BI
garlic	-	-	N, B	D	J	-	-	-	Hist BI
	-	-	+	-	-	-	-	-	Arch EU
Amaranthus lividus L.	-	-	-	-	-	-	-	-	Arch BI
amaranth	-	-	-	-	-	-	-	-	Hist BI
	+	+	+	+	+	-	-	-	Arch EU
Asparagus officinalis L.	-	-	-	-	-	+	-	-	Arch BI
asparagus	-	-	-	-	-	T	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Beta vulgaris L.	-	-	-	-	+	+	-	-	Arch BI
beet	-	-	N, B	D	-	-	-	-	Hist BI
	-	-	+	-	+	+	+	-	Arch EU
Brassica oleracea L.	-	-	+	-	+	+	+	-	Arch BI
cabbage etc.	-	-	N	-	-	+	-	-	Hist BI
	-	-	+	-	+	+	+	+	Arch EU
Cichorium intybus L.	-	-	-	+	-	-	-	-	Arch BI
chicory, endive	-	-	-	H	-	H	-	-	Hist BI
	+	+	-	-	-	-	-	-	Arch EU
Cucumis melo L.	-	-	-	-	-	-	-	-	Arch BI
melon	-	-	N	D	M	-	-	-	Hist BI
	-	-	-	+	-	-	+	+	Arch EU
Cucumis sativus L.	-	-	-	-	-	-	-	?	Arch BI
cucumber	-	-	N, B	D	-	-	-	-	Hist BI
	-	+	+	+	+	+	+	+	Arch EU
Cucurbita pepo L.	-	-	-	-	-	-	+	+	Arch BI
pumpkin, marrow	-	-	-	-	-	-	+	+	Hist BI
	-	-	-	-	-	+	+	+	Arch EU
Lactuca sativa L.	-	-	-	-	-	-	-	-	Arch BI
lettuce	(Æ)	-	N, B	D	J	T	-	-	Hist BI
	-	+	-	-	-	+	-	-	Arch EU
Lepidium sativum L.	-	-	?	?	-	-	-	-	Arch BI
cress	Æ?	-	H	D	J	A?	-	-	Hist BI
	-	-	+	+	+	-	-	+	Arch EU
Lycopersicon esculentum Mill.	-	-	-	-	-	-	-	+	Arch BI
tomato	-	-	-	-	-	-	-	W	Hist BI
	-	-	-	-	+	-	-	-	Arch EU
Portulaca oleracea L.	-	-	-	-	-	-	-	-	Arch BI
purslane	-	-	N	D	+	T	-	-	Hist BI
	-	+	+	+	+	+	+	-	Arch EU

Century A.D.	11	12	13	14	15	16	17	18	
Raphanus sativus L.	-	-	-	-	-	-	-	-	Arch BI
radish	Æ	-	N, B	H, D	J	M	-	-	Hist BI
	+	-	+	-	-	-	-	-	Arch EU
Spinacia oleracea L.	-	-	-	-	-	-	-	-	Arch BI
spinach	-	-	-	D?	-	-	-	-	Hist BI
	-	-	+	+	-	-	-	-	Arch EU
Valerianella locusta (L.) Laterr.	-	-	-	-	-	-	-	-	Arch BI
common cornsalad	-	-	-	-	-	-	-	-	Hist BI
	-	-	-	-	-	-	-	+	Arch EU
FLAVOURINGS AND SPICES									
Aframomum spp.	-	-	-	-	+	+	-	+	Arch BI
grains of paradise,	-	-	+	-	+	-	-	-	Hist BI
Melegueta pepper	-	-	-	-	-	+	-	-	Arch EU
Anethum graveolens L.	-	-	+	-	+	-	+	+	Arch BI
dill	-	-	N, B	D	J	T	-	-	Hist BI
	+	+	+	+	+	+x	+	+	Arch EU
Anthriscus cerefolium	-	-	-	-	-	-	-	-	Arch BI
(L.) Hoffm.	-	-	N	D	-	A	-	-	Hist BI
garden chervil	-	-	-	-	+	+x	x	-	Arch EU
Apium graveolens L.	+	+	-	+	+	+	-	-	Arch BI
celery	-	+	-	+	J	T	-	-	Hist BI
	+	+	+	-	+	+	-	+	Arch EU
Artemisia abrotanum L.	-	-	-	-	-	-	-	-	Arch BI
southernwood	Æ	-	N, H	D	J	T	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Artemisia absinthum L.	-	-	-	-	-	-	-	-	Arch BI
absinthe, wormwood	-	-	N, B	D	J	M, T	-	-	Hist BI
	-	-	-	-	-	+	-	-	Arch EU
Boswellia dalzielii Hutch.	-	-	-	-	-	-	-	-	Arch BI
frankincense tree	-	-	-	-	G	G	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Brassica nigra (L.) Koch	-	-	-	-	-	-	-	-	Arch BI
black mustard	-	-	-	-	-	-	-	-	Hist BI
	-	+	+	+	+	+	+	-	Arch EU
Calendula officinalis L.	-	-	-	-	+	+	+	+	Arch BI
pot marigold	-	-	N, B	D	-	A, T	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Camellia sinensis (L.) Kuntze	-	-	-	-	-	-	-	-	Arch BI
tea plant	-	-	-	-	-	-	W	W	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Capsicum sp.	-	-	-	-	-	-	-	-	Arch BI
capsicum or sweet	-	-	-	-	-	-	P	-	Hist BI
pepper, paprika	-	-	+	-	+	+	-	-	Arch EU

Century A.D.	11	12	13	14	15	16	17	18	
Carum carvi L.	-	-	-	-	-	-	-	-	Arch BI
caraway	-	-	-	D	J	T	-	-	Hist BI
	-	+	+	+	+	+	+	+	Arch EU
Cinnamomum verum J.S. Presl.	-	-	-	-	-	-	-	-	Arch BI
cinnamon tree	-	-	-	-	W	-	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Coffea spp.	-	-	-	-	-	-	-	+	Arch BI
coffee	-	-	-	-	-	-	W	W	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Commiphora molmol Engl.	-	-	-	-	-	-	-	-	Arch BI
ex Tschirch	-	-	-	-	-	-	-	-	Hist BI
myrrh	-	-	-	-	-	-	-	-	Arch EU
Coriandrum sativum L.	+	+	+	-	+	+	+	-	Arch BI
coriander	-	-	N, B	D	J	T	-	-	Hist BI
	-	-	+	+	+	+	+	+	Arch EU
Crocus sativus L.	-	-	-	-	-	-	-	-	Arch BI
saffron crocus	-	-	N, B	D	J	A	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Cuminum cyminum L.	-	-	-	-	-	-	-		Arch BI-
cumin	Æ	-	B	D?	M	-	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Curcurma zedoaria	-	-	-	-	-	-	-	-	Arch BI
(Bergius) Rosc.	-	-	-	-	W	-	-	-	Hist BI
zedoary	-	-	-	-	-	-	-	-	Arch EU
Cyperus longus L.	-	-	-	-	-	-	-	-	Arch BI
galingale	-	-	-	-	-	-	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Elettaria cardamomum	-	-	-	-	-	-	-	-	Arch BI
(L.) Maton	-	-	W?	-	+	-	P	-	Hist BI
cardamom	-	+	+	-	-	+	+	-	Arch EU
Elettaria major Smith	-	-	-	-	-	-	-	-	Arch BI
cardamom	-	-	W?	-	+	-	P	-	Hist BI
	-	+	-	-	-	-	-	-	Arch EU
Foeniculum vulgare L.	+	+	-	-	+	+	-	+	Arch BI
fennel	-	-	B	D	J	A, T	-	-	Hist BI
	+	+	+	+	+	+	+	+	Arch EU
Glycyrrhiza glabra L.	-	-	-	-	-	-	-	-	Arch BI
liquorice	-	-	-	D	-	A, T	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Hyssopus officinalis L.	-	-	-	-	+	+	-	-	Arch BI
hyssop	-	-	N, B	D	J	A	-	-	Hist BI
	-	+	-	+	-	-	-	+	Arch EU

Century A.D.	11	12	13	14	15	16	17	18	
Pimpinella anisum L.	-	-	-	-	-	-	-	-	Arch BI
aniseed	-	-	N, B	D	-	F	-	-	Hist BI
	-	-	-	-	-	+	-	-	Arch EU
Piper cubeba L.	-	-	-	-	-	-	-	-	Arch BI
cubebs	-	-	-	W	-	-	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Piper longum L.	-	-	-	-	-	-	-	-	Arch BI
long pepper	-	-	-	-	-	-	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Piper nigrum L.	-	-	-	-	+	+	-	+	Arch BI
black pepper	W	W	-	-	W	W	W	-	Hist BI
	-	+	-	-	-	+	+	+	Arch EU
Rosmarinus officinalis L.	-	-	-	-	-	-	-	+	Arch BI
rosemary	-	-	-	D	-	A	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Ruta graveolens L.	-	-	-	-	-	-	-	-	Arch BI
rue	Æ	-	N, B	D	J	A	-	-	Hist BI
	-	-	+	-	-	+	-	-	Arch EU
Saccharum officinarum L.	-	-	-	-	-	-	-	-	Arch BI
sugar cane	-	-	-	-	W	-	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Salvia officinalis L.	-	-	-	-	-	-	-	-	Arch BI
sage	Æ	-	N	D	J, M	A	-	-	Hist BI
	-	-	-	+	-	-	-	-	Arch EU
Satureja hortensis L.	-	+	-	-	+	-	-	-	Arch BI
summer savory	-	-	N	D	J	T	-	-	Hist BI
	-	+	+	-	+	+	+	-	Arch EU
Satureja montana L.	-	-	-	-	-	-	-	-	Arch BI
winter savory	-	-	-	-	-	-	-	-	Hist BI
	-	+	-	-	+	-	-	-	Arch EU
Sinapis alba L.	-	-	-	-	+	-	-	-	Arch BI
white mustard	Æ	-	N, B	D	J, M	-	-	-	Hist BI
	-	-	+	+	+	+	?	?	Arch EU
Syzygium aromaticum	-	-	-	-	-	x	x	-	Arch BI
(L.) Merr. et Perry	-	-	+	-	+	-	-	-	Hist BI
clove	-	-	-	-	-	x	x	-	Arch EU
Theobroma cacao L.	-	-	-	-	-	-	-	+	Arch BI
cocoa	-	-	-	-	-	-	W	W	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Thymus vulgaris L.	-	-	-	-	+	-	-	+	Arch BI
thyme	-	-	N	D	-	-	-	-	Hist BI
	-	-	-	-	-	-	-	+	Arch EU

Century A.D.	11	12	13	14	15	16	17	18	
Zingiber officinale Rosc.	-	-	-	-	-	-	-	-	Arch BI
ginger	-	-	-	-	+	-	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
POSSIBLE MEDICINAL/DECORATIVE									
Aquilegia vulgaris L.	-	-	-	+	+	-	+	-	Arch BI
columbine	-	-	-	-	D	M, A	-	-	Hist BI
	-	-	-	+	+	+	-	-	Arch EU
Borago officinalis L.	-	-	-	-	+	x	x	x	Arch BI
borage	-	-	-	N	D	J	A, T	-	Hist BI
	-	-	-	-	-	x	+	-	Arch EU
Citrullus colocynthis	-	-	-	-	-	-	-	-	Arch BI
(L.) Schrad.	-	-	-	-	+	-	-	-	Hist BI
colocynth	-	-	-	-	-	-	-	-	Arch EU
Euphorbia lathyris L.	-	+	+	-	-	-	-	-	Arch BI
caper spurge	-	-	-	-	+	-	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Leonurus cardiaca L.	-	-	-	-	-	-	-	-	Arch BI
motherwort	-	-	-	-	-	-	-	-	Hist BI
	+	-	-	-	-	-	-	-	Arch EU
Rheum x *hybridum* Murray	-	-	-	-	-	-	-	-	Arch BI
rhubarb	-	-	-	-	G	H	H		Hist BIH
	-	-	-	-	-	-	-	-	Arch EU
Verbena officinalis L.	-	-	-	+	+	+	-	-	Arch BI
vervain	-	-	-	H	H	H	-	-	Hist BI
	-	+	+	-	-	-	-	-	Arch EU
INDUSTRIAL, FIBRES, AND OTHERS									
Cannabis sativa L.	+	+	+	+	+	+	-	+	Arch BI
hemp	-	-	-	-	-	-	-	-	Hist BI
	-	+	+	+	+	+	-	-	Arch EU
Dipsacus sativus L.	-	+	+	+	-	-	+	-	Arch BI
fuller's teazel	-	-	-	H	H	H	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU
Carthamus tinctorius L.	-	-	-	-	-	-	-	-	Arch BI
safflower	-	-	-	-	-	-	-	-	Hist BI
	-	-	-	x	x	x	-	+	Arch EU
Humulus lupulus L.	+	+	+	-	+	+	-	+	Arch BI
hop	-	-	-	-	-	-	-	-	Hist BI
	+	+	+	+	+	+	-	-	Arch EU
Isatis tinctoria L.	+	+	-	+	-	-	-	-	Arch BI
woad	-	-	+	+	+	-	-	-	Hist BI
	-	-	+	-	-	-	-	-	Arch EU

Century A.D.	11	12	13	14	15	16	17	18	
Linum usitatissimum L.	+	+	+	+	+	+	-	+	Arch BI
flax, linseed)	-	-	-	-	-	-	-	-	Hist BI
	-	+	+	+	+	+	+	-	Arch EU
Nicotiana sp.	-	-	-	-	-	-	-		Arch BI
tobacco	-	-	-	-	-	+	+	+	Hist BI
	-	-	-	-	-	-	+	-	Arch EU
Rubia tinctorum L.	+	+	-	+	-	-	-	-	Arch BI
madder	-	-	-			-	-	-	Hist BI
	-	-	-	-	-	-	-	-	Arch EU

The taxa have been selected as being the ones which seem to have a significant archaeobotanical or historical record relevant to northwest Europe. The list could easily have been much longer. All taxa included in the *New British Flora* are given according to Stace (1991); the exotics are named according to Schultze-Motel (1986).

The British macrofossil records (Arch BI) come from the summary in Greig (1991) and from Carruthers (1993, unpublished), Hall (1992a; 1992b), McKenna (1987; 1992), Moffett (1992; 1995) and Dickson (1996). The following symbols are used: + = macrofossil record, x = pollen record, ! = record of vines not being grown.

The British historical references (Hist BI) come from various sources. Those on gardening from Harvey (1981, 168-80) use the following symbols to denote source and date: Æ = Ælfric 995, N = Neckham 1200, B = Bartholomew 1240, D = Daniel 1375, J = John Gardener 1400, M = Mayer MS 1450, A = Ashmole 1520, T = Turner 1538, H = Harvey, (note that identifications of plants from old records cannot always be precise!). The references on fruit growing are shown by: R = Roach (1985). For the records from source material relating to food: W = Wilson 1973. For information from customs records: G = Gras (1918) (customs records), and further historical data: P = Parkinson 1640. Other historical records, such as economic history in Dyer (1989) are given as "+".

Archaeobotanical records from the European mainland (Arch EU) are quoted from Alsleben (1991), Bakels (1991), van den Brink (1988,1989), Čuliková (1994, 1995a, 1995b), Hellwig (1990), Hjelmqvist (1991), Knörzer (1984, 1987), Kroll (1995), Maier (1983), Paap (1984), Ruas (1992), Rösch (1993) Rösch *et al.* (1994), Schultze-Motel (1992, 1993), Wiethold and Schulz (1991) van Zeist (1992) and van Zeist *et al.* (1987 and 1991).

This list is meant only as a guide, and not as a comprehensive record of all finds!

Revised disk version received: March 1996

Short Contributions and Conference Paper Summaries

Butchery versus biostratinomy. A short note on a perforated goat (Capra) scapula

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Perforated scapulae have been recorded from a number of mainly Roman sites in Britain and Europe. Numerous examples have been recorded from Lincoln, where some have been illustrated and described as showing 'typical damage caused by the perforation of a butcher's hook through the blade' (Dobney *et al.* 1996). At Lincoln, as elsewhere, this type of bone modification is attributed to the hanging of shoulder joints from hooks for immersion in brine, smoking or curing. Both cattle (*Bos*) and sheep (*Ovis*) scapulae have been found with similar marks.

During a search for comparative bone material on the Greek island of Corfu in the summer of 1991, I collected a goat (*Capra*) right scapula. The scapula was lying on a hillside, together with many other mainly disarticulated but complete bones. Together they appeared to represent the greater part of an animal which had died of natural causes and had decomposed on the hillside. There was no evidence to indicate human interference. A roughly circular hole on the blade of the scapula (Figure 79) is of similar dimensions and position to some illustrated examples of Roman butchery (e.g. Denison 1995; Dobney *et al.* 1996, plates 3 and 5a). Despite the hole, and a crack and further small puncture radiating from it, the scapula was in good condition. The only signs of surface weathering were a few tiny cracks at the blade edge and a small area of erosion on the thoracic angle, exposing cancellous bone. While it is not immediately obvious how the perforation was caused, it would appear to be the product of a post-depositional process or event. The most likely explanation may be that it represents damage resulting from contact with a sharp stone.

The number of perforated scapulae occurring together, and often exhibiting other butchery marks, would suggest that in most cases archaeological reports of perforated scapulae are genuine examples of bones deliberately holed in order to suspend the joints from hooks.

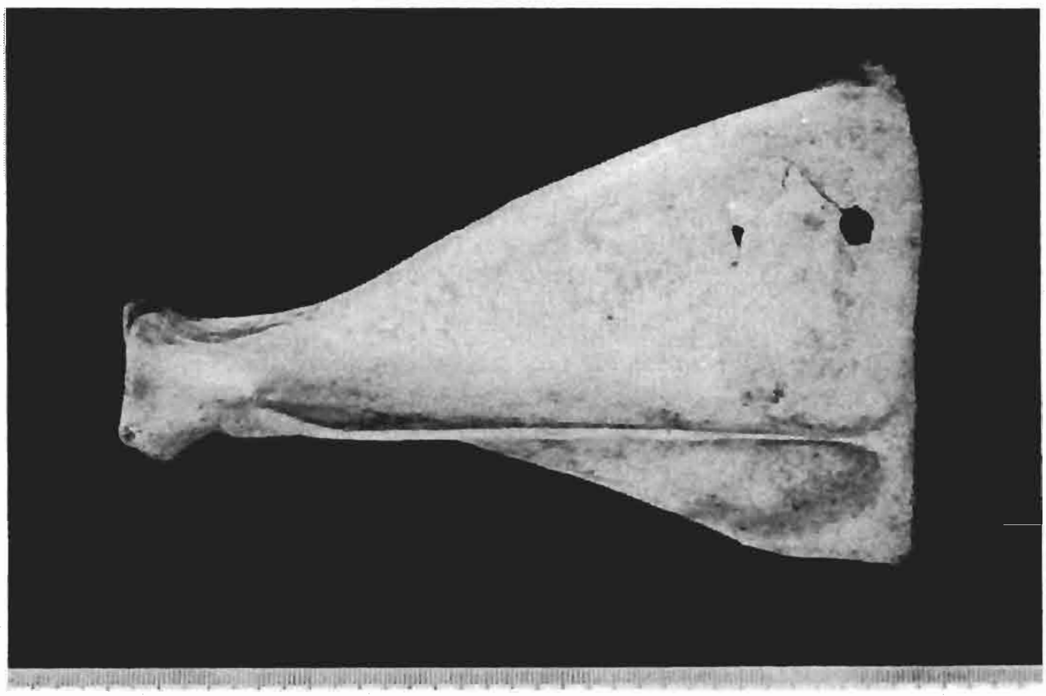

*Figure 79. Modern, holed, goat (*Capra*) scapula from Corfu, Greece.*

However, isolated examples should be treated with caution, particularly where perforations occur in the absence of knife or other blade marks.

References

Denison, S. (1995). Cattle bones show Roman Lincoln's late survival. *British Archaeology* 5, 4.

Dobney, K. Jaques, D. and Irving, B. (1996). Of butchers and breeds. Report on vertebrate remains from various sites in the City of Lincoln. *Lincoln Archaeological Studies* 5.

Archaeological evidence for cephalopods: taphonomic loss or unfortunate ignorance?

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It appears to be accepted by ichthyo-archaeologists (Wheeler and Jones 1989, 12) that, at least in the NE Atlantic, the geographic location and types of marine fish species have remained virtually unaltered for many millennia. Using modern comparisons, plenty of cephalopods are being caught today mixed in with general catches of mixed fish. On this basis, it seems logical to infer that there was a similar population of these animals in virtually the same areas in the past. Certainly in Roman and Greek classical antiquity, squid and octopus were well known in the Mediterranean. They are depicted on mosaics (Christies 1991) and plates and vases (Wilkins *et al.* 1995). Although no palaeolithic parietal art depicting these species has been found to date there is no reason to doubt their existence during that period either, if my argument above is accepted. If we are to enhance our understanding of the diets of coastal dwelling peoples in prehistory, we certainly need to be aware of the possible existence of any surviving body parts of cephalopods at excavations.

Several criteria need to be addressed. One concerns a knowledge of the anatomical details of the cephalopods likely to inhabit the waters of the NE Atlantic. Standard biology textbooks do not contain this detail, so the archaeologist needs to consult more specialized literature (e.g. Clarke 1977; 1980; Donovan 1977). The second criterion concerns taphonomic loss, something which is problematical to all archaeologists in the field. Archaeological reports on fish remains at coastal sites contain no mention of cephalopods. What has happened to their hard parts? Have they completely disintegrated in the substrate? Could they have been completely missed during excavations? This leads to the third criterion: the inability of the excavator to recognize those hard parts of cephalopods that might have been present with other animal remains. The mouthparts could even have been erroneously labelled as 'parts of bird beaks', perhaps.

These problems are not difficult to remedy. I illustrate here (Fig. 80) the three basic hard parts of two common cephalopods which can be found today in the NE Atlantic: the translucent 'pen' of a 14 cm (mantle or body length) specimen of the squid (*Loligo vulgaris* Lamarck), the off-white 'bone' of an 8 cm (mantle length) cuttlefish (*Sepia officinalis* Linnaeus) and the dark brown and black 'beak' of the same specimen of cuttlefish. Both species have 'beaks' as hard mouthparts. However, the octopus (*Eledone cirrhosa* (Lamarck)) has no 'bone' or 'pen' within its body. The only part that may already be recognized by archaeologists is the 'bone' of the cuttlefish. It is often washed ashore on beaches in Britain and widely used by cage birds to sharpen their beaks.

To most people, the cephalopod 'beaks' will be unfamiliar. All these parts are hard, and the beaks, in particular, have been used in the past to determine the diet of whales (Clarke 1980).

I would firstly therefore like to emphasize the importance of recognition. Familiarity with diagrams of the hard parts of these animals will help initially. Secondly, examination of these parts in a biological collection will help further with this appreciation. Thirdly one should then perhaps be aware that even if these parts are not actually found at a coastal site, there should at least be some discussion of the fact that these animals might have existed in the past, either in the sea locally or as part of the debris at an occupation site.

I hope this brief introduction to this fascinating group of animals prompts further investigations and discussion.

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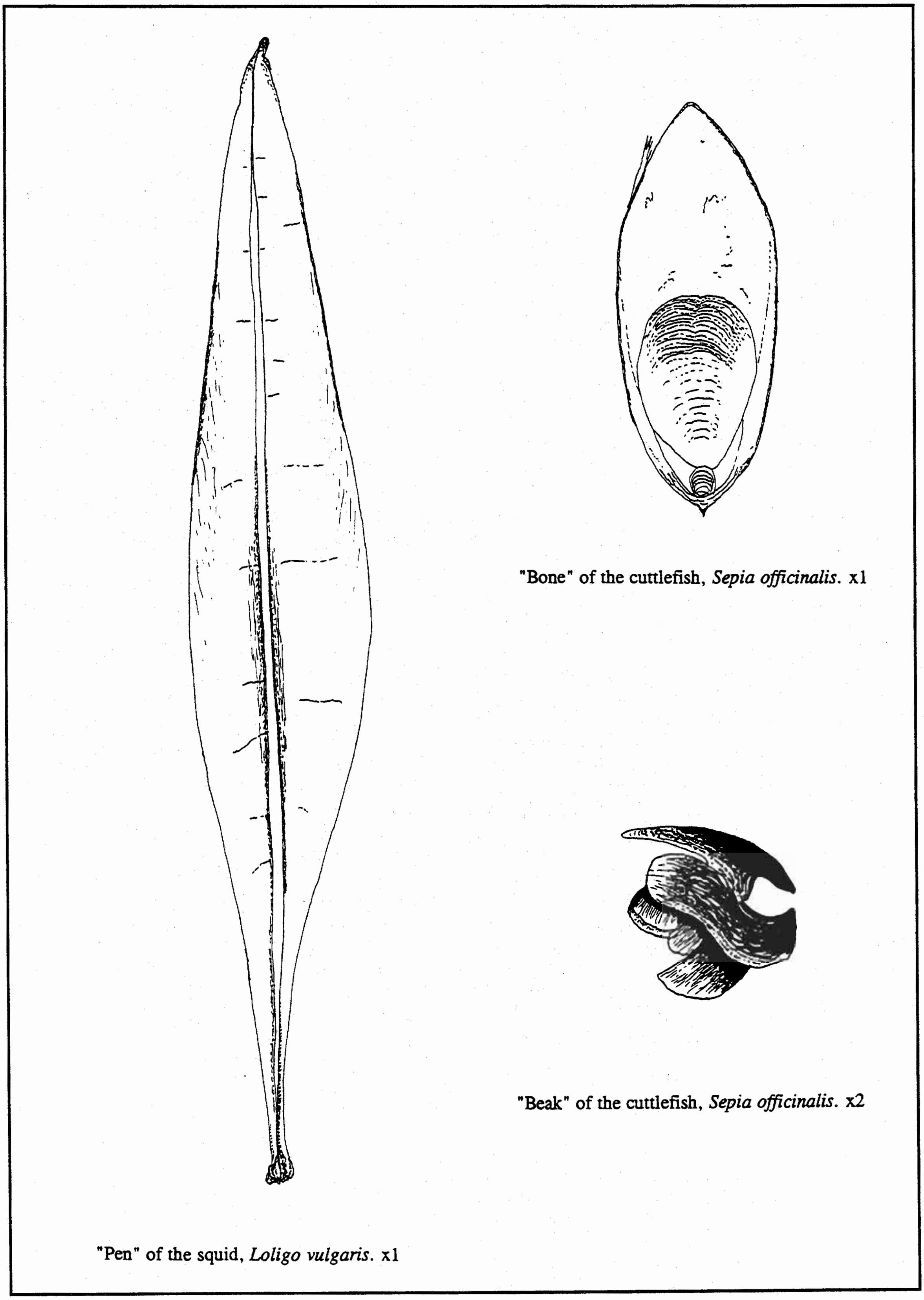

Figure 80. Hard parts of two species of cephalopod: (a) 'pen' of the squid, Loligo vulgaris *(x1); (b) 'bone' (x1) and (c) 'beak' (x2) of the cuttlefish,* Sepia officinalis.

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CONFERENCE PAPER SUMMARIES

The following summaries have been provided by some of the speakers at the AEA's Spring Meeting held at the University of Birmingham, 17th April 1996

The LAXS approach to studying osteoporosis in archaeological bone

Osteoporosis is a metabolic disease of bone in which the equilibrium which normally exists between bone turnover processes is disrupted, resulting in a net loss of bone.

Bone consists of a hard outer shell, the cortex, and a rigid framework of bony struts, trabecular bone. Trabecular bone is far more metabolically active, so it is in this region where bone loss will first be seen.

Several scanning techniques were compared on 30 femora and 25 vertebrae. Low Angle X-ray Scattering (LAXS) is a technique being developed at the Department of Medical Physics, University College London, for early detection of osteoporosis. This is the first time the technique has been applied to archaeological bone. The technique can be configured to measure trabecular bone density only. Data obtained contain information that can be used to determine the type and amount of minerals present, so diagenetic changes could be detected.

Measurements were also made using Dual Energy X-ray Absorptiometry (DEXA) and photodensitometry techniques. The results were compared with bone mineral density values which were obtained through the physical removal of the trabecular bone. LAXS gave the most accurate results—correlation coefficients of r=0.8 and 0.9 respectively for femora and vertebrae, compared with r=0.64 and r=0.74 for DEXA, and r=0.78 and 0.85 for photodensitometry.

LAXS could prove a valuable tool for those wishing to carry out a range of studies on archaeological bone.

Acknowledgement

Megan Brickley would like to thank Museum of London Archaeology Service for providing the skeletal material.

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Sub-fossil Mollusca: improving environmental interpretation

As in other subfossil or fossil analyses, the interpretation of subfossil Mollusca relies, to a greater or lesser degree, on a 'uniformitarianist' approach, at the species level (autecology), the community level (synecology), or both. The notion, however, that present-day ecological preferences or associations can simply be applied to the past inevitably leaves a nagging doubt. Recently, Evans (1991) and Evans *et al.* (1992) have sought to identify recurrent molluscan taxocenes, particularly in Holocene overbank alluvium, and to rely on internal taxocene characteristics for interpretation rather than direct species or habitat analogy. To date, eight taxocenes have been recognised from such contexts. The approach is still analogous but at a more general level, relying on concepts such as species diversity, habitat diversity and succession, and the interrelationship of all three. To a large degree, interpretation proceeds without reference to named species.

In order to determine whether taxocenes had a numerical basis the data from three molluscan profiles through Holocene overbank alluvium at Kingsmead Bridge on the River Wylye, Wiltshire, were analysed using Detrended Correspondence Analysis (DCA). Data were entered into a spreadsheet on a species-by-sample basis and DCA used to group similar samples. Furthermore, the data set was transposed and DCA used to group similar (i.e. similarly behaving) species.

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

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

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

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

Introduction

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

The deposits encountered at this site were free-draining sands and gravels above Mercian Mudstone so that, although bone was well preserved and plant remains were charred or mineralized, there was only a very little waterlogged material from the deeper features. The range of remains recovered included fish bones and scales, mineralized fly puparia and woodlice, eggshell, oysters, charcoal and plant macrofossils. In addition to samples taken for a wide range of macrofossils, samples for analysis of pollen and parasite eggs were also taken (Monckton 1995). It was hoped that the results would add to evidence from The Shires sites, particularly to The Shires plant macrofossils (Moffett 1993). The analysis of the plant and animal remains was completed in September 1994 and is to be included in the site report (Connor and Buckley, forthcoming).

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

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

Analysis of the plant remains

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

Grassland plants

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

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

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

Other plants

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

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

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

Cultivated and collected plants

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

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

Discussion

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

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

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

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

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

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

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

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

Conclusions

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

Acknowledgements

I am very grateful to Lisa Moffett for help with the identification of the plant remains and also to James Greig for all his help and for his constructive comments on this paper. I am also grateful to Aileen Connor for information about the site and help throughout the project. I would like to thank Richard Buckley for the opportunity to do this work, and also the site and environmental staff, particularly Peter Boyer, Stefan Gula and Lucy Wheeler.

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

CONFERENCE REPORT

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

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

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

Illustrations of herring *Clupea harengus* preparation in Denmark greeted conference participants after breakfast on day 2: Inge Bødker Enghoff demonstrated the continuity of tradition from Medieval times to the present day. The impact of Romanisation on fishing in the Mediterranean was discussed by Miriam Sternberg, while light was shed by Omri Lemau on the range of fish sauces available to the Romans. Wim van Neer discussed the investigation of age and season of capture by otolith growth band analysis, using a collection of plaice believed to have originated from a single catch. This paper provoked considerable discussion and the value of the technique was disputed by some members. A selection of papers crudely grouped under the heading 'taphonomy' came after coffee, in which we were shown illustrations of fish being prepared in Panama (Richard Cooke and Irit Zohar) followed by a discussion of fish decomposition based on experiments conducted in a range of different soils in Britain (Rebecca Nicholson). Suzanne Needs-Howarth discussed fish bone discard patterns at a Iroquoian site in Canada. Then a session on osteology and osteometry, subjects which have dominated meetings in previous years. Jean Desse lamented the under-use of fish-bone biometry, and presented a new model for estimating fish size and weight. Jean and Nathalie Desse-Berset also presented new techniques for identifying species within the 'groupers', and László Bartosiewicz presented an integrated approach to the study of pike *(Esox lucius)*. Another lengthy lunch, followed by a session on physico-chemical and numerical methods which included papers on extracting and identifying DNA from ancient fish bones (Susan Crockford) and looking at Ba/Sr ratios in fish bone from South Africa as an indicator of changes in the exploited water habitats (Cedric Poggenpoel).

Two papers examined quantification: firstly comparing sample size and relative abundance of fish taxa (Heidemarie Hüster-Plogmann) and secondly tackling the thorny problem of how to quantifying fish remains in order to establish a realistic estimate of relative frequency, based on the Global Rachidian Profil developed by Jean Desse (Carmen Rodríguez Santana). The final session of the day comprised papers based on historical studies, with contributions by Jenny Coy who compared evidence from Port Books with archaeological evidence from Southampton, and Dirk Heinrich who explored fish in myths and legends; Wim van Neer and Anton Ervynck presented the results of comprehensive archaeo-ichthyological research into fish consumption at a Benedictine abbey in Flanders, looking both at fish consumption through time and in different parts of the abbey. Juan Zozaya Stahbel-Hansen presented abundant illustrations of fish in ceramic art, while Angelika Lampen summarised documentary and archaeological evidence for medieval fish weirs.

Regional studies dominated the third day of papers. The richness and diversity of animal, including fish, remains from the Templo Mayor, Mexico (Ana Guzmán and Oscar Polaco), with their exceptional preservation, caused envy among many of us working in temperate European areas and offered an opportunity to explore unequivocally 'ritual' deposition. Judith Powell presented the results from several seasons excavation of Mesolithic and Neolithic material from the cave of Cyclope, on the island of Yora in the north Aegean, while Daniel Makowiecki described fish remains from sites in Poland. The final paper session included a contribution by Manuel Pellicer Cátalan and Carmen Rodríguez Santana describing the analysis of fish remains from Cueva de Nerja (Malaga, Spain) which illustrated the transition from hunter-gatherer economy to a specialist fishing community based on evidence from the Palaeolithic through to the Neolithic. An Lentacker described faunal remains from two Roman sites in Egypt, while Mark Rose summarised his research into fishing at Minoan Pseira, Crete. It was perhaps just as well that Anna Cardell's paper on fishing in medieval Sweden reminded us that not everyone else works in warm, sunny climates.

A poster session ended the formal part of the conference, with posters on: fishing at Franchthi Cave, Greece (Mark Rose); fish sauces from Italy and fish remains from a Roman ship (Barbara Wilkens); fishing in Ecuador during the Guangala period (Amelia Sánchez-Mosquera); identifying a hake-based medieval fishing industry at Launceston Castle, Cornwall, England (Pippa Smith); lake sturgeon bones from prehistoric Iroquoian sites, Canada (Suzanne Needs-Howarth); and using the internet as a tool for archaeo-ichthyology (Mark Beech).

The final afternoon was devoted to touring the extensive research area of Arturo's department, and enviously admiring the comparative collections and animal preparation building and facilities ('anyone want a mummified bird?').

A splendid, well-organised meeting in very beautiful city, it well lived up to the now very high expectations of the regular participants. The only real criticism which could be made was that the time allowed for each paper was by necessity rather short; a consequence of the enthusiasm and expansion of the group. Nevertheless, everything was miraculously fitted in, even allowing for the traditional long lunch which took place a few miles away from the lecture theatre. Arturo, Eufrasia and their support team ferried everyone between conference, lunch, and hotel on a daily basis and sorted out the inevitable stream of questions and problems. They deserve enormous thanks for all their hard work. The proceedings of this meeting will be published in the journal *Archaeofauna*.

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Book Reviews

Cox, M., Straker, V. and Taylor, D. (eds.) (1996). *Wetlands : Archaeology and Nature Conservation.* London: Published by HMSO Books for English Heritage and English Nature. ISBN 0 11 300004 9. Paperback, 284 pages, with numerous tables, maps, colour and black and white photographs. £19.95

This book is the result of a successful conference held in Bristol in April, 1994, which involved 23 speakers and 160 delegates from around the world. Most of the papers that were given at the conference are found in this volume, with the addition of a few new papers. In general, it is a very nicely produced book, well presented and crisp, with clear illustrations and set out somewhat like an undergraduate textbook in the natural sciences.

The book is divided into six sections: perceptions and values, problems, wetland rehabilitation, management and monitoring, integration, and the way forward. Unfortunately, the stimulating keynote address by Francis Pryor was not included as the first paper in the first section of the volume. Instead, its place is taken by Leendert Louwe Kooijmans on the Dutch case for prehistory as a reference for modern nature development, followed by papers on the values of natural and historic wetland environments by Carman and the state of wetlands in northeast India by Mandal.

Louwe Kooijmans' paper suggests that the reconstruction of past palaeoenvironments should be used as a frame of reference for present day nature management and development, rather than the desired habitats of nature conservationists being viewed as 'closer to paradise than prehistory'. How true a comment can you get! John Carman presents an interesting case based on his legal and theoretical perspective. Effectively, the law is mainly concerned with preservation, or storage for the future, not rehabilitation; in this it mirrors current archaeological and ecological perspectives and their differing objectives. It is essential that differing values of wetlands are mapped to identify areas of common interest as well as differences which need to be addressed. In my view, the tenor of these two papers more or less set the scene for the balance of the conference and this book—potential conflicts because of differing aims of archaeologists and conservationists, and the absence of any real management and legislative framework for dealing with wetland conservation and rehabilitation combined with the preservation of the archaeological record.

The second section of this book addresses some of the problems of dealing with wetland landscapes. As ever, an eloquent Martin Bell sets out the enormous wetland archaeological potential of the Severn Estuary and highlights the conflicting aims of archaeological and natural historical agencies. These need to be reconciled by developing new research strategies. Rippon echoes these themes for the coastal Gwent area, where he feels that legislation is needed to protect landscapes, not just sites. Eversham *et al.* highlight these problems further for the lowland raised-peat mires in the Humberhead Levels, as do Parker Pearson and Sydes for the Sutton Common sites. Nonetheless, many of us as archaeologists have been trying to expand the concept of site to include landscape preservation for some years now through the scheduling programme, but this has singularly failed to win over the powers that be. Moreover there is no planning control that applies to wetland rehabilitation; these schemes fall outside the remit of PPG16 (Department of Environment 1990).

In addition, too little is known in terms of hard data, as well as predictive models, for how wetland landscapes respond to changes brought on by development, rehabilitation and altered hydrological status. Too much is based on anecdotal accounts. Hopefully the new hydrological monitoring projects, for example those currently being funded by English Heritage in the Cambridgeshire and Lincolnshire fens, York and London, will begin to provide the requisite base-line reference data. It should then be possible to build models and give reliable predictions (along the lines of Brown and Bradley's paper in Section IV of this book) as to the effects of drainage, development or conservation schemes in different types of wetland environment.

The wetland rehabilitation section contained a series of three papers on various aspects of the preservation of peat by Brown, Johnson and Cox. There is little doubt that many excellent schemes for peatland rehabilitation have been undertaken by nature conservationists in recent years. The main problem from an archaeological point of view is that there is no evident view taken as to the possible effects on the archaeological record of re-wetting sites that have already begun to dry out and/or are severely oxidized already. PPG16 is not applied to conservation schemes, so archaeological evaluations of these diminishing peatland areas are not necessarily carried out prior to raising water levels, nor is there provision made for monitoring the effects on the archaeological record. Surely, this is something that could be easily addressed by collaboration between the conservationist bodies and county archaeo-logical development control officers.

Aptly following on from this is the next section on management and monitoring with seven papers ranging from Australia to Sutherland. Central to this section was Bryony Coles' paper setting out the current position on the threats to wetland archaeology and how archaeologists may learn from the conservationists. This paper is effectively a brief summary of her recent book (Coles 1995). She points out that archaeological surveys of wetlands can enable a better understanding of relationships between people and wetlands, and how evidence survives. Coles notes that the most successful attempts at preservation occurred as joint ventures with nature conservation bodies in wetlands occurs where there was very little disturbance and conditions remained optimal for the survival of buried evidence, such as at the Corlea I trackway in Ireland. It is essential that conservationists take more archaeological advice, and that monitoring schemes are instigated as an integral part of any wetland rehabilitation schemes. Again more hydro-logical work such as that undertaken by Brown and Bradley in the Nene valley in North-amptonshire is what is required and crucial to the design of the rehabilitation scheme.

The last two sections on working towards integration and the way forward follow logically and are essentially related to each other and the previous section in scope. What has to be worked towards is the integration of the best practices by both archaeologists and nature conservation specialists, and this will be a long term process. I found Tidy's paper on the voluntary creation of Environmentally Sensitive Areas by MAFF to be an interesting concept which could well be applied to any archaeological landscape and adopted by the planning authorities. Its guiding principles are the maintenance of permanent grassland, the enhancement of the ecological interests of grassland, and further enhancement of grassland by the creation of wet winter and spring grassland by raising water levels, all in areas where farming practices pose a threat to the existing environment. Although this scheme is voluntary, and only runs for five year periods, all three criteria would equally apply to many archaeological sites and landscapes. Entering into agreements with farmers to change land-use to grass and raise water levels over several years would help to protect both the archaeological record, enhance the ecological status of the land, and allow sufficient time for preservation and monitoring strategies to be worked out, implemented and acted upon.

Patrick Denny gives a lively and informative finish to the conference, just as his paper serves to end this volume. He recognizes that we need to know a lot more about microbiological activity in different wetland environments, the parameters of preservation in different wetland contexts, and the effects of water quality on preservation, whilst at the same time maintaining biological diversity and managing continuing exploitation. Denny advocates the need to set out a national wetland strategy, with a clear lead from a national government agency, with archaeologists, palaeobotanists and nature conservationists all as key players. I can see the groan going up from my colleagues—not another committee producing a quasi-management/planning document, but this may be the only way to mesh together the differing needs for wetland preservation and conservation, and with backing in planning law to make the policy effective and enforceable.

What has struck me throughout both the conference and this book is that the archaeological fraternity needs to dispel some myths as regards its professional approach to dealing with wetlands and the various conservation bodies. First of all, the conservation bodies have the distinct impression that archaeologists do not know what is actually present in wetlands. This is simply not the case: a vast amount is known and published. Even though there are still many unknowns in the archaeological record of wetlands, we as a profession have more than enough knowledge to make a case for what can be expected within various wetland areas. Obviously the archaeological profession is not making its experience and expertise readily available to those bodies which need our guidance in formulating wetland management schemes. Second, it would appear that the archaeologists giving advice to the various conservation bodies do not all have sufficient and relevant experience to be able to contribute the most useful and valuable information. Moreover, the conservation bodies seemed largely unaware of the large numbers of projects being commissioned by English Heritage and others to evaluate and monitor the archaeological record in wetland contexts. We, as archaeologists, must make a much better attempt to make our natural allies in the various conservation bodies much more aware of our work and its implications in the world of wetland conservation.

On the other hand, the nature conservation interests should educate the archaeological profession in the applicable conservation legislation as well as conservation field techniques. It is apparent that some of the most successful conservation schemes are those where the least is currently known about the archaeology. This glaringly suggests that there must be much more co-ordination between national and regional agencies for nature conservation and archaeology for mutual benefit. Collectively this would give us all much more influence and on a greater scale.

As ever, it would appear that the key strengths of both the conference and the book were that the relevant minds of the various bodies concerned need to be forcibly brought together on a regular basis in order to thrash out common approaches to a vast problem: how to preserve and conserve wetland habitats and resources for the future given all the possible working constraints imaginable. I am sure that the publication of this book will stimulate mutual co-ordination, collaboration and communication, so that further destruction of wetland landscapes can be prevented, and perhaps even reversed in some areas.

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Cohen, A. and Serjeantson, D. (1996). *A manual for the identification of bird bones from archaeological sites.* Revised edition. Archetype Publications Ltd. London. ISBN 1873132 905. 115 pp., figures. £19.00 (paperback).

The need to identify animal bones in the absence of reference collections is all the more pressing when one is confronted to taxonomically diversified groups whose osteological features are not thoroughly known. In response to it, a rather extensive literature of a mainly palaeontological and archaeo-zoological nature has grown throughout the years. The aim of most such works, as Alan Cohen and Dale Serjeantson very aptly stress in their introduction, is to allow the faunal analyst arrive at *preliminary* identifications of remains, something which not everybody seems to keep in mind.

If only for that previously stated need, Cohen and Serjeantson's revised version of their 1986 handbook should be, once again, greeted as a brave attempt to ease the task of bird bone identification for fieldworkers in general. Despite its scope being restricted to British birds from post-glacial times, it seems evident that the book aims at filling a deeply felt gap in a larger, pan-European, context.

My traditional scepticism on these works (e.g. Morales 1993) forces me to take a somewhat critical stance when addressing the contents of the manual. By doing this, I would not like to convey as much the impression of a negative attitude towards this book as towards 'bone atlases' in general and also want to make explicit some of the reasons for my concern (warnings which people have probably heard already a thousand times if not actually more!).

My first comment on Cohen and Serjeantson's book concerns the target taxa selected. It seems to me that, since the potential number of bird species in an archaeological site is far larger than that of mammals and that, osteologically speaking, closely related species are very similar to each other, that the family (i.e. a representative species which could be taken to exemplify the main diagnostic features of a whole family) would have been a much better choice than the species in this case. By targeting families, several important feats could have been simultaneously accomplished:

(a) Greater operativity. A restriction of osteomorphological diversity to a more manageable number of cases would have probably benefited the users (confronted by some 33 species). Targeting families would have allowed the authors to add a series of morphologically diagnostic and archaeozoologically relevant groups (i.e. divers, grebes, woodpeckers, barn owl, etc.) while keeping the number of cases around 20 (still quite a lot!).

(b) Better highlighting of diagnostic features. Since families of birds represent, to a far larger extent than is the case for other classes of vertebrates, ecomorphological groupings, their correspondence with specific osteological features should be rather high and would allow the user to much better detect particular morphotypes within each bone category (Feduccia 1980).

(c) Larger scope of application. Since the chorologies of most bird families greatly surpass those of their constituent species, by targeting families one would have accomplished a far larger chrono-geographical range than that of either the British Isles or post-glacial times (as I assume has been one of the authors' goals from the start).

(d) Minimisation of 'duplicate' information. Although certain ecomorphological groups of birds occur below family level (i.e. surface *vs* diving ducks), even if these had been incorporated into the manual, far less redundancy would have resulted than by using several species of the same family (and, consequently, almost identical morphologies). Redundancy is misleading and page-consuming!

Two other issues merit further consideration. Thus, for one thing, the inclusion of families would have really kept identifications at that 'preliminary level' which Cohen and Serjeantson sought. When species are included, however (and this is something to be blamed on the users) people might feel tempted, after detecting a 'close enough match' between their unknown specimen and a particular illustration, to jump to a definitive identification without further considering whether alternative species not shown in the plates would have actually been a better choice. Such a problem is particularly pressing in species which, like the herring gull, have basically identical osteology to that of many others.

Secondly, had the authors chosen families and later incorporated a selected series of tables with comparative measurements of closely related species, using the guide would have duplicated, to a certain extent, the steps which the faunal analyst follows in the lab (i.e. first identify morphotype, then look for specific features within it). Drawing similar morphologies with different sizes, as Cohen and Serjeantson have done, is not only more cumbersome but might also be misleading if one is confronted with intermediate situations and/or is not able to evaluate to what extent particular size differences can be attributed to intraspecific (i.e. subspecies, chronoclines, dimorphism) or interspecific variation.

The choice of species itself seems open to debate. Thus, the incorporation of species recently introduced into Britain (as is the case of the red-legged partridge whose first recorded attempt at introduction was in 1673 according to Sharrock (1976)) does not follow from the stated need '*... to illustrate at least ... species more commonly found in the archaeological sites*' (p. 5). Actually, it is not very clear to me the criteria used to decide what is 'common'. Thus, although the inclusion of a series of extinct or very rare British birds, like the great auk, crane and white-tailed eagle, seems fully justified on archaeozoological grounds, by the same token, one should have left out species like the kittiwake which the authors explicitly declare to be infrequent in British archaeological sites (p. 5). A second criterion for selecting species (i.e. none smaller than 26 cm) has an operative argument going for it (i.e. '*that all bones could be drawn at 1:1 scale*') but has left out of the atlas some birds of potentially palaeocultural interest such as the house sparrow (Morales *et al.* 1995).

By far my deepest reason for concern has to do with the validity of some of the diagnostic features. One striking thing related to this issue is the dangerously low number of specimens (i.e. normally one per species) which Cohen and Serjeantson seem to have taken into account (see their Table 1). Again, had families been the target taxa, such a typological setup might have worked, for the morphological gaps among groups should always be of a certain 'magnitude'. When working with species, often with a quite similar morphology, on the other hand, intraspecific and interspecific variation will always overlap to some extent, blurring the diagnostic value of certain features. Just to exemplify this with species I am more familiar with, some of the osteological differences between *Perdix perdix* and *Alectoris rufa* (e.g. those given for the femur, p. 63) do not seem to agree with our own, unpublished, data which had been previously recorded by Kraft (1972, 177, one of the few Munich monographs which, along with that of Fick, is not included in the bibliography). Now, the question: could those apparent discordances possibly reflect an incipient sub-speciation process on the red-legged partridge in the British Isles? I can perhaps suggest an alternative explanation. Thus, for one thing, the somewhat bent shape of *A. rufa*'s femoral dyaphysis drawn on p. 63 we have occasionally recorded in partridges from Spanish game farms and have tentatively attributed it to a mild pathology resulting from poor keeping conditions (Hernández unpublished data). Since British red-legged partridges continue to be released from gamefarms (Sharrock 1976), the possibility exists that the animal illustrated in Cohen and Serjeantson's book could exhibit some peculiar traits as a result of life in a confined space. This is not to say that all recorded features should be taken with caution. Much to the contrary. The case, nevertheless, exemplifies a danger implicit to all 'bone atlases' and one which might trick unacquainted readers into incorrect identifications, however preliminary. To a certain extent, some of these drawbacks could have been neutralized by adding more text along with some of the arrows or, alternatively, by setting the plates with numbered arrows in one page and a comprehensive text on the opposite page, much in the manner of Peterson's field guides (although, with such an arrangement, close to 100 'extra' pages would have resulted!).

I believe that the sections on measurements and zone recording methods greatly enhance the usefulness of the manual (an appendix with tables of measurements for similar-looking, different-sized, species would only make sense if the target taxon was the family!). Perhaps the zone recording section would have benefited, with little extra effort, had the more frequently retrieved bone portions been shaded, thus offering some taphonomic cues on top of the strictly quantitative data.

Producing an atlas of bird bones is indeed a dreadful task and one prone to suffer a lot of criticism. But, as the Italians say, *la critica è facile ma l'arte è difficile*. I believe that Alan Cohen and Dale Serjeantson have done a truly meritorious job and that they have certainly filled the gap they planned on filling. Their manual is bound to become a 'must' on the personal libraries of practising archaeozoologists, archaeologists, palaeontologists and others interested in such a fascinating subject. I will conclude by only adding that, when the time for a third edition comes, I would be very grateful if Alan and Dale could possibly introduce some changes along the lines which I have exposed previously.

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Eddison, J. (ed.) (1995). *Romney Marsh. The debatable ground*. Oxford: Oxford University Committee for Archaeology Monograph 41. ISBN 0 947816 41 0. £25. Paperback.

There is an olden saying which describes the world as being divided into Europe, Asia, Africa, America, and Romney Marsh.

Jerrold (1914, 187)

This collection of papers is the second volume to be published under the auspices of the Romney Marsh Research Trust, the first (Eddison and Green 1988) having preceded the second by some seven years. The volume is intended as a statement of work in progress, and comprises thirteen papers which range widely over the geomorphology, below- and above-ground archaeology, and documented history of this corner of England. It is this diversity which gives the volume both its strengths and weaknesses, leading on the one hand to a refreshing breadth of view, and on the other to a rather disjointed and uneven approach and style.

The region, and some of the major questions of environmental development and settlement, are well introduced by Tooley, whose paper is in itself a concise distillation of the methodological diversity which follows. Tooley also introduces the remainder of the volume, and explains its origins in a conference at the University of Kent in 1992. Perhaps the introduction could have done a little more to set the Marsh in its regional context, and to help readers unfamiliar with the area to orient themselves. A reviewer passingly familiar with the Marsh from a mis-spent youth felt the need for more scene-setting, so others will surely do so, and the passage of years between this volume and the first means that one will hardly be read as an introduction to the other. This is an easy failing with regional studies. A volume editor familiar with the study region may not realise what information the majority of readers will find essential. Similarly, some editorial smoothing and cross-referencing between papers would have been productive, and this point is returned to below.

Gripes about overall structure aside, there is much in the individual papers which commands attention. Andrew Plater's work on the evolution of Denge Marsh and the adjoining shingle banks has already been more concisely reported elsewhere (Plater 1992), though by exhaustively detailing here the results of palaeoenvironmental and mineral magnetic investigations, Plater and Long have produced a paper which both describes the morphology and evolution of their study area and provides an absorbing case study in the integration of a suite of field and laboratory techniques. Elsewhere in the volume there lurk pollen diagrams, but the beasts are in the safe hands of Antony Long and Jim Innes, in their examination of the so-called Midley Sand. By showing that the Midley Church bank of this deposit is of more complex origin than had formerly been supposed, Long and Innes call into question literally the foundations of the Marsh, as the 'Midley Sand' has long been believed to be a single unit underlying much of the Marsh. Martin Wass, on the other hand, settles a long-running difference of opinion by showing that a buried channel close to the north-western (inland) margin of the Marsh is a meandering tidal creek and not a former northern course of the River Rother, despite the aspirations of documentary historians that this might be the Saxon *Limen*. Wass nicely combines lithostratigraphic and micro-palaeontological evidence, and his discussion of the taphonomy of ostracod instars almost settles the debate on its own. It comes as a pleasant surprise to find that this paper is based on an MSc dissertation.

The most traditional archaeology in the volume is Anne Reeves' account of two years' field-walking. Although the maps of pottery scatters and other find spots give a rather broad-brush view of what below-ground archaeology may exist, it is none the less interesting to see field-walking reported as an investigative methodology in its own right, holding its place beside the magnetic gadgetry and the Calendar of Patent Rolls. It provides, too, one of the few links between papers, as Reeves shows finds of pottery later than the early 15th century to be relatively scarce, and Pearson shows this to be consistent with her model of late medieval depopulation on the Marsh, shown in particular by the lack of surviving open-hall houses in the region. A further connection might have been made with Hope All Saints church, a 12th century foundation in decay by the late 16th century, but Maureen Benell's otherwise useful survey of the surviving ruins and earthworks is more concerned with the construction of the church than with reasons for its desuetude and disintegration. One also wondered whether Wass' conclusions had some implications for the interpretation of field-walking data from the northern part of Romney Marsh proper: knowing that what had been thought to be river was actually saline creek might alter one's view of medieval land-use.

The remaining papers are essentially historical accounts, and may be of less general interest to readers of this journal, though a couple of the papers have curious contemporary resonance. Gross and Butcher examine the response of landlords to the challenge of making a profit off the Marsh during the stormy years of the late 1200s. Particularly telling is their Fig 8.2, which shows the Priory manor at Ebony to have spent virtually nothing on walling (i.e. sea-defence building) until 1287-8, when severe storms drove tidal waters far inland, and Ebony lost nearly half of the manor's sheep. The next year saw a huge amount of money spent on walling: a familiar case of being wise after the event, perhaps. Similarly, Hipkin's entertaining account of the knock-on effects which the inning and draining of the Marsh had on Rye harbour in the decades around 1600 brings to mind the present-day debate about piecemeal defence works and their detrimental effects on neighbouring stretches of coast, as does the bickering and buck-passing which went on amongst those most directly responsible and involved.

Elsewhere, Dorothy Beck is obliged to provide a glossary of obsolete and dialect terms (would that more historians would be so courteous), and in so doing she may have provided environmental archaeology with a useful term. How often do we need a handy term for a fine-grained sediment deposited by water, regardless (or uncertain) of whether it was deposited by sea, estuary, or river? The people of the Marsh have lived on just such mud for generations: it is called *sleech.*

Taken all in all, this is a very useful and interesting volume, albeit one which is very much a collection of papers rather than a regional synthesis. Romney Marsh is a surprisingly little-known area, archaeological work in the region having lacked the startling finds of the Somerset Levels, or the energetic self-promotion of the Fens. None the less, it is, as Tooley points out, 'a debatable ground between land and sea', where one or other has prevailed, and where base level changes and their topographical, lithostratigraphical, and human ecology correlates can be explored. That aim necessitates a multidisciplinary approach, and the Romney Marsh Research Trust have clearly met that particular challenge. But please, could we have a synthetic regional volume to draw all of this research together one day?

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Filer, Joyce (1995). *Disease.* London: British Museum Press. ISBN 0-7141-0980-0 (paperback), 112 pp., figures. £9.99

Taylor, John H. (1995). *Unwrapping a mummy. The life, death and Embalming of Horemkenesi.* London: British Museum Press. ISBN 0-7141-0978-9 (paperback), 111 pp., figures. £9.99.

Why should a journal devoted to environmental archaeology give space to reviewing short studies on the evidence for Ancient Egyptian diseases and the unwrapping of a mummy of these early African peoples? Well, for one thing, these topics have a general appeal, and for another thing one could argue that ancient disease is an aspect of palaeoecology and studying a decomposing mummy is a quirky aspect of taphonomy. So it is by this argument that these two excellent little publications by a dynamic 'new' publisher are included here.

Joyce Filer, who is a UCL graduate in Archaeology (including Egyptology and palaeopathology) has a long interest in the health—or lack of it—of the early Egyptians. If the ancient human dead seem far away from palaeoecology, one can only point out that they are dead and the reason for this is always a combination of the environment acting on ever-ageing tissues. For 'environment', one might mean inherited factors, or the intra-uterine environment, or diet during growth, or vitamin/protein/trace element deficiency, or too much sunshine, or smoked food, or of course, parasites of many shapes and sizes.

The arid environments of Egypt and Nubia have been kind to the 'natural' and intentionally 'mummified' bodies of people, cats, cows, alligators and others. Recent human society has not been so kind to such remains, so that many mummies were ransacked for saleable items or powdered for medicines. In the case of the thousands of cats, birds and other mummies found last century, they were at times dug out and exported for fertilizer. No wonder what is left is now valued as a scarce resource, deserving of restudy or further study, with the application of new techniques and lines of investigation never dreamt of last century.

Joyce Filer in her nicely illustrated brief review of Ancient Egyptian diseases provides evidence of the considerable range of diseases. It should be said that diagnosis can be a minefield, with identification as difficult as differentiating beetle species or the backsides of pupae. This is not because there are thousands of diseases, but because differential diagnosis can be so problematic. But this small book nevertheless demonstrates that one can hope to distinguish an inherited condition such as brittle bone disease (osteogenesis imperfecta) from bone deforming rickets or Paget's disease. And infections such as tuberculosis, leprosy and syphilis may all produce inflammatory changes, but the *pattern* of the changes over the skeleton is quite different.

Mummification is really culturally determined taphonomy with knobs on. For the part of the corpse which remained, once the guts, liver, lungs, heart and brain were dragged out, the soft tissue was stable for millennia. Admittedly, the mummifying procedure got careless in the later dynasties, and only the upper strata of society were so treated. But some of the pharaohs are in excellent condition, although I would still argue that the best preservation is in naturally dried bodies. Moreover, the degree of drying which tissues received in Egypt is by no means ideal, and there is a need for taphonomic studies to investigate the histological quality and variability of mammal remains from warm, wet and cold environments. We certainly need to have more information of this kind if DNA studies are to progress.

John Taylor provides a very good example of the kind of forensic work which can be carried out, in this case on Horemkenesi, an Egyptian priest from eleventh century BC Thebes. Because the body had become unstable in its Bristol resting place, it was carefully unwrapped and investigated in 1981. A battery of techniques were brought in to consider a variety of questions. These included well established lines of enquiry, such as radiography, but there were one or two interesting surprises from my point of view. I was intrigued to note that spores of the genus *Clostridium* had been found on the tongue, although it may not be a pathogenic form. More exciting was the work of Robert Miller and colleagues, who were able to demonstrate a clear antigenic response to *Schistosoma* infection (using skin tissue). The ultimate thrill was that Miller and colleagues were also able to demonstrate by immunological testing that Horemkenesi was suffering from malaria at the time of his death.

It would be excellent if this 'Egyptian Bookshelf' series, so well started by the British Museum, could progress to a consideration of animals in early Egypt, as well as crop plants and various other aspects of archaeological science.

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Hayward, P. J. and Ryland, J. S. (eds.) 1995. *Handbook of the marine fauna of North-West Europe* Oxford: University Press. ISBN 0-19-854055-8 (paperback). xi + 800 pp. £29.50.

While the development of comparative collections of land molluscs can be assisted by such reference works as John Evan's (1972) *Land snails in archaeology* and Kerney and Cameron's (1994) reprint of *Land snails of Britain and North-West Europe,* similar works on marine fauna have been more of a problem. Now, praise be to the god of ecology, a new and reconstructed edition of *The marine fauna of North-West Europe* has appeared in paperback. This is a nearly two inches (4.5 cm) thick volume, with 2000 excellent line drawings of molluscs, crabs and many other species of less archaeological relevance, and at an affordable paperback price. The only possible grumble to be levelled at this volume is that heavy use of the 800 pages is likely to result in a disintegration of the book's spine.

There are fourteen chapters with numerous subdivisions, written by twenty marine specialists. Introductory chapters include a brief guide to the animal groups, which could be useful for student beginners. The rest of the chapters provide concise and precise descriptions of some 1500 species. Many with soft bodies are not likely to occur in archaeological deposits other than rarely. In the case of sponges, spicule types are drawn in detail and thus could be of reference value. The crustaceans, including ostracods and barnacles, are well presented and illustrated. The molluscs, which form the substantial Chapter 10, clearly have most reference value to us, and it was a pleasure to see how well illustrated this section is. Fish form the final and perhaps least useful chapter as regards this handbook. References and further reading follow, as well as taxonomic and subject indexes.

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Valedictory

As this is the last issue of *Circaea* I shall be editing for the AEA, I am indulging myself with a short, written leave-taking.

I've co-edited every issue of this organ now, and I think it's fair to say I've actually word-processed every single word! *Circaea*, of course, grew out of the original *Newsletter* of the AEA, which Harry and I launched in 1979 and passed to other, very capable hands in 1982, so I feel I've more than adequately 'done my stint'.

A lot of it has been fun, especially working with Harry (on every issue) and Terry O'Connor (on a lot of them); a lot of it hasn't. Above all, it's been a very educative experience, and I don't think there's much I can learn now about the trials and tribulations of editing a scientific journal, at least as an amateur. My main regret is that I still only type with a couple of fingers, despite many hundreds of hours at the keyboard knocking *Circaea* into shape.

Looking back over the run of 12 volumes (in order to compile the list of contents appearing in this issue), perhaps the most striking thing is just how much the production style has changed. In the earliest days we produced copy for the printer using *Runoff*, very primitive page-making software package on the University of York's then mainframe. Subsequently, we generated copy on a *Brother* printer linked to a PC in the University's Computing Service, which meant we had to trek across the campus to print our text, fitting in between students printing out their interminable theses, often finding the hardware 'down' when we got there. The biggest revolution came when we were able to produce text with a word-processor on a PC in the lab. (this was a student's own machine—the EAU still hadn't the funds to buy one for its senior staff!) and we sent the files 'down the line' to the central computing facility and produced 'smart' laser-printed copy. This meant we still faced a walk across campus to pick up output every time we printed anything, however. Another walk, typically to another corner of the campus, was required to do photocopying, as the Unit didn't possess a photocopier, either!

Finally, in the past couple of years, the luxury of being able to process everything on one PC at one desk, with a link to a laser printer, and a photocopier nearby. One is almost sorry to be relinquishing the task, now it has got so (logistically) easy ...

The other thing that's changed is the fun-quotient. The early issues were always tinged by a sense of fun, not least through the *Inside Back Page* contributions from Terry's witty pen. All that's gone, with the inevitable need for *Circaea* to evolve into a serious refereed journal.

Looking through the back issues brought back many memories of amusing and frustrating evenings—like the times we spent squeezing someone's text into a tight space (word processing software didn't run to 'kerning' in the early days, or if it did we hadn't discovered it), or when a file from a 'foreign' PC insisted on jamming the works and had to be copied bit by bit and rebuilt. One particular contribution still brings a smile to my face: Barbara Noddle's account of the AEA's Annual Autumn Conference in Denmark in 1988. I leave those of you who have the issue concerned —6(1)—to work out the line which reduced me to helpless mirth one evening whilst working alone, transcribing Barbara's inimitable and idiosyncratic typescript onto the computer.

What next? Well for *Circaea*, it's metamorphosis into *Environmental Archaeology and Human Palaeoecology* and for me it's a chance to write something of my own rather than converting other people's prose into hard copy (observant readers will have noted that I've never written more than a few small pieces for *Circaea*—certainly never a full paper).

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Provisional guidelines for authors for *Environmental Archaeology & Human Palaeoecology*

Editorial policy for *Environmental Archaeology and Human Palaeoecology* (EA&HP) is to publish a wide range of kinds of contributions ranging from methodology through site reports and experimental results to synthesis and theory, as well as book reviews. Material of a controversial nature will be acceptable where important issues are involved. Although a high standard will be required in all contributions, the Editorial Board will be happy to consider material whose importance or relevance might not be apparent to the editors of other scientific and archaeological journals—for example, papers which consider in detail methodological problems such as the extraction or identification of difficult bioarchaeological remains. The length of papers should be appropriate to their content. There is no reason why data-rich papers (e.g. site reports or reviews) should not be long, but verbosity is not acceptable.

Articles for *EA&HP* should be typed well-spaced (1.5 word-processor spacing) on A4 paper with at least 30 mm margins. Pages should be numbered and preferably should bear a running head including author name and short form of title. Line drawings should be in black ink on white paper or drawing film, to fit within a frame 153 x 250 mm maximum after appropriate reduction. Drafting (e.g. line width, typography) should take account of the intended reduction. Captions should be supplied on a separate sheet of paper, and labelling on figures should be in publishable form. Half-tone photographs can be accommodated, but authors wishing to make extensive use of photographs, and particularly of colour, should note that they may be asked to contribute towards the high cost of production. The editors will modify idiosyncrasies of spelling, grammar and punctuation. Articles will be submitted to referees (normally two); authors may, if they wish, suggest suitable referees for their articles, although there will be no obligation to follow such suggestions.

TWO HARD COPIES and a 3.5" disk version (but see below) of contributions must be submitted to the Co-ordinating Editor, from whom an initial acknowledgement will be received. Authors will subsequently be contacted by a member of the Editorial Board, who will arrange refereeing and editing. Text proofs of papers will be provided and these should be returned to the Editor within one week of receipt. Note that authors genuinely unable to obtain access to appropriate word-processing facilities may submit typescripts, which can then be typed by EA&HP. WordPerfect (all versions up to 6.1 for Windows), Word and (if absolutely necessary) Wordstar or ASCII files can be accommodated; please contact the Co-ordinating Editor regarding other formats.

For guidance as to the preparation and presentation of material for publication, inexperienced contributors are referred to the British Ecological Society's booklet *A Guide to Contributors to the Journals of the BES*, and The Royal Society's *General Notes on the Preparation of Scientific Papers* (3rd ed., 1974).

Authorities must be given to Latin names, either at their first mention or in a comprehensive list, and species lists should follow a named checklist. Taxonomic names above genus should not be italicised. References should follow the style used in recent volumes of *Circaea* (broadly the so-called 'modified Harvard' convention, with place of publication before publisher, journal titles in full, volume numbers in Arabic and spaces between authors' initials).

Deadlines for receipt of copy: material will normally be dealt with when received and will, if suitable, normally be published in the next issue if received more than three months before publication date.

Free reprints (number to be established) will normally be supplied to the authors of scientific articles; further copies will be available, if requested at the time proofs are returned, at a cost which will be notified with proofs.

The Co-ordinating Editor, *Environmental Archaeology & Human Palaeoecology*, **c/o Environmental Archaeology Unit, University of York, Heslington, York YO1 5DD, U.K., Tel. (UK) 01904 433848 (Harry Kenward) or Fax 433850 or email: biol6@york.ac.uk.**

The Journal of the Association for Environmental Archaeology

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Circaea

Volume 12 Number 2 (1996 for 1995) ISSN 0268-425X