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Assessment of biological remains from the fills of a reredorter at St John's Hospital, Canterbury (site code SJH91)

by

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Summary

Samples from the fills of one of two reredorters at the Norman Hospital of St John, Canterbury, have been examined for their content of plant and animal remains. The deposits represent accumulations of debris rich in plant macrofossils, invertebrate and vertebrate remains from (a) a basal layer likely to pre-date the construction of the reredorter in 1085 and (b) from later fills (following a period of reconstruction), which have been dated to the period from the late fifteenth/early sixteenth century to the early nineteenth century.

Food remains formed the largest component, with an abundance of plant foods represented by fruitstones and pips, notably *Prunus* (plum, cherry, sloe), *Rubus* (blackberry, raspberry), elderberry (*Sambucus*), *Fragaria* (strawberry), *Malus (*apple*), Ficus* (fig), *Mespilus* (medlar) and *Vitis* (grape), together with nuts (hazel, *Corylus*, and walnut, *Juglans*), various herbs and spices. Wheat/rye 'bran' was also present in most layers. Vertebrate remains included many fish bones from food, notably flatfish and other marine and estuarine forms. Most of the mammal and bird bones were also probably food items and there was much bird eggshell and some marine molluscs such as oysters and mussels.

The faecal nature of the deposits is attested by the presence of *Trichuris* and *Ascaris* eggs through much of the sequence, but there was clearly other domestic waste as indicated by the synanthropic insects recorded. Other insects were primarily from natural or semi-natural habitats and these, together with some of the plant and vertebrate fossils, probably arrived without direct human intervention, through natural dispersal or in water used to flush the reredorter.

It is recommended that more work is carried out on this rare and valuable bioarchaeological resource with particular emphasis on the foodplant remains and fish bones.

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Introduction

During 1991, excavations took place in the northern of two reredorters on the site of St John's Hospital, Canterbury, as part of a detailed study prior to restoration of the standing building (Bennett 1991; Parfitt 1991). Following consultation with staff and contractors from the Ancient Monuments Laboratory of English Heritage, it was agreed that almost all of the fill of the reredorter would be sampled to provide a large corpus of potentially well preserved material from an archaeological context of an unusual kind for bioarchaeological analysis.

This report presents the results of the assessment of a selection of the samples for their content of macrofossil remains and parasite eggs; an assessment of pollen has been undertaken by Pat Wiltshire (Wiltshire 1994).

The material

The body of sediment in the central part of the rectangular reredorter was divided by the excavator into three contiguous columns of 1-1.25 m in length and about 0.95-1 m wide. As much as possible of the sediment in each context in each column was sampled, using 10 litre plastic tubs. The contexts were divided horizontally into a series of layers for sampling; the number of such divisions varied from one to six. The central column (2) was chosen for this assessment. From this, there was total of 59 subsample tubs containing sediment from 20 samples and representing eight contexts.

The deposits were dated by pottery to the period from the late fifteenth century to about 1825, the earliest medieval deposits (representing the period from the building of the reredorter in the late eleventh century to a phase of reconstruction and underpinning in the late fifteenth century) having presumably been removed during the medieval reconstruction work.

Of great importance in the consideration of these deposits is their formation and thus the taphonomy of the biological remains. It was evident that some sort of flushing mechanism must have operated to clear waste from this structure at intervals, if not more frequently (see comments by Bennett and Parfitt, *opp. cit.*) so the sequence of deposits recorded is unlikely to represent continuous accumulation. A certain amount of reworking during periods of flushing or excavation must have occurred and the more resilient biological remains (such as woody fruitstones, marine shell and bones) might all have become mixed into later layers. This is discussed further below.

Since the deposits were not uniform across the area excavated nor, indeed, across the whole of one of the columns, this assessment deals with most, but not all, of the contexts defined during excavation.

Methods

For each group of subsamples from a sample, one tubful was selected to provide a 'test' subsample (effectively from a GBA sample, *sensu* Dobney *et al.* 1992), to be investigated for plant and invertebrate macrofossils. For these tubs, a sediment description was made using a standard *pro forma* and a 1 kg subsample processed following methods of Kenward *et al.* (1980; 1986). Where there were two or more subsample tubs per sample, voucher subsamples of 3 kg were taken from each and the remainder weighed and bulk-sieved to 1 mm. The weights of these small bulk samples varied between 4 and 14 kg.

Plant remains were examined from both test and bulk-sieved subsamples, using the latter to concentrate the rarer and larger food remains. All of the ‘flots’ from paraffin flotation were examined, but only one residue for any context was checked for plant macrofossils. All plant remains (and the other components of these samples recorded at the same time as the plants) were recorded on four- (GBA subsamples) or three-point (BS samples) scales of abundance, but the detailed results are not presented here.

Insects, molluscs and some other invertebrates were recorded from ‘test’ subsamples (parasite eggs were investigated by means of ‘squashes’ *sensu* Dainton, 1992), and snails also investigated from bulk subsamples. The latter also provided almost all of the bone, marine shell and other components of the sediments, including an abundance of artefacts, amongst which were objects of glass, metal, ceramics, and leather.

The numbering system used was as follows. The separate subsample tubs were originally labelled ‘1 of 3’ , ‘2 of 3’, etc. These were transformed into unique sample numbers by adding the subsample number to the end of the sample number. Thus tub ‘2 of 3’ for sample 209 became 2092, and so on. This system was adopted in order to preserve the identity of the subsamples, though in practice for further work the material could probably be amalgamated for each sample from a context.

Results

Tables 1-4 present a summary of observations on the various categories of remains: plant and invertebrate macrofossils (excluding marine shell) in Table 1; remains from bulk-sieved samples in Table 2; and bone and marine shell in Table 3. Table 4 presents some results of the investigation of fish bone. A context-by-context summary of the sediment descriptions and of the results of examination of vertebrate material and marine mollusc shell are presented in the appendix to this report.

Discussion

The plant and invertebrate micro- and macrofossils and the vertebrate remains investigated in this assessment were usually present in significant numbers, and often very well preserved, in the deposits from most levels in the reredorter fills. There was a marked impoverishment of plant remains in the uppermost and lowermost deposits, however, no doubt relating to decay (in the top of the sequence) and a low original input (at the base). Mineral replacement was noticeable in contexts 22 and 27 (the uppermost) but not lower down the sequence. Preservation of insect remains ranged from excellent to poor, sometimes within the assemblage from a single sample, perhaps reflecting re-sorting of the deposits *in situ* and the introduction of remains from outside the reredorter. The condition of the bone was also rather variable, although probably for different reasons.

The remains—plant, invertebrate *and* vertebrate—appear to have had at least two quite distinct sources: (i) food remains in faeces and other domestic waste, together with eggs of intestinal parasites voided with faeces, and remains of insects likely to have lived within buildings; and (ii) flora and fauna of natural/semi-natural habitats.

Foodplants were abundant and quite diverse—and the list of taxa would undoubtedly be extended through further, more detailed analysis. The decay-resistant 'seeds' of fruits such as apple, blackberry, raspberry, plum, cherry, grape, fig, strawberry elderberry formed the largest component, but there were also some flavourings (fennel, dill, celery 'seed', parsley) and wheat/rye 'bran' formed a component of many samples. Nutshell from hazel and walnut was present in many samples, but it was noticeable that some of the less dense tissues such as leaf epidermis were only rarely recorded and it may be that the taphonomic vagaries of deposition in this feature resulted in differential sorting of this fraction. Arable weed seeds may have been flour contaminants, but the proportion of these seemed quite small and suggests that cereal-based foods were rather 'clean' by comparison with those inferred from results of analyses of faecal deposits from other sites.

Certainly these deposits did not appear to be primary faeces of the kind observed in, for example, many pitfills from tenth century York at 16-22 Coppergate (Kenward and Hall, forthcoming). They were generally silts rich in organic matter rather than the purely organic sediments observed in York and of course there was a component of fabric from the walls of the reredorter—mortar and flints—as well as artefacts. The bean weevils *Bruchus* sp. quite probably originated in faeces and the grain weevils *Sitophilus granarius* (Linnaeus) may have done. The eggs of the intestinal worms *Trichuris* and *Ascaris*, frequently abundant (and also recorded by Wiltshire in her assessment of pollen from these deposits: Wiltshire 1994), certainly must have done. Bone which probably originated in faeces consisted mainly of small fish remains, and small fragments of mammal bone (mostly pig lateral metapodials, sesamoids and phalanges) with characteristic 'acid etching' visible on their surface.

Other domestic food waste dumped into the cess deposits but not obviously having passed through the digestive tract included the larger fish bones, oyster shells, mammal and bird fragments. The remains of large mammals in this category were mainly caprovid, pig and cattle distal limb elements (mostly neonatal or juvenile), and teeth fragments, but there were several sheep skulls (split longitudinally). Overall, evidence for butchery was fairly frequent on the large mammal remains.

It is possible that a proportion of the insect remains were introduced in dumped waste, possibly floor sweepings, but if so, this component was not large. The stored product and domestic beetles may, however, in some cases at least have entered through their own activity, having lived within the reredorter structure. There was no evidence that insects invaded the deposits *in situ*.

A proportion of the plant, invertebrate and vertebrate remains certainly originated from natural or semi-natural habitats outside the structure. Plants which would have grown in the surroundings included several trees and shrubs (there were fruits or seeds of ash and yew and bud-scales of oak and beech, for example), and a range of herbaceous plants including some waste ground weeds and wetland taxa. The basal layer, in particular, was characterised by an abundance of sedge (*Carex*) nutlets, no doubt either from water flowing through the reredorter in its earliest years or originating in the (?fluviatile) deposits into which the feature was cut. A substantial proportion of the insect fauna of some of the layers certainly originated in the same way. This 'outdoor' component was (subjectively) extremely diverse and included some rather unusual taxa (for example, remains of what appears to be the wood-boring weevil *Caulotrupodes aeneopiceus* (Boheman)). There were modest numbers of water beetles and bugs, some waterside taxa, and a clear component from herbaceous vegetation. Many of these fossils were, however, fragmentary and many individuals represented by only single fragments or sclerites. The aquatic snails and some of the other invertebrate and vertebrate remains (caddis larvae, cladocerans, ostracods, amphibians) belong in this category of organisms from natural and/or semi-natural habitats.

How these animals and plants entered the deposits considered here has much significance in terms of archaeological interpretation and of their implications for the approach to further analysis. As suggested above, it is possible that the biological remains in the lowermost deposit of the sequence (context 49) pre-date the construction of the reredorter, this layer perhaps only being exposed during reconstruction of the reredorter in the late fifteenth century (this has the implication, of course, that the earliest fills, of the period from the twelfth to late fifteenth centuries, have been lost). The natural and semi-natural biota of the overlying layers presumably entered during use; it is necessary to consider more carefully how this may have occurred. The most likely routes would be:

(a) through constant flushing, remains consequently being sorted before deposition (the reredorter may once have been flushed by water from the River Stour to the north-west via a system of channels and sluices;

(b) through intermittent flushing, which might have scoured out deposits of waste and differentially removed remains, but also dropped sediment;

(c) via roof drainage from the reredorter structure or surface water drainage from the surroundings;

(d) through wind-blow and flight through openings into the reredorter.

Biological remains originating in each of these ways will carry different implications, and whether mechanism (a) or (b) operated will have major implications concerning the interpretative value of the deposits as a whole. Constant flushing would have resulted in constant sorting and reworking, and probably differential removal of some components. Intermittent flushing would remove a proportion of the sediment, but what remained would represent what was being deposited as the structure was used. The evidence from the assessment of biological remains does not, unfortunately, resolve this question, although the nature of the stratigraphy suggests that there was not a constant water flow, so that at least some of the deposits retain all of those original components capable of preservation under the conditions within the reredorter.

Fish remains

The preliminary investigation has identified 21 species from 17 families, indicating a wide range of habitats from which fish were being procured. There were local, riverine, estuarine, and deep-sea sources, the detailed nature of which may be revealed by further analysis; the greater proportion of the fish appear to be marine.

This assemblage of fish material is important in a number of ways. The fragile nature of fish bones often limits their interpretation (Wheeler and Jones 1989) but in this case preservation is excellent, giving a rare opportunity to analyze and compare material covering a wide time span. Fish bone assemblages from sites in the south of England (e.g. Irving 1992; 1993a b; Jones 1976) have, in the main, comprised isolated groups with poor preservation and broad dating.

The fish material from this site is especially interesting in that it contains abundant flatfish. The garfish is an interesting record as it is highly seasonal in British coastal waters, being found only during July and August.

Statement of Potential

Despite the deposit-formation and taphonomic problems outlined above, this sequence represents a rare example of accumulation of highly organic deposits under a more or less continuous regime over a period of perhaps four hundred years. Moreover, the material from St John's Hospital is clearly related to the activities and diet of an enclosed monastic and hospital establishment for the whole of this period and as such is extremely important.

The ability to date the deposits, layer by layer, reasonably closely (perhaps to within a hundred year period) is clearly a pre-requisite for further, more detailed, biological investigations, however. If such dating is feasible, the food remains, in particular, provide a means of addressing one of the academic objectives highlighted by English Heritage (1991) as 'processes of change', i.e. the transition from medieval to post-medieval traditions.

Few assemblages of food remains of this time range, size and diversity have been recovered, especially by such wholesale and systematic recovery procedures. *Published* work to date on comparable material has largely consisted of the results of analyses of material from one or two contexts and rarely has it been possible to integrate all the available lines of biological evidence—obvious comparanda for plant remains are Greig's (1981) report on a barrel latrine from Worcester, Wilson's (1975) list from a pit in Goss Street, Chester, Green's (1983) analysis of plant foods from Christchurch Priory, and Moffett's (1992) material from a Civil War latrine at Dudley Castle. The Worcester report also gives some details concerning insect remains. These, and most other post-medieval insect assemblages from latrines and cess pits, were very different from the fauna from St John's Hospital.

The plant remains include diverse food items, many of them likely to have been imported (fig, grape, black mulberry), although cultivation in this most south-easterly corner of England cannot be ruled out. The abundance of well-preserved *Prunus* (sloe, plum, cherry) fruitstones provides a very valuable archive, and changes in the size and shape of these stones through sequence may offer some information about changes in sources—in particular, the use of wild *versus* cultivated fruits. The grape pips show distinctive morphological differences and it may be possible to relate these types to fruit from different races of grape, particularly grapes grown for different purposes (fresh fruit, drying, wine-making). A small proportion of the plant material from the samples examined could not be identified but is distinctive and might repay closer examination; there were certainly fragments of cucurbit (cucumber, marrow, pumpkin) seed in some samples, and these, though sparse may provide rare evidence for the use of such plants by the denizens of the hospital at certain periods.

Little purpose would be served by the detailed examination of the remains of insects and other macro-invertebrates from every sample, although a rapid examination of at least a representative selection is desirable and useful information will doubtless be obtained from careful study of selected assemblages. The insects (and other macro-invertebrates) remains offer the opportunity to detect the amount of external influence undergone by the developing deposits. They will also indicate some aspects of diet and the condition of food (from the grain pests and bean weevils), and perhaps allow some reconstruction of conditions within the reredorter structure and in the surroundings. They may also allow recognition of some kinds of waste disposal.

Little additional zooarchaeological evidence would be obtained from more detailed study of the mammal and bird remains, save basic identification and quantification of the common domesticates and any additional species. However the fish assemblage is of potentially much greater interest. Further analysis of the fish bone would yield useful species identifications, and provide important information regarding the exploitation of an important wild resource for food, probably including seasonality, method of capture, and local trade.

There is also the opportunity to use a modern analytical technique on the material. Strontium analysis detects the amount of this element within bone, giving a signal which can be interpreted as indicating the type of habitat the fish was living in at time of death. This is based on the difference in the amounts of free strontium in sea- and freshwater, since freshwater is free of strontium and sea water is comparatively rich, with estuarine (brackish water) falling between the two. Using an electron microprobe (available in the Department of Physics, University of York), it should be possible to detect the level of strontium within the bone material, thus identifying the type of fishery being exploited. The technique might also be an indicator of seasonality, based on the migratory tendencies of the flatfishes (Pleuronectidae).

Strontium analysis has been used on modern fish skeletal material with great success (Casselman 1987). Its potential for work on archaeological material is, as yet, unknown; the well-preserved material from this site provides an excellent opportunity to test it.

The catchment area of Canterbury contains non-tidal and tidal river stretches, estuaries, the sea coast, and deep waters. It should be possible to identify specific biozones from which fish procurement was taking place. This should provide evidence concerning the fish trade, detecting long-range or local sources.

A further avenue of research is the identification of seasonality. It should be possible to produce information concerning the season-of-death for a range of species represented by bones in the reredorter, which may give evidence of changing exploitation patterns throughout the year.

An additional area of potential for further work concerns the recovery of artefacts from the remaining unsieved deposits (i.e. about two-thirds of the volume available). To the bioarchaeologist's untutored eye, this assessment yielded a rich and diverse group of artefacts from the late fifteenth-nineteenth century deposits, including fine glass and metal objects, some wood and leather materials and, of course, ceramics.

Recommendations

Some seven contexts from the reredorter fills were not examined in this assessment, since they were not represented in the sequence from column 2. These should be examined at least cursorily by means of GBA 'test' and BS subsamples to establish that they are not substantively different in their content of macrofossil and microfossil remains from those already examined.

The minimum amount of work that should be carried out on the macrofossil plant remains from these deposits is a closer examination of at least one sample from each context, both from the GBA and BS sequences, to produce a full species list for each level and to follow up unidentified material from the samples examined during this assessment. Although no residues from the subsamples processed in this study have been dried, the passage of time since processing (early in 1993) and the lack of adequate cold storage facilities means that they may not be in a very good condition and fresh subsamples should be processed.

The rich assemblage of *Prunus* fruitstones should be subjected to detailed recording of size and shape, using image analysis to make a record and to provide the basis for statistical analyses. Separation of the stones into morphological types has been attempted on the basis of three linear measurements by Behre (1978) for material of *P. domestica* of early medieval date from Haithabu and Alt-Schleswig in North Germany but this has not been attempted for a corpus of material from a British site. Image analysis should provide a more comprehensive record of the size and *shape* of the stones than Behre's three measurements and it is hoped that a more robust definition of *Formenkreise* (Behre *op. cit.*) can be obtained for this Kentish material. The emphasis would lie in observing changes in the size and shape of stones through the sequence, rather than attempting identification to infra-specific level (which poses considerable difficulties). This work has been identified by Carruthers (1993) as being important within the context of archaeobotanical research in England.

Further investigation of eggs of intestinal parasites is probably best restricted to a semi-quantitative survey of eggs from each sample, using replicate 'squashes', and measurement of some groups to ensure that the trichurid remains are *Trichuris trichiura*, the whipworm of humans.

Insect remains from one sample in each context should be fully analysed. It is possible that detail of episodes of water flow and rubbish dumping might emerge from rapid recording of a subsample from each 'layer' within each context, and this approach is recommended. Providing dating is reasonably secure, identification of rarer taxa is desirable, to allow reconstruction of environment in the catchment and to provide records in space and time for future synthesis.

The remaining samples from these deposits (apart from vouchers to be kept in case of the need for further analyses) should be sieved to 1 mm to provide additional fish and other bone. The analysis of the fish remains should take the form of species identifications, live-weight reconstructions and butchery practices. This should be followed by an analysis of fishing techniques, habitats exploited, and the seasonality of each fishery identified.

Analysis of strontium in fish bones is also recommended. This should result in a publication in a major journal (*Journal of Archaeological Science*, *International Journal of Osteoarchaeology*).

The sieving of the remaining sediment for vertebrate remains will, of course, produce a large corpus of small finds. If this is done, a 'watching brief' on plant remains should be maintained in case important specimens are brought to light, although of course only the larger specimens are likely to be recovered in this way if the coarser mesh is adopted.

Retention/disposal

All material should be retained in prospect of further work being undertaken.

Archive

All the samples discussed here, together with residues and extracted fossils, and paper and electronic archives, are currently stored at the EAU, York.

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Table 1. 'Test' subsamples: results of analyses of plant and invertebrate remains. The samples are listed in stratigraphic order, starting at the top. Key for plant remains column: F—flot examined; R—residue examined. Molluscs were only present in traces in the GBA samples; some results for the BS samples with more than traces of shells present are given.

Context	**(Sub) sample**	**Plant remains**	**Parasite eggs**	**Insects**	**Non-marine molluscs**	**Other invertebrates**
22	2014	F: small assemblage with moderate amounts of fig and grape and a few other foodplants	Many	Fairly small group of reasonably well-preserved insects; mixture of species from domestic and natural/semi-natural habitats, hints of foul matter		fly puparia
22	2021	FR: a modest-sized assemblage with much fig, grape, elderberry, and blackberry; moderate numbers of weeds: P1	Many	Modest-sized group of insects from artificial and natural/semi-natural disturbed habitats		ostracod
27	2033	FR: large assemblage very rich in 'plum', grape, fig, strawberry, blackberry (*Rubus fruticosus* agg.) and elderberry; also mulberry (*Morus nigra*) and a modest range of weeds and woody taxa; a little mineralisation apparent: P1	Many	Modest-sized group of insects from artificial and natural/semi-natural disturbed habitats		earthworm egg caps, ostracod
27	2041	F: small assemblage with small amounts of food plants; moderate numbers of fig seeds	Many	Modest-sized group of insects from artificial and natural/semi-natural disturbed habitats		earthworm egg caps
53	2052	F: rather small assemblage with moderate amounts of fig, fennel and strawberry; ?parsley, ?gooseberry	Many	Modest-sized group of insects from artificial and natural/semi-natural disturbed habitats; synanthropes perhaps rarer than in other		

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Context	(Sub) sample	Plant remains	Parasite eggs	Insects	Non-marine molluscs	Other invertebrates
				samples from this context		
53	2064	FR: Large assemblage rich in a variety of foodplant taxa, especially fig, grape, 'bran', strawberry; ?cucumber, ?black pepper; also a component of woody taxa, especially beech (*Fagus*) and oak (*Quercus*) bud-scales: P1	Very many	Fairly small group of well-preserved insects; mixture of species from domestic and natural/semi-natural habitats		ostracods
53	2071	F: small assemblage with moderate numbers of grape pips and 'bran' fragments; some other food plants	Many	Modest-sized group of insects from artificial and natural/semi-natural disturbed habitats		caddis; earthworm egg caps
53	2093	F: small assemblage with moderate amounts of strawberry achenes and 'bran' and a few other plant foods	Many	Small group of insects, with preservation rather poor; mixture of species from domestic and natural/semi-natural habitats	Abundant freshwater molluscs, mostly *Lymnaea peregra*, trace of terrestrial species	caddis
53	2131	F: moderately large assemblage with modest amounts of bran' and food plants, especially strawberry (*Fragaria*)	Many	Fairly small group of well-preserved insects; mixture of species from domestic and natural/semi-natural habitats		
56	2081	F: small assemblage with moderate amounts of 'bran' and some other food plants	Some	Few, but rather well preserved, insects. No strong synanthropes noted		

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Context	**(Sub) sample**	**Plant remains**	**Parasite eggs**	**Insects**	**Non-marine molluscs**	**Other invertebrates**
56	2101	FR: moderately large assemblage, rich in food plants (especially fig, with 'plum', sloe, fennel; ?cucurbit: P1	Few	Modest-sized group with varied preservation; aquatic and natural/semi-natural habitats represented, but no strong synanthropes		frequent ostracods
54	2112	F: small assemblage with moderate amounts of 'bran' and some other food plants	Many	Small assemblage of aquatics and natural/semi-natural disturbed habitats species, no clear synanthropes	Modest numbers of molluscs, mostly aquatic (principally *Lymnaea peregra*), some *Pisidium* spp.	
54	2121	FR: Large assemblage rich in foodplants (especially apple and 'plum'), but also with a variety of weeds and woody taxa: P1	Many	Small group of insects from aquatic and natural/semi-natural disturbed terrestrial habitats; a trace of synanthropes		ostracods, fly puparia, caddis larva cases
54	2141	F: small assemblage, rich in fig seeds and with some other foodplants, including a fragment of a cucurbit seed	Many	Rather small group with somewhat poor preservation. Natural/semi-natural habitats indicated, but some synanthropes present		
63	2172	FR: a modest sized assemblage with quite large numbers of sedge nutlets and fig seeds, a convincing mixture of material in context 49 and 55: P0	Few	Large flot, poor preservation, few insects. Character of assemblage not clear		earthworm egg caps
55	2152	FR: A moderately large assemblage rich in foodplant remains, especially	Few	Small group of insects, apparently of mixed origins		ostracods,

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Context	**(Sub) sample**	**Plant remains**	**Parasite eggs**	**Insects**	**Non-marine molluscs**	**Other invertebrates**
		'plum' (*Prunus domestica*), grape (*Vitis vinifera*), apple (*Malus*) and elderberry (*Sambucus nigra*), traces of 'bran': P1				
55	2162	F: A small assemblage with moderate numbers of fig (*Ficus carica*) seeds and some other fruit seeds and stones; traces of 'bran'	Many	Few insects, with a mixture of synanthropes and species from natural and disturbed habitats		
49	2183	F: Very small assemblage, quite rich in sedge nutlets	None	Few remains, although not clear whether input low or preservation poor		caddis
49	2191	F: Very small assemblage, with moderate numbers of sedge nutlets and rush (*Juncus*) seeds	None	Modest-sized group of insects, all from natural/semi-natural habitats		*Daphnia* and another cladoceran
49	2202	FR: Moderately large assemblage of plant remains, particularly sedge (*Carex*) nutlets and a range of taxa suggesting woody vegetation near water: P1	None	Beetles and bugs quite numerous, nearly all from aquatic, waterside, and terrestrial natural/semi-natural habitats. No characteristic synanthropes. Preservation rather poor.		mites, foraminiferans, bryozoa and *Daphnia*

*Table 2. Bulk-sieved samples: results of preliminary sorting of residues. All components recorded on three-point scale of abundance from 1 (rare) to 3 (abundant). Key: C—context; SN—sample; Wt—Weight sieved (kg); Flt—flints; LB—large bones; SB—small bone; B/T—brick/tile; Mtr—mortar; Pot—pottery; Ltr—leather; Gls—glass; FeO—iron objects; Cndr—cinder; MSh—marine shell; NM—non-marine molluscs; Chcl—charcoal; Wd—wood fragments; Twg—twig fragments; WdC—wood chips; Cor—*Corylus *nutshell fragments; Jug—*Juglans *nutshell; Prn—*Prunus *fruitstones; Mes—*Mespilus *seeds; Mal—*Malus *endocarp; Cad—caddis larva cases; Eggs—eggshell fragments; EgM—eggshell membrane; EW—earthworm egg capsules.*

C	SN	Wt	Flt	LB	SB	B/T	Mtr	Pot	Ltr	Gls	FeO	Coal	Cndr	MSh	NM	Chcl	Wd	Twg	WdC	Cor	Jug	Prn	Mes	Mal	Cad	Eggs	EgM	EW
22	2011	6	2	2		2	2	1		1		1	1	1								1						
22	2012	7	1	2	1	3	1	1		1		1	1			1						1			1			1
22	2013	7	2	1		2	2					1	1			1	1					1						
22	2015	6	1	1	1	1	1	2		1		1	3			1		1				1					1	
22	2016	5	1	1		2		1		1			2			1						1					1	
22	2017	7	1	2		1	1			1		1	1	1		1	1			1		1						
22	2018	5	1	2	1	1	1			1		1	1		1	1	2					1				1		
22	2022	9	2	3	1	2	1	1		1						1	1		1			1						
22	2023	9		2		2	2									1				1		1						
27	2031	8		2		1	1	1				1	1		1		1					2				1		
27	2032	7	1	2		1	2			1		1	1			1	1	1		1		3						
27	2034	8	1	2		1	1			1			1			1	1				1	2				1	1	1
27	2042	8		1	1	2	2	1					1	1		1	1	1		1	1	3				1		
27	2043	8	1	1	2	1	1			1			1	1			1	2		1		3		1				
27	2044	8	2			2	1		1				1	1		1	1	1	1	1	1	3		1	1			

C	SN	Wt	Flt	LB	SB	B/T	Mtr	Pot	Ltr	Gls	FeO	Coal	Cndr	MSh	NM	Chcl	Wd	Twg	WdC	Cor	Jug	Prn	Mes	Mal	Cad	Eggs	EgM	EW
27	2045	7		1	1	2	1				1			1		1	3					2	1					
27	2046	6	1	2	1	1				1			1			1	1	1	1	1	1	3	1			1		
27	2047	6		2		2	1			1						1	1	1				3						
27	2048	7		2		1		3			1		1				1			1	1	2	1					
53	2051	9		1	1	2	1	1	1	1	1		1	1		1	1	1		1		3	1					
53	2053	8		2		1		1						1		1	1			1	1	2	1					
53	2054	8		1		1	1	1	1		1		1	1		1	1	1		1		3		3				
53	2061	4			1	1	1							1		1	1		1			2	1					
53	2062	6			2	1	1									1	1	1		1		3	1		1	1		
53	2063	7	1	1	1	1	1						1			1	2	1	1			2		2	1	1		
53	2091	8			2	1	1							1		1	1			1	1	2	1		1	2		
53	2092	9	1	1	1	1	1									1	1	1		1	1	2	1			1		
53	2094	6		1	1	1	1	1	1		1			1	2	1	1	1	1	1	1	2	1	2		1		
53	2132	8	1	1	2	1		1			1			1		1	1	2		1		2	1	2				
54	2111	7		1	1			1	1		1			1	2	1	1	1		1		2	1	2		2		
55	2151	12	2	3		2	3	2	1		1			2	1	1	1	1		1	1	1	1			2		
55	2161	13	3	2	2	1	1	1			1			2		1				1		1	1					
55	2163	11	1	2	2		3							2			1	1			1	1	1		1	2		

C	SN	Wt	Flt	LB	SB	B/T	Mtr	Pot	Ltr	Gls	FeO	Coal	Cndr	MSh	NM	Chcl	Wd	Twg	WdC	Cor	Jug	Prn	Mes	Mal	Cad	Eggs	EgM	EW
63	2171	14	3	2			2	2			1			2	1	1	1			1		1				2		
49	2181	10	2	1			1	1						1								1						
49	2182	11	1	1	1	1	1	1						1								1						
49	2192	13	1	1	1	1	1	1						1			1	1				1				1		
49	2201	13	3	1	1			1						1		1	1	1				1		1		2		
49	2203	12	2				1	1						1								1				2		

Table 3. Bone and marine shell from bulk-sieved and GBA 'test' subsamples. P = present (i.e. <10% of total assemblage), C = common (10-50%), A = abundant (>50%). Letters in parentheses: for large mammals, LM—(F) = few measurable bones (i.e. <10%); for medium-sized and small mammals, birds, fish and shell—(L) = low diversity (i.e. 1 species present), (M) = moderate (2 - 4 species) and (H) = high (>4 species).

Context	**Sample**	**LM**	**MM**	**SM**	**Bird**	**Fish**	**Amph**	**Shell**
22	2011/B	A(F)	P(L)		P(L)	P(M)		P(M)
	2012/B	A(F)	P(L)		P(L)	P(L)		
	2013/B	A			P(L)			
	2015/B	A	P(L)		P(L)		P	
	2016/B	A						
	2017/B	A(F)	P(L)			P(L)		P(L)
	2018/B	A		P(L)		P(M)		
	2022/B	A(F)				P(L)		
	2023/B	A			P(L)	P(M)	P	
27	2031/B	A(F)			P(L)	P(M)	P	P(L)
	2032/B	A		P(L)	P(L)	P(L)	P	
	2034/B	A(F)			P(L)	C(H)	P	
	2042/B	A		P(L)		A(M)	P	
	2043/B	A			P(L)	C(H)		P(L)
	2044/B	A(F)			P(M)	P(M)		
	2045/B	A				P(L)	P	P(L)
	2046/B	C			P(L)	C(H)		
	2047/B	A		P(L)	P(L)	C(H)	P	P(L)
	2048/B	A(F)	P(L)		P(L)	C(M)	P	
49	2181/B	A			P(L)	P(L)	P	P(M)
	2182/B	A			P(L)	P(M)	P	P(M)
	2192/B	A			P(L)	C(H)		P(L)
	2201/B	A				P(L)		P(M)
	2203/B	A				P(M)		P(L)
53	2051/B	A(F)			P(L)	P(M)		P(L)
	2053/B	A(F)		P(L)	P(L)	P(M)		P(L)

Context	**Sample**	**LM**	**MM**	**SM**	**Bird**	**Fish**	**Amph**	**Shell**
	2054/B	A			P(L)	C(M)		P(M)
	2061/B	A			P(L)	P(M)		
	2062/B	A		P(L)	P(L)	A(H)	P	
	2063/B	C	P(L)	P(L)	P(L)	A(H)	P	
	2091/B	A			P(L)	A(H)		P(L)
	2092/B	C	P(L)		P(L)	C(H)		
	2094/B	A		P(L)	P(L)	A(H)		
	2132/B	A			C(M)	A(H)	P	P(M)
54	2111/B	A(F)	P(L)	P(L)	P(M)	C(H)	P	P(M)
55	2151/B	A(F)		P(L)	P(M)	C(H)	P	C(H)
	2161/B	C(F)			P(L)	C(M)		C(H)
	2163/B	A(F)	P(L)		C(M)	C(H)		C(L)
63	2171/B	A(F)	P(L)		P(L)	A(H)		C(L)
27	2033/T	P				A(H)	P	
54	2121/T	P			P(L)	A(H)		
55	215/T	C	P(L)			C(H)		P(M)
56	210/T	P			P(L)	A(H)		P

Table 4. Fish identified from the reredorter fills at St John's Hospital, Canterbury, by context.

Context		**22**	**27**	**49**	**53**	**54**	**55**	**56**	**63**
Marine species									
spurdog	*Squalus acanthias*		+		+	+	+	+	+
thornback ray	*Raja clavata*		+		+	+	+	+	
herring	*Clupea harengus*	+	+		+	+	+	+	
smelt	*Osmerus eperlanus*				+				
conger	*Conger conger*						+		
cod family	Gadidae	+	+	+	+	+	+	+	+
cod	*Gadus morhua*								+
whiting	*Merlangius merlangus*		+		+				+
sea bass	*Dicentrarcus labrax*					+	+		
sea bream	*Sparus* sp.		+						
john dory	*Zeus faber*				+				
mackerel	*Scomber scombrus*		+		+		+		
garfish	*Belone belone*	+	+		+	+			
gurnard	*Aspitrigla* sp.		+	+			+		
flatfish family	Pleuronectidae	+	+	+	+		+		
flounder	*Platichthys flesus*				+		+		
plaice	*Pleuronectes platessa*		+		+	+	+		
turbot	*Scophthalmus maximus*								+
Migratory species									
eel	*Anguilla anguilla*		+	+	+	+	+	+	+
salmon/ trout	*Salmo* spp		+	+			+		+

Freshwater species									
perch	*Perca fluviatilis*	+			+				
pike	*Esox lucius*								+
carp family	Cyprinidae	+		+					
roach	*Rutilus rutilus*			+					

Table 5. Resources required for further work recommended on material from the St John's Hospital reredorter fills. Times allow for leave and contingency. See Table 6 for consumables.

Material	**Task**	**Staff**	**Time (days)**	**[Cost]**
GBA samples	(i) Process 'test' subsamples from contexts not examined during assessment (approx. 20) (ii) Process fresh subsamples from a selection of those already examined for plant/insect analysis (approx. 10)	Tech. Tech.	12 6	
BS samples	(i) Process BS subsamples from contexts not examined during assessment (approx. 20) and remaing samples from columns 1 and 3 (ii) Sieve and sort remaining sediment for bone and artefacts (iii) 'Watching brief' for plant remains from sievings	Tech. Tech. RF 1	18 18 2	
Plant remains	Detailed analysis of selected GBA and BS samples (including pursuing difficult identifications)	RF 1	75	
	Image analysis of *Prunus* fruitstones	Tech. RF 1	6 25	
	Technical and publication reports	RF 1	25	
Parasite eggs	Practical work Technical and publication reports	Tech. RF 2	6 3	
Insect remains	Practical work, including pursuing difficult identifications	Tech. RA 1 RF 2	19 19 19	
	Data analysis and technical and publication reports	Tech. RA 1 RF 2	12 6 19	
Non-marine molluscs	Processing, identification, technical and publication reports	Tech. RF 3	2 5	
Marine molluscs	Recording selected material, reports	RF 3	4	
Fish bone	Practical work	RA 2	19	
	Technical and publication reports	RA 2	19	
	Strontium analyses	RA 2	12	

Mammal and bird bone	Practical work	Tech.	2	
	Analysis and technical report	Tech RF 4	4 2	
	Publication report	RF 4	2	
Totals		Tech. RA 1 RA 2 RF 1 RF 2 RF 3 RF 4	105 25 50 127 41 9 4	

Project duration

The critical path will be botanical analysis, with 127 days RF including leave and contingency. Allowing a likely maximum of 40% effort on the project, this work would take an elapsed time of 318 work days, i.e. 63.6 working weeks.

Table 6. Consumables (etc.) required for biological analyses of material from St John's Hospital.

Item	**[Cost]**
Reagents	
Glass specimen tubes	
Microscope slides and cover slips	
Computer consumables	
Beatson jars	
Stationery	
Postage	
Telephones/fax	
Polyethylene bags	
Labels and markers	
Miscellaneous	
Total	

Appendix

(i) Sediment descriptions

The contexts are considered in stratigraphic order within column 2, starting at the base; note that, because of intercalation and varying lateral extent, the sequence is not the same in each of the three sample columns. For each context, archaeological information and interpretation and, where available, dating, are given in brackets.

Context 49 [basal layer across whole of excavated area; pre-Norman ?river mud disturbed by initial construction of reredorter]

Sample 220 (basal part of context **49**; 3 subsamples)

Dark brown (with slight purplish cast), plastic to slightly brittle amorphous organic material with a slight sand/clay component, traces of flints 6-20 mm, shellfish and eggshell and patches of pale grey ash and lime/mortar.

Sample 219 (middle part of context **49**; 2 subsamples)

Dark brown (with slight purplish cast), plastic to slightly brittle amorphous organic material with a little clay and sand and traces of shellfish.

Sample 218 (upper part of context **49**; 3 subsamples)

Dark brown (with slight purplish cast), plastic to brittle to very sticky, humic, slightly sandy silt with traces of stones 2-6 mm, bone, and brick/tile (one of the other 2 subsamples seemed more stony and included some rather large very rounded pebbles).

Context 63 [overlying **49** on southern side of column; construction deposit associated with underpinning; pottery date of 1375-1450 plus a small residual component)

Sample 217 (whole thickness of context; 2 subsamples)

Dark greyish-brown, plastic to sticky to slightly crumbly, ?humic sandy silt with traces of flints 20-60 mm, marine shell, eggshell, tile and pottery.

Context 55 [overlying context **49** in the northern part of the column; 'fill', dated by pottery to 1575-1600/1625, with residual late C15/early C16th material]

Sample 216 (lower half of context; 3 subsamples)

Mid/dark grey-brown, crumbly (working plastic), sandy silt, with traces of flints 6-60 mm, bone (including fish), eggshell, pottery and fruitstones and abundant marine shell.

Sample 215 (upper half of context; 2 subsamples)

Mid/dark grey to grey-brown, crumbly, slightly humic clay silt with traces of stones 6-60 mm, bone (including fish), mortar and tile, moderate amounts of eggshell and abundant marine shell.

Context 54 [overlying **55** on the southern side of the column and overlying **63** on the northern; 'fill']

Sample 214 (lower part of **54**; 1 subsample)

Mid/dark grey to grey-brown, crumbly (working plastic), humic sandy clay silt with traces of stones 6-20 mm, charcoal, ?ash, nutshell and fruitstones and abundant eggshell and marine shell.

Sample 212 (middle part of **54**; 1 subsample)

Dark grey-brown (with slight purplish cast), crumbly, humic, slightly sandy silt with freshwater bivalve molluscs (*Pisidium*) and grape pips.

Sample 211 (upper part of **54**; 2 subsamples)

Mid/dark grey-brown, crumbly, humic, slightly sandy silt with traces of stones 2-6 mm, mortar, tile and *Pisidium* shells.

Context 56 [overlying **54**, **55** and **63** in various parts of column; dump]

Sample 210 (lower part of **56**; 1 subsample)

Mid/dark grey-brown, crumbly, sandy silt with traces of flints 20-60 mm, and traces of bone (including fish), marine shell, eggshell and mortar.

Sample 208 (upper part of **56**; 1 subsample)

Mid/dark grey-brown, crumbly (working plastic), slightly sandy, slightly clay silt, with traces of bone (including fish) and fruitstones and patches of grey ash- or mortar-rich material.

Context 53 [overlying **54** and **55** on southern side of column and **54** and **56** on the northern; 'fill', with pottery dated to *c.*1600-1625/50, mainly 1600-1625]

Sample 213 (lowermost part of **53**; 2 subsamples)

Mid/dark grey (with slight purplish cast), crumbly (working very slightly plastic), very humic sandy clay silt with traces of bone.

Sample 209 (immediately above 213; 4 subsamples)

Mid/dark grey-brown, crumbly, humic sandy silt with traces of charcoal, twigs, wood, freshwater bivalves and gastropods, marine shell, eggshell and tile. Fish bone observed in one of the other subsamples.

Sample 207 (middle part of **53**; 1 subsample)

Mid/dark greyish-brown, crumbly (working plastic), very humic silt with traces of charcoal, marine shell and eggshell.

Sample 206 (above 207; 4 subsamples)

Dark brown, crumbly (working slightly plastic),very humic, slightly sandy silt, with traces of wood fragments, marine shell, eggshell, freshwater molluscs (*Pisidium*) and abundant apple 'core' fragments (endocarp). A little mortar was observed in two of the other subsamples and the third was more organic and contained more wood.

Sample 205 (uppermost part of **53**; 4 subsamples)

Mid/dark greyish-brown, crumbly, humic silt with traces of bone, eggshell, mortar and apple 'core'.

Context 27 [overlying **53** across whole of column; 'fill']

Sample 204 (lower part of **27**; 8 subsamples]

Dark grey-brown, crumbly (working plastic), very humic silt with traces of charcoal, wood, bone (including fish), eggshell, mortar flecks, tile, pottery, fruitstones and fruit pips.

Sample 203 (upper part of **27**; 4 subsamples]

Lithology like 204, but a little more grey; some glass present; a larger proportion of mortar in one of the subsamples, and a worm cast as evidence of modern contamination in another.

Context 22 [overlying **27** across whole of column; domestic rubbish, dated by pottery to *c.*1800-1825]

Sample 202 (lower part of **22**; 3 subsamples)

Dark grey, crumbly, very humic sandy silt with traces of flints 20-60 mm, charcoal, bone and fruitstones, moderate amounts of tile and abundant mortar.

Sample 201 (upper part of sample **22**; 8 subsamples)

Dark grey-brown, crumbly (working slightly plastic), slightly humic silt with traces of flints 6-60 mm, bone (including fish), eggshell and glass, with some large lumps of mortar. Evidence of modern contamination in the form of worm casts. A brass 'knob' was recovered from one of the other subsamples.

(ii) Vertebrate remains (with comments on marine molluscs)

Context 22 (*c.*1800-1825)

Preservation overall is good to fair with one sample recorded as poor and another as varied, and colour and angularity are both mostly varied (total nine samples). Large mammal fragments are present in all the samples but most of the material is unidentifiable, with very few measurable bones. Species present include cattle, caprovid and pig, mostly as phalanges, sesamoids, carpals, tarsals, teeth frags and pig lateral metapodials and phalanges (some juvenile). Medium-sized mammals are represented by a single hare metapodial (2011/B), a cat mandible (of a different colour and better state of preservation than the remaining bone, 2012/B), humerus (foetal/neonatal, 2015/B), and a phalanx (2017/B). Small mammals are represented by a single rat tibia (2018/B). whilst bird fragments are all unidentifiable. Fish remains include a mixture of marine and freshwater species, including perch, herring, garfish, gadid, cyprinid and flatfish. Shell fragments are mostly oyster.

Context 27

Preservation is mostly fair, with a few 'good' groups and one 'poor'. Colour ranges from dark brown to brown with some material recorded as varied. Large mammal remains are much the same as the previous context, although not quite so abundant. Most are ribs, phalanges, and sesamoids and some are juvenile. Medium-sized mammals are represented by a single lagomorph metapodial (probably rabbit (2048/B)). Small mammals include a single rat humerus (2047/B) and several unidentifiable fragments. Bird remains are all unidentifiable. Amphibian remains include a few elements of toad (2032/B) and frog (2045/B). Fish species include trout, herring, eel, gadid, mackerel, whiting, gurnard, sea-bream, thornback ray, spur dog, garfish, and flounder, plaice and other flatfish. There are a large number of flatfish suggesting a very specific fishery or seasonal resource. Shell fragments are mostly oyster.

Context 49

Preservation is mostly fair and colour mostly brown, whilst angularity varies among the samples. Large mammal remains appear to be mostly caprovid rib, shaft, vertebrae and cranial fragments, with some pig lateral phalanges also present. Birds are all unidentifiable. Fish remains are a mixture of marine and freshwater species, flatfish again being represented in quite large numbers. Species include eel, trout, gurnard, cyprinid (possibly roach), gadid and flatfish . Molluscs include oyster and mussel.

Context 53 (*c*1600-1625/50, emphasis on 1600-1625)

Preservation is fair, colour mostly dark brown or brown, and angularity varied Large mammal remains are similar to those from contexts 22 and 27 and medium-sized mammals are represented by rabbit fragments (2063/B, 2092/B). Small mammals include both microtine (2063/B, 2062/B, 2053/B), and murine (2094/B) fragments. Bird remains include some identifiable fragments (mainly goose and domestic fowl fragments from 2132/B), but also included a corvid tarsometatarsus (2062/B), a duck tibiotarsus (2053/B), and a finch-sized ulna (2051/B). Identified fish species are thornback ray, john dory (a single vertebra), gadid (including whiting), mackerel, also garfish, ray, herring, eel, perch, spurdog, smelt. and flatfish (including flounder, plaice). There are large numbers of flatfish, some fragments showing evidence of chewing. Shells are represented by oyster and mussel fragments.

Context 54

This context was represented by only two samples, one of which was a GBA test subsample. Preservation is fair, colour dark brown, and angularity is varied. Large mammals are mostly pig, (lateral phalanges and metapodials). Rabbit is present (tibia and metapodial fragments (2111/B). Small mammals are represented by an atlas (possibly murine(2111/B)). In addition, a human molar fragment was identified. Unidentifiable bird remains are present, as well as frog. Fish species present include spurdog, eel, thornback ray, garfish, herring, plaice, sea-bass, and large and small gadid. These represent a wide range of marine species. The shell is oyster and mussel.

Context 55 (1575-1600/25, + residual late 15th-early 16th)

Four samples (including a test) showed preservation to be mostly fair, with varied angularity and colour dark brown. Large mammal is represented by cattle, caprovid and pig remains, of which quite a number are neonatal or juvenile. Sample 2161/B also produced some horse fragments. Numerous rib shaft and vertebral fragments are also present. Rabbit and small mammal remains were also identified. Bird remains are relatively common from 2163/B, most of them domestic fowl (although some wild species are represented). This context yielded a high percentage of inshore marine species. Species present are eel (including conger), spurdog, herring, gadid, gurnard, thornback ray, mackerel, sea-bass, salmonid, and flatfish (including flounder and plaice). Molluscs are similar to those in previous samples

Context 56

Represented by a single GBA 'test' subsample with a few large mammal and bird fragments. Fish bones make up the bulk of the assemblage and include eel, spurdog, herring, thornback ray and gadid.

Context 63 (1375-1450, + some residual)

A single (bulk) sample, with preservation of bone fair, colour dark brown, and angularity varied. Large mammal remains are relatively abundant and represent cattle, caprovid and pig. Numerous rib and vertebral fragments are also present. Medium-sized mammal is represented by a single cat tibia. Fish remains show high species diversity and are a mixture of marine and freshwater components. Species present include eel, salmonid, spurdog, pike, trout, turbot, and gadid (including cod and whiting).