

Reports from the Environmental Archaeology Unit, York 94/11, 52 + 142 pp.
Appendix

**Insect and other invertebrate remains from the Roman fort at Ribchester,
Lancashire (site code RB89): Technical report**

by

Frances Large, Harry Kenward, John Carrott, Colin Nicholson and Pat Kent

Summary

A selection of 131 sediment samples from deposits associated with the Roman fort at Ribchester, Lancashire, were processed and prioritised by a rapid assessment. Insect and other invertebrate remains from 122 of these samples were recorded quantitatively or (in a few cases) semi-quantitatively.

Many cut features (mostly ditches, but some pits) gave modest sized to quite large assemblages of beetles and bugs, the insect groups primarily targeted. A large proportion of the groups included fauna probably or possibly indicating stable manure or some material closely akin to it. This characteristic component often included numerous grain pests, which it is suggested originated in spoiled grain used for feed. There were also some plant feeders possibly introduced in cut vegetation - perhaps hay - and a characteristic suite of decomposers associated with rather foul, but coarse-textured, material such as stable manure. This last material seems to have been very abundant at the site, but there is little evidence that other artificial habitats were exploited on a large scale by insects. In particular, there was remarkably little evidence for human dwellings, presumably because these were kept clean, the sweepings containing few insects and the buildings not developing a large insect population.

Grain pests were present from the earliest stage of Roman presence, indicating their importation with supplies for the troops responsible for the construction of the fort.

Some of the ditch fills gave insects and other invertebrates indicating the presence of open water, sometimes probably long-lasting. These fills often, but by no means always, seem to have included dumped organic waste, usually, it appears, stable manure. External surfaces appear to have been kept rather clean.

Analysis of eggs of parasitic worms gave only very limited evidence for contamination by human faeces.

Authors' address:

Environmental Archaeology Unit
University of York
Heslington
York YO1 5DD

Telephone: (0904) 433843-51
Fax: (0904) 433850

Prepared for:

Lancaster University Archeological Unit
Storey Institute
Meeting House Lane
Lancaster LA1 1TH

Date: 24.2.94

Insect and other invertebrate remains from the Roman fort at Ribchester, Lancashire (site code RB89): Technical report

Introduction

Part of the Roman fort at Ribchester was excavated in 1989 by Lancaster University Archaeology Unit. A substantial body of samples of sediments from the site was collected, representing General Biological Analysis samples in the scheme of Dobney *et al.* (1992), and subsamples from a large number of them were submitted to the EAU for analysis for insect remains and for the eggs of nematodes parasitic in the guts of vertebrates. The material represented ditch and pit fills, and a variety of surface-deposited layers.

The aims of the present study were, broadly, as follows:

1. To interpret the deposits context-by-context (for which the importance of integration of the invertebrate evidence with that from botanical studies must be emphasised);
2. To build a broader view of the ecology of the site, and especially of human activities and living conditions.
3. To form part of a wider synthesis of evidence from insects from Roman deposits in Britain and elsewhere.

Methods

The samples were stored in a laboratory in the EAU under conditions which were rather too warm and dry for some years before processing; no better storage facilities were available at the time.

Eggs of parasitic nematodes

Analysis for eggs of parasitic nematodes was carried out using the 'squash' method of Dainton (1992). Selected samples were examined using methods based on those

given by MAFF (1977). Measurements were made of the length and width of the *Trichuris* eggs recovered from these subsamples.

Macro-invertebrates

Selection of material for examination

A small-scale assessment was carried out during the planning stage of the post-excavation project. This showed potential preservation of delicate organic remains such as insect cuticle to be patchily distributed among the samples.

As any insect remains from well-dated and clearly identified deposits from the site were considered to be of potential importance, and in view of the nature of the material and unpredictability of preservation, it was hoped by HK that it would be possible to process almost all of the samples, and then assess the resulting insect assemblages so as to determine which should be recorded more fully. Before practical work was carried out, however, it was established that the funding for technical assistance on this project was too small for the approach initially planned (funding had been cut *pro rata* by English Heritage without the possibility of consultation with HK). Although a small amount of additional funding was available from EAU internal budgets, it was clear that only a proportion of the samples could be examined. A random selection was processed to start with, but cut fills were subsequently targeted preferentially in the light of a rapid examination of the material already extracted.

Practical methods

Test subsamples of 1 kg were employed in each case, following methods of Kenward *et al.* (1980) as modified by Kenward *et al.* (1986).

A few of the samples were rejected at the description stage, being too small (and usually completely dehydrated) or consisting of clearly unpromising sediment.

Processed material was recorded selectively after assessment, almost all large groups being recorded but a substantial selection of smaller ones being studied to allow their fauna to be characterised.

Recording methods followed those outlined by Kenward (1992). A fully quantitative scan was carried out for most samples. In these cases remains of adult beetles and bugs of the groups used for calculating main statistics (see below) were all counted and identified as far as possible within a reasonable period of time. A few groups were recorded by semi-quantitative scanning or rapid scanning, and some were left only assessment-recorded, having been assigned low priority.

Invertebrates other than adults of the beetles and bugs used in calculating 'main statistics' of the assemblages were usually recorded semi-quantitatively. This method employs a five-point scale (Kenward *et al.* 1986), abundance for each taxon being estimated as 1, 2, 3, 'several' or 'many'. The last two are converted to 6 and 15 for statistical purposes, a conversion discussed by Kenward (1992).

The manuscript lists and notes made during insect recording were entered to the University of York VAX mainframe computer and processed using a Pascal system written by HK, producing 'main statistics' and species lists in rank and taxonomic order for each assemblage, together with files of main statistics, species records and notes for the whole site. These were interrogated using the DATATRIEVE system.

Interpretative methods

The interpretative methods employed in this study were essentially as employed in work on a variety of sites by Kenward and co-workers (see Kenward 1978, with modifications outlined by, for example, Kenward 1982; 1988 and Hall and Kenward 1990). In this approach, interpretation rests primarily on a number of 'main statistics' of whole assemblages of adult beetles and bugs, and on the recognition of ecologically-related groups of species.

The main statistics used include: (a) a measure of species-richness (or diversity), \forall of Fisher *et al.* (1943), for the whole assemblage and for components of it; and (b) proportions of 'outdoor' species (OB), aquatics (W), waterside species (D), phytophages (plant feeders) (P), species associated with dead wood (L), moorland/heathland taxa (M), and decomposers (species associated with decomposing matter of some kind).

Decomposers are subdivided into (a) species primarily associated with somewhat dry habitats (RD), (b) those found mostly in rather, to very, foul habitats (RF), and (c) a residuum not easily assignable to one of these. The category 'RT' includes all three of these groups of decomposers.

The quantification of an 'outdoor' component in what are sometimes clearly natural or semi-natural assemblages may not appear entirely logical, but in fact is useful when working with any deposits associated, even if rather indirectly, with human occupation.

The abundance of these 'ecological' groups is discussed against the background of values for many other assemblages from a large number of sites. Thus, % N OB = 30 is a high value, but % N RT = 30 is low; while % N W or RF is high at 10.

The index of diversity offers a guide to the presence or absence of remains of insects which bred in or on the developing deposit

(autochthones), low values indicating breeding communities, high ones faunas of mixed origins. Note that 'significantly' low values differ for the various components of assemblages; the more inherently rich a component is, the higher the value of the index of diversity for a living community will be. Thus, 'outdoor' communities associated with natural vegetation tend to give a high value of \forall , while very specialised communities, such as those of decaying matter deposited by humans, or stored grain, have low or very low ones.

A group of species mentioned repeatedly in this report, and of great importance at this site, is that believed to be indicative of rather foul open-textured rotting material such as mouldering straw or stable manure. Usually accompanying these decomposers were plant-feeding species which may be indicative of imported hay-like cut vegetation; this includes certain *Apion*, *Sitona*, and *Hypera* species and a variety of others (see Table 5). In some periods, grain beetles indicate

another feed material; cereals. This 'stable manure' group is considered further in the discussion section.

Results

The parasite egg analyses

Results of the systematic survey by means of 'squashes' and of the measurements of eggs recovered by the MAFF method are given in Appendix 1. Few samples gave eggs, and then only a trace except for some fills of a single pit, where substantial quantities were present.

Analyses of insect and other macro-invertebrate remains

Insect and other macro-invertebrates were present in a substantial proportion of the samples, although numbers were often quite modest. A complete list of the taxa recorded is given in Table 1.

Table 1. Complete list of invertebrate taxa recorded from Ribchester. Conventions: `sp(?)` - indicates probable additional taxon; `sp(?) indet.` - indicates may be (or include) previously listed taxon or taxa. Order and nomenclature for Insecta follows Kloet and Hincks (1964-77). Taxa not included in the calculation of main statistics are indicated by enclosing their ecological code in parentheses. An asterisk () against a code indicates that there are reservations concerning its appropriateness.*

Annelida		<i>Megophthalmus ?scabripennis</i> Edwards	oap
		<i>Megophthalmus</i> sp.	oap
Oligochaeta sp. (egg capsule)	(u)	<i>Cicadella viridis</i> (Linnaeus)	oap
		Aphrodes sp.	oap
		<i>Conomelus anceps</i> (Germar)	oap
Crustacea: Cladocera		Auchenorhyncha spp. indet.	oap
		Auchenorhyncha sp. (nymph)	oap
<i>Daphnia</i> sp. (ephippium)	(oa-w)	Coccoidea sp.	(oap)
Cladocera spp. (ephippium)	(oa-w)	Aphidoidea sp.	(oa)
		Hemiptera sp.	u
		Hemiptera sp. (nymph)	(u)
Dermaptera			
Dermaptera sp.	(u)	Diptera	
		Psychodidae sp.	(u)
Mallophaga/Siphunculata		Bibionidae sp.	(u)
		Diptera sp. (adult)	(u)
Louse (s.l.) sp.	(u)	Diptera sp. (larva)	(u)
		Diptera sp. (pupa)	(u)
		Syrphidae sp. (larva)	(u)
Thysanoptera		Diptera sp. (puparium)	(u)
Thysanoptera sp.	(u)	Siphonaptera	
		<i>Pulex irritans</i> (Linnaeus)	(u)
Hemiptera		Siphonaptera sp. indet.	(u)
<i>Aneurus</i> sp.	l		
Pentatomidae sp.	oap	Hymenoptera	
<i>Drymus brunneus</i> (Sahlberg)	oap	Proctotrupeoidea sp.	(u)
? <i>Scolopostethus</i> sp.	oap	Chalcidoidea sp.	(u)
Lygaeidae sp.	oap	Parasitica sp.	(u)
<i>Berytinus</i> sp.	oap	Apoidea sp.	(u)
<i>Anthocoris</i> sp.	oap	Formicidae spp.	(u)
<i>Lyctocoris campestris</i> (Fabricius)	rd	Hymenoptera Aculeata sp	(u)
Anthocorini sp.	oap	Hymenoptera spp.	(u)
Cimicidae sp.	u		
Miridae sp.	oap	Trichoptera	
<i>Saldula</i> sp.	oad	Trichoptera sp.	(w)
Saldidae sp. indet.	oad		
<i>Hydrometra</i> sp.	oaw		
Corixidae sp.	oaw		
Heteroptera sp.	u		
Heteroptera sp. (nymph)	(u)		

Lepidoptera

?Lepidoptera sp. (pupa) (u)

Coleoptera

Cicindela sp. oa
Carabus nemoralis Muller oa
Carabus sp. indet. oa
Leistus sp. oa
Nebria sp. oa
Loricera pilicornis (Fabricius) oa
Dyschirius globosus (Herbst) oa
Dyschirius sp. indet. oa
Clivina fossor (Linnaeus) oa
Clivina sp. indet. oa
Patrobus sp. oa
Trechus quadristriatus (Schrank) oa*
Trechus obtusus or *quadristriatus* oa*
Trechus micros (Herbst) u
Trechus sp. indet. ob
Bembidion lampros (Herbst) oa
Bembidion lampros or *properans* oa
Bembidion (Philochthus) sp. oa
Bembidion sp. indet. oa
Pterostichus melanarius (Illiger) ob
Pterostichus ?strenuus (Panzer) oa
Pterostichus diligens or *strenuus* oa
Pterostichus ?versicolor (Sturm) oa
Pterostichus (Poecilus) sp. indet. oa
Pterostichus sp. indet. ob
Calathus sp. oa
Agonum albipes (Fabricius) oad
Agonum dorsale (Pontoppidan) oa
Agonum sp. oa
Amara sp. oa
Harpalus sp. oa
?Bradycellus sp. oa
Carabidae spp. indet. ob
Haliplidae sp. oaw
Hydroporinae spp. oaw
Hygrotus inaequalis (Fabricius) oaw
Agabus bipustulatus (Linnaeus) oaw
Agabus sp. indet. oaw
Ilybius sp. oaw
Colymbetes fuscus (Linnaeus) oaw
Colymbetinae sp. indet. oaw
Helophorus aequalis (Thomson) oaw
Helophorus grandis Illiger oaw
Helophorus aquaticus or *grandis* oaw
Helophorus tuberculatus Gyllenhal oa
Helophorus spp. (small aquatic) oaw
Coelostoma orbiculare (Fabricius) oaw

Sphaeridium ?bipustulatum Fabricius rf
Sphaeridium sp. indet. rf
Cercyon analis (Paykull) rt
Cercyon atricapillus (Marsham) rf
Cercyon haemorrhoidalis (Fabricius) rf
Cercyon lateralis (Marsham) rf
Cercyon lugubris (Olivier) rt
Cercyon melanocephalus (Linnaeus) rt
Cercyon quisquilius (Linnaeus) rf
Cercyon terminatus (Marsham) rf
Cercyon unipunctatus (Linnaeus) rf
Cercyon ustulatus (Preyessler) oad
Cercyon spp. indet. u
Megasternum obscurum (Marsham) rt
Cryptopleurum minutum (Fabricius) rf
Hydrobius fuscipes (Linnaeus) oaw
Anacaena sp. oaw
Chaetarthria seminulum (Herbst) oaw
Hydrophilinae spp. oaw
Acritus nigricornis (Hoffmann) rt
Onthophilus striatus (Forster) rt
Histeridae sp. u
Ochthebius minimus (Fabricius) oaw
Ochthebius sp. oaw
Hydraena sp. oaw
Limnebius ?truncatellus (Thunberg) oaw
Limnebius sp. oaw
Ptenidium sp. rt
Acrotrichis spp. rt
Ptiliidae sp. u
Catops sp. u
Catopinae sp. indet. u
Silphidae sp. u
Scydmaenus tarsatus (Muller & Kunze) rt
Scydmaenidae sp. u
Micropeplus fulvus Erichson rt
Micropeplus sp. indet. rt
Megarthritis sp. rt
Olophrum sp. oa
Acidota crenata (Fabricius) oa
Lesteva sp. oad
Phyllodrepa sp. rt
Dropephylla sp. u
Omalius caesum or *italicum* rt
Omalius ?rivulare (Paykull) rt
Omalius spp. indet. rt
Xylodromus concinnus (Marsham) rt
Omaliinae sp. and spp. indet. u
Coprophilus striatulus (Fabricius) rt
Syntomium aeneum (Muller) oa
Carpelimus bilineatus Stephens rt
Carpelimus bilineatus or *rivularis* u
Carpelimus ?corticinus (Gravenhorst) oad
Carpelimus elongatulus (Erichson) oad

<i>Carpelimus fuliginosus</i> (Gravenhorst)	u*	Aleocharinae spp.	u
<i>Carpelimus pusillus</i> group	u	<i>Trichonyx sulcicollis</i> (Reichenbach)	u
<i>Carpelimus</i> spp. indet.	u	Euplectini sp.	u
<i>Aploderus caelatus</i> (Gravenhorst)	rt	<i>Pselaphus heisei</i> (Herbst)	u
<i>Platystethus alutaceus</i> Thomson	oad	Pselaphidae spp.	u
<i>Platystethus arenarius</i> (Fourcroy)	rf	<i>Geotrupes</i> sp.	oarf
<i>Platystethus degener</i> Mulsant & Rey	oad	<i>Aphodius ater</i> (Degeer)	oarf
<i>Platystethus cornutus</i> group indet.	oad	<i>Aphodius ?contaminatus</i> (Herbst)	oarf
<i>Platystethus nitens</i> (Sahlberg)	oad	<i>Aphodius granarius</i> (Linnaeus)	obrf
<i>Anotylus nitidulus</i> (Gravenhorst)	rtd*	<i>Aphodius prodromus</i> (Brahm)	obrf
<i>Anotylus rugosus</i> (Fabricius)	rt	<i>Aphodius</i> spp. indet.	obrf
<i>Anotylus sculpturatus</i> group	rt	<i>Onthophagus</i> sp.	oarf
<i>Anotylus tetracaratus</i> (Block)	rt	<i>Phyllopertha horticola</i> (Linnaeus)	oap
<i>Anotylus</i> sp. indet.	rt	<i>Dascillus cervinus</i> (Linnaeus)	oap
<i>Oxytelus ?laqueatus</i> (Marsham)	rf	? <i>Clambus</i> sp.	rt
<i>Oxytelus sculptus</i> Gravenhorst	rt	<i>Cyphon</i> sp.	oad
<i>Stenus</i> spp.	u	<i>Simplocaria ?semistriata</i> (Fabricius)	oap
<i>Lathrobium</i> spp.	u	Byrrhidae sp.	oap
<i>Lithocharis ochracea</i> (Gravenhorst)	rt	<i>Dryops</i> sp.	oad
<i>Rugilus orbiculatus</i> (Paykull)	rt	<i>Esolus parallelepipedus</i> (Muller)	oaw
<i>Rugilus</i> sp. indet.	rt	<i>Oulimnius</i> sp.	oaw
<i>Othius ?myrmecophilus</i> Kiesenwetter	rt	<i>Agrypnus murinus</i> (Linnaeus)	oap
<i>Leptacinus pusillus</i> (Stephens)	rt	<i>Melanotus</i> sp.	l
<i>Leptacinus</i> sp. indet.	rt	<i>Ctenicera cuprea</i> (Fabricius)	oap
<i>Phacophallus parumpunctatus</i> (Gyllenhal)	rt	<i>Ctenicera</i> sp. indet.	oap
<i>Gyrohypnus angustatus</i> Stephens	rt	<i>Ctenicera</i> sp. indet. (larva)	(oa-p)
<i>Gyrohypnus fracticornis</i> (Muller)	rt	<i>Actenicerus sjaelandicus</i> (Muller) (larva)	(oa*)
<i>Gyrohypnus ?punctulatus</i> (Paykull)	rt	<i>Agriotes</i> sp.	oap
<i>Gyrohypnus</i> sp. indet.	rt	<i>Denticollis linearis</i> (Linnaeus)	u
<i>Xantholinus gallicus</i> or <i>linearis</i>	rt	<i>Dalopius marginatus</i> (larva)	(oa-p)
<i>Xantholinus ?linearis</i> (Olivier)	rt	Elateridae spp. indet.	ob
<i>Xantholinus longiventris</i> Heer	rt	Elateridae sp. (larva)	(ob)
<i>Xantholinus</i> sp. indet.	u	<i>Cantharis rustica</i> Fallen	ob
? <i>Neobisnius procerulus</i>	u	<i>Dermestes</i> sp.	rt
<i>Neobisnius villosulus</i> (Stephens)	u*	<i>Grynobius planus</i> (Fabricius)	l
<i>Neobisnius</i> sp. indet.	u	<i>Anobium punctatum</i> (Degeer)	l
<i>Philonthus</i> spp.	u	Anobiidae sp. indet.	l
<i>Philonthus</i> or <i>Gabrius</i> sp.	u	? <i>Tipnus unicolor</i> (Piller & Mitterpacher)	rd
<i>Staphylinus</i> sp.	u	<i>Ptinus fur</i> (Linnaeus)	rd
<i>Quedius boops</i> group	u	<i>Ptinus</i> sp. indet.	rd
Staphylininae spp. indet.	u	<i>Lyctus linearis</i> (Goeze)	l
<i>Tachyporus ?hypnorum</i> (Fabricius)	u	<i>Tenebroides mauritanicus</i> (Linnaeus)	rt
<i>Tachyporus ?obtusus</i> (Linnaeus)	u	<i>Malachius ?marginellus</i> (Olivier)	u
<i>Tachyporus</i> spp. and spp. indet.	u	<i>Kateretes rufilabris</i> (Latreille)	oapd
<i>Tachinus laticollis</i> or <i>marginellus</i>	u	<i>Kateretes</i> sp. indet.	oapd
<i>Tachinus signatus</i> Gravenhorst	u	<i>Brachypterus</i> sp.	oap
<i>Tachinus</i> sp. indet.	u	<i>Meligethes</i> sp.	oap
<i>Cilea silphoides</i> (Linnaeus)	rt	? <i>Epuraea</i> sp.	u
<i>Cordalia obscura</i> (Gravenhorst)	rt	<i>Omosita</i> sp.	rt
<i>Falagria caesa</i> Erichson	rt	Nitidulidae sp.	u
<i>Falagria caesa</i> or <i>sulcatula</i>	rt	<i>Rhizophagus parallelocollis</i> Gyllenhal	rt
<i>Falagria</i> or <i>Cordalia</i> sp. indet.	rt	<i>Rhizophagus</i> sp. indet.	u
<i>Crataraea suturalis</i> (Mannerheim)	rt	<i>Monotoma bicolor</i> Villa	rt
Aleochara sp.	u	<i>Monotoma longicollis</i> (Gyllenhal)	rt

<i>Monotoma picipes</i> Herbst	rt	<i>Chaetocnema arida</i> group	oap
<i>Monotoma</i> sp. indet.	rt	<i>Chaetocnema concinna</i> (Marsham)	oap
<i>Cryptolestes ferrugineus</i> (Stephens)	g	Halticinae sp.	oap
<i>Oryzaephilus surinamensis</i> (Linnaeus)	g	<i>Apion</i> spp.	oap
<i>Cryptophagus scutellatus</i> Newman	rd	<i>Phyllobius</i> or <i>Polydrusus</i> sp.	oap
<i>Cryptophagus</i> spp.	rd	<i>Barynotus</i> sp.	oap
<i>Atomaria nigripennis</i> (Kugelann)	rd	<i>Sitona hispidulus</i> (Fabricius)	oap
<i>Atomaria</i> spp.	rd	<i>Sitona lepidus</i> Gyllenhal	oap
<i>Ephistemus globulus</i> (Paykull)	rd	<i>Sitona</i> sp. indet.	oap
Phalacridae sp.	oap	<i>Hypera nigrirostris</i> (Fabricius)	oap
<i>Orthoperus</i> sp.	rt	<i>Hypera punctata</i> (Fabricius)	oap
<i>Stephostethus lardarius</i> (Degeer)	rt	<i>Hypera</i> sp. indet.	oap
<i>Lathridius minutus</i> group	rd	<i>Leiosoma</i> sp.	oap
<i>Enicmus</i> sp.	rt	<i>Tanysphyrus lemnae</i> (Paykull)	oawp
<i>Dienerella</i> sp.	rd	Cossoninae sp.	u
<i>Corticaria</i> spp.	rt	<i>Sitophilus granarius</i> (Linnaeus)	g
<i>Corticarina ?fuscula</i> (Gyllenhal)	rt	<i>Notaris acridulus</i> (Linnaeus)	oadp
<i>Corticarina</i> sp. indet.	rt	<i>Cidnorhinus quadrimaculatus</i> (Linnaeus)	oap
<i>Cortinicara gibbosa</i> (Herbst)	rt	<i>Ceutorhynchus</i> sp.	oap
<i>Corticarina</i> or <i>Cortinicara</i> sp. indet.	rt	<i>Rhinoncus castor</i> (Fabricius)	oap
<i>Cis</i> sp.	l	<i>Rhinoncus</i> sp.	oap
Cisidae sp. indet.	l	Ceuthorhynchinae spp. indet.	oap
<i>Typhaea stercorea</i> (Linnaeus)	rd	<i>Gymnetron labile</i> (Herbst)	oap
<i>Aglenus brunneus</i> (Gyllenhal)	rt	<i>Gymnetron</i> sp. indet.	oap
<i>Palorus ratzeburgi</i> (Wissman)	g	Curculionidae spp. indet.	oa*
<i>Tenebrio obscurus</i> Fabricius	rt	<i>Scolytus</i> sp.	l
<i>Anthicus formicarius</i> (Goeze)	rt	<i>Leperisinus varius</i> (Fabricius)	l
<i>Anthicus floralis</i> or <i>formicarius</i>	rt	<i>Dryocoetinus villosus</i> (Fabricius)	l
Bruchinae sp.	u	Scolytidae sp.	l
<i>Gastrophysa viridula</i> (Degeer)	oap	Coleoptera spp. and spp. indet.	u
<i>Gastrophysa</i> sp. indet.	oap	Coleoptera sp. (larva)	(u)
<i>Phaedon</i> sp.	oap	Insecta sp.	(u)
<i>Hydrothassa ?marginella</i> (Linnaeus)	oap	Insecta sp. (larva)	(u)
<i>Prasocuris junci</i> (Brahm)	oapd	Insecta sp. pupa	(u)
<i>?Prasocuris phellandrii</i> (Linnaeus)	oapd		
Chrysomelinae spp. indet.	oap		
<i>Galerucella</i> sp.	oap	Arachnida	
Galerucinae sp. indet.	oap		
<i>Phyllotreta nemorum</i> group	oap	Aranae sp.	(u)
<i>Phyllotreta</i> sp.	oap	Opiliones sp.	(u)
<i>?Aphthona</i> sp.	oap	<i>?Ixodes</i> sp.	(u)
<i>Longitarsus</i> sp.	oap	Acarina sp.	(u)
<i>Altica</i> sp.	oap		

Notes on identifications

Most of the identifications of beetle and bug remains from this site were straightforward. In some cases, potentially difficult identifications were not pursued because it was considered to be reasonably certain that the resulting ecological information would not justify the time spent. It is intended that some of these identifications will be taken further as part of a synthetic project dealing with Roman insects. It is worth noting that the *Ptinus* remains probably included a second species in addition to *P. fur*; it has not yet proved possible to determine the remains with certainty. Material from 16-22 Coppergate, York (Anglo-Scandinavian in date: Kenward and Hall, in press) similarly appeared to include a second *Ptinus*.

Remains of large *Carpelimus* were perhaps all *C. bilineatus*, but may have included *C. rivularis*; most were therefore recorded as *C. ?bilineatus*.

Some of the samples contained *Cercyon* spp. with unusual patterning, perhaps the result of the vagaries of preservation: some of the specimens of *C. haemorrhoidalis*, *C. lateralis*, *C. melanocephalus* and *C. quisquilius* were identified from such material. These patterns were retained, and indeed intensified, after treatment with dilute hydrochloric acid (following Kenward 1983).

It has been assumed that all material of *Cryptolestes* was *C. ferrugineus*, and that of *Oryzaeophilus* was *O. surinamensis*.

Context-by-context account

This section of the report presents the evidence from each assemblage in summary, together with a brief interpretation. It is arranged in phase order; within phases, cut features are dealt

with first, then surface layers. This not-quite-logical approach is taken because nearly all the useful insect assemblages came from the fills of cuts. A summary of the evidence from each group of related contexts (for example fills of a ditch) is given, and the evidence from each phase is summarised very briefly at the end of the context-by-context account for that phase.

For each context, preliminary archaeological information taken from the context data provided by ULAU is given in braces ('{ }'), and for each sample the sediment description made in the laboratory is followed by a short account of the insects and other invertebrates recorded, and a note on the parasite egg analysis.

In using the following account it should be noted that:

- (a) Remains were of adults unless otherwise stated.
- (b) Numbers are MNIs
- (c) Recording was 'scan-recording' *sensu* Kenward (1992) unless otherwise stated.
- (d) Statistics given refer to the assemblage of adult beetles and bugs excluding aphids and scale insects. Abbreviations for these statistics are given in Table 2.
- (e) Flot size is mentioned where unusually large or small: typical flots could be examined in one to three petridish-fulls and were thus fairly easy to manage.
- (f) P1..P3 = high..low priority for recording.
- (g) In the context-by-context account, the results from 'squashes' for worm eggs are only mentioned where positive.

Table 2. Abbreviations used in text and tables. Lower case codes in parentheses are those assigned to taxa and used to calculate the group values (codes in capitals).

Number of individuals estimated (MNI)	N
Number of taxa	S
Index of diversity (alpha)	alpha
Standard error of alpha	SE alpha
Number of 'certain' outdoor taxa (oa)	SOA
Percentage of 'certain' outdoor taxa	%SOA
Number of 'certain' outdoor individuals	NOA
Percentage of 'certain' outdoor individuals	%NOA
Number of 'certain' and probable outdoor taxa (oa + ob)	SOB
Percentage of 'certain' and probable outdoor taxa	%SOB
Number of 'certain' and probable outdoor individuals	NOB
Percentage 'certain' and probable outdoor individuals	%NOB
Index of diversity of the outdoor component	alpha OB
Standard error of index of diversity of outdoor component	SE alpha OB
Number of aquatic taxa (w)	SW
Percentage of aquatic taxa	%SW
Number of aquatic individuals	NW
Percentage of aquatic individuals	%NW
Number of damp ground/waterside taxa (d)	SD
Percentage of damp ground/waterside taxa	%SD
Number of damp ground/waterside individuals	ND
Percentage of damp ground/waterside individuals	%ND
Number of strongly plant-associated taxa (p)	SP
Percentage of strongly plant-associated taxa	%SP
Number of strongly plant-associated individuals	NP
Percentage of strongly plant-associated individuals	%NP
Number of heathland/moorland taxa (m)	SM
Number of heathland/moorland individuals	NM
Percentage of heathland/moorland individuals	%NM
Number of wood-associated taxa (l)	SL
Number of wood-associated individuals	NL
Percentage of wood-associated individuals	%NL
Number of decomposer taxa (rt + rd + rf)	SRT
Percentage of decomposer taxa	%SRT
Number of decomposer individuals	NRT
Percentage of decomposer individuals	%NRT
Number of 'dry' decomposer taxa (rd)	SRD
Percentage of 'dry' decomposer taxa	%SRD
Number of 'dry' decomposer individuals	NRD
Percentage of 'dry' decomposer individuals	%NRD
Number of 'foul' decomposer taxa (rf)	SRF
Percentage of 'foul' decomposer taxa	%SRF
Number of 'foul' decomposer individuals	NRF
Percentage of 'foul' decomposer individuals	%NRF
Index of diversity of decomposer component	alpha RT
Standard error of index of diversity of decomposer component	SE alpha RT
Number of individuals of grain pests (g)	NG
Percentage of individuals of grain pests	%NG
Number of individuals of grain pests	NG
Number of uncoded taxa (u)	SU
Percentage of uncoded individuals	PNU

Pre-Roman activity

Context 413 {Natural}

Sample 4375: Moist, mid grey to mid to dark brown with orange flecks (?iron salt), plastic and crumbly working more plastic, slightly humic, sandy silty clay. Small stones (6-20 mm) were common and some charcoal was present in the sample.

Insects: The flot was very small and contained only some seeds, plant tissue fragments and sand grains.

Context 418 {The fill of a shallow linear feature [417] running North-South cut into [413]}

Sample 4381: Moist, light to mid brown-grey with orange flecks, stiff working plastic, sandy clay. Medium-sized stones (20-60 mm) were present and charcoal was common.

Insects: The flot was minute and contained some sand grains and plant debris; there was a single unidentifiable beetle fragment.

Context 432 {Natural sand below [413] distinguished by its more grainy nature and orange colour}

Sample 4401: Dry, mid orange-brown, unconsolidated, very slightly clay sand with some small lumps of grey clay with orange flecks and some charcoal.

Insects: The flot appeared to consist principally of humified plant debris; there were only scraps of putative arthropod cuticle.

Context 815 {What appears to be an archaeologically sterile silt. It is probably natural river flood silt, grading gradually into natural sand and gravel}

Sample 4916: Moist, slightly heterogeneous, orange-brown externally to mid grey internally, compressed to crumbly working more crumbly (and sticky when wetted), sandy clay with orange streaks (?iron staining) and black flecks.

Insects: Flotation produced no material.

Summary of pre-Roman activity

The deposits of pre-Roman date gave no significant invertebrate remains.

Phase 1:1 Fort Construction

Fill of gully 809

Context 810 {The fill of gully cut [809]. This fill consisted mainly of a dull grey sticky sandy clay with a large amount of organic debris. The fill surrounded on the west side of a stake line [823] and wattle [824] suggesting that the gully fence was present prior to the infilling of the gully by [810].

Sample 4902: Moist, dark grey-brown with orange flecks, crumbly working plastic, very humic, sandy silty clay. Charcoal, wood, twigs and leather were all present.

Insects: The flot was tiny, yielding some seeds, plant tissue fragments and sand grains, but included a small group of insects and other arthropods. These included 'several' mites and 20 individuals of 19 beetle taxa. This assemblage was too small to be reliably interpreted, and the statistics calculated from it must be treated with caution. However, almost half of the individuals were of taxa likely to have originated in 'outdoor' natural or semi-natural habitats, including a single individual of *Esolus parallelepipedus*, associated with flowing water. There were rather few species associated with decomposing matter (under a third of the individuals). Perhaps this was largely 'background fauna', in the sense of having arrived by varied and largely accidental means. Despite its lithology, there is no evidence from the invertebrates that the deposit formed in water or received human ejectamenta. Some strong synanthropes (including grain pests) were, however, present.

Other deposits of phase 1:1

Context 225 {A layer of grey/buff clay situated between the inner and middle defensive ditches. Of similar appearance to the clay build-up of the rampart and probably derived from material excavated during the cutting of the two ditches, this

making the ditches deeper by the construction of a central bank }

Sample 4140: Moist, mid pinkish brownish-grey, stiff working plastic, sandy silty clay. Iron-mineralised tubes of 1-5 mm diameter (?earthworm burrows) common .

Insects: The flot contained some plant tissue fragments and charcoal, and numerous seeds. There were single individuals of three beetle taxa and a single insect larva; these remains had no interpretative significance.

Context 340 {The fill of post pipe cut [339].

Sample 4278: Moist, slightly heterogeneous, dark purplish-grey, plastic and soft, of noticeably low density, very humic clay with minor component mid-grey, sticky, smearing clay.

Insects: The tiny flot contained only a few pale plant tissue fragments.

Sample 4281: Moist, slightly heterogeneous, light brown, plastic, slightly silty clay with traces of orange-brown ?silt or clay and a large amount of mid-brown, slightly humic clay.

Insects: The tiny flot consisted mostly of charcoal, with a few plant tissue fragments and a single beetle fragment, poorly preserved and unidentifiable.

Context 525 {The fill of large tubular post-pipe [526].}

Sample 4578: Wet, mid to dark grey-brown, soft and sticky, slightly sandy clay. Lumps of ?rotted sandstone and coal were present.

Insects: Flotation produced no material.

Context 121 {A mixed clay layer seen directly below [105] the upper corduroy. Dark linear stains are probably the result of decay of [105]. }

Sample 4076: Moist, dark grey with mid orange-brown patches, indurated becoming sticky when wetted, slightly silty clay.

Insects: The flot consisted of a trace of sand grains.

Sample 4077: Moist, mid to dark grey-brown, indurated, working plastic and sticky when wetted, slightly sandy silty clay. Charcoal was present.

No material was processed as another sample from this context was selected for analysis.

Summary of Phase 1:1

Only one of the seven samples processed from Phase 1:1 deposits gave more than a few insect remains: that from gully fill 810 (in 809). This appeared to represent natural accumulation, with no evidence of dumping from the insect remains despite the presence of some leather and charcoal.

Phase 1:2 Establishment of the extra-mural settlement and deterioration of the defences.

Fills of ditch 220

Context 215 {A layer of fill in the original inner defensive ditch [220]. This layer was cut by the re-cut of the inner ditch [428]}

Sample 4125: Moist, slightly heterogeneous, mid brown to buff, crumbly to slightly compressed working plastic, slightly humic clay with orange flecks in localised patches. Charcoal and root traces were present in the sample.

Insects: There were 'several' ephippia (resting eggs) of *Daphnia* sp. and of another cladoceran (water flea), showing the deposit to have been waterlain, perhaps where standing water was impermanent. There were single individuals of thirteen beetle taxa, but few other remains. More than half of the beetles were from natural or semi-natural habitats, perhaps being colonists of waste ground or meadowland, suggesting the possible nature of the surroundings of the ditch.

Context 216 {A layer of ditch fill within the original, inner defensive ditch [220]. This layer

consisted of rotted organic material that could be pulled or flaked apart}

Sample 4127: Moist, mid to dark grey-brown, crumbly working plastic, humic clay with yellow, brown and black mottling, orange patches and coarse organic detritus. Charcoal was present and wood was common.

Insects: The beetle and bug assemblage from this layer was of modest size, with 59 individuals of 39 taxa. Other invertebrates included 'many' mites and 'several' beetle larvae, adult flies, fly puparia (and probably fly pupae), and three bug nymphs.

The group of adult beetles and bugs was of moderate diversity ($\alpha = 50$, $SE = 13$) and a fifth of it was contributed by 'outdoor' forms. Decomposers made up only about two-fifths of the individuals. The more abundant taxa (with three or four individuals) included grain pests, decomposers probably associated with organic matter which was not too foul, and *Apion* sp. These, and some of the rarer taxa (including *Cryptophagus scutellatus* and *Crataeraea suturalis*), suggest that the material may have incorporated stable manure. There was no evidence for the presence of standing water; no aquatics were recorded.

Context 243 {A fill of the early inner ditch [220]. This material may contain finds from [259] a fill of the re-cut of the inner ditch [428]}

Sample 4150: Moist, mid brown, firm but slightly crumbly working plastic, ?humic clay silt with mm-scale mottling - more orange in places.

Worm eggs: A trace of *Trichuris* was noted.

Insects: A modest group of rather well-preserved beetles (and one bug) was recovered ($N = 49$, $S = 38$). In addition, there were 'many' mites, unidentified pupal fragments, fly puparia and Hymenoptera Parasitica. Diversity was estimated to be mathematically high ($\alpha = 77$, although $SE = 25$), and almost half of the assemblage was contributed by 'outdoor' forms, many of them aquatics (the latter giving about a fifth of the individuals). Decomposers were very weakly represented by comparison with assemblages from occupation deposits in general (less than a third of the individuals). Beetles from foul matter were

relatively well represented.

Clearly deposited into water, this material probably accumulated 'naturally', without much material being dumped into it. The surroundings may have been disturbed ground with some foul matter - perhaps dung.

Sample 4162: Moist, mid brown, sticky to plastic working soft and plastic, moderately humic slightly silty clay and fine herbaceous detritus. Very small patches of yellow-brown clay, charcoal and twigs were present in the sample.

Worm eggs: Small numbers of *Trichuris* eggs were present.

Insects: This group had much in common with that from Sample 4150. There were numerous beetle larvae, adult flies and pupal fragments, probably of flies, 'several' *Daphnia* ephippia, fly puparia and mites, and a group of 57 beetles and bugs (49 taxa). Diversity was higher (but with an even larger standard error), the outdoor component a little smaller, aquatics somewhat rarer. Only *Anotylus rugosus* was represented by more than two individuals, but even of this species there were only three. This group too appears to have come together essentially naturally, with a 'background fauna' which included species from human occupation debris, probably including litter from stabling.

Context 253 {A fill of the early inner ditch [220]}

Sample 4170: Moist, mid to dark brown to mid to dark buff, soft to crumbly working plastic, slightly humic moderately stony clay slightly sandy silt. Very small stones (2-6 mm) were common and small and medium-sized stones were recorded.

Worm eggs: Trace amounts of *Trichuris* eggs were present.

Insects: The flot contained appreciable quantities of moss and bran. There were 'many' ?fly pupae and fly adults and puparia, mites, and *Daphnia* ephippia, the last indicating aquatic deposition. Other remains included 'several' beetle larvae and a group of 51 individuals of 41 taxa of beetles, and a single bug, of the groups used in calculating main

statistics. The assemblage was of high diversity (although the standard error of the estimate was high) and had a large proportion of 'outdoor' forms. Aquatics were proportionally important (although only seven individuals of five taxa were present), and decomposers were not very numerous. It is very likely that this was a waterlain deposit into which some 'background fauna' became incorporated. The terrestrial forms included species undoubtedly associated with human occupation, but also a range of taxa perhaps originating in adjacent disturbed ground.

Context 256 {A fill of the early inner ditch [220] entirely made up of degraded plant remains }

Sample 4176: Moist, varicoloured - light brown to mid brown to light grey to buff to dark grey-brown to black (from varied levels of reduction/oxidation), brittle and layered to sticky working soft and plastic, very humic clay and fine herbaceous detritus. Very small stones (2-6 mm), charcoal, very small patches of orange clay and modern contaminant mould were all noted.

Worm eggs: Small numbers of *Trichuris* eggs were present in two squashes.

Insects: The flot, which contained numerous seeds and some moss and other plant detritus, included numerous invertebrate remains. There were 'many' beetle larvae, mites and *Daphnia* ephippia, 'several' adult flies and unidentified insect larvae, a few other remains, and 39 individuals of 32 species of beetles and bugs. Three-fifths of the latter were 'outdoor' forms, and diversity appears to be high ($\alpha = 82$, but $SE = 33$). There were enough aquatics to suggest that the deposit was waterlain, and very few decomposers. The terrestrial fauna was probably all of 'background' origin, perhaps mostly from the immediate environs of the ditch, which appear to have been waste ground with some vegetation, mostly 'weedy'. There were no synanthropes apart from a single *Cryptolestes ferrugineus*, doubtless from grain, so human influence appears to have been weak at this stage.

Context 257 {The primary fill of the early inner ditch [220]}

Sample 4178: Moist, mid brown, brittle and slightly layered to plastic working more plastic,

clay silt. There were no obvious inclusions in the sample which had the appearance of having been water-lain.

Insects: Only a small flot with a restricted arthropod fauna was recovered: there were 'several' fly puparia and adults, but almost no other remains apart from single individuals of five beetles and one bug. This assemblage is not interpretable, except to observe that it resembled a small random extract from a fauna like that of Sample 4176.

Summary of fills of ditch 220

Samples from the six fill contexts of ditch 220 examined gave very small to modest-sized groups of insect remains. The material from context 257 could not be interpreted (although the small group was reminiscent of those from other fills of this cut). The assemblages from 215, 243, 253 and 256 clearly indicated that these layers were waterlain, with the fauna accumulated 'naturally' in situ, there being no evidence from the insects of large-scale dumping of organic waste. Insects from each of these layers gave indications of weedy waste ground, probably disturbed by human activity, with exposed decomposing matter (perhaps including stable manure). There was some, limited, evidence for nearby structures. Context 216 may have received stable manure; it lacked aquatics. Two of the fills contained trace amounts of *Trichuris* sp. eggs, not sufficient evidence for the deliberate incorporation of human faeces.

Fill of ditch 226

Context 288{A fill of the middle ditch [226]}

Sample 4198: Moist, dark grey-brown to dark orange-grey, with flecks of red clay, stiff to crumbly working plastic, slightly humic slightly silty clay. Wood was present and charcoal common.

Insects: This material was assessment-recorded and assigned P2. The flot was of modest size but more than half of it was made up by invertebrate fragments. Aquatic beetles were numerous. The assemblage gave only limited evidence other than the fact that the deposit was clearly waterlain.

Fills of ditch 278

Context 299 {A fill of the outer defensive ditch of the stone fort [278]}

Sample 4247: Moist, mid grey-brown with mm-scale orange mottling (reduction-oxidation), brittle working soft, slightly humic slightly sandy slightly clay silt. Wood and very small stones (2-6 mm) were present in the sample.

Worm eggs: A single ?*Trichuris* egg was seen.

Insects: Few invertebrate remains were present in the flot, among them 'several' mites and a small group of beetles (N = 13, S = 12). Subjectively, this group may have originated in stable manure, but the whole assemblage might easily have been 'background fauna' of one kind or another.

Context 310 {A layer of fill from the outer defensive ditch of the stone fort [278]}

Sample 4250: Moist, dark grey-brown, layered, coarse herbaceous detritus with mm-scale pinkish, whitish and yellowish patches. Some noticeably softened (flexible) fragments of bone (>20 mm) were present.

Worm eggs: A trace of *Trichuris* eggs was present.

Insects: Arthropod remains were moderately numerous, and included 'many' mites, 'several' beetle larvae and fly puparia, four unidentified bug nymphs, and 47 adult individuals of 31 beetle and bug taxa of the groups used for the calculation of statistics. The value of the index of diversity was depressed by the presence of a large proportion of two grain pests, *Sitophilus granarius* (seven individuals) and *Cryptolestes ferrugineus* (five), between them accounting for a quarter of the assemblage. Another third were 'outdoor' forms, and decomposers were relatively rare (less than a quarter). Aquatics were sufficiently numerous to suggest that the layer was waterlain. It seems possible that there was dumping of material from occupation (perhaps stable manure), although the whole terrestrial fauna might have arrived more randomly, perhaps reflecting surroundings with a little short vegetation in addition to spoiling grain and other organic components of occupation debris. There was a single, unidentified, body sclerite of a flea, perhaps favouring the hypothesis that debris from a floor used by humans had been dumped.

Context 324 {A fill of the original outer ditch [278], that slumps into the ditch from the South}

Sample 4257: Moist, mid to dark brownish-grey, plastic, slightly humic clay. Small and large stones (6-20 and 60+ mm), wood and 'straw' were present in the sample.

Insects: The flot, about half of which consisted of arthropod remains, was only assessment recorded and assigned P2. The proportion of aquatics suggested the deposit to be waterlain, and the terrestrial species appeared likely to have originated in short vegetation by the ditch.

Context 327 {A waterlogged, smelly fill of the outer defensive ditch [278]}

Sample 4266: Moist, mid to dark grey-brown, stiff to plastic working more plastic, slightly humic silty clay with mid to dark orange patches - ?rotted sandstone or burnt earth. Small stones (6-20 mm) were noted.

Insects: The flot was very small, and contained only a few insect remains and other invertebrate remains. There were fifteen individuals of 13 beetle taxa, including three aquatics. Probably waterlain, the deposit appears not to have received organic detritus containing insects in more than very small numbers, despite its odour in the field.

Context 344 {The bottom layer of fill of the original outer ditch [278], seen below [327]}

Sample 4287: Moist, moderately heterogeneous, mid brown with patches of orange, dark grey mid grey and mid grey-brown, plastic and slightly sticky, slightly sandy clay.

Worm eggs: A single *Trichuris* egg was seen.

Insects: The flot was very small and yielded only a few seeds and plant fragments, a little charcoal, and a small group of insects, among which Diptera pupae were noted as rather numerous. There were single individuals of twelve beetle and bug taxa, two-fifths of them 'outdoor' forms but with only a single aquatic. This group is not interpretable, although it is reminiscent of some other larger ones from ditch fills at Ribchester.

Summary of fills of ditch 278

Five fill contexts of ditch 278 were investigated. None gave more than a modest-sized assemblage. That from 344 was too small for interpretation; 299 may have included stable manure, and had no evidence for aquatic deposition. The insects indicated that 310, 324 and 327 were all probably or definitely waterlain, with a probable 'background fauna' from adjacent surfaces. Context 310 seemed to have received dumped organic material - perhaps stable manure.

Fills of gully 419

Context 397 {A dark brown loamy fill of a small gully [419] that runs along the edge of cut [400]. This fill was very organic and was directly below [393]}

Sample 4343: Moist, mid to dark brown, crumbly working plastic, humic, sandy silt clay. Small and medium-sized stones (6-60 mm) were present in the sample.

Worm eggs: A trace of *Trichuris* was noted.

Insects: Only single individuals of two beetle taxa were found in the minute flot.

Context 403 {The grey friable sandy clay that forms the top layer of gully [419]}

Sample 4341: Moist, dark brown, soft to sticky, moderately humic, slightly clay silt. Very small and medium-sized stones (206 and 20-60 mm) and wood were recorded.

Insects: A small flot, mostly fine and coarse plant detritus, contained rather abundant insect remains. 'Several' fly puparia, beetle larvae, adult flies and unidentified pupae were recorded.

The beetle and bug assemblage was recorded semi-quantitatively, although only one species was not counted. In addition to about 64 individuals of 43 beetles and bugs there were assorted other invertebrates including 'several' fly puparia, beetle larvae and unidentified pupae (probably Diptera), and two human fleas *Pulex irritans*. Diversity and the proportion of outdoor individuals were

estimated to be moderate (alpha = 57, SE 14, and % N OB = 20). There was only a single aquatic; this, and one *Daphnia ephippium*, cannot stand as evidence of aquatic deposition. Over a quarter of the individuals were grain pests. The assemblage left after the subtraction of these (47 individuals of 40 taxa) was of borderline size for interpretation, but the presence of three individuals of each of *Cercyon analis* and *C. haemorrhoidalis* and the nature of some of the rarer species rather suggests an origin in somewhat foul decomposing matter. This may have been something like stable manure, the grain pests perhaps indicating that it was such, containing insects from spoiled grain used for feed.

Summary of gully 419

Two fills of gully 419 were studied. The sample from context 397 was almost barren. A modest-sized group of insects from 403 gave no clear evidence of aquatic deposition, and was probably detritus from a building - something resembling stable manure. There were two human fleas, but these were not necessarily evidence that the structure was used primarily for human occupation.

Fill of pit 406

Context 407 {A pale grey-brown fill of a pit [406], seen below [396]}

Sample 4348: Moist, mid grey-brown, stiff working plastic, slightly silty clay. Very small and small stones (2-20 mm) were present in the sample.

Insects: The small group of arthropod remains included 'several' adult flies and mites and 24 individuals of 20 beetle taxa. Half of these individuals were 'outdoor' forms. Interpretation is difficult, beyond a probable origin in the open, all or most of the remains perhaps being background fauna. The *Helophorus* sp. (two individuals) possibly indicate the presence of open water in the pit at some time.

Fill of pit 811**Context 812** {Fill of pit [811]}

Sample 4900: Moist, dark brown, crumbly working soft, very humic, slightly clay silt. Wood and charcoal were present.

Insects: The flot was very large, including abundant fragmentary plant tissue, moss and seeds. Invertebrates were numerous. There were 'many' mites, beetle larvae and unidentified pupae, 'several' Hymenoptera and flies, various other remains in smaller numbers, and an assemblage of beetles and bugs including a minimum number of 81 individuals of 63 species. This group appeared to be of high diversity (in other words of mixed origins or reflecting rich and well-developed habitats in the surroundings): $\alpha = 129$, although $SE = 33$. Over a quarter of the individuals were from 'outdoor' habitats and decomposers were rare (in comparison with the proportions seen in most assemblages from occupation sites). In the latter group, species from foul decomposing matter were rather well represented (ten individuals of six taxa). The decomposer component was of rather high diversity for such a component ($\alpha_{RT} = 48$, $SE = 17$), suggesting mixed origins.

Most taxa were represented by only one or two individuals; of the five with three or more, *Cercyon haemorrhoidalis* probably exploited somewhat foul matter, *Cryptolestes ferrugineus* and *Sitophilus granarius* are grain pest, present in substantial numbers in most Roman occupation site deposits but increasingly suspected by HK of originating in feed grain in many deposits, and *Lathridius minutus* group and *Aglenus brunneus* may have lived in the organic detritus of human occupation or animal stabling. Several of the species present in small numbers suggest that this fill probably indeed included stable manure, with species from hay and feed grain in addition to colonisers of the manure itself.

Layers and other surface-lain contexts of Phase 1:2

Context 405 {An organic layer similar to [376], that appears to be under [37?], [375], [391], [392], [376] (but probably not) [405] are all part of a build up of interleaving organic and clay layers in this area, below a substantial pebble layer [342]}

Sample 4888: Moist, mid to dark grey-brown, crumbly to brittle working more crumbly, moderately humic, slightly sandy silt. Small, medium-sized and large stones (6-60+ mm) and wood were present.

Insects: A modest group of beetles and bugs ($N = 57$, $S = 45$) was accompanied by various other arthropods including 'many' fly puparia and beetle larvae and 'several' bug nymphs. Of high mathematical diversity ($\alpha = 98$, though $SE = 31$) and rich in 'outdoor' forms (nearly two fifths of the individuals), the content of aquatics in this group suggested deposition in water. Although decomposers formed a relatively small part of the assemblage the species present, with the grain pests, suggested stable manure; the plant-feeders included species which may have been imported in hay. There was also a soft, newly emerged *Apion*, likely to have come from cut vetches or clover.

Context 535 {A sub-circular area just below the area of machine removal of road surfaces [534]. This area was capped with a thick grey clay below a stone road surface, presumably the earliest road surface. It is likely that this material is in fact [396]. It is possible that this is debris from a road metalling or a hearth as a metal working bun was found}

Sample 4596: Moist, varicoloured - from black to fawn through orange, brown and grey and mixtures thereof - sandy, clay silt with the appearance of ash. Very small, small and medium-sized stones (2-60 mm) were abundant.

Worm eggs: A single *Trichuris* egg was observed.

Insects: A very small flot contained no recognisable invertebrate remains.

Context 286 {A mixed layer from the central hearth area of the extra-mural settlement, containing material possibly derived from the underlying hearths}

Sample 4258: Dry, mid to dark grey-brown with mm-scale mid-orange mottles (probably oxidation), brittle to crumbly working plastic and sticky when wetted, clay silt. Charcoal was common and brick/tile, mortar/plaster, numerous round 1mm-diameter ?burrows and very small stones (2-6 mm) were observed.

Insects: There were only three mites and a fly puparium, a little charcoal, and some other (uncharred) plant remains in the small flot.

Summary of Phase 1:2

The fills of ditches 220, 226 and 278 of phase 1:2 gave some small, uninterpretable, insect groups, some groups indicating that the deposits from which they came were waterlain, and some which were probable dumps of organic matter, with no indication of aquatic deposition. There were often hints, or clearer evidence, of the presence of stable manure. The surroundings appeared, on rather limited evidence, to be disturbed ground with some vegetation and foul matter such as dung.

Gully 419 gave limited evidence, with no indication of aquatic deposition, but hints of stable manure.

The two pit fills of Phase 1:2 examined gave contrasting results. A fill of 406 appeared to contain primarily background fauna, with hints of open water and no indication of the dumping of organic waste. On the other hand, a fill of 811 gave an assemblage which probably indicated stable manure, although the deposit seems to have also included other material.

Two of the surface layers - 286 and 535 - were barren, while organic layer 405 probably included stable manure.

Phase 2:1 Fort Modification

Fill of ditch 278

Context 277 {The upper organic fill of the outer defensive ditch of the timber fort [278]}

Sample 4200: Moist, dark grey-brown, crumbly working soft, very humic silty clay with coarse woody detritus and a large number of pieces of chopped wood, some of which was partly burnt. Wood and twigs were abundant and small and medium-sized stones (6-60 mm) and charcoal were present.

Insects: Recorded during assessment only, as assigned P2, the flot contained a small group of insects, probably all terrestrial taxa and including at least some species associated with organic waste from human occupation.

Other deposits of phase 2:1

Context 294 {A thin horizon overlying the upper fills of the outer defensive ditch [278] and the area between the middle and outer ditches}

Sample 4215: Moist, mid grey-brown, soft to crumbly working more soft, very slightly humic slightly sandy silty clay. Charcoal and very small stones (2-6 mm) were present in the sample.

Insects: The flot was rather small and included a small and rather poorly preserved group of invertebrates; it was considered likely that at least some remains had rotted completely away, such was the state of some of those remaining. There were 'several' ephippia of one kind of water flea, and two others identifiable as *Daphnia* sp., indicating aquatic deposition but not necessarily a large body of water. There were single individuals of nine beetle taxa, whose origin cannot reasonably be deduced.

Sample 4231: Moist, moderately heterogeneous, mid to dark grey to buff, layered to brittle working plastic, moderately humic slightly sandy silty clay with coarse woody detritus. The sample's overall appearance was of layers of 'straw' and wood in clay. Wood was abundant, very small stones (2-6 mm) common and small stones (6-20 mm) present.

Insects: This material was only recorded during assessment (given priority P2). There was a small group of insects, predominantly grain pests.

Summary of phase 2:1

The upper fill of ditch 278 appeared to contain organic waste, with no evidence that it was deposited into water. The overlying layer (294), by contrast, had some evidence of aquatic origin, although the water fleas recorded may have exploited short-lived pools.

Phase 2:2: Extra-mural settlement modification and duration of timber-built associations

Fills of ditch 122

Context 107 {A layer of dark brown, organic fill in ditch cut [122], which fronts the rampart}

Sample 4580: Moist to wet, dark grey-brown, crumbly working plastic and laminated/brittle in patches, slightly heterogeneous mix of silt and fine and coarse herbaceous detritus. Small stones (6-20 mm) were noted.

Worm eggs: One of two squashes gave a single *Trichuris* egg.

Insects: A small group of beetles and a single bug (N = 26, S = 22) were accompanied by 'many' mites and fly puparia, 'several' beetle larvae, and a few other remains. Decomposers were proportionally important (about two thirds of the individuals), with the putative stable manure community seen repeatedly at this site clearly present, albeit in small numbers.

Context 124 {An organic clay fill of ditch [122]} When first exposed it was an orange-brown colour, later turning to green-grey. It contained bone fragments, leather and straw }

Sample 4592: Moist, mid to dark grey-brown, crumbly working plastic (sticky when wetted), slightly humic silty clay. Charcoal was present in the sample.

Insects: In addition to a modest group of beetles (N = 48, S = 35) there were other remains including 'many' fly puparia, 'several' mites, adult and pupal flies, and beetle larvae. Outdoor forms were abundant (about two-fifths of the individuals) and decomposers rare (less than a third). Grain pests were proportionally quite numerous.

This was a difficult group to interpret; presumably formed outdoors, it seems not to have received a decomposer community (other than the flies, perhaps) even though 'straw' was seen in the field. Possibly the decomposer fauna was in the early stages of invasion when the material was buried or flooded; the flies seem to have had time to establish

themselves. The grain pests may have been strays or, more probably, were introduced in dumped material with a limited fauna.

Context 130 {An early fill of ditch [122] which appears to have accumulated through natural silting processes. It varied in depth and contained some dark patches, possibly decayed timber. }

Sample 4073: Wet, moderately heterogeneous, dark brown, plastic to soft, very humic slightly sandy silt and fine herbaceous detritus with dark brown fibrous layers (olive internally) and dark grey layers. Charcoal and 'straw' were common and twigs were recorded.

Insects: The assorted invertebrates included 'several' mites and fly puparia and 41 individuals of 31 bugs and beetles. The main statistics were not very illuminating in such a small assemblage; subjectively, this had the appearance of a stable manure assemblage.

Context 131 {The lowest fill of ditch [122] fronting the rampart, probably primary silting }

Sample 4083: Almost dry, mid grey-brown, brittle, silty clay with abundant mm-scale, lighter and darker mottling. Probable root traces were observed.

Worm eggs: A single *Trichuris* egg was seen.

Insects: The small flot contained 'several' mites, 22 individuals of 20 beetle and bug taxa, and a small number of other invertebrates. The main statistics showed three-fifths of the assemblage to be contributed by outdoor forms and decomposers to be rare. There were sufficient aquatics for deposition in water to be probable, but the remaining fauna, although very typical of most of the assemblages from Ribchester, could not be interpreted beyond suggesting its possible origin as background fauna.

Context 154 {A fill of the recut ditch, [122]}

Sample 4090: Moist, mid to dark brown to light to mid grey-brown (internally black), brittle to stiff working plastic, slightly humic, slightly sandy clay

with localised patches of sand and fused lumps of burnt soil. Medium-sized stones (20-60 mm) were present.

Insects: The flot was minute and contained, apart from 'several' mites, only very few arthropods. There were single individuals of three beetle species.

Context 746 {A fill of the inner ditch recut [122]}

Sample 4865: Moist, slightly heterogeneous, very dark brown, brittle and layered to crumbly working more crumbly, very humic, slightly silty fine and coarse herbaceous detritus and amorphous organic material with some clasts of light grey clay. Very small stones (2-6 mm) and 'straw' were present.

Worm eggs: One *Trichuris* egg was seen.

Insects: The flot contained substantial numbers of beetles and bugs (N about 143, S = 62, with the abundance of one taxon estimated semi-quantitatively), together with other remains including 'many' fly puparia, probable fly pupae, beetle larvae and mites.

The main statistics suggested the presence of a substantial breeding community of decomposers, with whole-assemblage diversity rather low (alpha estimated as 42, SE = 6), a modest outdoor component (% N OB = 12), a large decomposer group (for this site: % N RT = 64, considerably higher if some uncoded probably decomposers were included), and a low value of alpha RT (14, SE = 2).

Foul decomposers were present in significant numbers (% N RF = 17). Two species dominated the assemblage: *Cercyon atricapillus* (20 individuals) and *Acrotrichis* sp., (18) with seven each of a *Philonthus* species and *Megasternum obscurum*, five *Cercyon analis*, and four each of *Oxytelus sculptus*, *Lathridius minutus* group and *Anthicus formicarius*. This community (with some of the rarer forms) indicates rather foul, mouldering, perhaps ammoniacal material, such as stable manure. There were hints of a group of remains which might have been imported in cut hay-like vegetation, grain pests, and some strong synanthropes suggesting that the plant material in which the fauna bred had lain inside a building. The latter included *Crataeraea suturalis*, *Aglenus*

brunneus and *Atomaria nigripennis*, the possible 'hay' taxa including *Apion* sp., *Sitona hispidulus*, *Megophthalmus ?scabripennis*, *Cicadella viridis* and several other leafhoppers.

This deposit seems very likely to have included stable manure or other litter from the housing of animals.

Summary of ditch 122

Six contexts from ditch 122 were examined for invertebrate remains. Layer 131, the lowest fill, seemed to have been waterlain and not to have received dumped material. Layers 107, 124 and 130 all perhaps included material such as stable manure, although large insect communities had not developed. Layer 746 clearly included something much like stable manure. Context 154, the fill of a re-cut, was almost barren.

Fills of ditch 226

Context 210 {An upper fill of the middle ditch [226]}

Sample 4118: Moist, light to mid grey-brown, crumbly to brittle in places working plastic, silty clay with 1-10 mm patches of buff, orange and black. Charcoal was present in the sample.

Insects: The very small flot contained fragmentary plant remains, a few seeds, 'many' beetle larvae, 'several' fly larvae and probable fly pupae, small numbers of other remains, and single individuals of ten beetle taxa. In this group, outdoor forms predominated, but no interpretation could reasonably be put forward.

Context 227 {A thin, black organic fill of the middle ditch [226], seen only on the eastern side of the section}

Sample 4134: Moist, dark greyish brown, brittle and locally compressed working plastic, amorphous organic sediment. Pale grey lumps of clay were present and wood was common.

Insects: There were 'several' mites, but few other remains; single individuals of eight beetle taxa

were noted, a group without significance. Preservation was quite good, so input of insects into the deposit was probably small, implying rapid formation.

Context 252 {A layer of fill from the middle ditch [226]}

Sample 4164: Just moist, light to mid grey-brown (internally more grey), brittle to slightly layered working crumbly to plastic and sticky when wetted, slightly humic clay. Flecks of buff coloured clay (sometimes lining root channels) and fragments of large mammal bone were present.

Insects: The flot was small, but was mostly of bran with some moss, a combination perhaps suggesting a faecal deposit (bran from faeces, moss used as 'toilet paper'). The small assemblage of insects did nothing to confirm this hypothesis; only one species (an unidentified aleocharine staphylinid) was represented by more than a single individual in an assemblage of 22 beetles.

Context 254 {A layer of waterlogged organic ditch fill from the middle ditch [226]. Cobbles, probably resulting from tumble, were found in the central area}

Sample 4172: Moist, mid grey-brown to mid to dark grey-brown, brittle to crumbly working plastic, slightly silty clay with 1-5 mm clasts of buff clay and very small stones (2-6 mm) also present.

Insects: Although small, the flot contained abundant invertebrates, among them 'many' water flea ephippia (resting eggs), fly larvae, pupae and adults and beetle larvae, 'several' adult flies and mites, and a single human flea (*Pulex irritans*). Adult beetles were present in rather small numbers (N = 42, S = 35), a small, diverse assemblage rich in outdoor forms but with a few synanthropes. There were sufficient aquatics to suggest formation in standing water. The terrestrial forms seem likely to have been background fauna, reflecting disturbed vegetation on the ditch edges and human occupation beyond.

Summary of ditch 226

Four fill contexts of ditch 226 were examined: samples from 210, 227 and 252 produced few insects, 227 at least giving hints of rapid accumulation. Context 254 was waterlain on the evidence of the insects, with in addition what was probably background fauna from disturbed ground and human occupation.

Fills of ditch 428

Context 259 {A fill of the later inner ditch [428].

Sample 4187: Moist, mid buff mottled with orange flecks, stiff to crumbly working plastic, moderately humic, slightly silty clay. Very small stones (2-6 mm), charcoal, wood, twigs and 'straw' were all noted.

Insects: The flot was only assessment-recorded, the fauna being small and subjectively considered likely to represent a variation of the fauna seen in sample 4648. It was assigned P3.

Sample 4648: Moist, light to mid grey brown, stiff working plastic, slightly silty clay. Very small stones (2-6 mm) and charcoal were present in the sample.

Worm eggs: A single *Trichuris* egg was present.

Insects: The flot was large, and preservation of insects variable, most being average to good, but some being very fragmentary or very rotted. Invertebrates were present in considerable variety, with 'many' fly puparia and *Daphnia* ephippia, 'several' parasitic Hymenoptera, beetle larvae, mites and ephippia of a second cladoceran, and assorted other remains including larvae of the click beetles *Dalopius marginatus* and *Ctenicera* sp.

The adult beetle and bug assemblage consisted of 71 individuals of 54 taxa. Almost half the fauna was classified as 'outdoor' forms, with aquatics proportionally abundant (over a fifth of the individuals). There is thus little doubt that this was an aquatic deposit, especially in view of the evidence from the water fleas. Much the most abundant species was a *Helophorus* (eight individuals), with three *H. aequalis* or *grandis* and single individuals of four other aquatic beetles. Decomposers were present in negligible numbers

(well under a third of the fauna), and these and the other terrestrial forms may have been a mixture of background fauna and species living in sparse semi-natural vegetation along the ditch.

Context 426 {The bottom fill of the recut inner ditch [428], below [259]. The number was given in post excavation, it was removed as part of [259]}

Sample 4711: Lumps of dark brown, crumbly, sandy silty clay layered with 'straw', wood and twigs with patches of black ?burnt clay and charcoal.

Worm eggs: There was a trace of *Trichuris* eggs.

Insects: The flot was rather large, consisting mostly of plant debris and some large pieces of charcoal. There were 100 individuals (MNI based on counted parts) of 46 taxa of adult beetles and bugs, with other remains including 'several' mites, *Daphnia* ephippia and fly puparia, two human fleas (*Pulex irritans*) and a bug nymph.

Grain pests were numerous (% N G = 29). The assemblage remaining after their subtraction was of quite low diversity and two thirds of it was contributed by decomposers, suggesting that these were exploiting decaying matter. Outdoor forms accounted for about a quarter of the fauna, and although aquatic insects were not numerous, the water fleas indicate aquatic deposition. Inspection of the species list suggests that, as elsewhere at the present site, something like stable manure was being dumped.

Context 541 {An organic ditch fill of the re-cut inner ditch [428]. This layer was only found in the area of ditch excavated in the extension}

Sample 4610: Moist, light to mid grey-brown, brittle working plastic, moderately humic, silty clay. Wood was present and charcoal common.

Insects: The material was only assessment-recorded, being designated P2. The flot was large, with much fine plant debris. The fauna included some aquatics and decomposers, suggesting deposition of plant remains into water, but otherwise had (subjectively) no special character.

Summary of ditch 428

Four samples from three fill contexts of ditch 428 were examined, two being only assessed. All these contexts were clearly waterlain, while 259 (perhaps), and 426 (probably), had stable manure dumped into them. The terrestrial component of 541 had no special character, so it is not certain if dumping of organic matter took place to a significant extent.

Other deposits of phase 2:2

Context 727 {A small lens of organic material sitting below [109]}

Sample 4813: Moist, stiff and layered to crumbly working soft, humic, bands of brown silty clay between layers of leafy/woody material and some bands of very pale grey clay. Very small stones (2-6 mm) were present and charcoal, wood and ?'straw' were common.

Insects: The rather large flot (mostly plant fragments) included a rather small group of arthropod remains, including 'several' mites and parasitic Hymenoptera, five water flea resting eggs apparently representing three species, and a fairly small group of beetles and bugs (N = 49, S = 36). The main statistics of the latter were rather undistinguished for the present site. Although this group may have accumulated randomly (presumably in water, on the basis of the evidence from the cladocerans), subjectively it may include animal bedding litter, perhaps the identity of the organic component observed in the raw sample material.

Context 266 {The fill of pit [265]}

Sample 4231: Assigned P2 on assessment, this sample gave a small group of insects, primarily grain pests.

Context 347 {The fill of a linear feature seen below [279], the rampart in Trench 2}

Sample 4378: Moist, slightly heterogeneous, dark grey, soft working plastic, slightly silty clay with orange-red flecks of pure clay. Charcoal was abundant in the sample.

Insects: The trace of flot contained no recognisable invertebrate remains.

Context 416 {The upper fill of linear feature [351], below [272] and above [347]}

Sample 4376: Moist, mid grey and gingery-red-brown, crumbly working plastic to crumbly, clay. Charcoal and flecks of light grey clay and dried orange clay were present.

Insects: Processing produced no flot.

Summary of Phase 2:2

Among the samples deposits of Phase 2:2, three ditches (122, 226 and 428) had varied fills, some in each ditch clearly being waterlain. Ditch 122 gave assemblages with probable stable manure; one of them was very rich. Several of the other fills of 122 and of 428 probably had stable manure, although some groups were too small for reliable interpretation. Samples from 226, in contrast, in most cases gave few insects. One layer in this ditch was clearly waterlain, with indications of adjacent disturbed ground carrying short vegetation. A sample from the fill of Pit 265 (only assessment recorded) gave a small group, primarily grain pests.

Phase 3 Demolition and rebuilding

Fills of ditch 247

Context 65 {The uppermost fill of the 'punic' ditch [247]. This layer is the same as [358]. This material is very organic in nature and was probably initially deposited at the end of Phase 3, the deliberate infilling of the punic ditch. The rather mixed nature is probably due to incorporation of material deposited later. Therefore it may well have Phase 4 finds in it}

Sample 4032: Moist, mid grey-brown, crumbly and slightly sticky working soft, sandy clay silt. Charcoal, wood and pot fragments were present.

Worm eggs: There were trace amounts of *Trichuris* eggs in two squashes.

Insects: There were 'many' mites, fly pupae and beetle larvae in the flot, with a group of 65 individuals of 35 adult beetle taxa. Diversity was rather low ($\alpha = 31$, $SE = 7$), but other statistics were generally unremarkable apart from a rather high proportion of 'RD' taxa (% N RD = 17) and a decomposer component of low diversity ($\alpha RT = 14$, $SE = 4$). Dominated by grain pests and decomposers in the high ranks, this group also contained other taxa perhaps suggesting an origin in stable manure.

Context 174 {A layer of mixed organic material forming the latest fill of the punic ditch [247], probably the upper contaminated part of the ditch fill [357] deposited during the final infilling of the ditch in Phase 3. [174] is the result of the exposure of [357] and later deposition of material during the construction and use of timber building [722] in Phase 4.

Sample 4104: Moist, dark brown, crumbly to indurated to brittle working, moderately humic slightly sandy silt. Small and medium-sized stones (6-60 mm), charcoal and wood were present.

Insects: 'Many' fly puparia, 'several' adult flies and beetle larvae, a few other remains, and a modest group of beetles and bug (N = 48, S = 39) were recorded. Probably of high diversity ($\alpha = 96$, but $SE = 34$), and including nearly a quarter of 'outdoor' forms, this assemblage was not very rich in decomposers relative to typical groups from occupation sites, although this component included the only taxa with more than single individuals.

This insect fauna resembled, subjectively, a random extract from an 'averaged' one for the site as a whole, so it may have largely been background fauna. Some decomposing matter was probably present nearby, however.

Context 205 {A layer of mixed organic material that forms the latest fill of the punic ditch [247]. This material is probably the upper contaminated part of ditch fill [357] which was deposited during the final infilling of the ditch in Phase 3. [205] is the result of the exposure of [357] and later deposition of material during the construction and use of timber building [722] in Phase 4}

Sample 4787: Moist, dark brown with red, greyish and orange flecks, soft and crumbly working plastic, sandy silty clay. Charcoal and very small to large stones (2-60+ mm) were noted.

Insects: There were 'many' mites, fly puparia and beetle larvae, 'several' fly pupae, small numbers of other remains and an assemblage of 77 individuals of 46 beetle and bug taxa. Removing the grain pests (which contributed over a tenth of the individuals) gave a fauna (proportionally) rich in decomposers (over two thirds RT, over a fifth RD, and with an appreciable foul-matter group). The nature of these decomposers was not, however, clear, and they may have had mixed origins, including a large proportion of background fauna.

Context 209 {The upper fill of the punic ditch [247]. It appears that this ditch was filled very rapidly with rubbish deposits (rather than gradual silting) as most of its depth contains similar deposits.}

Sample 4116: Moist, mid to dark brown, layered and locally slightly compressed working soft, very humic clay silt with layers of fine and coarse herbaceous detritus and patches of buff clay. Wood was abundant and medium-sized stones (20-60 mm) and charcoal were present in the sample.

Insects: This sample was recorded only during assessment; although assigned P1 at the time, it was not recorded more fully for shortage of time. The flot was quite large, including much coarse and fine plant detritus. There were 'many' *Cryptophagus* sp. and 'several' *Oryzaephilus surinamensis*, and it was noted that subjectively this may have been an assemblage from stable manure.

Sample 4143: Moist, considerably heterogeneous, mid brown, layered and fibrous working crumbly, very humic clay with minor components of grey clay, black amorphous organic material, flecks of orange-grey clay and a large amount of fine and coarse herbaceous detritus. Very small stones (2-6 mm), charcoal, twigs and 'straw' were present.

Insects: The large flot, consisting mainly of plant tissue fragments, gave one of the largest insect assemblages from the site, with 126 individuals of 63 beetle and bug taxa, and other remains including

'many' mites and fly puparia and adults, 'several' beetle larvae, and a tentatively identified tick (*Ixodes* sp.).

Grain pests were a major component of the assemblage, contributing 29% of the individuals. The main statistics were recalculated after subtraction of these beetles, giving a residual assemblage of 89 individuals. This was of rather high diversity ($\alpha = 76$, $SE = 16$), and this, together with the substantial proportion of outdoor forms (% N OB = 22) at first sight suggests ecologically mixed origins. However, decomposers were important (% N RT = 66) and suggested the presence of at least some quite foul decaying plant matter or dung. Some of the recorded species, including two individuals of *Crataraea suturalis*, suggest an origin within a building. The 'outdoor' taxa might, with very few exceptions (notably the water beetles), have been brought in hay-like cut vegetation, and it seems likely that this is in fact a stable manure assemblage, with the now familiar mixture of grain pests from feed, outdoor taxa from hay or other feed/bedding, and decomposers typical of foul (but usually open-textured) matter. Thus, although beetles from various habitats are mixed, they have been channelled through a single functional source.

Sample 4144: Moist, slightly heterogeneous, dark brown (black internally), brittle and fibrous to layered working soft and sticky, very humic very slightly sandy clay silt. Wood was abundant and charcoal, mammal bone and modern contaminant mould were observed.

Worm eggs: A single, tentatively-identified, *Trichuris* egg was seen.

Insects: This material was recorded semi-quantitatively, since there was more than one sample from the context. Although there were some differences from the fauna of sample 4143, the implications were essentially the same.

Context 218 {The upper fill of the punic ditch [247]. It appears that this ditch was filled very rapidly with rubbish deposits, as the majority of the depth of the ditch contains similar material}

Sample 4130: Moist, dark brown to light to mid grey-brown, crumbly and slightly layered (locally more strongly layered) working soft, very humic

slightly sandy clay silt with fine herbaceous detritus and amorphous organic material. Very small stones (2-6 mm) and 'straw' were noted.

Insects: 'Many' mites and fly puparia, 'several' adult flies and a few other remains were accompanied by a small group of beetles and a single bug (N = 31, S = 21). The main statistics are, of course, of little value for such a group. However, grain pests predominated and there were also some synanthropic decomposers. This seems to be detritus from occupation, just possibly from stabling.

Sample 4271: Moist, dark brown, compressed and fibrous to crumbly working more crumbly, very humic very slightly sandy silt with some coarse woody detritus. Very small and small stones (2-20 mm) and fly puparia were present in the sample.

Worm eggs: There was a single structure which resembled an egg of *Ascaris*, but the identification was uncertain.

Insects: A large flot consisted of pale fine plant detritus, including wood fragments and fibres. There were also some moss and some seeds. Insects were fairly abundant, the assemblage being remarkable for the presence of remains of at least 18 human fleas, *Pulex irritans*. There were also some lice. Other abundant invertebrates were fly puparia and pupal fragments and beetle larvae (all 'many'), and scale insects, mites, Hymenoptera and adult flies (all 'several'). There were 72 individuals of 43 beetle and bug taxa of the groups used for preparing main statistics.

The assemblage included a large proportion (over a third) of grain pests, with eleven individuals of each of *Cryptolestes ferrugineus* and *Oryzaephilus surinamensis*. Removing this component left an assemblage of 47 individuals of 39 taxa, nearly half of which must have originated in natural or semi-natural habitats. There were few aquatics, and decomposers made up only about half of this residual assemblage. On the beetle evidence, these outdoor forms might be assumed to have lived in vegetation adjacent to the ditch, but the fleas and lice suggest an origin for at least part of the deposit as floor cleanings. It is thus possible that the deposit represented the 'mucking out' of a stable, perhaps one in which people lived, with plant-associated bugs and beetles from hay or plant litter, and fleas which had developed in the filth on the

floor. Some of the decomposers support this interpretation, although there was no large distinctive 'house fauna' group.

Context 246 {A fill of the punic ditch [247]}

Sample 4751: Moist, dark brown, brittle and crumbly working plastic, moderately humic, silty clay. Wood and small stones (6-20 mm) were present.

Insects: The tiny flot consisted predominantly of insect remains, with 'many' puparia and pupae of flies, and beetle larvae, and an assemblage of 59 individuals of 33 beetle and bug taxa. Over a quarter of these were grain pests; subtracting them gave a small group whose overall character was much like that of many assemblages from Ribchester, but which could not reasonably be interpreted. Much of it may have been background fauna.

Context 262 {A layer of fill from the punic ditch [247], this material was removed along with [209] and finds are marked accordingly.}

Sample 4756: Moist, dark grey-brown, soft to crumbly working more soft, slightly humic, slightly sandy silty clay. Medium-sized stones were common and wood, twigs, very small and small stones (2-20 mm) were recorded.

Worm eggs: One tentatively-identified *Trichuris* egg was seen.

Insects: A modest group of beetles (and one bug) was recorded (N = 72. S = 56); there were also other remains including 'many' unidentified pupae and 'several' harvestmen (Opiliones), mites, beetle larvae, adult flies and *Daphnia* ephippia.

Diversity of the beetle and bug assemblage was high (alpha = 115, though SE = 31), but other statistics were of no special note other than a proportionally large foul matter group (only nine individuals, however). Although probably of mixed origins, this fauna included some remains suggesting the presence of material such as stable manure.

Context 338 {A layer or patch of grey clay in ditch [247] and within the fill [218] which was both above and below [338]. The measurements are approximate as it was an irregularly shaped 'lump'. There were a few organic fragments within [338] but they appeared to have been pressed in from the layer above}

Sample 4275: Moist, moderately heterogeneous, mid to dark grey-brown, crumbly working plastic, ?slightly humic slightly sandy clay and fine and coarse woody detritus with minor components of mid to dark brown, crumbly, amorphous organic material and mm-scale, generally rounded particles of pale grey-brown clay. Some twigs were present in the sample.

Insects: There were 'many' adult and puparial flies, and mites, assorted other remains and a group of 63 individuals of 45 beetle taxa. Almost a third of these were grain pests. The residual assemblage after their subtraction was small (N = 44, S = 41), consisting of 'outdoor' forms (over a third), including sufficient aquatics to make deposition in water likely, and decomposers. The latter were all represented by one or two individuals, and were a difficult group to interpret. They may have been imported in litter (together with the grain pests), but almost the whole assemblage may have been of naturally transported origin ('background fauna').

Context 357 {A layer of ditch fill of the outer annex ditch [247]. This layer was seen after the removal of [358] a lighter, more loamy fill. Less organic material was found in the excavation of the central area of the ditch}

Sample 4875: Moist, moderately heterogeneous, dark brown, crumbly and soft to layered working more soft, very humic, slightly clay silt with layers of wood and fibrous material. Wood was abundant in the sample and large mammal bone was present.

Insects: Assessment-recorded, the rather large flot was noted to contain a small group of insects, perhaps dominated by the fauna of dryish plant litter. It was designated P2.

Context 728 {A fill of punic ditch [247], the same as [357]}

Sample 4844: Dry, slightly heterogeneous, mid

grey-brown to dark brown, indurated silt with some light buff clay. Very small and small stones (2-20 mm), charcoal and fly puparia were present in this very small sample.

Insects: No further action in view of lithology, condition and size of sample.

Summary of ditch 247

The ditch 247 was extensively sampled and nine contexts have been examined for insect remains. The assemblages recovered varied, but most suggested that the deposits had received organic litter, in some cases clearly stable manure. Layer 218 included abundant human fleas as well, so it is possible that humans co-habited with stock or that litter came from two separate rooms or buildings. There was no large component of 'house fauna', however. Only one layer (338) gave any evidence of aquatic deposition.

Other deposits of Phase 3

Context 298 {The fill of an irregular feature/hollow cut into the edge of the outer ditch of the stone fort [281] seen in Trench 2}

Sample 4245: Moist, mid to dark grey-brown, soft working plastic, slightly humic slightly sandy silty clay with some orange-brown clay patches. Very small and small stones (2-20 mm) were present.

Insects: The flot consisted mainly of sand grains, with traces of organic matter. There were single individuals of three beetle taxa, two of them grain pests.

Context 326 {An organic layer, one of a number of interleaving organic and clay layers above surface [342], in the eastern area of the extra-mural settlement}

Sample 4302: Moist, dark brown, crumbly, slightly humic, sandy silt. Very small stones (2-6 mm) and ash were common and small stones (6-20 mm), charcoal and moss were noted.

Insects: Arthropod remains were rather few in number, with 'several' mites, a few other remains,

and 38 individuals of 34 beetle and bug taxa. The main statistics (unreliable for a small group of this kind) suggested high diversity and a large proportion of outdoor taxa. Decomposers accounted for over half of the assemblage, however, and more than half of them were of species coded 'rd'. This may have been background fauna, straying from nearby structures, perhaps, or have consisted of colonists of litter *in situ*.

A notable record was of a single specimen of *Helophorus tuberculatus*. This terrestrial 'water beetle', quite rare at the present day, has now occurred repeatedly in Roman sites in northern England (see below). It is not yet certain whether it was much commoner in the past, or is still common but not found for some reason, or was accidentally imported to sites in the past with some raw material which tended to contain it.

Context 353 {A layer of organic material below [326], [348] and [341]}

Sample 4309: Dry, light grey to orange-brown, indurated and brittle working crumbly, very stony, sandy clay silt. Various sizes of stones (2-60+ mm) were common and twigs and slightly burnt large mammal bone were present.

Insects: The small flat (mostly plant remains, including a little moss and some bran) contained 'many' mites, fly puparia (and probable pupae) and adults, and beetle larvae. There was also a single unidentifiable body segment from a flea. A total of 97 individuals of 60 beetle and bug species were recorded. Diversity was moderately high ($\alpha = 67$, $SE = 13$) and the outdoor component substantial (% N OB = 29). By comparison with many assemblages from Ribchester, the decomposer component was quite large (% N RT = 57), with both the RD and RF components (proportionally) well-represented. There were six individuals of each of *Cercyon analis*, *Anotylus nitidulus*, *Atomaria* sp. and *Lathridius minutus* group, and assorted species in smaller numbers which may have lived with one or more of these. The nature of the decomposing matter was not obvious, however, although it was perhaps mixed in moisture content and hence in foulness. A few species hint at 'stable manure', but these may have been of background origin bearing in mind the varied nature of the fauna and of the outdoor component in particular.

Context 375 {A layer of pale clay below [342] a compact stony layer and [353] an organic layer. [375], [391], [392], [376] and [405] are all part of a build up of interleaving organic and clay layers in this area, below a substantial pebble layer [342].

Sample 4318: Moist, slightly heterogeneous, mid grey-brown (with mm- and 10 mm-scale browner and greyer mottling), crumbly working plastic, slightly humic, silty clay. Very small and small stones (2-20 mm), charcoal and very rotted wood were present.

Insects: Arthropod remains included 'several' fly puparia, adults and pupae, mites and beetle larvae, with 35 individuals of 34 beetles. Most of the species recorded were typical of the site, but the assemblage could not reasonably be interpreted. There were various species which may have originated in stable manure, perhaps being introduced in trample or discarded organic refuse as the interleaving layers were deposited.

Context 391 {A thin layer of green grey organic material with brushwood set below [375]. [375], [391], [392], [376] and [405] are all part of a build up of interleaving organic and clay layers in this area, below a substantial pebble layer [342]. Above [342] were similar clay and organic layers [353], [348] and [326]}

Sample 4327: Moist, dark brown, layered and brittle working crumbly, moderately humic, slightly sandy slightly clay silt. Small and medium-sized stones (6-60 mm), charcoal and twigs were present and wood was common in the sample.

Insects: In addition to 75 individuals of 55 bug and beetle taxa, there were 'many' fly adults, larvae and pupae, and beetle larvae, 'several' mites and fly puparia, a human flea (*Pulex irritans*) and a few other remains.

The beetle and bug assemblage was ecologically mixed (reflected in the high value of α , 92, albeit with an SE of 23), with a very substantial proportion of outdoor forms (well over a third). There were rather more aquatics than might be predicted in 'background fauna', although most were of a single *Helophorus* sp., members of a notably migratory group. Only about a third of the individuals were contributed by coded decomposers, but two fifths of these were species

primarily associated with foul matter. There were three individuals of each of *Cercyon haemorrhoidalis* and *Platystethus arenarius*, these (with a few of the other beetles) suggesting foul matter nearby. This may, as seems likely for many other deposits at the site, have been stable manure or horse dung.

Context 555 {A very mixed layer in the north-east corner of the site seen after the removal of [534]. This layer is probably part of a general pre-road build up of layers [544], [545], [555], [560] and [565]}

Sample 4629: Moist, dark grey-brown with rather orange flecks, crumbly working slightly plastic, slightly sandy clay silt. Very small and small stones (2-20 mm) and ash were present and charcoal was common.

Insects: The only invertebrates recorded from the tiny flot (mostly sand grains) were an unidentified insect larva and a modern fly.

Context 560 {A dump/mixed layer of stony material, probably just a variation in [565] filling in a slight gully in the surface below. This layer is probably part of a general build up of layers [544], [555], [560] and [565] to the south of the central hearth area of the extra-mural settlement}

Sample 4635: Moist, mid to dark grey-brown and ashy with orange flecks, brittle working crumbly, sandy silty clay. Small, medium-sized and large stones (6-60+ mm) were present and charcoal was common.

Insects: The minute flot consisted entirely of sand grains.

Context 564 {A layer surrounding stone [563], probably clay laid as a foundation to base [563] coloured orange due to intense heat}

Sample 4639: Moist, mid orange-brown, stiff to crumbly working plastic, slightly sandy clay with some charcoal present.

Insects: The flot was minute, and included only sand grains and balls of undissociated sediment.

Context 566 {A mottled area of pink and grey clay lying around hearth stone [563]}

Sample 4642: Moist, stiff to plastic mixture of pinkish, buff and dark brown clays. Charcoal was common in the sample.

Insects: The flot consisted only of traces of sand grains.

Context 570 {A semi-circular area of dark burnt soil within hearth [572]. There is a slightly dished profile to the layer and it contains localised patches of burnt material as well as being generally burnt}

Sample 4647: Moist, dark brown, stiff to crumbly working soft, moderately humic silty clay. Charcoal was common.

Insects: The flot, which was small, contained only charcoal and plant debris.

Context 645 {A very organic clay layer situated in the north east sondage [644]. This layer contains a large amount of wood fragments and also a few charcoal flecks}

Sample 4726: Moist, slightly heterogeneous, mid brown, plastic, slightly humic silty clay with a minor component of orange-brown clay. Charcoal and wood were present in the sample.

Insects: There were rather few insects in the small flot, including 'several' beetle larvae and 19 adult individuals of 16 beetle and bug taxa. This appeared to be a synanthropic decomposer group, possibly from within a building, but is too small for reliable interpretation.

Context 686 {organic patch within clay [392]}

Sample 4767: Moist, slightly heterogeneous, mid brown with mm- and 10 mm-scale mottling, plastic, slightly sandy silty clay with a minor component of mid orange-brown clay and some evidence of gleying. Very small stones (2-6 mm), charcoal and wood were present.

Insects: The tiny flot gave a small group of arthropods, with 'several' mites, fly pupae and beetle larvae and single adult individuals of twelve

beetle and bug taxa. Although not out of place among the material from Ribchester, this assemblage cannot usefully be interpreted further.

Context 715 {A band of re-deposited natural, presumably upcast from and on the northern side of the annex ditch [247]. This material is presumably the same as [441]. The ditch [247] was used from the top of this material but cut from below it}

Sample 4861: Moist, mid to dark brown, crumbly, slightly silty sand. Medium-sized stones (20-60 mm) were common and very small and small stones (2-20 mm) were present.

Insects: The large flot, consisting mostly of moss and plant fragments, appeared to contain no insect remains.

Context 236 {A layer of clay within the material derived from the cutting of the punic ditch [247]. This material may have been dumped from elsewhere during the cutting of [247] just prior to the re-building of the fort in stone}

Sample 4154: Moist, mid to dark grey-brown to mid rusty brown and mid grey, crumbly working plastic, ?slightly humic slightly silty clay with some very small stones (2-6 mm) present.

Insects: The flot was minute and contained no recognisable invertebrate remains.

Context 163 {A general layer of re-deposited natural removed in bulk as [441]. This material represents upcast from the cutting of the punic ditch [247]}

Sample 4152: Dry, mid buff, indurated working soft and slightly sticky when wetted, slightly clay silty sand with ashy patches mottled with charcoal and patches of orange and yellow sand. Ash and charcoal were abundant, small stones (6-20 mm) common and medium-sized and large stones (20-60+ mm) were present.

Insects: No invertebrates were seen during assessment of the very small flot.

Context 800 {A mixture of plastic clay, charcoal and organic debris sitting (in) a shallow depression above [405]}

Sample 4892: Moist, dark grey-brown, crumbly and ashy working sticky when wetted, slightly humic, slightly clay slightly sandy silt. Very small and medium-sized stones (2-6 and 20-60 mm), brick/tile, very small fragments of burnt ?clay and wood were present and charcoal was common.

Insects: The flot contained considerable amounts of charcoal and some uncharred plant remains, various arthropods including 'many' beetle larvae, and 28 individuals of 21 beetle taxa. The main statistics of a group as small as this are not very reliable as an interpretative guide, but 'outdoor' forms were important; these, together with three *Tachyporus ?hypnorum*, suggest deposition in the open, perhaps in a place with a little sparse vegetation.

Summary of Phase 3

In Phase 3, most of the fills of ditch 247 appear to have included organic litter, in at least some cases undoubtedly stable manure. In once case it was possible that detritus from a human dwelling was included as human fleas were numerous. Upcast from this ditch (three contexts examined) was barren.

Eleven 'layers' were studied. Most gave few, or no, insect remains, but others gave small assemblages indicating the presence of organic matter, sometimes apparently including stable manure. These layers may, however, have received trample rather than being deliberately used for waste disposal. Context 800 may have formed in the open where there was sparse vegetation. A dump and two deposits associated with hearths were barren and the fill of a hollow was almost so.

Phase 4:1: Construction of the military enclosure

Context 55 {A layer of clay loam that appears to have built up at the end of the demolition period of the stone fort above the redeposited rampart and the upcast from the punic ditch (Phase 3).

Deposition (and re-deposition) of this layer was probably continued into the early stages of Phase 4 during the construction of the "fabrica" building [722]}

Sample 4713: Dry, light to mid grey-brown, indurated working crumbly, sandy silt. The sample may be mostly ash with charcoal as a common inclusion.

Insects: The tiny flot included only very small numbers of invertebrates, with fragments of two beetles.

Context 374 {A layer of wood chippings, the same as [378]}

Sample 4314: Moist, dark brown to mid grey, layered and brittle working crumbly, moderately humic, slightly silty sandy clay. Wood was common and very small and medium-sized stones (2-6 and 20-60 mm) were present in the sample.

Insects: There were only single individuals of six beetle taxa in the very small flot.

Context 710 {The fill of trench [709]}

Sample 4794: Moist, dark brown externally to buff internally (reduction), brittle working plastic, moderately humic, slightly silty clay. Medium-sized stones (20-60 mm), wood and seeds were noted.

Insects: The modest group of insects and other invertebrates included 'many' fly puparia, 'several' earthworm egg capsules and an assemblage of 43 individuals of 37 beetle and bug taxa. Although obviously main statistics for such a small group are unreliable, outdoor forms made up almost a quarter of it and decomposers about three fifths, with rather more foul-matter taxa than might be expected by accident. Subjectively, this assemblage seems to have come together in the open air, most of the beetles and bugs perhaps having had a 'background' origin; the fly puparia presumably represent the product of larvae exploiting organic matter *in situ* or in material dumped into the trench.

Context 774 {Two lines of stakes positioned on average every 0.06 metres along the north and south sides of the timber drain [736] holding the wooden planking in position. These stakes are thought to be made of green wood, as the pointed tips are bent and fractured. They descend well below the base of the planking into the ditch fill layer [357] and are slightly angled so as to support the planking. It would appear that they were hammered into the ditch fill after the planking had been positioned along the drain edges} [It is odd that there is a sediment sample from this!]

Sample 4811: Moist, dark brown, crumbly, very humic, slightly clay silt. Charcoal and wood were present in the sample.

Insects: Arthropods were rather rare in the processed subsample, and a modest group of beetles was present (N = 45, S = 26). Almost a third of these were grain pests. Interpretation of this group would be unwise; it could be a small randomly-selected group from an 'averaged' fauna for the site.

Summary of Phase 4:1

Four contexts from Phase 4:1 were examined, of which only 710 and 774 gave more than a few insects. The former, a trench fill, appeared to have accumulated in the open air, with some dumping of organic matter. The latter, supposedly a line of stakes, contained an insect assemblage which was probably randomly accumulated.

Phase 4:2: Use of the military enclosure

Fills of ditch 92

Context 90 {A thin, organic layer of fill in ditch cut [92]}

Sample 4785: Moist, slightly heterogeneous, black, charcoal rich, soft and sticky, clay silt with small lumps of buff coloured clay. Medium-sized stones (20-60 mm) were present.

Insects: The trace flot contained only two beetles, both grain pests.

Context 91 {A layer of ditch fill in cut [92]. This material contained much carbonized wood}

Sample 4217: Moist, dark brown, brittle and layered to crumbly working more crumbly, very humic silt with amorphous organic sediment. Charcoal and 'straw' were observed.

Insects: The flot was extremely large, reflecting the presence of 'strawy' plant material. There were 'many' of the following: fly puparia, pupae, larvae and adults; beetle larvae; mites; *Daphnia* ephippia; and ants. A large beetle assemblage was present, and there was a single bug (N = 156, S = 87). A tenth of these were grain pests, subtracted from the lists for further analysis.

The residual assemblage was still large (N = 140) and was of high diversity (alpha = 86, SE = 13), with a substantial proportion of 'outdoor' forms (% N OB = 24). Aquatics suggested a waterlain deposit (or dumping into water). Decomposers were quite important (% N RT = 57), with numerous individuals of taxa coded 'rd' (% N RD = 21). The most abundant beetle by far was *Lathridius minutus* group, with 14 individuals, but there were smaller numbers of other decomposers which may have co-existed with this in decaying plant material which was not too foul, as well as hints of fouler matter (e.g. from five *Cercyon haemorrhoidalis*). Some of the plant feeders, particularly the weevils, may have been introduced in cut hay-like vegetation, and on balance this deposit seems likely to contain stable manure.

This was one of only two samples from Ribchester giving *Tenebroides mauritanicus*. The other was sample 4146, Context 232 (also phase 4:2, see below).

Summary of ditch cut 92

The sample from context 90 was almost barren, but that from 91 gave a substantial assemblage, apparently from stable manure dumped into the ditch.

Fills of pit 233

Context 149 {The dark, charcoaly, upper fill of a rectangular pit presumably associated with the timber building [722]}

Sample 4158: Just moist, dark grey to buff, stiff working plastic when wetted, slightly silty clay. Small and medium-sized stones (6-60 mm) were present and the sample had an overall ashy/mottled (mm-scale) look because of the abundance of charcoal.

Insects: The flot was recorded during assessment; it was very small, with sand grains and rotted plant debris. Only a single beetle was present, a very decayed *Cryptolestes ferrugineus*, represented by all four main sclerites.

Context 228 {A thin, sticky layer of pit fill from pit [233], below [149] and above [229]}

Sample 4160: Moist, slightly heterogeneous, black, crumbly working plastic and slightly sticky, sandy clay silt with minor component mid grey-brown, slightly sandy silty clay.

Worm eggs: Traces of *Trichuris* eggs were recorded.

Insects: The flot was very small and contained, in addition to a few seeds, some charcoal and some sand, remains of only two beetles.

Context 229 {A layer of pit fill from [233], below [228] and above [230]}

Sample 4135: Moist to wet, mid to dark greyish brown, crumbly to plastic working more plastic, sandy silty clay. Small and very small stones (2-20 mm), mm-scale orange clasts and mineralised root traces were present in the sample.

Worm eggs: *Trichuris* eggs were quite numerous and suggested the presence of faeces.

Insects: There were rather few remains in the flot, including 'several' fly puparia and 19 individuals of 15 beetles. Only the grain beetles *Oryzaephilus surinamensis* and *Sitophilus granarius* were represented by more than single individuals (three

in each case). Rather good preservation implied low input of insects.

Context 230 {A layer or lump of pit fill from [233], below [229] and above [232]}

Sample 4138: Moist, mid to dark brown with a slight greyish cast, crumbly brittle and faintly layered, amorphous organic material and fine and coarse herbaceous detritus with patches of humic clay silt.

Worm eggs: There were large numbers of *Trichuris* eggs, and substantial numbers of *Ascaris*; faeces undoubtedly contributed to the deposit.

Insects: This sample gave one of the more substantial assemblages from the site: there were 122 individuals of 55 beetle taxa (semi-quantitative recording), with unusually good preservation. Other remains included 'many' adult flies, beetle larvae and fly puparia and 'several' mites. Cereal bran was noted to be abundant.

The assemblage of adult beetles was of rather low diversity (alpha estimated at 39, SE = 6), but this was a result of the presence of numerous grain pests, contributing almost a third of the individuals. Removing this component produced a residual assemblage of about 85 individuals (51 taxa), of moderately high diversity (alpha estimated as 54, SE = 11), with a significant (but by no means large) outdoor group. Only a single aquatic was recorded and plant-feeders were quite rare. Decomposers (RT) accounted for about 70% of the residual assemblage, with a substantial group of taxa generally associated with rather dry, often indoor, habitats (over a third of the individuals). Only *Lathridius minutus* group ('many') and a *Cryptophagus* species ('several') were particularly abundant, but there were smaller numbers of a substantial group of taxa likely to have lived with these in mouldering, perhaps at least locally foul, decomposing matter. This may have been the dumped remains of fairly clean (or rapidly cleaned out) animal bedding, but the fauna might have had more complex origins, the two main components entering the fill by different routes.

Context 232 {The lowest fill of pit [233], below [230]}

Sample 4146: Moist, light to mid greyish brown with a pink cast, soft and plastic, silty clay with 10-mm scale lighter and darker mottling and some small stones (2-6 mm) present.

Worm eggs: There were sufficient *Trichuris* eggs (and a single *Ascaris*) to suggest the presence of faeces.

Insects: The flot was very small and contained only a modest group of insects. There were fragments of 'several' unidentified pupae (perhaps of flies), fly puparia and beetle larvae. Forty-four beetles and bugs were recorded, representing 29 taxa. The presence of four individuals of two *Helophorus* species perhaps indicated deposition in, or dumping into, water, and the five *Cercyon haemorrhoidalis* (the most abundant species) suggested the presence of rather foul matter. This assemblage was too small for reliable interpretation, however.

This sample was one of only two from the site giving a fossil of the large introduced stored-products pest *Tenebroides mauritanicus*.

Summary of pit 233

Four contexts from pit 233 were examined. The sample from 228 gave few remains, while that from 229 produced few but well preserved fossils, suggesting low input. Layer 232 was probably deposited in water, perhaps where there was some foul matter. Context 230 gave a large insect assemblage with abundant decomposers, probably representing dumped animal bedding. Three contexts (229, 230, 232) gave sufficiently large numbers of parasite eggs (in the case of 232, both *Trichuris* and *Ascaris*) to indicate faeces; the ratio of the two identified species might be taken to suggest that the fills included human excrement.

Fills of ditch 281

Context 273 {The upper fill of the outer ditch of the stone fort [281] seen in Trench 2}

Sample 4191: Dry, mid to dark grey, indurated to stiff working plastic when wetted, slightly sandy clay. Very small and small stones (2-20 mm) were present.

Insects: Assessment showed the minute flot to contain only a few sand grains.

Context 280 {A fill of the outer defensive ditch of the stone fort [281] seen in Trench 2}

Sample 4195: Moist, mid to dark grey, stiff working plastic, slightly sandy clay. Very small stones (2-6 mm) were present in the sample.

Insects: The flot was minute, mostly sand grains, with no arthropod remains.

Context 296 {A fill of the outer ditch of the stone fort [281], seen in Trench 2}

Sample 4221: Moist, dark grey-brown, soft to crumbly working more soft, moderately humic slightly sandy silty clay. Very small stones and wood were common in the sample and small stones (6-20 mm) were also present.

Insects: In addition to a substantial group of beetles and bugs (N = 148, S = 93) there were assorted other arthropods, including 'many' beetle larvae, mites, unidentified pupae and *Daphnia* ephippia.

More than half of the diverse assemblage ($\alpha = 107$, SE = 17) consisted of 'outdoor' forms (% N OB = 64), an exceptionally high value. This mathematically high diversity probably in part reflecting the mixture of insects from several habitats, but there was a rich fauna of aquatics and waterside species, suggesting a well-established, long-lived community developed over some years at least. Almost half of the beetles and bugs were aquatics (% N W = 28), with 16 taxa identified in this group. They suggest still, weedy water and muddy edges, with only moderate levels of pollution by foul matter. The most numerous species, *Tanysphyrus lemnae*, is (as its name suggests) associated with duckweeds, *Lemna* spp.

The terrestrial beetles suggest that habitats for ground beetles, click beetles and some others existed nearby, suggesting modest disturbance. Decomposers were unusually rare (% N RT = 20), and may have lived in natural litter or dung. There was no clear evidence of human occupation from the insects, something most unusual in a deposit formed in close association with a large establishment such as a Roman fort. This suggests

extreme cleanliness, or a period of abandonment.

Sample 4229: Moist, layers of organic material (leaves, twigs etc.) between layers of clay. One lump of the sample was 'brick-like' in size and shape with an outer coating of iron concretion. Iron concretions were also present in the rest of the sample and chunks of wood were abundant.

Insects: The flot was very large, but contained a huge quantity of arthropod remains. These included 'many' fly puparia, larvae, pupae and adults, beetle larvae, parasitic Hymenoptera, mites and *Daphnia* ephippia. The concentration of beetle and bug remains was very high: the minimum number of adults of these groups was 249, with 125 taxa recognised. This assemblage was of high mathematical diversity ($\alpha = 100$, SE = 11). Ecologically, it was dominated by 'outdoor' forms (% N OB = 63), with a very high proportion of aquatics (% N W = 34, with 25 taxa). This outdoor component was of rather modest diversity (α OB = 56, SE = 7), confirming the impression from the species list that rather few habitats (or habitat complexes) were represented. Among these, rather weedy water with muddy edges stood out, but many other species may have lived at the edges of the ditch in herbaceous vegetation, perhaps with modest disturbance and some open areas. Much the most abundant taxon (27 individuals, possibly including more than one species) was a small *Helophorus*; all or most of these may have been *H. brevipalpis*, but this identification was very uncertain.

Decomposers contributed only a small proportion of the assemblage (% N RT = 24), although absolute numbers were quite high (59 individuals of taxa coded 'rt', 'rd' or 'rf'). The foul matter component was well-represented. It accounted for a tenth of the assemblage, with 25 individuals. These included several *Cercyon* species: *C. haemorrhoidalis* (7); *C. lateralis* (4) and *C. lugubris* and *C. melanocephalus* (both 3) being the most numerous. These, and some of the other decomposers, may have exploited dung on nearby surfaces. Most of the other decomposers may have lived in natural plant litter. The only suggestion of strongly synanthropic habitats came from a single individual of *Tenebrio obscurus*, represented by a small elytral fragment, and *Sitophilus granarius*, although there were a few individuals of other, less strongly synanthropic, species often found in

artificial habitats.

Overall, the evidence (like that for sample 4221) suggests a lack of intensive human activity, with no suggestion of waste disposal nearby

Summary of ditch 281

Three contexts from ditch 281 were examined. Two (273, 280) were barren, but the third (296), from which two samples were studied, was very rich indeed in insect remains. A large aquatic component testified to deposition in water. No dumping appeared to have occurred, and there was almost no evidence of human occupation nearby. Adjacent surfaces probably had dung on them.

Fills of pit 293

Context 300 {A layer of fill comprising a lip of material running around the east and south edges of pit [293]}

Sample 4747: Moist, mid to dark brown-grey, crumbly to stiff working plastic, moderately humic, slightly sandy silty clay. Small and medium-sized stones (6-60 mm) were common and very small stones (2-6 mm) and wood were present.

Worm eggs: A single *Trichuris* egg was recorded.

Insects: The small flat gave a group of 20 individuals of 18 beetle taxa and a few other invertebrates. The assemblage had no clear character in the context of the present site.

Context 301 {A lens of fill close to the northern edge of pit [293]}

Sample 4225: Moist dark grey-brown with reddish and yellowish flecks, soft, moderately humic sandy clay. Very small stones were common and wood and charcoal were present.

Insects: Recorded as a rapid scan during assessment, the processed subsample gave single individuals of 17 beetle and bug taxa, predominantly synanthropic forms. The origin of this group cannot be more than guessed at; it is possible that it came from a building with litter.

Context 305 {A thin layer of what appeared to be matted straw in pit [293]}

Sample 4237: The sample was mostly wood with some moist, dark brown, fibrous and crumbly working soft, very humic slightly clay silt. Charcoal and medium-sized stones (20-60 mm) were noted.

Insects: The arthropod remains included 'many' mites, 'several' beetle larvae and fly puparia, a single unidentified flea, and 37 individuals of 29 beetle and bug taxa. The main statistics were not unusual for a group of this size from Roman Ribchester; subjectively the species list suggested that the material originated within a building, probably as stable manure.

Sample 4749: Moist, dark grey-brown, crumbly and layered working soft, very humic, slightly clay silt with some coarse woody detritus. Wood was abundant, twigs common and small stones (2-6 mm) present in the sample.

Worm eggs: Two putative *Trichuris* eggs were noted.

Insects: This sample gave a moderately large insect assemblage, which was recorded by semi-quantitative scanning (although only one taxon was not counted).

There were about 113 individuals of 69 beetle and bug taxa, other remains including 'many' fly puparia and beetle larvae, and several adult flies (and probable fly pupae) and aphids. Preservation was recorded as being rather good.

Although including a large 'outdoor' component (% N OB estimated at 26) and of quite high ecological and mathematical diversity (alpha estimated as 75, SE = 13), the assemblage was dominated by decomposers (% N RT = 63), including a component characteristic of somewhat foul, probably open-textured, mouldering plant remains; the most abundant species was *Cercyon atricapillus* (10 individuals), with seven *Oxytelus sculptus*, 'several' *Lathridius minutus* group, five *Leptacinus pusillus* and four *Cercyon analis*. Some of the other decomposers may have co-existed with these. This material may have been stable manure, and a few of the outdoor taxa may have come with

it, originating perhaps in hay. Other taxa probably lived near to the point of deposition, particularly the Carabidae, and yet others may have invaded *in situ*.

Context 306 {A fill of pit [293]}

Sample 4240: Moist, dark grey-brown, soft, moderately humic slightly sandy clay silt with some lumps of orange-brown clay. Charcoal was abundant and small and medium-sized stones were present.

Insects: The insect assemblage was only assessment-recorded. Assigned P3, it was small and probably would give very little information on further analysis.

Context 307 {A thin layer of organic material within pit [293]}

Sample 4242: Moist, dark brown, crumbly working soft, moderately humic slightly clay silt. Small and medium-sized stones (6-60 mm), charcoal, wood and twigs were present.

Insects: This material was only assessment-recorded, being designated P2. It included a small group of arthropods, including some grain pests and decomposers.

Context 308 {A gritty clay fill of pit [293]}

Sample 4244: Moist, dark brown, crumbly working soft, moderately humic slightly sandy clay silt. Wood was common and twigs and very small and small stones (2-20 mm) were noted.

Insects: The flot was only assessment-recorded and assigned P2. The small group of beetles included some grain pests, ground beetles and decomposers.

Contexts 292 (sample 4212) and **302** (sample 4226), not examined for insect remains, gave traces of *Trichuris* eggs.

Summary of pit 293

Six contexts from pit 293 were examined by means of seven subsamples. All gave small groups of insect remains except one of two samples from context 305, which produced a substantial assemblage, probably indicating stable manure, with a local fauna from disturbed ground. Layer 301 may have included litter from a building, while 307 and 308 gave hints (no more) of stable manure. Some of the fills gave trace amounts of *Trichuris* sp. eggs, but these were too rare to be taken as evidence of the presence of human faeces.

Fill of pit 464

Context 465 {The fill of pit [464]}

Sample 4525: Moist, mid brown to rather orange with yellow and orange flecks, crumbly working plastic, sandy clay. Very small, small and medium-sized stones (2-60 mm) were present.

Worm eggs: A single ?*Trichuris* egg was noted.

Insects: The flot was small, with mineral grains and some plant tissue fragments but no more than traces of arthropod cuticle.

Fill of pit 512

Context 510 {A lens of gritty orange sand material which has been affected by burning}

Sample 4557: Moist, mid to dark grey-brown, crumbly to stiff working more crumbly, slightly clay slightly sandy silt. Small stones (6-20 mm), ?slag and pot were present.

Insects: Only a single beetle was recorded in the trace flot, which consisted mostly of mineral grains.

Fill of pit cut 519

Context 518 {The lower fill of pit cut [519]}

Sample 4564: Moist, dark grey, crumbly, moderately humic, slightly clay silt. Very small,

medium-sized and large stones (2-6 and 20-60+ mm), charcoal and wood were present.

Insects: No invertebrates were discovered in the flot, which consisted mostly of charcoal but included some plant tissue fragments preserved by anoxic waterlogging.

Fill of pit 533

Context 470 {Clay loam fill of pit [533]}

Sample 4598: Dry, light grey with orange-brown flecks (?iron oxidisation), indurated, brittle and crumbly (sticky when wetted), silty clay. Very small, small and medium-sized stones (2-60 mm), very rotted bone and charcoal were noted.

Insects: The material was barren, nothing being produced by paraffin flotation.

Surface deposits of Phase 4:2

Context 78 {An area of industrial debris part of/derived from hearth [490]. This material lies above the "shadow" of the timber wall [200], showing that this building was used first with a divided interior and then in open plan}

Sample 4539: Moist, dark grey, crumbly, slightly clay silt. Very small, small and medium-sized stones (2-60 mm) were present in the sample.

Insects: There were no animal remains in the tiny flot.

Context 238 {The line of the western wall of building [722]. This feature never existed as a cut, as it was created by the discolouration of the surrounding material by the timber superstructure of building [722]}

Sample 4167: Dry, grey, indurated working crumbly (sticky when wetted), sandy silty clay with flecks of pale orange and very pale grey clay. Very small, small and medium-sized stones (2-60 mm) and charcoal were present.

Insects: Nothing was obtained by flotation.

Sample 4168: Dry, mid grey, stiff to crumbly (soft and sticky when wetted), moderately stony sandy clay. Very small and medium-sized stones (2-6 and 20-60 mm) were common and small and large stones (6-20 and 60+ mm), wood and ?slag were seen.

Insects: The minute flot contained only mere traces of insect cuticle.

Context 245 {The line of the central wall of the building [722]. This feature never existed as a cut, for it was created by the discolouration of the surrounding material by the superstructure of the building}

Sample 4174: Dry, light yellowish-grey, indurated, sandy silty clay with some small stones (6-20 mm) present. Sample becomes mid grey-brown, crumbly, slightly sticky and plastic when wetted.

Insects: Nothing was recovered when the material was subjected to paraffin flotation.

Context 443 {The fill linear feature [442]}

Sample 4398: Dry to moist, mid to dark brown-grey, indurated working crumbly (plastic and sticky when wetted), slightly humic, sandy silty clay. Small and medium-sized stones were common and charcoal was present.

Insects: The flot was minute and contained only sand grains and a few fragments of plant tissue.

Context 450 {A layer of soft brown loam above mixed clays in the northern area of the site, below [152]. This layer is cut by [449] a band of large stone to the south. It is possible that this layer is the equivalent to [287]}

Sample 4403: Moist, mid to dark brown with a few small lumps of orangish-pink, crumbly, slightly humic, slightly silty clay sand. Very small, small and medium-sized stones (2-60 mm) and charcoal were present.

Insects: There were only minute quantities of unidentifiable arthropod cuticle in the trace flot.

Context 488 {A band of lime lumps running below [463] and forming an edge to the large cobbles [311]}

Sample 4527: Moist, dark grey-brown with mm-scale lighter orange-brown mottles, indurated and brittle working crumbly, ?humic stony clay. Chalk (2-60+ mm) was present in the sample which had a white flecked appearance due to small fragments of chalk and limestone.

Insects: Flotation produced no material.

Context 485 {An upper layer of hearth [490]. Part of this layer was removed [78] during the first stage of excavation, it consists of hard, friable, burnt clay, probably hearth debris}

Sample 4551: Moist, moderately heterogeneous, mid to dark brown, crumbly working soft and plastic, clay with solid lumps of burnt stone surrounded by mid to dark grey clay patches and orange sand.

Insects: There were no beetles or bugs, and only two individuals of other insect groups.

Context 486 {A thin layer of burnt organic material found below [485], in hearth [490]. This layer was to the north of the main hearth area and may represent hearth debris or burnt hearth construction material}

Sample 4549: Moist, dark grey, crumbly, slightly clay silt. Very small and small stones (2-20 mm), charcoal and small (1-2 mm) patches of dried orange clay were present in the sample.

Insects: The flot, which was very small, contained some charred plant remains but no invertebrates.

Context 487 {A small patch of hearth debris}

Sample 4540: Moist, mid to dark grey-brown, crumbly working plastic, slightly humic, sandy silty clay with very small and small stones (2-20 mm) present.

Insects: The tiny flot contained only plant tissue fragments.

Context 492 {A sub-circular area of mixed, possible hearth debris from hearth [490]}

Sample 4543: Dry, considerably heterogeneous in colour - buff, light grey, dark grey, orange-brown with some areas very discreet and others very mixed - brittle working crumbly, clay. Very small stones (2-6 mm) and charcoal were present.

Insects: The flot was minute and consisted only of plant tissue and sand grains.

Context 498 {A sub-rectangular area of clay, which butts the flat hearth stone [493] and a grey pink clay [499]. This material is the fill of cut [529]}

Sample 4585: Dry, layered and brittle, burnt ?stone or Burnt ?clay. Very small and small stones (2-20 mm) were present.

Insects: Nothing was produced by paraffin flotation.

Context 548 {A small patch, layer of burnt clay/ceramic material directly below the tile [494]}

Sample 4621: Dry, mid orange-brown to light to mid orange, indurated (sticky when wetted), slightly silty sandy clay. Small stones (6-20 mm) were common and charcoal was noted.

Insects: The flot was tiny, consisting of sand and a few plant fragments. There were no insects, and very few other invertebrates.

Context 559 {A rectangle of pinkish brown clay, originating from the first phase hearth [440], and coloured by intense heat from both [440] and the later phase hearth [490]}

Sample 4627: Dry to moist, slightly heterogeneous, mid to dark brown to orangish, stiff working plastic, slightly sandy silty clay with bands of mid to dark grey clay. Small stones (5-20 mm) and charcoal were present in the sample.

Insects: There were no invertebrates in the minute flot, which consisted of sand grains and some plant tissue fragments.

Context 623 {A grey clay matrix/pad for brick and tile [622]}

Sample 4704: Dry, moderately heterogeneous, light brown, indurated, sandy silty clay with pale yellow-brown, orange and grey patches probably caused by reduction/oxidation effects of drying. Medium-sized stones (20-60 mm), ?mortar/plaster and brick/tile were observed.

Insects: The very small flot (mostly charcoal fragments) contained remains of only two beetles.

Context 630 {A layer of hearth debris within the timber building [722]}

Sample 4718: Dry, slightly heterogeneous, very light brown, indurated working sticky when wetted (and darkening slightly), slightly sandy clay. Very small to large stones (2-60+ mm) were present in the sample.

Insects: The paraffin flotation produced nothing.

Context 690 {A small patch of burnt material roughly in the centre of the square room of building [722]}

Sample 4772: Moist, grey-buff with mm- and 10 mm-scale orange/red mottling, crumbly to soft and sticky working plastic, clay. Very small stones (2-6 mm) were present, Small and medium-sized stones (6-60 mm) common and charcoal abundant.

Worm eggs: There was one *Trichuris* egg in the squash.

Insects: The flot, consisting of rotted fragments of plant tissue and grains of charcoal, contained remains of only a single invertebrate, the grain beetle *Cryptolestes ferrugineus*.

Summary of Phase 4:2

Fills of two ditches (92, 281) of phase 4:2 were examined. One context from 92 was clearly an aquatic deposit, while another appeared to contain animal bedding and two others gave few remains. Fills of 281 similarly gave some barren samples and one which was rich in aquatics. In this case, however, there

was no evidence of dumping or human occupation on adjacent surfaces.

Samples from seven pits of this phase gave a variety of results. Those from 149, 456, 510, 533 and 518 were wholly or almost barren. Pit 233 contained one fill which was apparently waterlain (with foul matter nearby) and another containing probable animal bedding; samples from two other contexts contained few remains; some of the fills of this pit probably contained human faeces. Pit 293 gave mostly small groups, but one was larger, probably indicative of stable manure. Three other fills had hints of stable manure or other litter from buildings.

Surface 'layer' contexts of Phase 4:2 were almost or completely barren, as were seven hearth or burning deposits, a clay patch and a 'lens'.

Archaeological information was not available for the following at the time of writing:

Phase ?5

Context 53 {A layer of black industrial debris that forms part of a build-up of material derived from the demolition of the Phase 4 "fabrica" features. This layer contains a number of large masonry blocks, some dressed, these may be derived from the stone fort and associated buildings}

Sample 4075: Moist, dark brown to yellow (?ash), silt with some charcoal and dry, solid lumps of mottled, gingerish-red ?ash.

Insects: Only a trace of rootlets and mineral grains was present in the flot.

Context 460 {A layer of mid brown loam similar to, but below [54]}

Sample 4514: Dry, dark grey-brown, indurated and brittle working soft when wetted, slightly ashy, slightly sandy clay silt. Charcoal and very small and small stones (2-20 mm) were common and medium-sized stones (20-60 mm) were present.

Insects: The flot was minute and no invertebrate

remains could be discovered in it.

Context 446 {A layer of grey material accumulated to the South of the rampart of the timber fort}

Sample 4411: A completely dry, indurated lump of dark grey material.

Insects: No further action was taken after the initial examination in view of the condition of the material.

Context 429 {A patch of organic material below [286] and partly above [430]. It is likely that this patch/dump of material forms part of a large dump of interleaving layers}

Sample 4390: Dry to moist, mid to dark grey-brown to light orange with sandy partings, layered working crumbly and slightly plastic (and slightly sticky when wetted), compressed amorphous organic material. Small and medium-sized stones

(6-60 mm) and wood were common and charcoal and nutshell were seen.

Insects: The rather substantial beetle and bug assemblage (N = 108, S = 44) was dominated by grain pests, which accounted for 49% of the individuals. *Oryzaephilus surinamensis*, of which there were 50 (MNI based on counted parts), was much the most numerous species. Subtraction of the G component left an assemblage in which outdoor forms were important (about three tenths of the individuals), but with a substantial proportion of decomposers (about two thirds). Within the latter group, both RD and RF components were proportionally well represented. These insects may have been background fauna, but the grain pests and some of the other taxa (particularly *Lathridius minutus* group) presumably originated in a structure, and there were other components suggesting that stable manure was present. The presence of 'many' fly puparia supports an *in situ* or bulk-transported origin for the other decomposers. There were also 'many' mites and 'several' beetle larvae and fly pupae.

Table 3. Main statistics for the assemblages of adult beetles and bugs from scan- and rapid-scan recorded subsamples from Ribchester, by phase. For P%NOB etc: P%Nx - 'period percentage', i.e. percentage based all individuals from that phase and parameter. For explanation of abbreviations see Appendix. For 'number of assemblages', the number in parentheses indicates the number of assemblages with 20 or more individuals. For the \forall values, the number in parentheses indicates the number of assemblages where the value of \forall exceeded its standard error, or half its standard error; other values have been excluded from calculation of means, and \forall values have not in any case been calculated for assemblages of less than 20 individuals. Note the small number of cases available for some phases.

Phase	All	pre-Roman	1:1	1:2	1	2:1	2:2	2	3	4:1	4:2	4	?5
Number of assemblages	119	4	5	20	25	1	17	18	27	3	37	40	4
S	20.6	0.25	4.6	25.2	21.0	9.0	24.5	23.6	27.6	15.0	18.2	17.9	11.0
N	31.9	0.25	4.8	32.8	27.2	9.0	36.7	35.2	42.1	17.0	32.2	31.1	27.0
Where SE alpha less than alpha:													
\forall	82.0 (50)	- (0)	- (0)	82.2 (11)	82.2 (11)	- (0)	80.0 (11)	80.0 (11)	91.7 (17)	- (1)	66.8 (8)	72.6 (10)	- (1)
\forall OB	74.7 (17)	- (0)	- (0)	102.0 (6)	102.0 (6)	- (0)	- (1)	34.0 (3)	58.5 (2)	- (0)	54.6 (5)	54.6 (5)	- (0)
\forall RT	34.3 (30)	- (0)	- (0)	36.8 (5)	36.8 (5)	-	18.3 (3)	18.3 (3)	38.8 (14)	- (1)	25.6 (6)	30.5 (7)	- (1)
Where SE alpha less than alpha/2:													

Phase	All	pre-Roman	1:1	1:2	1	2:1	2:2	2	3	4:1	4:2	4	?5
∇	67.9 (44)	- (0)	- (0)	85.0 (10)	85.0 (10)	- (0)	63.5 (8)	63.5 (8)	58.3 (15)	- (1)	66.8 (9)	72.6 (10)	- (1)
∇ OB	44.4 (9)	- (0)	- (0)	27.0 (2)	27.0 (2)	- (0)	34.0 (3)	34.0 (3)	- (1)	- (0)	54.6 (5)	54.6 (5)	- (0)
∇ RT	26.2 (26)	- (0)	- (0)	38.0 (4)	38.0 (4)	-	18.3 (3)	18.3 (3)	28.2 (11)	- (0)	25.6 (6)	25.6 (6)	- (1)
Total individuals	3807	1	24	656	680	9	625	634	1138	51	1195	1246	108
Phase percentages													
P%NOB	29.7	-	45.8	34.5	34.9	-	30.4	30.8	22.7	27.5	34.3	34.0	14.8
P%NW	8.2	-	12.5	7.2	7.4	-	7.5	7.4	4.0	3.9	13.7	13.3	3.7
P%ND	2.8	-	0.0	2.3	2.2	-	3.4	3.3	3.0	3.9	2.6	2.6	1.8
P%NP	9.3	-	8.3	11.7	11.6	-	9.1	9.1	8.0	5.9	10.0	9.9	3.7
P%NM	0.0	-	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P%NL	1.1	-	0.0	0.9	0.7	-	0.6	0.6	0.4	2.0	1.9	2.0	0.9
P%NG	14.8	-	8.3	12.2	12.1	-	13.4	13.2	19.2	9.8	9.3	10.1	49.1
P%NRT	42.1	-	29.2	37.2	36.9	-	44.3	44.0	45.5	58.8	40.8	41.5	33.3

Reports from the EAU, York **94/11**

Technical report: Invertebrates from Roman Ribchester

Phase	All	pre-Roman	1:1	1:2	1	2:1	2:2	2	3	4:1	4:2	4	?5
P%NRD	11.0	-	16.7	8.8	9.1	-	9.4	9.3	12.7	3.9	11.7	11.4	11.1
P%NRF	9.6	-	8.3	8.5	8.5	-	11.5	11.5	9.5	17.6	9.1	9.5	7.4

Table 4. Minimum number of assemblages from which the more frequently-occurring taxa at Ribchester were recorded. '?' records included in totals. ec - ecological code applied for the calculation of main statistics; hc - tentative code applied for current exercise only; assemblages - number of assemblages from which taxon was recorded; total NI - total number of individuals for taxon from site; % - percentage of total fauna accounted for by taxon. Total NI for all adults of beetle and bug taxa from site: 3807. See text for explanation of habitat codes.

Taxon	ec	hc	Assemblages	Total NI	%
<i>Acritus nigricornis</i>	rt	ST	16	20	0.5
<i>Acrotrichus</i> spp.	rt	EU ST	12	45	1.2
<i>Aglenus brunneus</i>	rt	HO	16	25	0.7
Aleocharinae spp.	u	-	most	207	5.4
<i>Anobium punctatum</i>	l	HO	17	25	0.7
<i>Anotylus nitidulus</i>	rtd	EU	29	47	1.2
<i>Anotylus rugosus</i>	rt	EU	30	48	1.3
<i>Anotylus tetracarinatus</i>	rt	EU	27	38	1.0
<i>Anthicus formicarius</i>	rt	ST	23	39	1.0
<i>Aphodius</i> spp.	obrf	VF	64	142	7.7
<i>Apion</i> spp.	oap	HA	22	34	0.9
<i>Atomaria</i> spp.	rd	HO	25	54	1.4
Auchenorrhyncha spp.	oap	?HA SN	30	65	1.7
<i>Carpelimus bilineatus</i> (mostly ?)	rt	EU	31	42	1.1
<i>Cercyon analis</i>	rt	EU	34	84	2.2
<i>Cercyon atricapillus</i>	rf	ST	19	59	1.5
<i>Cercyon haemorrhoidalis</i>	rf	EU ST VF	30	69	1.8
<i>Cordalia obscura</i>	rt	ES	12	14	0.4
<i>Corticaria</i> spp.	rt	EU	26	36	0.9
<i>Cryptolestes ferrugineus</i>	g	GR	51	193	5.1
<i>Cryptophagus</i> spp.	rd	HO	42	110	2.9
<i>Cryptopleurum minutum</i>	rf	EU VF	20	25	0.7
Elateridae spp.	ob, oap l	?HA	28	42	1.1

Taxon	ec	hc	Assemblages	Total NI	%
<i>Falagria</i> spp. (not <i>Falagria/Cordalia</i>)	rt	EU ST	13	27	0.7
<i>Gyrophypnus fracticornis</i>	rt	EU ST	>12	16	0.4
<i>Helophorus aequalis</i> , <i>grandis</i> and <i>aequalis/grandis</i>	oaw	AQ	20	35	0.9
<i>Helophorus</i> spp. (small aquatic species)	oaw	AQ	47	171	4.5
Hydroporinae spp.	oaw	AQ	13	30	0.8
<i>Lathridius minutus</i> group	rd	HO	50	178	4.7
<i>Leptacinus pusillus</i> and sp.	rt	EU ST	19	27	0.7
<i>Longitarsus</i> spp.	oap	HA SN	16	22	0.6
<i>Megasternum obscurum</i>	rt	EU ST	28	38	1.0
<i>Monotoma bicolor</i> , <i>picipes</i> , <i>longicollis</i> and spp.	rt	ST	20	30	0.8
<i>Omalium</i> spp.	rt	EU ST	16	18	0.5
<i>Onthophilus striatus</i>	rt	EU ST	10	11	0.3
<i>Oryzaephilus surinamensis</i>	g	GR	44	232	6.1
<i>Oxytelus sculptus</i>	rt	ST	24	38	1.0
<i>Palorus ratzeburgi</i>	g	GR	21	32	0.8
<i>Philonthus</i> spp.	u	-	25	72	1.9
<i>Phyllopertha horticola</i>	oap	HA	28	28	0.7
<i>Platystethus arenarius</i>	rf	ST VF	22	31	0.8
<i>Ptenidium</i> sp.	rt	EU ST	10	14	0.4
<i>Pterostichus</i> spp.	oa ob	SN	18	23	0.6
<i>Sitophilus granarius</i>	g	GR	43	108	2.8
<i>Stenus</i> spp.	u	-	21	39	1.0
<i>Tachyporus</i> spp.	u	EU SN	15	23	0.6
<i>Trechus quadristriatus</i> and <i>quadristriatus</i> or <i>obtusus</i>	oa	SN	23	27	0.7

Taxon	ec	hc	Assemblages	Total NI	%
<i>Typhaea stercorea</i>	rd	ST	30	38	1.0
<i>Xantholinus linearis</i> , <i>longiventris</i> and <i>linearis</i> group	rt u	EU	15	16	0.4
<i>Xylodromus concinnus</i>	rt	HO	14	15	0.4

Table 5. 'House fauna' and taxa considered particularly likely to have been imported in hay-like cut vegetation, by phase. House fauna is calculated on Anobium punctatum, Cryptophagus spp., Lathridius minutus group, Atomaria spp., Ptinus spp., Tipnus unicolor, Aglenus brunneus, Xylodromus concinnus, Crataraea suturalis and (not found at Ribchester) Mycetaea hirta; hay insects from Apion, Sitona, Gymnetron, Hypera and Kateretes spp. Data for three other sites added for comparison.

Phase	Total NI	house	P% house	hays	P% hays
Pre-Roman	1	0	0	0	0
1:1	24	3	12.5	0	0
1:2	656	47	7.2	16	2.4
1	680	50	0.7	16	2.4
2:1	9	0	0	0	0
2:2	625	28	4.5	9	1.4
2	634	28	4.4	9	1.4
3	1138	71	6.2	26	2.3
4:1	51	2	3.9	0	0
4:2	1195	85	7.1	19	1.6
4	1246	87	7.0	19	1.5
?5	108	6	5.6	1	0.9
16-22 Coppergate, York (Anglo-Scandinavian)	52228	9872	18.9 (most phase/feature type groups in range 10-40%)	493	0.9
Deer Park Farms, N. Ireland (early historic)	15072	6257	41.5	41	0.3
Tanner Row, York (Roman)			around 20% for most phases		mean of 1-3 per sample for main phases

Discussion

Many of the samples from Ribchester were barren of insect remains, or effectively so. Many of the recovered groups were small; processing larger samples would have probably allowed better characterisation of some if resources had permitted, but in most cases, insect remains were simply too thinly distributed.

Preservation was consistently better, and remains more abundant, in the fills of cuts. Indeed, almost none of the surface-laid deposits contained more than a trace of invertebrate remains.

The accounts of the insect assemblages from Ribchester given in the previous section are based on inspection of the material assemblage-by-assemblage, and overall impressions of the fauna of the site are of course somewhat subjective. The evidence may be examined in other ways, by analysis of the abundance and frequency of the various species in the amalgamated fauna for the whole site or phase-by-phase (Table 4), and by examination of the main statistics at the same level (Table 3).

As an experiment, ecological divisions currently being defined on the basis of species association analyses (Kenward and Carrott, forthcoming) have been applied tentatively to the material from this site at the whole-site level. Table 4 shows the more frequently-occurring beetle taxa at Ribchester, in terms of numbers of the number of assemblages in which they occurred. Taxa recorded in ten or more assemblages are included.

Most of these beetles fall into the following categories:

1. Aquatics (AQ in Table 4). Only three taxa are included in the table, but two of them (*Helophorus* spp. (small) and Hydroporinae spp.) probably include several species.

2. Grain pests (GR). *Cryptolestes ferrugineus*, *Oryzaephilus surinamensis*, *Palorus ratzeburgi* and *Sitophilus granarius*, species which occur together with great regularity in Roman archaeological deposits.

3. Decomposers which, when found together, are regarded as indicative of decaying matter with the consistency of uncompressed stable manure, marked 'ST' in the table.

4. More eurytopic (generalist) decomposers which would typically find habitats in common with those listed as 'ST', and listed as ST, EU.

5. Taxa regarded as part of the 'house fauna' community (HO).

6. Species typical of very foul material including dung (VF).

7. Eurytopic decomposers (EU).

8. Species probably occupying semi-natural habitats in areas disturbed by human activity (SN).

9. Species thought perhaps to be likely to have been introduced in cut vegetation, in the light of other evidence from this and other sites (HA).

It should be noted that these codes have been devised for the present exercise only and are not intended to have any more general application. It is emphasised that the divisions are only tentative and that some species are assigned to them on the basis of experience with archaeological material, with the dangers consequent upon circular argument. Nevertheless, the data in Table 4 strengthen the impression gained during sample-by-sample analysis that the fauna of Roman Ribchester was very restricted, with most of the beetles living in ditches or originating in stable manure in buildings, or exploiting dung on external surfaces, or colonising disturbed open-air 'semi-natural' habitats in open ground with 'weedy' herbaceous vegetation.

Many of the ditch fills, particularly those lower in each fill sequence, showed clear evidence of aquatic deposition, in some cases without any, or only very little, evidence of human presence. On the other hand, a good proportion of the ditch fills were either devoid of aquatics or included so few that they may have been strays from elsewhere, so it was uncertain whether there had been deposition into water; many of these fills were probably backfills into ditches which had silted up or been infilled above the water table by dumping.

The presence of stable manure, evidenced by insect remains suggesting hay, feed grain and foul matter of a characteristic kind, was frequently indicated more or less strongly, and indeed this material seems to have been predominant at the site. The presence of stable manure assemblages is gradually being recognised as a characteristic feature of many archaeological deposits, especially of the Roman period (Allison et al. 1991a, b; Allison and Kenward, forthcoming; Hall and Kenward 1990; Kenward and Allison in press a; Kenward et al. 1991; Kenward, Allison et al. (1992); Kenward, Dainton et al. 1992a; 1992b). The importance of stable manure at a military site such as a fort is perhaps hardly surprising. What is rather more unexpected is the rarity of evidence of other kinds of wastes detectable by insect remains. It appears that the site was kept pretty much clear of other wastes and of more than a thin vegetation cover for most of the period represented by the samples described here.

A component of occupation-site assemblages which is rather poorly represented at Ribchester is 'house fauna' (Tables 4, 5). This is a group identified on the basis of archaeological records as apparently typical of primitive buildings housing people, stock, or stored organic material such as hay or straw. It is not necessarily suggested that they formed a single community; species living in timber, wattle, thatch, floors and stored products may be present in any particular case. The species are not likely to be found

together today as a rule, since the habitats harbouring them have largely disappeared.

'House fauna' assemblages of the type found in Anglo-Scandinavian buildings at 16-22 Coppergate, York (Kenward and Hall, in press), in Early Historic structures in Northern Ireland (Kenward and Allison in press b), and to a lesser extent at Roman Tanner Row, York (Hall and Kenward, 1990), were not very strongly developed, with values for a group of characteristic species never approaching those for many deposits at those sites. It appears that the insides of buildings, whether for humans or animals, were rarely allowed to remain unclean for long periods. Nor, probably, were external surfaces. This is supported by the %N RT values for the site and by phase. When compared with values for a range of occupation sites (e.g. 16-22 Coppergate, and Tanner Row, York) they are consistently very low: 42% for the site as a whole (about 60-70% for most phase/feature type groups at Coppergate) and ranging from 30-44% for all phases other than 4:1 (which gave 59%, but based on only three assemblages and a small total number of individuals).

The ultimate formation of all these deposits in the open - often in water - was doubtless an important factor in producing the consistently high proportion of 'outdoor' forms. The site %N OB was 30; phase values ranged from 22-46%, apart from the Phase ?5 group, which can be disregarded. These values were, however, probably also influenced by a lack of occupation of the unclean kind producing huge decomposer populations which it is believed diluted the outdoor fauna at many other sites, 16-22 Coppergate being again the classic case. 'Outdoor' forms exploiting sparse habitats on the site, or arriving as background fauna, were perhaps not being diluted by decomposers to anything like the same extent at Ribchester. Even the principal decaying matter detected by insect analysis - stable manure - is likely to have, itself, been a source of 'outdoor' forms which originated in hay or other cut vegetation used for fodder and litter. This appeared particularly likely for a few

characteristic 'stable manure' assemblages, although the proportion of 'cut vegetation' phytophages was low for the site as a whole (Table 4). These taxa may, of course, have originated from plants growing on the site rather than having been brought in hay. However, a paucity of local vegetation is suggested by the consistently low phase percentages for phytophages - 9% for the whole site, ranging from 8-12% for all phases other than 4:1 and ?5, both of which are probably best disregarded for the present purpose.

Aquatics were generally rather well represented (relative to other occupation sites), with the site percentage at 8% and phase values ranging from 4-14% for the phases with more than a few assemblages. This is not surprising, in view of the fact that many of the assemblages came from what could clearly be identified as ditches. What may be significant, however, is the relative rarity of damp ground and waterside forms (indeed, a good part of the 'D' component shown in Table 3 was contributed by *Anotylus nitidulus*, probably best seen as a generalised decomposer in archaeological assemblages). The ditch margins thus do not seem to have developed much of a fauna, suggesting disturbance, clearing, or short existence of the ditches themselves. This, again, is consistent with a high degree of organisation and control at the site for much of the time represented by the samples considered here.

Grain pests contributed, overall, a modest but significant proportion of the fauna. The species included here were all certainly (for *Cryptolestes ferrugineus*, extremely probably) introduced to the North of England in consignments of contaminated grain, probably being carried from place to place as the Roman army advanced. These species were for a long time regarded by HK as originating in granaries and other stores of grain intended primarily for human consumption: their possible significance in this respect has been discussed for the site at Coney Street, York by Hall and Kenward (1976) and

Kenward and Williams (1976). However, at many sites they appear to be most abundant in 'stable manure' deposits and they are now seen as mostly having originated in spoiled grain used for animal feed (mostly for horses, mules or donkeys). Whether this grain was produced specially as feed, and consequently stored with less regard than that for human consumption, can so far only be guessed.

Grain pests were probably first distributed throughout Britain, and indeed the rest of NW Europe, in grain supplies provisioning Roman troop movements. At the present site, these species (and a few other strong synanthropes) arrived in Phase 1:1, presumably with the troops building the fort.

There was no evidence from the insect remains for peat or acid turf, materials strongly indicated by biological evidence at a variety of other northern Roman sites (Hall *et al.* 1980; Hall and Kenward 1990; Kenward, Allison *et al.* 1992; Kenward, Dainton *et al.* 1992a; 1992b). The authors are uncertain as to the likely availability of peat or heathland turf near to the site at Ribchester in the Roman period, however.

Notable among the fossils from Ribchester were remains of *Helophorus tuberculatus*, a terrestrial 'water beetle' (Hansen 1987, 102) which appears to be rare in Britain at the present day (Balfour-Browne 1958, 95; Kenward 1976; Booth 1981). It has now been found in Roman archaeological deposits at Carlisle (Goodwin *et al.* 1991, 23; Allison and Kenward forthcoming; Kenward 1984a; Kenward, Allison *et al.* 1992) and York (Kenward 1988a; Hall and Kenward 1990). Clearly there is something of interest in the way this beetle occurs repeatedly: one explanation may be its importation in some material taken from its habitat, but various other explanations could be put forward.

A note concerning the fly puparia

Fly puparia were sometimes present in the samples from Ribchester in quite substantial numbers, although in most cases there were small numbers and there was a diversity of species (so that ecological interpretation might not be very clear). Fly puparia are very time-consuming to identify (substantially more than the other remains discussed here, since they require dissection, chemical preparation and slide-mounting). Thus, routine systematic work on puparia such as that by Skidmore (1992) at Buiston Crannog, Ayrshire is not yet practical on a large scale. This is regrettable, as selective work on these puparia would undoubtedly produce useful information, especially where beetles were rare.

Conclusion

Although this study has given rather routine results at the context-by context level, it has been important in gaining a view of the site as a whole, showing it to have had a very specialised nature. The data obtained will undoubtedly have considerable importance at the level of synthesis of results from the Roman period as a whole, and in terms of refinement of interpretation of archaeological insect assemblages in general.

Archive

The flots and extracted insect material from the processed samples are stored in IMS at the EAU, together with a small number of slide-mounted specimens. The manuscript records of identifications are also stored at the Unit. The computer input files and processed 'database' files for the site are stored in the University of York central mainframe computer at the time of writing. A set of hard copies of the processed data for each sample is stored at the EAU.

Acknowledgements

Samples were processed by Frances Large, John Carrott and Deborah Jaques. The skeleton of this report was entered from the preliminary archaeological report by JC, who also input the sediment descriptions. The insect and other remains from flots were recorded by FL and HK, and the worm egg survey was carried out by PK.

The authors are grateful to the Ancient Monuments Laboratory and the Lancaster University Archaeology Unit for giving them the opportunity to carry out the work on this site and funding a large part of it; the remaining funds came from EAU reserves. Kath Buxton and other members of the archaeological post-excavation team provided copious information, for which they are duly thanked.

References

- Allison, E. P., Hutchinson, A., Jones, A. K. G., Kenward, H. K. and Morgan, L. M. (1991a). *passim* in McCarthy, M. R., The structural sequence and environmental remains from Castle Street, Carlisle: excavations 1981-2. *Cumberland and Westmorland Antiquarian and Archaeological Society Research Series 5*(fascicule 1).
- Allison, E. P., Hutchinson, A., Kenward, H. K., Jones, A. K. G., and Morgan, L. M. (1991b). *passim* in volume and fiche in McCarthy, M. R., The Roman waterlogged remains and later features at Castle Street, Carlisle: Excavations 1981-2. *Cumberland and Westmorland Antiquarian and Archaeological Society Research Series 5* (main volume).
- Allison, E. P. and Kenward, H. K. (forthcoming). [Contributions to the Annetwell Street, Carlisle, report.] In Caruana, I. (ed.)
- Balfour-Browne, F. (1958). *British water beetles 3*. London: Ray Society.
- Booth, R. G. (1981). A second British colony of *Helophorus tuberculatus* Gyll. (Col., Hydrophilidae). *Entomologist's Monthly Magazine 117*, 26.

Dainton, M. (1992). A quick, semi-quantitative method for recording nematode gut parasite eggs from archaeological deposits. *Circaea, the Journal of the Association for Environmental Archaeology* **9** (2), 58-63.

Dobney, K., Hall, A. R., Kenward, H. K. and Milles, A. (1992 for 1991). A working classification of sample types for environmental archaeology. *Circaea, the Journal of the Association for Environmental Archaeology* **9** (1), 24-6.

Fisher, R. A., Corbet, A. S. and Williams, C. B. (1943). The relation between the number of species and the number of individuals in a random sample of an animal population. *Journal of Animal Ecology* **12**, 42-58.

Goodwin, K, Huntley, J. P., E. P. Allison, H. K. Kenward and L. M. Morgan (1991). The plant and insect remains from Building 1090. Pp. 22-4 in McCarthy, M. R. The structural sequence and environmental remains from Castle Street, Carlisle: excavations 1981-2. *Cumberland and Westmorland Antiquarian and Archaeological Society Research Series* **5** (fascicule 1).

Hall, R. A. and Kenward, H. K. (1976). Biological evidence for the usage of Roman riverside warehouses at York. *Britannia* **7**, 274-6. [NB: this is by Richard, not Allan, Hall]

Hall, A. R. and Kenward, H. K. (1990). Environmental evidence from the Colonia: General Accident and Rougier Street. *The Archaeology of York* **14** (6), 289-434 + Plates II-IX + Fiche 2-11. London, Council for British Archaeology. 12.90

Hall, A. R., Kenward, H. K. and Williams, D. (1980). Environmental evidence from Roman deposits in Skeldergate. *The Archaeology of York* **14** (3), 101-56. London, Council for British Archaeology.

Hall, A. R., Kenward, H. K., Williams, D. and Greig, J. R. A. (1983). Environment and living conditions at two Anglo-Scandinavian sites. *The Archaeology of York* **14** (4), 157-240 plus fiche 1. London: Council for British Archaeology.

Hansen, M. (1987). The Hydrophiloidea (Coleoptera) of Fennoscandia and Denmark. *Fauna Entomologica Scandinavica* **18**. Leiden and

Copenhagen: Brill/Scandinavian Science Press.

Jones, A. K. G. (1982). *Human parasite remains: prospects for a quantitative approach*, pp. 66-70 in Hall, A. R. and Kenward, H. K. (eds). Environmental archaeology in the urban context. *Council for British Archaeology Research Reports* **43**.

Kenward, H. K. (1978). The analysis of archaeological insect assemblages: a new approach. *The Archaeology of York* **19** (1), 1-68 + Plates I-IV. London: Council for British Archaeology.

Kenward, H. K. (1982). *Insect communities and death assemblages, past and present*, pp. 71-8 in Hall, A. R. and Kenward, H. K. (eds). Environmental archaeology in the urban context. *Council for British Archaeology Research Reports* **43**.

Kenward, H. K. (1983). Colour patterns of Quaternary fossil insects. *Entomologist's Monthly Magazine* **119**, 160.

Kenward, H. K. (1984). *Helophorus tuberculatus* Gyll. (Col., Hydrophilidae) from Roman Carlisle. *Entomologist's Monthly Magazine* **120**, 225.

Kenward, H. K. (1988a). *Helophorus tuberculatus* Gyll. (Col., Hydrophilidae) from Roman York. *Entomologist's Monthly Magazine* **124**, 90.

Kenward, H. K. (1988b). Insect remains. Pp. 115-40 in Schia, E. (ed.) *De arkeologiske utgravninger in Gamlebyen, Oslo. Vol. 5 Mindets Tomt - Sondrefelt*. Ovre Ervik:Alvheim and Eide.

Kenward, H. K. (1992 for 1991). Rapid recording of archaeological insect remains - a reconsideration. *Circaea, the Journal of the Association for Environmental Archaeology* **9** (2), 81-8.

Kenward, H. K. and Allison, E. P. (in press a). *Rural origins of the urban insect fauna*, in Hall, A. R. and Kenward, H. K. (eds.), Urban-rural connexions: perspectives from environmental archaeology. *Symposia of the Association for Environmental Archaeology*.

Kenward, H. K. and Allison, E. P. (in press b). *A preliminary view of the insect assemblages from the Early Christian rath site at Deer Park Farms, Northern Ireland*. In Rackham, D. J., Environment

and economy in Anglo-Saxon England. *Council For British Archaeology Research Report* **89**. (Publication date: 1993) (21.12.92)

Kenward, H. K., Allison, E. P., Dainton, M., Kemenes, I. K. and Carrott, J. B. (1992). Evidence from insect remains and parasite eggs from Old Grapes Lane A, The Lanes, Carlisle: Technical report. *Ancient Monuments Laboratory Report* **78/92**.

Kenward, H. K., Allison, E. P., Morgan, L. M., Jones, A. K. G. and Hutchinson, A. R. (1991). *Chapter 10. The insect and parasite remains*, pp. 65-72 in McCarthy, M. R., *The structural sequence and environmental remains from Castle Street, Carlisle: excavations 1981-2. Cumberland and Westmorland Antiquarian and Archaeological Society Research Series* **5** (fascicule 1).

Kenward, H. K., Dainton, M., Kemenes, I. K. and Carrott, J. B. (1992a). Evidence from insect remains and parasite eggs from the Old Grapes Lane B site, The Lanes, Carlisle: Technical report. *Ancient Monuments Laboratory Report* **76/92**.

Kenward, H. K., Dainton, M., Kemenes, I. K. and Carrott, J. B. (1992b). Evidence from insect remains and parasite eggs from the Lewthwaites Lane A site, The Lanes, Carlisle: Technical report. *Ancient Monuments Laboratory Report* **77/92**.

Kenward, H. K., Engleman, C., Robertson, A., and Large, F. (1986). Rapid scanning of urban archaeological deposits for insect remains. *Circaea* **3**, 163-72.

Kenward, H. K. and Hall, A. R. (in press). Biological evidence from Anglo-Scandinavian deposits at 16-22 Coppergate. *The Archaeology of York* **14** (7).

Kenward, H. K., Hall, A. R. and Jones, A. K. G. (1980). A tested set of techniques for the extraction of plant and animal microfossils from waterlogged archaeological deposits. *Science and Archaeology* **22**, 3-15.

Kenward, H. K. and Williams, D. (1979). Biological evidence from the Roman warehouses in Coney Street. *The Archaeology of York* **14** (2), 45-100. London: Council for British Archaeology.

Kloet, G. S. and Hincks, W. D. (1964-77). *A check list of British Insects*. Second edition. London: Royal Entomological Society.

MAFF (Ministry of Agriculture, Fisheries and Food) (1977). Manual of veterinary parasitological laboratory techniques. *Technical bulletin* **18**. London.

Skidmore, P. (1992). *Provisional report on the Diptera from the excavation of Buiston crannog [sic] near Kilmarnock*. Appended to Dinnin (1992a).