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# Environmental Evidence from Adams Hydraulics II (Y.A.T/Yorkshire Museum sitecode: 90.13)

by

J. B. Carrott, A. R. Hall and H. K. Kenward

## Summary

Analysis of twenty eight samples for invertebrate and plant macrofossil remains was undertaken. Samples thought to represent agricultural soils and ditch fills were essentially low in organic content; a combination of low organic input and poor preservational conditions is the likely explanation.

Samples from boreholes included a small number with relatively few organic remains, but the majority contained modest to large assemblages of plant and animal remains. The first group appear, in the main, to have represented 'natural' drift deposits, mostly water lain (fluvial or limnic). The more organic borehole samples showed a range from those with primarily aquatic taxa to those rich in remains which must have originated in rubbish dumping. These differences presumably reflect distance from the waters' edge at the time of deposition.

It is strongly recommended that these deposits, which have considerable historic importance, are investigated further via trenching and extensive sampling.

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## Introduction

This report discusses the results of analyses of invertebrate animal and plant remains from deposits excavated from the Adams Hydraulics II (Y.A.T/Yorkshire Museum sitecode: 90.13) site.

## Methods

Subsamples of raw sediment were examined in the laboratory for plant and invertebrate animal remains. A 'rapid assessment' was carried out on twenty-eight of the samples. 'Test' subsamples (Kenward *et al.* 1986) of 1 kg were taken and processed by paraffin flotation (Kenward *et al.* 1980) to extract insect remains. Plant remains were recorded from the flots from paraffin flotation and from the residues or washovers of the residues.

## The samples and results of the analyses

The analyses carried out on each sample, and the remains recovered, are described below, together with a laboratory description of the sediment. A brief archaeological description and/or interpretation of the context (provided by the excavator) is given in brackets where available. The samples are presented in context order.

### Context 4050 [14th/15th century - probably agricultural soil]

Sample 201: Mid grey-brown, moist, plastic to crumbly, silty, clay. Large and small fragments of burnt bone, charcoal, brick/tile and small pieces of limestone were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The flot contained a small quantity of charcoal, sand grains and very decayed plant material.

A washover (to 300 microns) was performed on the residue to separate the small amount of organic material so that this could be examined wet, whilst the predominantly mineral remainder was dried prior to examination. The very small washover was mostly fine chalk and coal, but included some very decayed plant material.

The small residue (dry weight 147 g) consisted mostly of sand and some cinder, chalk and coal with small bone fragments (mammal bone, including one large tooth and fish bone), shellfish (?freshwater mussel), brick/tile, mortar and charcoal.

Poor preservation of the less durable organic remains would not be surprising in a tilled soil.

### Context 4071 [17th century. Possibly ditch fill - much domestic rubbish within sample]

Sample 204: Mid grey-brown, moist, plastic to crumbly, loamy in appearance, slightly sandy, silty, clay. Large bone fragments, traces of gastropod snails, brick/tile and very small stones were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The flot contained only a trace of sand and charcoal.

The small residue (dry weight 235 g) was mostly brick/tile and sand with small amounts of mortar, coal, charcoal, stone (to 30 mm), large and small bone fragments and shellfish.

Clearly conditions were unfavourable for organic preservation, unless there was very low input of organic matter.

**Context 5005** [late 14th/15th century. Possibly agriculturally derived, but there was quite a lot of domestic rubbish within the context]

Sample 202: Mid to dark grey, moist, plastic to crumbly, loamy, sandy, silty, clay. Snails, fragments of rotted oyster shell, brick/tile and large pieces of limestone were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. One aquatic beetle and a small amount of charcoal were present in the flot.

A washover (to 300 microns) was performed on the residue to separate the lighter organic fraction so that this could be examined wet, whilst the bulk of the material was dried prior to examination. The smallish washover contained only fine fragments of coal and charcoal and a fish scale.

The modest residue (dry weight 257 g) was mostly coal, cinders, sand and tile with large bone fragments (mammal), small bone fragments (fish), shellfish (including one whole oyster valve), charcoal and an iron object.

The same comments apply as for context 4071.

**Context 5011** [14th/15th century. This layer was almost exclusively made up of shellfish]

Sample 205: Mid to dark, brown to grey-brown, moist, plastic to crumbly, slightly sandy, silty, clay. Small oyster shells, at least two of which were still associated in apparently unopened pairs, were abundant in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The tiny flot from this sample contained charcoal and the burrowing snail *Cecilioides acicula*; there were no insect remains.

The modest residue (dry weight 317 g) was mostly oyster shell, ranging from whole valves to tiny fragments, with large and small bone fragments, brick/tile and charcoal. Some pieces of pot found in the residue were removed to be returned to the excavator.

**Context 5025** [Later 18th century. Probably agricultural land]

Sample 206: Mid to dark grey-brown, moist to wet, crumbly to brittle, humic, slightly sandy, silty, clay. Traces of mineral deposition in the form of convoluted, orange layers approximately 1mm thick (?around rotted organic matter). Holes of 1.5 to 3 mm diameter (?formed by earthworms or roots), mortar and small pieces of limestone were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The very small flot was approximately half plant material and half arthropod remains. Preservation was unusual, the remains being reminiscent of part-decayed modern material. There were a few terrestrial beetles but in insufficient numbers to determine a definite character for the group.

A washover (to 300 microns) was performed on the sample to separate the organic fraction so that this could be examined wet, whilst the mainly mineral remainder was dried prior to examination. The small washover was mostly fine coal with some remains of *Rumex* sp(p), *Ranunculus* Section *Ranunculus*, Gramineae sp(p), *Atriplex* sp(p), *Capsella bursa-pastoris*, *Plantago major*, *Stellaria media* and *Potentilla anserina*, all probably weeds of waste places. Taken together they might indicate neglected arable or disturbed pasture.

The very small residue (dry weight 73 g) was mostly sand with some tile fragments, coal, cinders, an iron concretion and *Crystatella mucedo* statoblasts; the last suggest corporation of at least some water-lain material.

#### Context 5028 [18th century agricultural build-up]

Sample 207: Mid to dark grey-brown, wet, crumbly, slightly sandy, silty, clay (very friable and soil-like despite the high water content). Snails, shellfish (oyster) and pieces of brick/tile were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The tiny flot consisted mostly of charcoal and fine sand grains with some very poorly preserved insect remains and several *Lophopus crystallinus* statoblasts; the latter indicating aquatic deposition of the sediment. This was a peculiar assemblage, reminiscent of some groups laid down under natural conditions where preservation was poor.

A washover (to 300 microns) was performed on the sample to separate the organic fraction so that this could be examined wet, whilst the mainly mineral remainder was dried prior to examination. The very small washover was mostly coal with a few *Sambucus nigra* (?elderberry seed) fragments and a little plant detritus.

The modest residue was predominantly coal and cinder with shellfish (?oyster), small bone fragments (mammal bone, including a burnt tooth and fish bone), brick/tile (to 30 mm), charcoal and an iron object.

If this deposit was agricultural land it received at least some domestic rubbish and there are hints that some waterlain deposits were also included.

#### Context 8000 [Borehole sample]

Sample 100: Mid and dark grey-brown as distinct colours associated with contorted layering (mm scale), moist, heterogeneous, humic, silty clay with several pieces of sticky, black ?amorphous organic material. On the basis of the lithology this deposit was obviously waterlain. Quite a lot of snails, fragments of brick/tile and a twig coated in vivianite were present as inclusions in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. Extremely well preserved insect remains formed a large proportion of the small flot. Some aquatic insects, ostracods and many *Daphnia ephippia* were present together with a fairly large group of terrestrial beetles, mostly decomposer types with a few forms associated with natural/semi-natural habitats. The beetle assemblage is generally indicative of the early medieval period. However, the presence of *Sitophilus granarius* suggests later medieval. A *Melophagus ovinus* (sheep ked) puparium, *Tipnus unicolor* and a flea were also recorded, suggesting the presence of urban rubbish rather than all the remains having originated as background fauna.

The very small residue was mostly plant detritus and grit-sized tile and stone. The identifiable plant component was composed of large amount of *Alisma* sp(p). with *Rumex ?maritimus*, oak (*Quercus* sp(p).) bud scales, *Nuphar lutea*, *Raphanus raphanistrum*, *Heracleum sphondylium*, *Hypnum* cf. *cupressiforme*, *Sambucus nigra*, *Ranunculus* Section *Ranunculus*, *Salix fragilis*, *Oenanthe ?aquatica*, *Rubus fruticosus*, *Atriplex* sp(p)., *Agrostemma githago*, *Prunella vulgaris*, *Anthemis cotula*, *Polygonum persicaria*, *P. lapathifolium*, *P. aviculare*, *Stellaria media*, *Myriophyllum* sp(p)., *Ranunculus* Subgenus *Batrachium*, *Urtica dioica*, wheat/rye 'bran', *Sphagnum* leaves, *Scorpidium scorpioides* and hazelnut shell (*Corylus avellana*). The residue also contained wood, twig and leather fragments, coal, mortar, glassy slag and fish bone.

The plant remains suggest dumping at the water's edge, an interpretation with which the insect and other evidence is compatible.

#### Context 8001 [Borehole sample]

Sample 101: Varicoloured, moist, resilient, heterogeneous sandy, silty, clay. Clasts of various clays and silts and small and very small stones of varying lithologies were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The very small flot contained at least one *Daphnia ephippium* and an ostracod as well as one or two terrestrial beetles and a corixid bug (aquatic).

The modest residue (dry weight 281 g) was mostly sand and gravel with stone, including gritstone, mudstone and micaceous sandstone (all to 25 mm), coal and fragments of ?freshwater mussel.

This deposit may be 'natural' drift formed in standing or gently flowing water.

#### Context 8002 [Borehole sample]

Sample 102: Mid brownish-grey, moist, sticky, plastic, sandy, silty, clay. Large numbers of small pieces of brick/tile and limestone, mortar and pot were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. Much of the tiny flot was charcoal and sand, with many *Daphnia ephippia* and some poorly preserved insect remains. The deposit was clearly laid down in water.

A washover (to 300 microns) was performed on the sample to separate the organic fraction so that this could be examined wet, whilst the mainly mineral remainder was dried prior to examination. The small washover contained a little plant detritus and some *Daphnia ephippia*, but was mostly fine coal. The plant remains included *Lemna* sp(p). and *Conium maculatum* with smaller amounts of *Urtica dioica*, *Sambucus nigra*, *Solanum dulcamara* and *Marrubium vulgare*. Deposition in water is indicated, but the weed taxa point to disturbed terrestrial habitats in the vicinity.

The smallish residue (dry weight 212 g) was mostly sand, mortar and tile with freshwater mussel fragments, coal (including part-burnt coal), cinder and ?chalk.

#### Context 8003 [Borehole sample]

Sample 103: Mid brown externally, dark grey-brown internally, moist, stiff-cheesy plastic, silty, clay. Several large freshwater bivalve shells, vivianite and small and medium-sized stones were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The flot was small and largely composed of plant fibres with abundant 'filmy' arthropod remains. Many ostracods, a few *Daphnia ephippia*, and remains of a very small number of aquatic and terrestrial insects were present.

A washover (to 300 microns) was performed on the sample to separate the organic fraction so that this could be examined wet, whilst the mainly mineral remainder was dried prior to examination. The washover contained quite a lot of plant detritus including wood fragments, large amounts of *Potamogeton* sp(p)., flax (*Linum usitatissimum*) capsule fragments, *Ranunculus* Section *Ranunculus*, *Rumex maritimus*, *Fumaria* sp(p). and *Juncus inflexus/effusus/conglomeratus*.

The small residue (dry weight 131 g) was mostly sand and stones (limestone and micaceous sandstone to 25 mm) with ?freshwater mussel shell and a small number of tile fragments.

Undoubtedly this was an aquatic deposit, but with some waterside terrestrial plants and insects; the flax may have originated in retting in the Foss.

#### Context 8004 [Borehole sample]

Sample 104: Two lithologies: a mid pinkish grey-brown moist sticky, plastic clay and a mid to dark grey, very slightly sandy, silty, clay. Pieces of brick/tile, mortar and small and very small stones were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The flot consisted mostly of well rotted plant fragments with some *Daphnia ephippia*, a few aquatic snails and a small number of beetle remains including some aquatics and *Tipnus unicolor* and some other terrestrial forms.

A washover (to 300 microns) was performed on the residue to separate the organic content so that this could be examined wet, whilst the remainder of the material was dried prior to being examined. The modest washover of plant detritus contained rather a lot of oak (*Quercus* sp(p).) bud-scales with quite

a few seeds of *Reseda luteola*, *Rumex ?maritimus*, *Juncus* sp(p)., *Chenopodium* Section *Pseudoblitum*, *Atriplex* sp(p)., *Conium maculatum* and *Potentilla* cf. *erecta* with traces of *Plantago major*. These taxa are a rather disparate mixture ecologically; that they occur together perhaps indicates dumping of urban rubbish.

The modest residue was mostly tile (to 50 mm), mortar and cinders with coal, freshwater mussel and small bone fragments (mammal bone and bird bone).

#### Context 8005 [Borehole sample]

Sample 105: Mid grey, moist, resilient plastic, silty, clay with darker, more silty clay and greenish yellow-grey silt present as minor matrix components. Traces of brick/tile and one large stone (to 200 mm) were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The small flot was mostly well rotted plant debris with an ostracod, some ehippia of *Daphnia* and another, unidentified, cladoceran and a few insect remains. The latter included the aquatic *Helophorus* sp.

The very small residue (dry weight 174 g) was almost all sand and gravel with traces of brick/tile, mortar, stone and coal.

This deposit seems likely to be 'natural' waterlain drift.

#### Context 8006 [Borehole sample]

Sample 106: Black, moist, crumbly to brittle, silt grading to mid brown, sandy silt. Brick/tile and a small number of sand grains were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The tiny flot was mostly charcoal with a few aquatic and terrestrial beetle remains.

A washover (to 300 microns) was performed on the sample to separate the organic fraction so that this could be examined wet, whilst the mainly mineral remainder was dried prior to examination. The small washover contained *Ranunculus* Section *Ranunculus* and Gramineae sp(p).

The modest residue was composed mostly of sand with some 'twiggy' fragments of *?Calluna vulgaris*, pieces of tile (to 20 mm), ?freshwater mussel, mortar, charcoal, cinder, coal and a rounded pebble (30 mm).

There was evidence here for dumping of occupation debris, though the organic component was very small.

#### Context 8007 [Borehole sample]

Sample 107: Mid grey-brown, moist, dense cheesy-plastic homogeneous silty/clay with paler (?higher sand content) mottling. Numerous white flecks and very small stones were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The small flot was largely composed of arthropod remains. There were many ehippia of an unidentified cladoceran and some ostracods were present. A small number of aquatic and terrestrial beetles, including one *Trox scaber*, were noted. This last was the only evidence of human influence from the invertebrates.

A washover (to 300 microns) was performed on the sample to separate the organic fraction so that this could be examined wet, whilst the mainly mineral remainder was dried prior to examination. The washover was composed mostly of small plant detritus (woody and herbaceous) including *Sambucus nigra* and *Pteridium aquilinum* with *Stellaria media*, *Urtica dioica*, *Coronopus squamatus*, *Carex* sp(p)., *Ranunculus* series *Ranunculus*, *Raphanus raphanistrum* and *Sphagnum* sp(p). leaves. There was also a small amount of fine charcoal.

The small residue (dry weight 203 g) was mostly 'shelly' limestone (to 50 mm) and micaceous sandstone with some tile, coal, sand and a small mammal tooth. A piece of pot was removed from the residue to be returned to the excavator.

The biological and lithological evidence suggest that this deposit included some terrestrial occupation detritus.

#### Context 8008 [Borehole sample - probably natural]

Sample 108: Varicoloured and of patchy appearance, slightly moist, very stiff, heterogeneous, 'boulder clay' of varying grain sizes with various yellow/orange colours of silty texture present as minor matrix components. Very small, small and medium-sized stones were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The tiny flot was mostly charcoal with some rotted plant fragments.

The small residue (dry weight 211 g) was mostly sand and gravel with a few pebbles (to 25 mm).

There was no evidence to refute the suggestion that this was, indeed, 'natural' drift.

#### Context 8009 [Borehole sample]

Sample 109: Mid grey to orange-brown, moist, sticky, heterogeneous (on cm scale) sandy, silty, clay with patches of very sticky pink and grey clays. Charcoal, brick/tile and small and very small stones were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The very small flot was mostly plant fragments, charcoal and sand grains with a few beetle remains including *Anobium punctatum*, *Tipnus unicolor* and a leg of *Sitophilus granarius*, all indicative of human influence, probably dumping.

The small residue (dry weight 236 g) consisted mostly of sand and gravel with some small bone, tile (to 50 mm), mortar, coal, cinder and stone (various lithologies to 70 mm). A piece of pot found in the residue was removed to be returned to the excavator.

#### Context 8010 [Borehole sample]

Sample 110: Mid brownish-grey with very dark grey reduction patches, moist, stiff, plastic to cheesy, silty, clay. Snail and freshwater bivalve remains and a trace of coarse organic detritus were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The large flot was composed almost entirely of plant fragments with a very few *Daphnia ephippia*, a flea and some other aquatic and terrestrial insects.

A washover (to 300 microns) was performed on the residue to separate the small amount of organic material so that this could be examined wet whilst the mineral fraction was dried. The rather large washover consisted of medium to coarse plant detritus including remains of *Atriplex* sp(p), *Chenopodium* Section *Pseudoblitum*, *Agrostemma githago*, *Carex* sp(p), *Scorpidium scorpioides*, *Rumex* ?*maritimus*, *Sagittaria sagittifolia*, *Ranunculus* Section *Ranunculus*, some ?straw fragments, wheat/rye 'bran', *Leucobryum glaucum*, *Thuidium* ?*tamariscinum*, *Polytrichum* sp(p), *Rhinanthus* sp(p) and *Reseda luteola*.

The modest residue (dry weight 185 g) was mostly angular limestone and some chalk (both to 30 mm) with small bone (mammal), tile (to 30 mm), charcoal, coal, cinders and nutshell (*Corylus avellana*

These assemblages suggest perhaps aquatic deposition polluted by dumping of terrestrial deposits including organic rubbish.

#### Context 8011 [Borehole sample]

Sample 111: Mid grey-brown, moist, plastic to crumbly, slightly cheesy, silty, clay. Pale flecks and patches of paler yellowish or greyish silt, snails and small stones were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The small flot was mostly invertebrate remains. There were large numbers of ostracods and *Daphnia ehippia*, some aquatic snails and beetles and a very few terrestrial beetles, the latter forming a group of no special character. Very unusually, there were also several extremely well preserved (but definitely not modern) aphids, deserving further study.

A washover (to 300 microns) was performed on the residue to separate the small amount of organic material so that this could be examined wet, whilst the mineral fraction was dried. The small washover was mostly plant detritus, large numbers of *Zannichellia* sp(p). were present with *Juncus bufonius*, *Calluna vulgaris*, *Coronopus squamatus*, *Prunella vulgaris*, *Stellaria ?palustris*, *Sambucus nigra*, *Potentilla anserina*, a *Hyoscyamus niger* fragment, *Corylus avellana* and *Ranunculus* Subgenus *Batrachium*. *Daphnia ehippia*, fly puparia and a charred twig were also present as well as large numbers of ostracods.

The very small residue (dry weight 79 g) was mainly sand and a little grey limestone (to 20 mm) with a trace of tile, a freshwater snail and one freshwater bivalve.

The species present are indicative of an open water habitat with some rubbish dumping.

#### Context 8012 [Borehole sample]

Sample 112: Mid to dark grey-brown, moist, crumbly to buttery clay with a high organic content. A few rootlets, other organic detritus and large pieces of birch (*Betula* sp(p).) stake were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The flot consisted mostly of arthropod remains including abundant aquatic and terrestrial beetles, some of which were extremely well preserved. Amongst the terrestrial component of the beetle assemblage there were various phytophages, while *Sitophilus granarius*, *Oryzaephilus* sp., *Anobium punctatum* and some decomposers were represented, the latter in sufficient numbers to suggest nearby/on-the-spot dumping into what was clearly a waterlain deposit.

The very small residue was mostly plant detritus and was therefore examined wet. The identifiable plant remains present in the residue were; some birch (*Betula* sp(p).) bark, a hazelnut shell (*Corylus avellana*), *Polygonum lapathifolium*, *Homalothecium sericeum/lutescens*, *Ranunculus* Section *Ranunculus*, *Prunella vulgaris*, *Brassica rapa*, *Quercus* sp(p). (buds and wood, including wood chips), *Polygonum aviculare*, *Carex* sp(p)., *Antitrichia curtispindula*, *Rumex* sp(p). (including *R. ?maritimus*), *Hypnum* cf. *cupressiforme*, *Eriophorum vaginatum* (sclerenchyma spindles), *Sphagnum* sp(p). leaves (including *S. imbricatum*), *Agrostemma githago*, *Atriplex* sp(p)., *Chenopodium album*, quite a lot of *C.* Section *Pseudoblitum*, *Rumex acetosella*, *Raphanus raphanistrum*, *Centaurea* sp(p)., *Rosa* sp. (prickle), *Calluna vulgaris*, *Reseda luteola*, *Juncus bufonius* and a fairly large number of small wheat/rye 'bran' fragments. The non-plant fraction of the residue consisted of a few fragments of tile, cinder and a few snails. Some of the components of the residue had been subject to pyritization.

There were indications here of acid peatland and perhaps also grassland; these components may have been the remains of peat and hay in rubbish dumped into the river.

#### Context 8014 [Borehole sample]

Sample 114: Mid grey-brown, moist, plastic, to cheesy, clay, silt with dark grey-brown reduction mottling. Freshwater bivalve, small pieces of limestone and traces of coarse organic detritus were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The flot consisted mostly of arthropod remains with some very rotted plant fibres. Large numbers of *Daphnia ehippia* and ostracods and some aquatic beetles and bugs were present. A few terrestrial beetles were also noted, but there was no evidence of a distinct urban or decomposer group.

The very small residue was examined wet. The identifiable plant remains consisted of *Ceratophyllum* sp(p)., flax (*Linum usitatissimum*) capsule fragments, *Nuphar lutea*, *Potamogeton* sp(p)., dock (*Rumex* sp(p).), *Alisma* sp(p)., *Ranunculus* Section *Ranunculus*, *Chenopodium* Section *Pseudoblitum*, Leguminosae petals and a large number of *Sparganium* sp(p). fruits. The non-plant remains were small fragments of mortar and



tile, fish bone, fish (percid) scale, a few very small ehippia, a snail operculum (?*Bithynia tentaculata*) and stones (including limestone, to 15 mm).

The plant assemblage suggests a water-margin habitat, possibly with some rubbish dumping.

#### Context 8015 [Borehole sample]

Sample 115: Strongly laminated, mid olive-brown to black, compressed herbaceous detritus (?monocotyledon stems).

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The large flot was mostly fibrous plant detritus and seeds. The non-plant remains consisted of some fly puparia and a few terrestrial beetles (phytophages and decomposers) whose preservation was not very good. Included in the beetle remains were *Tipnus unicolor* and *Sitophilus granarius* and a well-preserved *Hypera* sp.. Plant remains in the flot included *Caltha palustris*, *Brassica* sp(p). (including *B. rapa*), *Triglochin maritima*, *Senecio* sp(p)., *Thalictrum flavum*, wheat/rye 'bran', *Trifolium pratense* (pod lid), *Atriplex* sp(p)., *Heracleum sphondylium*, *Chrysanthemum segetum*, *Rumex acetosella*, *Lapsana communis*, *Eleocharis palustris*, cf. *Trifolium* sp(p)., *Bilderdykia convolvulus*, *Ranunculus* Section *Ranunculus*, *R. flammula*, Gramineae sp(p). (culm nodes) and large numbers of *Prunella vulgaris* and legume fragments (?clovers), including a small pod.

The very small residue was examined wet. The 2-4 mm fraction of the residue consisted mostly of monocotyledonous stem and leaf fragments. Other plant remains present were some unidentifiable wood, a fairly large amount of *Rumex* sp(p). (including *R. acetosella*), a lot of legume petals and calyces, *Ranunculus* Section *Ranunculus* (including some *R. ?acris*), ?*Raphanus raphanistrum* stalk, *Lapsana communis*, *Chrysanthemum segetum*, *Rhinanthus* sp(p)., *Eleocharis palustris*, *Centaurea* sp(p)., *Prunella vulgaris*, *Senecio* sp(p)., *Agrostis* sp(p)., *Bilderdykia convolvulus* and quite a lot of wheat/rye 'bran' (less than 1 mm). The non-plant fraction was composed of coal, charcoal, small fragments of brick/tile and bone and a few small angular stones (to 6 mm). Some of the components of the residue had been subject to pyritization.

The most likely interpretation of the deposit is that it consisted very largely of the remains of hay and perhaps also some straw.

#### Context 8016 [Borehole sample]

Sample 116: Mid grey to grey-brown (darker internally) moist, cheesy with indications of irregular horizontal lamination, silty, clay. This is clearly a water lain sediment, probably formed in a large body of essentially still water. A large birch stake (to 80 mm), large freshwater bivalve shells and rotted sandstone were present in the sample. The following modern contaminants were noted: pieces of wood.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The small flot was mostly invertebrate remains including large numbers of ehippia of *Daphnia* and another, unidentified, cladoceran and ostracods, but principally insect larvae. There was a small, mixed group of beetles, mostly terrestrial with a few aquatic species. However, the assemblage was too small for interpretation. This material was clearly deposited in water, perhaps a good distance from the shore.

The very small residue was quite rich in plant detritus and was therefore examined wet. There were large numbers of seeds of *Ranunculus* Subgenus *Batrachium* and *Zannichellia* sp(p)., *Myriophyllum spicatum* and *Potamogeton* sp(p). were present and there were traces of *Urtica urens* and *Conium maculatum*. The other components of the residue were: large numbers of small cladoceran ehippia, sand, brick/tile, stone (to 30 mm), birch wood and bark, fragments of nacre (presumably from freshwater bivalves), freshwater gastropod and a trace of eggshell and eggshell membrane.

The plant remains principally represented a freshwater community.

#### Context 8017 [Borehole sample]

Sample 117: Light grey, moist, plastic to crumbly, fine sand and yellowish sandy clay. Large stones were present as inclusions in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The large flot was effectively barren of animal remains being composed mostly of well-macerated, pale, plant tissue.

The modest residue (dry weight 390 g) was mostly sand and pebbles with lumps of birch wood, fragments of birch bark, ?freshwater mussel, gravel and a trace of tile fragments.

The deposit seems likely to have been formed far from the waters' edge, probably where there was an appreciable current.

#### Context 8018 [Borehole sample]

Sample 118: Mid grey-brown, moist, cheesy, silty, clay. Coarse organic detritus (roots and 'reeds'), a willow stake and branch fragments, also of willow, were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The flot contained mostly superbly preserved insect remains including numerous aquatic beetles and bugs. *Tipnus unicolor* was present but few other terrestrial species of beetle were represented. In addition, some *Daphnia ephippia* and *Lophopus crystallinus* statoblasts and a large lygaeid bug (possibly *Megalonotus dilatatus*) were noted. The last lives among dead leaves in dry sandy places and doubtless was a far-travelled corpse.

The modest residue was mostly plant detritus, much of it rootlet fragments, and was examined wet. *Daphnia ephippia*, fish bone and tile (to 30 mm) were present. *Polygonum lapathifolium*, *Oenanthe ?aquatica*, *Solanum nigrum*, *Nuphar lutea*, *Coronopus squamatus*, *Alisma* sp(p). and *Apium nodiflorum* were represented in the plant remains.

The plant remains and lithology suggest that this may be a waterlain sediment on to which vegetation had grown.

#### Context 8019 [Borehole sample]

Sample 119: Mid to dark grey internally, brownish mid-grey externally, moist, plastic, 'yeasty' in texture, with hints of irregular horizontal lamination, silty, clay. This material was clearly waterlain. Snails, very rotted plant detritus, patches of mid brown clay and cylindrical oxidation marks suggesting root traces were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The large flot was composed mostly of fine plant material but also included abundant insect remains. There were a large number of fragments of corixid bugs (water boatmen), some water beetles and a mixed group of a few terrestrial beetles and bugs (mostly from natural/semi-natural habitats); the latter gave no clear indication of habitat, but contained no synanthropic element and there were no indications of rubbish dumping apart from one indeterminate flea segment. A few ostracods and a large number of *Daphnia ephippia* were also present.

The small residue had a high organic content and was therefore examined wet. There were large numbers of *Nuphar lutea* (including ?*N. lutea* stem nodes) and *Scirpus lacustris* with *Ceratophyllum* sp(p)., *Rumex ?maritimus*, *Myriophyllum* sp(p)., *Polygonum lapathifolium*, *Chrysanthemum segetum*, *Chenopodium* Section *Pseudoblitum*, *Ranunculus flammula* and a few small fragments of wood, also present. The non-plant remains in the sample were; a few very worn fragments of rotted ?freshwater mussel, *Crystatella* statoblasts and traces of tile and metallic slag.

The remains from this sample suggest an open-water habitat with weeds from marginal disturbed communities or, less probably, from dumping.

#### Context 8020 [Borehole sample]

Sample 120: Internally black oxidising to slightly brown mid grey moist, cheesy/buttery, clayey, amorphous organic material. This sample smelled strongly of pond water and was clearly water lain near the water's edge. Coarse organic detritus, shell (?bivalve) and a planorbid snail were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The flot consisted mostly of very well-preserved arthropod remains with some plant fibres and charcoal. Some *Daphnia ephippia*, ostracods, aquatic snails, aquatic and waterside beetles and ?chironomid larvae (head

capsules and puparia) were present. There were also a few terrestrial insect remains with representatives from decomposer and phytophage communities. None of the species were strong synanthropes and the beetle component of the assemblage contained no members of the group associated with decaying rubbish.

The very small residue contained a high proportion of organic material and was therefore examined wet. *Oenanthe ?aquatica*, *Ulex* sp(p). (needles), *Polygonum hydropiper* and *Chenopodium* Section *Pseudoblitum* were strongly represented with *P. amphibium*, *P. lapathifolium*, *Heracleum sphondylium*, *Alisma* sp(p)., ?*Glyceria* sp(p)., *Ranunculus* Section *Ranunculus*, *R. sceleratus*, *Sambucus nigra*, *Rumex ?maritimus*, *R. sp(p).*, *Rubus fruticosus*, *Atriplex* sp(p)., *Agrostemma githago*, *Urtica dioica*, *Plantago major* and *Veronica beccabunga*-type and unidentifiable dicotyledonous leaf fragments also present. The non-plant component of the residue was composed of a small amount of charcoal, coal, cinder, tile, mortar, glass (?modern), *Crystatella* statoblasts and snails (including one large planorbid); the latter requiring more detailed examination and identification.

The plant remains suggest dumping in a marshy habitat. The *Ulex* (gorse) needles are a most unusual record - perhaps the first time this taxon has been recorded from archaeological deposits in York. It is most likely to have been cut for some purpose, brought to the city and eventually dumped at this site with other organic rubbish.

#### Context 8021 [Borehole sample]

Sample 121: Mid to dark grey-brown, moist, low-density crumbly to brittle, amorphous organic material with some fine mineral components. There were no inclusions in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The fairly large flot was composed mostly of plant tissue with a few *Daphnia ephippia* and some poorly preserved insect remains. Aquatic and terrestrial/water-side insects were both represented, but no synanthropic species were present.

The extremely small residue had a high organic content (mostly plant detritus) and was therefore examined wet. *Scirpus lacustris*, *Urtica dioica*, *Stellaria media*, *Oenanthe ?aquatica* and *Salix* sp(p). were strongly represented with *Polygonum lapathifolium*, *Sambucus nigra* and *Alisma* sp(p). also present. The non-plant remains included caddis larval capsules and cladoceran ephippia, charcoal, a few pieces of wood, metallic and glassy slag and some tile fragments.

The plant remains and, to a lesser degree, the insect assemblage from this sample are indicative of water-margins with some disturbed ground nearby.

#### Context 8022 [Borehole sample]

Sample 122: Mid to dark grey internally, mid grey-brown externally moist, cheesy to plastic (with hints of irregular lamination) clay silt. Coarse organic detritus and large numbers of snails were present in the sample.

A 1 kg 'test' subsample (/T) was processed by paraffin flotation to extract insect remains. The large flot contained abundant, filmy, ?monocotyledonous plant fragments, many *Daphnia ephippia* and a large number of well-preserved, adult and immature, beetles and other insects. A substantial proportion of the beetles were eurytopic aquatics, probably indicating still or very slow flowing water; there was evidence for emergent vegetation from donaciine beetles. There were also a large number of terrestrial forms, mostly from natural/semi-natural habitats with a few possibly urban species; the latter, however, contained no clear urban rubbish component.

The very small residue was mostly a mixture of fine, medium and coarse plant detritus and was therefore examined wet. The identifiable plant remains consisted of quite a few *Nuphar lutea* with *Alisma* sp(p)., *Sambucus nigra*, *Rumex ?maritimus*, *Polygonum persicaria*, *Ranunculus* Section *Ranunculus*, *Carex* sp(p)., *Myriophyllum* sp(p)., *Chenopodium* Section *Pseudoblitum*, *Scirpus lacustris*, *Rubus fruticosus* and *Sphagnum* leaves. The residue also contained a few tiny fragments of tile and wood, metallic slag and a few snails (and fragments of snail, including an operculum).

The aquatic component of the insect assemblage suggest still or slow-flowing water and the presence of *Donaciinae* sp. provide evidence of emergent vegetation. The composition of the plant assemblage suggests an open-water habitat with some marginal disturbed ground.

## Implications

These deposits fall into three main categories:

1. Primarily terrestrially deposited sediments with a very low organic content and poor preservation of plant and invertebrate remains. It is surmised that these represent deposits with both a low input of organic matter and strong post-depositional decay. These were deposits thought by the excavator to be agricultural soils or ditch fills. However, the presence in at least two of these samples of aquatic invertebrates indicates some incorporation of waterlain material, either as part of the overall build-up of the deposit or through temporary addition of sediment, e.g. by flooding.
2. Waterlain deposits of low organic content. These probably represent 'natural' drift deposits which were formed in the Foss, probably before the formation of the King's Pool, and perhaps in prehistoric times.
3. Waterlain deposits of moderate to high organic content, moderate to rich in plant and invertebrate remains. These showed considerable diversity, apparently within a range from those whose assemblages were predominantly aquatic or from natural/semi-natural terrestrial habitats, to those where the biota were mainly terrestrial taxa, typically associated with urban environments and archaeological build-up.

The material in categories 2 and 3 requires further investigation, in order to address pressing historical problems concerning the development, use and infilling of the 'King's Pool', and of course of the Foss before it was dammed. It is essential that these deposits are examined in a trench section perpendicular to the river at a series of stations. The material should be examined in conjunction with a similar trench downstream at the Dundas Street site, if possible. Three groups of organisms require particular attention: plant remains, insects and molluscs. Some work on vertebrates may be required. It will be necessary to process a large number of samples by bulk-sieving, in order to obtain dating evidence and to investigate the size range of rubbish components with the aim of investigating the transport of material from dumps at the waters' edge.

The vouchers from these samples should be retained at least until the deposits are re-sampled from a trench.

## References

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